

WestminsterResearch

<http://www.westminster.ac.uk/westminsterresearch>

Landscapes of the invisible: sounds, cosmologies and poetics of space

Piva, A.

This is an electronic version of a PhD thesis awarded by the University of Westminster.
© Miss Anna Piva, 2015.

The WestminsterResearch online digital archive at the University of Westminster aims to make the research output of the University available to a wider audience. Copyright and Moral Rights remain with the authors and/or copyright owners.

Whilst further distribution of specific materials from within this archive is forbidden, you may freely distribute the URL of WestminsterResearch: (<http://westminsterresearch.wmin.ac.uk/>).

In case of abuse or copyright appearing without permission e-mail repository@westminster.ac.uk

**LANDSCAPES OF THE INVISIBLE:
SOUNDS, COSMOLOGIES AND POETICS OF SPACE**

ANNA PIVA

A thesis submitted in partial fulfillment of the requirements of the
University of Westminster for the degree of Doctor of Philosophy

August 2015

DECLARATION

This thesis is submitted to the Centre for Research and Education in Art and Media (CREAM) at the School of Media, Arts & Design, University of Westminster. It is entirely the author's own work, except where noted.

ABSTRACT

In this PhD by Publication I revisit and contextualize art works and essays I have collaboratively created under the name Flow Motion between 2004-13, in order to generate new insights on the contributions they have made to diverse and emerging fields of contemporary arts practice/research, including digital, virtual, sonic and interdisciplinary art.

The works discussed comprise the digital multimedia installation and sound art performance *Astro Black Morphologies/Astro Dub Morphologies* (2004-5), the sound installation and performance *Invisible* (2006-7), the web art archive and performance presentation project *promised lands* (2008-10), and two related texts, *Astro Black Morphologies: Music and Science Lovers* (2004) and *Music and Migration* (2013).

I show how these works map new thematic constellations around questions of space and diaspora, music and cosmology, invisibility and spectrality, the body and perception. I also show how the works generate new connections between and across contemporary avant-garde, experimental and popular music, and visual art and cinema traditions.

I describe the methodological design, approaches and processes through which the works were produced, with an emphasis on transversality, deconstruction and contemporary black music forms as key tools in my collaborative artistic and textual practice. I discuss how, through the development of methods of data translation and transformation, and distinctive visual approaches for the re-elaboration of archival material, the works produced multiple readings of scientific narratives, digital X-ray data derived from astronomical research on black holes and dark energy, and musical, photographic and textual material related to historical and contemporary accounts of migration.

I also elaborate on the relation between difference and repetition, the concepts of multiplicity and translation, and the processes of collective creation which characterize my/Flow Motion's work. The art works and essays I engage with in this commentary

produce an idea of contemporary art as the result of a fluid, open and mutating assemblage of diverse and hybrid methods and mediums, and as an embodiment of a cross-cultural, transversal and transdisciplinary knowledge shaped by research, process, creative dialogues, collaborative practice and collective signature.

TABLE OF CONTENTS

Abstract	i
Table of contents	ii
List of figures	viii
Acknowledgements	ix

CHAPTER 1 **1**

OVERVIEW OF PRACTICE AND RESEARCH QUESTIONS

1.1 Overview of my collaborative work as/with Flow Motion	1
1.2 Overview of the submitted works	1
1.3 Research questions	3
1.4 The structure of the commentary	4

CHAPTER 2 **5**

METHODOLOGICAL OVERVIEW AND RESEARCH METHODS

2.1. Introduction	5
2.2 Methodology	6
2.3 Transversality and other conceptual tools	9
2.4 Methodological summary	15
2.5 Research Methods	17

CHAPTER 3 **28**

CONTEXTUAL REVIEW

3.1 Mutant Creative Universes: Post-Media	28
3.2 Two Lands	29
3.3 Art & Science	33
3.4 Theorizing new media and post-media	35
3.5 Cyberculture and cyberspace	36
3.6 New sounds from the underground	38
3.7 Sound Art	43

3.8 Artworks	46
3.9 Summary	51
CHAPTER 4	52
ASTRO BLACK MORPHOLOGIES: MUSIC AND SCIENCE LOVERS (2004-6)	
4.1 About the Essay	52
4.2 Research aims	52
4.3 Methods employed	53
4.4 Themes and approaches	53
a) Structure and narratives/repetition and difference/iteration and montage	53
b) The title/citationality/versioning	54
c) The process/multiple voices/the Poetics of (textual) Space	55
d) Music and cosmic becoming: on Sun Ra	55
e) Becoming music of the cosmos	56
4.5 Summary of achievements and contributions	57
CHAPTER 5	59
ASTRO BLACK MORPHOLOGIES/ASTRO DUB MORPHOLOGIES (2004-5)	
5.1 About the project	59
5.2 Research aims	60
5.3 Methods employed	61
5.4 Themes and approaches	61
5.5 Spaces	62
5.6 Roles and collaborations	64
5.7 Summary of contributions and achievements	65
CHAPTER 6	69
INVISIBLE (2006-7)	
6.1 About the project	69
6.2 Research aims	70

6.3 Methods employed	70
6.4 Themes, approaches and outputs	70
6.5 Roles and collaborations	72
6.6 Summary of contributions and achievements	74
CHAPTER 7	78
PROMISED LANDS (2008-10)	
7.1 About the project	78
7.2 Research aims	78
7.3 Methods employed	79
7.4 Themes and approaches	80
7.5 Project's outputs	
a) promisedlands.info	80
b) Performance presentations	82
c) Workshops	83
6.6 Summary of contributions and achievements	85
CHAPTER 8	92
MUSIC AND MIGRATION (2013)	
8.1 About the text	92
8.2 Research aims	92
8.3 Methods employed	92
8.4 Themes and approaches	92
8.5 Summary of contributions	95
CHAPTER 9	96
CONCLUSION	96
9.1 How the research questions were explored	96
9.2 Final considerations	103

LIST OF APPENDICES**APPENDIX A (I-IV)**

Table of contents	1
Introduction	2
(I) On Transversality	3
(II) Transversality, Machines and the Spaces Between	10
(Music and Science Lovers: Resonances)	15
(III) Black Holes, Music, Flicker Noise and Fractality	16
(IV) On Sun Ra	39

APPENDIX B: PUBLISHED TEXTS

Astro Black Morphologies: Music and Science Lovers (Leonardo Journal, 2006)

Music and Migration (Wiley-Blackwell, 2013)

APPENDIX C: SUPPORTING AUDIOVISUAL DOCUMENTATION

DVD 1. *Astro Black Morphologies/Astro Dub Morphologies*, 4 movies extracts (Flow Motion/A.Ward)

DVD 2. Audiovisual documentation

1. *Astro Black Morphologies/Astro Dub Morphologies*

 Folder 1: Pictures

 5 Stills from the John Hansard Gallery (Steve Shrimpton, 2005)

 Science Museum Dana Centre, card (2005)

Folder 2: Sounds

1. Extract of sonifications and soundscapes (Flow Motion, 2005)
2. Extract of Science Museum Dana Centre installation (Flow Motion, 2005)
3. Soundscape for room 2 at John Hansard Gallery, extract (Flow Motion, 2005)
4. Version of soundscape for room 1 (Flow Motion, 2005)

Folder 3: Movies

- Documentation, John Hansard Gallery, Room 1 (S. Shrimpton, 2005)
- Documentation, John Hansard Gallery, Room 2 (S. Shrimpton, 2005)

2. *Invisible*

Folder 1: Sounds

1. Cambridge Institute of Astronomy, sound installations extracts (Schmidt observatory. Northumberland observatory. Thorowgood observatory. Children voices.) (Flow Motion, 2007).
2. *Invisible 0.1 (Hallucinator remix)* Finetuned [online] (Flow Motion, 2007)
3. BBC radio program (recordings of installations at the IoA observatories)
4. *Invisible Workshop*, Merz Akademie (extract of installation soundscape)

Folder 2: Movies

- Invisible*, live at the Science Museum Dana Centre (extract 1)
- Invisible*, live at the Science Museum Dana Centre (extract 2)
- Flow Motion interview with Saul Perlmutter

3. *promised lands*

- Folder 1: www.promisedlands.info (images selection)

4. Additional documentation material

- Folder 1: Hallucinator recordings (Chain Reaction, Burial Mix). *Rainmaker* (2000); *Waterline* (2003); *Goldcoast* (1999); *Wipeout I* (1999); *Black Angel* (1999); Rhythm & Sound w/ Willi Williams, *See Mi Yah (Hallucinator Remix)* (2006)

LIST OF FIGURES

Figure 1. <i>Astro Black Morphologies/Astro Dub Morphologies</i> . Cygnus X-1 data visualization (Flow Motion/Adrian Ward).	59
Figure 2. <i>Astro Black Morphologies/Astro Dub Morphologies</i> : Room One, John Hansard Gallery (S. Shrimpton, 2005).	66
Figure 3. <i>Astro Black Morphologies/Astro Dub Morphologies</i> : Room One, John Hansard Gallery (S. Shrimpton, 2005).	67
Figure 4. <i>Astro Black Morphologies/Astro Dub Morphologies</i> : Room One. John Hansard Gallery (S. Shrimpton, 2005).	67
Figure 5. <i>Astro Black Morphologies/Astro Dub Morphologies</i> : Room Two. John Hansard Gallery (S. Shrimpton, 2005).	68
Figure 6. <i>Astro Black Morphologies/Astro Dub Morphologies</i> : Room Two. John Hansard Gallery (S. Shrimpton, 2005).	68
Figure 7. Thorowgood observatory, Cambridge Institute of Astronomy.	69
Figure 8. <i>Invisible</i> , Science Museum Dana Centre, sound-check. 1 st November 2007.	76
Figure 9. <i>Invisible</i> , Science Museum Dana Centre, performance. 1 st November 2007.	76
Figure 10. Projection of a drawing from an <i>Invisible Workshop</i> participant on the Jodrell Bank's Lovell telescope.	77
Figure 11. Schmidt Observatory, Cambridge Institute of Astronomy. Details of telescope and hanging speaker on metal dome.	77
Figure 12. <i>promisedlands.info</i> , triptych for page 70.	78
Figure 13. <i>promiseland.info</i> , extracts from the triptychs.	86
Figure 14. <i>promisedlands.info</i> , triptychs for pages 96, 97, 89.	87
Figure 15. <i>promisedlands.info</i> , triptychs for pages 77, 60, 62.	88
Figure 16. <i>promisedlands.info</i> , triptychs for pages 27, 53, 13.	89
Figure 17. <i>promisedlands.info</i> , triptychs for pages 5, 3 and 6.	90
Figure 18. <i>promised lands</i> , performance presentation II, Iniva, London (2009).	91
Figure 19. <i>promised lands</i> , performance presentation, FACT, Liverpool (2010).	91

ACKNOWLEDGEMENTS

I am grateful to the School of Media, Art and Design of the University of Westminster for making this research possible. I would especially like to thank my supervisor Dr Tom Corby, for generously sharing his knowledge, for his encouragement and for providing insightful feedback and advice. I am very grateful to Hannah Redler at the Science Museum of London and to Dr Saer Maty Ba, for their support at the beginning of this research and for supporting the works submitted for this thesis.

I am very thankful for the help of all those who took part in the development, production and dissemination of the works: Adrian Ward at Signwave, Dr Phil Uttley, Dr Tim O'Brien at Jodrell Bank, Youngjae Cho, Dr Doug Vakoch at SETI, Dr Carolin Crawford at the Cambridge Institute of Astronomy, Steve Hook at Heston Community School, Prof Reza Tavakol at Queen Mary University of London and Prof Giorgia Dona at the University of East London; Nicola Triscott and Dr Rob La Frenais at Arts Catalyst, Helen Sloan at SCAN, Gary Stewart, Omar Kholeif, Ros Carter at the John Hansard Gallery, Frank Pietronigro and Lowry Burgess at Carnegie Mellon University's Studio for Creative Enquiry, and Annick Bureaud at Leonardo/Olats. I am also very grateful to the inspiring musicians who participated in the improvised sessions and performances: Sukhdeep Singh, Harmeet Raj Singh Virdee, Charles Bullen, Jim Dvorak, Harrison Smith and Marc D'Inverno.

I must thank all my friends, colleagues and mentors who supported me in various ways, and in particular, Dave Bray and Helen Dyer, for their generosity and for making the time to help me proofreading; Vladimiro Pellicciardi, Cristina Bolzan, Paolo Spedicato, Augusto Garbellotto, Walter Dal Cin and my sister Simonetta, for the discussions and reflections on the context and the musical and artistic currents which have provided the foundations for my development and inspired my work, and for sourcing archival material; I am very thankful to philosopher, teacher and friend Renzo Mulato, for his initial advice in approaching some of the themes and critical voices elaborated in the research.

A very special thanks goes to my father, Giorgio Piva, for his constant love and support; to my teacher, Shiv Charan Singh, for sharing his deep insight on life and numbers; and to Edward George, my colleague and companion in adventures, for being with me on this journey.

I would like to dedicate this work to the memory of my late mother, Ivana Piaia.

CHAPTER 1

OVERVIEW OF PRACTICE AND RESEARCH QUESTIONS

1.1 Overview of my collaborative work as/with Flow Motion

The works of Flow Motion (1996-present) comprise a body of digital art, sound art, multimedia installations, online archival artwork, recordings and essays, which attempts to create new correspondences between questions of space and diaspora, science and cosmology, contemporary music forms and processes, digital art and cinema, and which is shaped by research and process, collaborative practice and collective signature.

Running through our work is a constant weaving of different senses of Space/space, a concern with sonic, cosmic and counter-cultural spaces, with marginal voices and the spaces-between, and with the trace and the phantomic in sound, text and the photographic and moving image. Our interest in the cosmos has autobiographical roots in the international Space Race of the 1960s and the landing of the first man on the moon; in black music and electronica and their tradition of the exploration of space in sound; in philosophical and scientific writing on the nature of our universe; and in the literature of the fantastic and science fiction (Piva and George, 2003).

1.2 Overview of the submitted works

The submissions for this PhD consist of three of Flow Motion's multi-modal artworks and two related essays, which appear and are discussed in the following chapter order:

- the essay *Astro Black Morphologies: Music and Science Lovers*, published by the Leonardo on-line journal in 2004 and, in revised printed form, in the Leonardo Special on Space Art in 2006;
- the multimedia installation and sound art performance *Astro Black Morphologies/Astro*

Dub Morphologies (also referred to as *Astro Black/Astro Dub*, or *Astro Black*), originally shown as work-in-progress in 2004 and exhibited and performed in various locations during 2005;

- the sound installation, workshop and performance project *Invisible* (2006-7);
- the web art archive and performance presentation *promised lands* (2008-10);
- the text *Music and Migration* (2013), published in the Encyclopedia of Global Human Migration (Wiley-Blackwell).

These collaborative works, jointly authored by Flow Motion's co-founder Edward George and myself, have emerged in an organic way during the last decade across diverse contexts; they are heterogeneous in their forms and mediums, yet they also constitute a coherent whole. The projects *Astro Black* and *Invisible* are part of a trilogy of art-science works titled *Music and Science Lovers*, whose development began in 2003 during *Sounds of Science*, a research commissioned by the London Arts Board and aimed at generating new cross-cultural connections around contemporary cosmological research on the invisible universe. The music and migration project *promised lands* was developed during and following an artists' residency at the International Institute of Visual Arts (2008-10). The related published essays frame, contextualize, discuss and expand on these projects.

Common to each of these works is an exploration of music, space and cosmology as themes and relations through and between ideas of diasporic cultures and otherness, invisibility and absence, liminality and spectrality, memory and futurity, the body and perception. The themes and concepts of multiplicity and heterogeneity, difference and repetition, translation and transformation are also explored and recur in all the works, in various and diverse configurations. Together with these is a concern with deconstruction and the disruption of received structures and linear narratives, with improvisation and dub processes, and with the new spaces and forms these destructive and transformative activities might produce.

Our research aimed at generating spaces where different creative planes and ‘universes of reference’ (Guattari [1992] 1995:18) could be intersected, interfaced, juxtaposed and overlapped; spaces of play and inclusivity; immersive sonic and cinematic spaces; spaces of cosmological reflection and reflection on cosmology; and spaces where grand narratives and totalizing discourses could be questioned and deconstructed.

The artworks were purposely exhibited and performed in very different locations and contexts, from traditional art galleries to astronomical observatories and scientific institutions, and from web platforms to cinema and performance spaces. They are site-specific, and were created and reshaped in relation to the different possibilities these spaces and contexts suggested.

1.3 Research questions

Although they have in various instances interfaced and interacted with the world of academia, these works were not developed from pre-defined, fixed or ‘structured’ research questions. However, a cluster of concerns driving their research and production can be identified and formulated as questions, or areas of academic enquiry:

Q1. How can diverse knowledge bases and practices be connected to interrogate and expand on scientific and received cultural framings of cosmological space?

Q2. What are the aesthetic possibilities for translating and transforming scientific data derived from cosmological science?

Q3. How can spatial approaches from sonic, visual and installation practices (framed as ‘multimedia’) be used to re-articulate diverse imaginaries, poetics and experiences of space exploration?

1.4 The structure of the commentary

This commentary comprises nine chapters. Following this introduction, in Chapter 2, I provide a description of methodological design inclusive of concepts from critical theory and philosophy which informed the research process. I also describe the research methods and their use in the works.

Chapter 3 consists of an extended contextual review that addresses the fields of practice and literature. I discuss the cultural debates on new/post-media and the emerging fields of digital, sonic, virtual and interdisciplinary art in the mid-late 1990s and the first years of the 21st century, and, in the final section, I review artworks which emerged before, in parallel and after our research, to demonstrate its relation to similar work.

In Chapters 4-8 I provide a summary of the published artworks and essays, the research questions, themes and approaches that were explored in the works, and the knowledge outcomes that resulted from the research.

In Chapter 9, the conclusion of my commentary, I summarize the ways in which the research questions were explored in the published works, the works' distinctive thematic, conceptual and methodological approaches, and describe how the works collectively constitute a contribution to knowledge.

Three appendices supplement this commentary. In Appendix A I further address key ideas that informed our methodological design and describe how we used these ideas as part the research that produced *Astro Black*. I also discuss the ideas and music of the composer Sun Ra and his influence on our work. Appendix B comprises the two published essays discussed in the commentary. Appendix C consists of two DVDs comprising audio-visual documentation of the published artworks.

CHAPTER 2

METHODOLOGICAL OVERVIEW AND RESEARCH METHODS

2.1 Introduction

PhDs by publication that involve art practices arising outside of an academic research frame are a relatively new phenomena; any formulation of such must acknowledge that, for the majority, methodological frameworks were likely not originally designed alongside the development of work, as any description of methodology must necessarily be post-hoc to the events it describes and the knowledge produced during them. However, this is not to deny that a methodology would have existed throughout the production of the work, and it might be argued that one of the functions of a PhD by publication is to articulate this and bring what might have normally been hidden to the fore. Webb and Brien (2012) in discussing the haphazard and developmental aspects of art-based methodologies have stated that for many, a methodological framework is something that arises at project-end, after full comprehension of its research dimension has been achieved. Likewise in setting out our methodology it has been the writing process of this commentary that has enabled an accounting for and understanding of methodological design, in interaction with and through reflection on a completed set of projects.

This brings its own problems of description and ‘tense’: the work is historic, the commentary writing contemporary. To resolve this, in the following sections I adopt a past-tense voice to avoid over-complicating comprehension and to be consistent. I start with a discussion of methodology in art and design, its distinctive character and the role it asks the researcher to take in relation to knowledge generating activity. This is followed by a description of ‘bricolage’ as a valued and valuable way of formulating how methodology operated throughout the research, and a discussion of how transversality and other ideas derived from critical theory and philosophy were woven into the research process to aid its progress and inspire it. Finally a list of research methods and their applicability to the project is given.

2.2 Methodology

This research can be viewed through the lens of a number of established methodologies of practice-based art into which are incorporated theoretical perspectives from critical theory, with specific reference to transversality as formulated by Félix Guattari and Gilles Deleuze. Together these ideas functioned to prime and guide the research as a systematic process, framing and producing the specific methods outlined in the following section.

For Allison (1992) methodology is a system or set of approaches specific to the themes and questions the research is oriented to. This rather orderly description appears to fit uneasily to practice-based research, which for Watson (1992) involves significant degrees of chance, chaos, randomness and even anarchy in the manner it attempts to accommodate the contingencies of creative practice within a research frame, reliant as it is on serendipitous discovery and creative leaps as approaches to problem solving. This in itself leads to a kind of research process that, as noted by Borgdorff, relies on intuition, emotional responses, is erratic and often random, ‘more like exploration than like following a firm path’ (Borgdorff, 2012:57). Art and design research, as Gray and Malins (2004) have noted, is also commonly hermeneutic (interpretative in a wider sense), eclectic, multi-method, interdisciplinary, discursive and collaborative in approach, in a manner that values complexity and real experience, and gives reign to a bottom-up development of methodological design. Similarly Bunnell (1995) has described the necessity for a hybrid approach to artistic methodologies that joins diverse disciplines, knowledge traditions and practices in the generation of ‘emergent’ methodological assemblages.

Throughout this research we took a similar hybrid, interdisciplinary and collaborative approach, which drew upon and made connections with diverse practices, cultures and knowledge (e.g. black music culture, the narratives of science fiction, cinema and contemporary art) to design emergent methodological approaches and refine issues in response to the developing focus of studio practice and research. In doing so, the serendipitous, exploratory, improvisatory and contingent played a significant role in

devising and discovering solutions as and when needed, and the research drew from external areas, outside of immediate visual art traditions (including scientific research, critical theory and philosophy, and marginal histories) to create ensembles of ideas, materials and practices through which the work was conducted and knowledge generated.

This approach has been formulated as ‘bricolage’, a term which describes a use of multiple methodologies integrated within a broader scheme of enquiry which mutates in response to the development of research (Hickman, 2008:188). For Rogers (2012), the ‘bricoleur’ takes an inventive and pragmatic approach to the use of ideas, tools, materials and situations, appropriating them where necessary to create a matrix of possibilities for knowledge production. Bricolage is also a resolutely interdisciplinary schema that treats forms of knowledge, for example theory and practice, as components of research operative on the same plane. For Goddard, this enables and frees researchers to integrate ‘competing and overlapping perspectives and paradigms’ that for example might include ideas and outlooks derived from ‘Feminism, Marxism and Cultural Studies [...] and other research approaches’ (Goddard, 2007:127). Similarly, within the research presented here, theories of transversality and deconstruction were woven into research processes, threading through and operating alongside practice in a manner that functioned to inform an understanding of both the poetics of the work, and approaches to making as an assemblage of disparate components, technologies, histories and themes.

This intertwinement between theory and practice, according to Borgdorff (2012), displaces theory from its ancient traditions of abstraction and distance to practice, by emphasizing the connectedness of art to wider themes including environment, race, identity and philosophical issues. Theory and practice in this regard, intersect, congeal and transact to mutually inform each other within an overall methodological frame. Acknowledging a constructivist position, Borgdorff formulates theory as having a performative function in practice-based art research:

Theory itself is a practice [...] theoretical approaches always partially shape the practices they focus on. Whether we are dealing with the theory of linear perspective, classical rhetoric, the twelve-tone technique, set theory in serial music, or insights into

the cultural meanings and societal functions of art, the performative power of theory not only alters the way we look at art and the world, but it also makes these into what they are. (Borgdorff, 2012:20b)

So for Borgdorff there can be no ‘innocent practice’ as all practices are imbricated and shaped by theories, histories and beliefs either consciously or not. That is not to say that practice illustrates theory, or provides a schema for its generation. Art for Borgdorff always embodies its own form of knowledge within form and matter ‘in auditory, visual and tactile ways, aesthetically, expressively and emotively’ (Borgdorff, 2012:21b) which has a unique power to expand our understandings of the world via affective encounters that go beyond the discursive and rational understanding.

Similarly concepts of transversality and deconstruction within our research project were immanent to the practices they intersected, as part of a complex bricolage and a process of production, acting as informative ideas and inspirations in our re-elaborations of fragments, narratives, data and archival materials, in our interdisciplinary collaborations and ensemble improvisations, and as conceptions of connectivity and how this leads to new and alternative assemblages, objects, artworks, ideas and knowledge.

Bricolage in itself originally derives from structuralism, as formulated by Lévi-Strauss in *The Savage Mind* ([1962] 1966), an anthropological treatise on myth¹, and as argued by Gray and Malins, artistic research methodologies are often rooted in and sympathetic to interpretative and social constructivist traditions that draw upon structuralism, post-structuralism and postmodernism, particularly in their articulation of the relationship

¹ In the first chapter of *The Savage Mind*, ‘Science of the Concrete’, Lévi-Strauss defines bricolage as ‘making do with whatever is at hand’ (1966:17) and formulates a theoretical distinction between two modes of knowledge production, modern scientific inquiry and ‘mythical’ (or ‘magical’) thought. The latter is described as ‘an intellectual form of bricolage’ which generates structured sets (i.e. language) by using ‘the remains and debris of events’ (1966:21-22). The scientist and the ‘bricoleur’ are distinguished by ‘the inverse functions which they assign to events and structures as ends and means, the scientist creating events (changing the world) by means of structures and the ‘bricoleur’ creating structures by means of events’ (1966:22). For Lévi-Strauss, art operates in the in-between of scientific knowledge and mythical thought. Lévi-Strauss’s concept of bricolage has been subsequently revisited and expanded by Derrida ([1966] 1970) and Deleuze and Guattari ([1972] 1980). The bricoleur’s ‘deviant’ approach to knowledge production identified by Levi-Strauss - in old French, he explains, the verb *bricoler* signifies ‘extraneous movement’, or straying from direct course to avoid an obstacle (1966:16), has been correlated to the African American jazz idiom, to improvisation, and to the aesthetics of swing (Veneciano, 2004:264). This ideas was explored in Flow Motion’s project *Invisible*.

between the researcher and the subject, and the researcher's view of knowledge (and by extension reality) as a relativist and subjective construct (Gray and Malins, 2004:20). In a research setting, this highlights how the subjectivity of the enquirer interacts with the object of study to generate research findings, and arguments or contributions to knowledge are agreed upon in a wider sense, through a consensual, dialectic or dialogic process. The researcher is located within or immanent to the research process (as opposed to being an external observer), generating research through a direct and reflective engagement in and through it as it evolves, as paradigmatically proposed by Schön (1983) in his famous case study of architectural practices, education and health practitioners.

Similarly this research was conducted from a perspective that placed us as central to the generation of research and that stressed our subjectivities as a key motivating factor in the research process. Schön discusses the dynamics of this process in a two-stage formula, namely that tacit knowledge is drawn upon and created 'in the midst' of making (reflection in action), and this knowledge is then codified or generalized afterward (reflection on action); reflection 'in action' also functions to plan next steps and thus has a generative aspect. In a practice-based PhD by publication, the temporal gap between the two reflective forms described by Schön can be considerable, often occurring many years after the activities they refer to, but as a methodological form it is still useful for systematically and rigorously generating knowledge in a way sensitive to practice, other connected bodies of knowledge and the subjectivity of the artist-researcher.

Before going further it will be useful here to give an overview of transversality and other ideas from critical theory that were integrated into, and influenced this research.

2.3 Transversality and other conceptual tools

In geometry, a transversal is a line cutting a system of lines, and is described with the sign ' / '. The noun transversality describes 'the state of being transversal' (Collins English Dictionary online, 2012) and conveys the sense of lying across, of intersecting and bringing into communication diverse elements, systems or viewpoints, but 'without

suppressing their difference or distance' (Deleuze, [1964] 2000:168).

Félix Guattari extensively developed this idea within his psychiatric practice, activism and writings (Guattari 1964, 1984, 1989, 1992, 1995, 1996a, 1996b), as a conceptual tool to generate mobility across different planes and existential territories, for creativity and self-engendering, and for the creation of new universes of reference. He rooted this concept within a plural and 'polyphonic' (Bakhtin in Guattari, 1995:1, 15) notion of subjectivity, and saw it as the unconscious source of action in the group, a dimension carrying the group's desire, producing a movement away from oppressive structures, binarisms and totalizing discourses and towards heterogeneity and 'deterritorialized instances' (Guattari, [1992] 2011:26). He re-elaborated this concept in many ways in the course of his life, stating that 'transversality [is] never given as "already there", but always to be conquered through a pragmatics of existence' (Guattari, 1995:125). In this sense, it can be considered as an emerging and open-ended theory, deeply connected with practice, experimentation and embodied experience.

For Guattari, transversality valorizes the creative process itself and is future oriented, unpredictable, 'chaosmic' and 'always linked to a risk of plunging outside of sense, outside of constituted structures' (Guattari, [1992] 2011:26-27). He envisaged it as a key tool towards transdisciplinary knowledge, for understanding the interactions between ecosystems, the social and the individual, for creating new modes of production of subjectivity, knowledge, culture and sociability, and for the development of a new 'ethico-aesthetic' paradigm in the 'dissensual', 'post-media' era, where:

Every aesthetic decentring of points of view, every polyphonic reduction of the components of expression passes through a preliminary deconstruction of the structures and codes in use and a chaosmic plunge into the materials of sensation. Out of them a recomposition becomes possible, an enrichment of the world (something like enriched uranium), a proliferation not just of the forms but of the modalities of being. (Guattari, 1995:90)

The concept of transversality recurs throughout Guattari's collaborative writings with Deleuze, and in Deleuze's own writings: they traced its presence in many fields,

including literature (Proust's reweaving of fragments, Joyce's notion of re-embodiment), genetics (Deleuze and Guattari, [1972] 1983:42-4) and music (Deleuze and Guattari, [1980] 1987:309). Its key aspects and functions, its relation to concepts of assemblage, machine, flow and autopoiesis, to art and transdisciplinarity and to my/Flow Motion's work are further discussed in Appendix A of this thesis. Briefly and to summarize, transversality in this context is, as argued by Vattimo (1989) and Nordstrom (2015) amongst others, not confined to a philosophical tradition or critical theory, but is ubiquitous in its widespread application to the visual, aesthetic and epistemological in art and design research. This can be seen in the way in which it values the power of human subjectivity and intuition as part of knowledge generating process, or to use Genosko's phrase promotes an 'undisciplined creativity' (Genosko, 2000:151) which favours the production of artworks (undisciplined in this context means an unshackling of knowledge creation from singular conceptions or institutional canons). From a similar perspective, Tan (2015) has described how transversal methodologies are valuable in arts research contexts in their ability to cut across multiple fields and create assemblages or engines of knowledge production inclusive of subjectivities, practices and marginalized discourses and histories.

This openness to bringing into view marginalized histories and cultures played a significant role in informing the research presented here, as both system and set of ideas for relating and connecting diverse fields, but also including perspectives from 'other'² voices. That is, our research was polyphonic in the themes that particular artworks took,

² The term 'other' has been used in many ways, primarily in opposition to notions of self-identity and norm, in relation to questions of hegemony and minority, power and representation, and to the unconscious. Simone de Beauvoir (1949) stated that the category of the Other is as primordial as consciousness itself, and introduced the idea of 'Woman as Other'. In a letter to Paul Demeney in 1871 (Mathieu, 1991:1), Arthur Rimbaud stated that 'Je est un autre' (I am an other). In the *The Gay Science* (1882, in 307, 'In Favour of Criticism'), Friedrich Nietzsche wrote: '...you are always another person'. For Edward Said, and for Franz Fanon, the Other is constructed through a dialectics of subject-object, master-slave, colonizer-colonized, rational West and irrational Orient/non-West, through race and cultural imperialism, and towards the formation of a white European identity. In *Black Skin, White Masks* ([1952] 1967), Fanon analyzed the dynamics through which the imaginary Other is constructed through race, in perception, in the process of looking and negatively evaluating, and the inferiority complex this produces in black people. 'There is of course the moment of "being for others", of which Hegel speaks, but every ontology is made unattainable in a colonized and civilized society' (1967:109). 'I remain silent, I strive for anonymity, for invisibility [...] Shame, shame and self-contempt. Nausea.' (1967:116). Drawing from Fanon, Said and other post-colonial and post-structuralist perspectives, Edouard Glissant argued for a 'Poetics of Relation' ([1990] 1997) in which 'the other' is considered not just as a moral obligation, which, he writes, 'would be banal', but also as 'an aesthetic constituent' (Glissant, 1997:29).

but also through the collaborative spirit that generated artworks and the collaborative dynamics that informed them. There are some crossovers in this approach with the methodological traditions of participatory action research (PAR) and in particular its concern with giving voice to marginal people, empathy for peripheral or alternative cultures and a collaborative ethos that enables and encourages other voices to contribute to research (Manzo and Brightbill, 2007). As argued by Thompson, PAR also does not distinguish between theory and practice, which operate symbiotically to render research results and allow for ‘readjustments, revisiting, false starts, revisions’ (Thompson, 2011:2). This iterative re-working was prevalent throughout the research in various guises, both as a ‘working through’ of ideas and experiments in practice, and as represented by the use of sampling, versioning and dubbing, as translations, echoes and re-visitations in a formal sense.

Other key conceptual tools utilized in the submitted works derive from the writings of Walter Benjamin and Jacques Derrida. Benjamin’s concept of translation as an art form and as the expression of a continuous, transformative life force (Benjamin, [1923] 1992) inspired and informed multiple approaches and different ‘modes’ of translation and transformation of scientific data. Benjamin’s de-structuring of traditional historiography through a non-linear, figural approach to historical inquiry, through fragments and montage, as proposed in ‘Convolute N (On the Theory of Knowledge, Theory of Progress)’ of his *Arcades Project* (Benjamin, [c1927-40] 1999) influenced our approach towards the creation of an archival artwork on music and migration. Derrida’s idea of deconstruction informed our readings of textual material from a variety of disciplines and sources, and was utilized as a tool towards the development of visual, sonic and spatial architectures. Derrida’s use of deconstruction was focused on ‘the other time already at work’ (Derrida, 1988:62), the forces of rupture already present from the start in each inscription, and the non-discursive sonority in language³. It is a mode of reading in which

³ An example of this concern within Derrida’s larger project of deconstruction of Western metaphysics and its language can be found in *Writing and Difference*, where he discusses Antonin Artaud’s theatre as a practice which ‘lays bare the flesh of the word, lays bare the word’s sonority, intonation, intensity—the shout that the articulations of language and logic have not yet entirely frozen, that is, the aspect of oppressed gesture which remains in all speech (Derrida, [1966]1978:240). Derrida’s concern with non-discursive sonority, and his love for jazz, also produced a

is present the concept of iterability, a word whose etymology Derrida traces to the Latin ‘iter’ (again) and the Sanskrit ‘itara’ (other). The term iterability describes ‘the logic that ties repetition to alterity’ (Derrida, 1988:7), and serves to signal the possibility of creative translations and transformations, of dissemination, play, and artistic intervention. In this sense, it can be conceived as a mode of production (of difference) that can be applied to the spatial and time-based arts (Derrida in Brunette and Willis, 1994:9-32).

Deleuze and Guattari’s formulations of different modes of ‘becoming’, e.g. becoming-minor, becoming-molecular, becoming-cosmic ([1972] 1983, [1980] 1987), and concepts of minority and minor literature ([1975] 1986), also inspired and contributed to the theoretical framework of our research. The ethical dimension of these concepts can be identified in the uses envisaged by Deleuze and Guattari: the production of new modes of thought, language and experience, the development of a people ‘yet to come’ (Deleuze and Guattari, 1986:18), of groups with a high coefficient of transversality, and the affirmation of the power of ‘collective enunciation’. Particularly relevant for our works are the sonic and musical dimensions of these concepts, and their relation to ideas of flow, intensity and transformation⁴, which were considered in this research in their possible correspondences to ideas and processes in digital art, dub, jazz, experimental music, contemporary science and Taoist and Vedanta philosophies. These concepts have informed participatory and improvisatory approaches in *Invisible*, formal approaches to the transformation of scientific data in *Astro Black* and photographic and textual material in *promised lands*, and the production of multiple, ‘minor’ sonic, visual and textual

collaborative performance with Ornette Coleman in 1996 and an interview/dialogue (1997) whose published title *The Other’s Language* evidences possible correspondences between their different practices.

⁴ In *A Thousand Plateaus* ([1980] 1987) Deleuze and Guattari explored the idea of music as a deterritorializing force, and utilized Varese’s ideas of ‘sound molecule’ and of a sonic energy irradiating the universe, to envisage a ‘becoming-music of the world, or a diagonal for a cosmos. [...] The molecular has the capacity to make the *elementary* communicate with the *cosmic*: precisely because it effects a dissolution of form that connects the most diverse longitudes and latitudes, the most varied speeds and slownesses’ (1987:308-9). These concepts were utilized and formally explored in *Invisible* and *Astro Black*. In discussing the works of Kafka, Deleuze and Guattari ([1975] 1986) connect the concept of ‘minor literature’ to that of ‘minor music’: an intensive and poly-linguistic use of language which is ‘...always made up of deterritorialized sounds [...] What we call pop - pop music, pop philosophy, pop writing’ (1986:26). They describe Kafka’s literature as ‘...a cry that escapes signification, composition, song, words—a sonority that ruptures in order to break away from a chain that is still all too signifying (1986:6). These ideas influenced our approach to the making of *promised lands*, and the transformation and montage of archival data and narratives of global migration.

readings of cosmological research on the invisible universe, of migration histories and diasporic cultural forms, through installation and virtual art, performance and writing.

Many of the aspects, aims and functions of transversality envisaged by Guattari and Deleuze (e.g. self-engendering and emancipation, mobility across different planes, the production of new universes of reference, spaces of collective creation and modes of ‘molecular’ and cosmic becoming) find a correspondence in the transdisciplinary research, poetics and art-music practice developed by African-American composer, musical director, thinker and educator Sun Ra. Ra’s music and writings have informed the making of each of our artworks and essays, as discussed in the following chapters and in appendix A. The philosophical writings of African American composer Anthony Braxton aided me in re-articulating ideas of transversality in relation to the diverse music forms and sonic cosmologies featured in our works. In the first of his three-volumes work *Tri-Axium Writings* (1985) Braxton developed conceptual tools for a creative re-thinking aimed at moving beyond dichotomies of avant-garde and jazz/popular music, or Western and non-Western cultural traditions, and towards the notion of a ‘meta-reality’ of world creativity. Braxton’s vision embraces and moves across multiple perspectives and forms, identifying music as a global force for transformation through the tripartite notion, and the coming together of, ‘trans-African’, world and Western art music. His ideas, as well as those of Sun Ra (who Braxton acknowledged as a main influence in his own thinking and music) are echoed in, and have informed the revisiting of our works.

Many other ideas were explored and utilized in this research. Amongst these are concepts derived from Theodor W. Adorno, Gaston Bachelard, Roland Barthes, Niels Bohr, David Bohm, Ivan Chatcheglov, W.E.B. Du Bois, Franz Fanon, Edouard Glissant, Donna Haraway, Hazrat Inayat Khan, Thomas S. Kuhn, Benoit Mandelbrot, Maurice Merleau-Ponty, Friedrich Nietzsche, Henri Poincaré, Edward Said, Tzvetan Todorov, Lao Tzu, Edgard Varèse and Alfred North Whitehead. Their writings provided conceptual tools and critical frameworks to inspire openings towards experimentation, sonic, visual and textual production, and orientation tools in our approach to questions of otherness, diaspora, spectrality and invisibility, and emerging paradigms in the sciences and cosmology.

2.4 Methodological summary

Methodology in the research presented here can broadly be considered as taking a 'bricolage' form in the manner in which are integrated other methodological models (e.g. PAR, reflection in/on action), voices, theoretical traditions, ideas, materials, media and cultures into the research process. Bricolage is an appropriate and effective means to describe the interweaving of eclectic components, assembled to answer research questions primarily concerned with bringing together diverse knowledge bases and translating them into new poetic and critical constellations through art-making. Informing this bricolage, and helping us to reflect upon our roles as artists-researchers were ideas derived by concepts of transversality as discussed above.

In discussing the appropriateness of using critical theory within a practice-based art methodology, Marshall uses an architectural metaphor to outline how it intersected and informed his doctoral project, describing it as 'pillars holding up the roof of my study', a foundation of that which is made, he states:

My practice emerges out of theory I suppose – while I'm making something I'm thinking about it, but while I'm not, I'm still thinking about it – a continuum of theorising or thinking about making that extends beyond the making (Marshall in Gray, 2007:10)

Similarly in this research, concepts from philosophy and critical theory intersected and operated synergistically with practice, but in a manner which, given the different focus of our research (the interweaving of multiple perceptions of space, sonic cosmologies and marginal and diasporic forms, the production of immersive audio-visual, performative and virtual spaces) diverges from Marshall's descriptions, perhaps suggesting astral or oceanic metaphors, and a more liquid, expanded, chaotic, and networked architecture. Our approach reflects a perspective, which considers the complex relation between theory and practice in arts research not in terms of hierarchical models, but rather, using a Deleuzian formulation, as a network of interrelated activities, 'a system of relays within a larger sphere, within a multiplicity of parts that are both theoretical and practical'

(Deleuze in Foucault, [1972] 1977:206). This image offers a framework for envisaging different and differential relations between theory and practice, including, as Lycouris (2000) noted, elements of discontinuity. It allows for an understanding and an accounting of the long-distance resonances, echoes and feedbacks, the untimely connections, the dynamics of unfolding and re-folding, and the (productive) gaps and discontinuities present in the research process and in the spaces between reflection in and on action.

Specifically in relation to concepts of transversality, inspiration and relay comes from the emphasis transversality places on experience and experimentation, on the interstitial and the collective, on movement and transformation, and on the generation of new creative forms, inclusive of non-mainstream knowledge and marginal cultures and voices, and thus gives a political angle to our research in its focus on ‘the other’, a concern also of PAR. Transversality as a concept used in this research also provided us with models of thinking and approaches that enabled us to generate intersections between and across diverse fields, technologies and practices. In this sense, and as integrated within a more generalizable bricolage approach, transversality is argued here as being a sympathetic companion to existing ways of conceiving and informing methodological processes in art and design as something designed ‘from the ground up’ (Gray, 2007) and which joins diverse disciplines, knowledge traditions, voices and practices in the generation of an ‘emergent’ focus of research.

These approaches have developed in close relation to our musical practice and, especially, to our engagement with black music forms and live improvisation, the use of sampling technology and the experimentation with analogue and digital recording studio technologies. Underpinning my particular approach and concerns, is a belief that listening and musical thinking, improvisation and sonic experimentation are inherently transversal, connective and multi-directional and as such, they can contribute to the creation of new and autonomous ‘fields of the possible’ (Guattari, 1995:27), new art forms and modes of art production, new constellations and poetics of space, new spaces of transdisciplinarity and new knowledge.

2.5 Research methods

In this section I list, account for and provide illustrative examples of the methods utilized to explore the research questions and produce the works. In doing so, I develop an alphabetic shorthand (A-K) for clustered approaches, which will be referred to hereafter (rather than repeat the description of specific methods for each work in subsequent chapters).

Research methods comprise the following:

A

(A1) Reading (solitary and collaborative, multi and cross disciplinary) of primary and secondary research material, comprising print media (books, journals, academic papers, specialist literature, fanzines, magazines) and online media (via search engines, specialist and academic websites, blogs).

This method informed the research in each of the works. For example, for the project *Astro Black* and the related essay, my reading included: scientific material on black holes (Hawking, 1988; Thorne, 1994; Rees, 2000; Barrow, 2001; Uttley and McHardy, 2002), fractals (Mandelbrot, 2002; Voss and Clark, 1975) and ‘acoustical quanta’ (Gabor, 1947), and material on Xenakis’s application of granular synthesis to music theory and on John Coltrane’s systems of composition amongst many other sources.

(A2) Archival research (in *promised lands*: consulting photographic, musical and historical documents, visual artworks, and maps for the production of the work’s textual, musical and visual components).

(A3) Trips to art galleries (in *promised lands*, we visited the National Gallery to research the work’s triptych format, the Royal Academy of Arts to research Japanese visual art, and the Tate Gallery to research the work of Francis Bacon).

(A4) Analysis of musical compositions and songs (for the essay *Astro Black Morphologies: Music & Science Lovers* we analyzed the music of Sun Ra, John and Alice Coltrane, Iannis Xenakis, Lee Perry, Karlheinz Stockhausen, Juan Atkins and Underground Resistance), films (for the *Invisible Workshop* the films of David Lynch, Derek Jarman and Alan Resnais), visual art (for *promised lands*, the repository of visual art books contained within INIVA's library).

(A5) Literature and contextual review (through the methods above).

These methods aided the development of the conceptual and interdisciplinary sensibility of the artworks, and were utilized to research diverse disciplinary fields, make thematic and conceptual links between disciplines and derive formal knowledge about those areas, and situate our work in relation to diverse artistic currents and emerging fields of contemporary art and media research/practice.

B

(B1) Deep listening

Composer Pauline Oliveros (2000) describes deep listening as an 'active', 'intense' listening which 'includes the sounds of daily life, of nature, or one's own thoughts as well as musical sounds [...]. It involves two attention processes - focal and global listening, and the interdependence of the two modes'. In the linear notes of her CD *Deep Listening* (1989) she describes this term in relation to her practice of collective improvisation: 'As we improvise together, and listen intensely to one another, our styles encounter in the moment, and intermingle to make a collective music. I call the result deep listening.' (in Oliveros, 2000).

This method was used in all the works. In *Astro Black* and *Invisible* it informed my approach to the transformations and assembling of the works' sonic components (sonified data, radio astronomy and environmental sounds, vocal data readings, poems and group improvisations) and workshops' activities. Solitary listening informed the initial stages of the digital and analogue processing of the sonic materials used in the installations'

soundscapes. Collaborative listening aided us in gaining knowledge of and working with the acoustic properties and resonances of the installation spaces, in the production and in situ mixing of the installations' final soundscapes, and in the collective improvisations that constituted the works' live component. Collaborative listening to phonographic recordings also informed the production of *promised lands*. This method is closely related to, and used in conjunction with the following:

(B2) Musical thinking (using non-linear, polyrhythmic and polyphonic modes of formulating thought), which formed the basis for the development of the installations' soundscapes and live performances in *Astro Black* and *Invisible*, and of musical, visual and narrative sequences in *promised lands*.

(B3) Environmental recordings (in the locations of the installments. In *Invisible*, night time recordings of the Institute of Astronomy's grounds were used in the installation's soundscapes and the performances, to engage with ideas of darkness and invisibility).

(B4) Improvisation (individual, collective, with people, musical instruments and analogue, digital, sonic and visual processing tools).

(B5) Counterpoint.⁵ I used this compositional technique as a method to approach difference and diversity as polyphony (e.g. in my collaboration with George, to harness our creative tensions and interweave our respective concerns, research and technologies). I used it in *Astro Black* and *Invisible* to generate sonic textures and multiple stereo movements in vocal data readings, sonified data, feedback networks, radio astronomy/environmental sounds, and in the collective improvisations; and to interweave

⁵ Counterpoint is a polyphonic music technique involving the simultaneous sounding of two or more parts or melodies. My use of this figure as a method for this research relates both to my musical and improvisational practice and to Deleuze and Guattari's transversal use (1980:314, 1994:185) of the figure of counterpoint based on biologist Jakob Uexküll's 'theory of transcoding' and concept of nature as polyphonic art-music:

Oak leaves in the form of tiles find their counterpoint in the raindrops that stream over them. This is not a teleological conception but a melodic one in which we no longer know what is art and what is nature ("natural technique"). There is a counterpoint whenever a melody arises as a "motif" within another melody, as in the marriage of bumblebee and snapdragon. These relationships of counterpoint join planes together, form compounds of sensations and blocs, and determine becomings. (Deleuze and Guattari 1994:185).

different narrative strands, songs, music and visual motifs with my images production for *promised lands*.

These methods allowed us to: explore, gain knowledge of, and produce synaesthetic responses to data, installation spaces and physical environments; develop collaborative processes, non-linear, transversal, spatialized, polyphonic and polyrhythmic approaches to the re- elaboration of scientific and archival material, and new audio/visual languages; produce immersive installation spaces and sonic architectures; and develop a particular aesthetics in the artworks.

C

(C1) Serendipity (by welcoming the unexpected)

(C2) Chance (openness to the moment, working with the forces at play)

(C3) Intuition (sensing the invisible and its pathways)

(C4) Use of I-Ching

(C5) Tai-chi, yoga and meditation practice

These methods, often used in conjunction with deep listening, contributed in generating new connections amongst diverse fields of research, supporting the emergence of unforeseen research strands, and new spaces and forms; and in building bridges between European philosophical concepts and some of the concepts and practices of embodied knowledge present in Taoist and Vedanta philosophical traditions. They provided orientation tools in my engagement with ideas of open work, flow, transformation and becoming, ideas in contemporary science and cosmology (e.g. theories of space and invisible phenomena, of ambiguity, unpredictability, chaos and fractality), and in developing a poetics of the unknown and unknowable spaces. Methods C1-2-3 aided me in formulating modes of data translation and transformation, in the processes of collective improvisation in *Astro Black* and *Invisible*, and in mapping cross-correspondences in historical/archival research and visual production in *promised lands* (in conjunction to the methods grouped in D and E).

D

(D1) Deconstruction (in order to creatively problematize the opposition between visibility and invisibility that informs astronomy's metaphors of darkness in *Astro Black* and *Invisible*, and explore the ambiguities of the Promised Land trope in its textual, sonic and photographic disseminations).

(D2) Iteration (in order to generate different readings of astronomical data in *Astro Black*, the notion of darkness in *Invisible*, and visual motifs in *promised lands*).

(D3) Decoding, de-segmenting, de-centering, de-contextualizing.

(D4) Exploring the movements of transformation already at work in narratives and structures (e.g. metaphors and musical analogies in cosmological discourse).

(D5) Exploring the spaces that constitute the between: the liminal⁶ spaces, the spaces of 'non-meaning', the unstable elements in narratives and in sonic and pictorial space. These 'minor' components have suggested unexpected possibilities, new approaches and modes of thinking and making; their ambiguous nature makes them 'unfixed', open to multiple transformations and spatial/temporal re-configurations.

(D6) Exploring the otherness, the surreal, the untimely, the edge of perception in image/music/text, by focusing on dead time, sonority, and through processes of

⁶ The term 'liminal' derives from the Latin 'limen' (threshold), and signifies an in-between, interstitial space, or a state of transition and/or transformation. This term was coined by ethnographer Arnold van Gennep, who used it in his tripartite model of rites of passage (*Rites de Passage*, 1909) to describe the quality of ambiguity and disorientation occurring in the passing through the threshold that marks the boundary between two phases: a stage in which the participants, who have gone through a ritual, metaphoric death, no longer hold their pre-ritual status or identity, and have not yet acquired a new one. Scottish anthropologist Victor Turner revisited and revived this concept in *The Ritual Process: Structure and Anti-Structure* (1969) identifying the states of transition which mark both temporal and cultural cycles as key to the shaping of embodied, temporal and social experience. For Turner these 'floating worlds', which in contemporary societies also include carnivals, dramas and films, are un-fixed, 'liminal areas of time and space [...] open to the play of thought, feeling, and will' ([1969] 1977:vii). The term liminal has also been used to define physical spaces (e.g. boundary lands), historical times (Thomassen 2009:19-20), persons or principles in the interstices or margins of social structure, or which occupy its lowest rungs (Turner, [1969] 1977:125), and in relation to experiences of cultural hybridity, migration and exile (Bhaba, 1994:5). For Edward Said, 'The exile [...] exists in a median state, neither completely at one with the new setting not fully disencumbered of the old, beset with half-involvements and half-detachments, nostalgic and sentimental on one level, an adept mimic or a secret outcast on another' (Said in Graves, 1988). Flow Motion's works often interweave these meanings, exploring interstitial spaces, states and places of transition and transformation, margins and marginal cultures, from different perspectives and in various combinations.

sonic/visual ‘ghosting’⁶ (e.g. dub processes of erasure and re-composition: tracing, filtering, layering, use of effects etc).

These methods were utilized to develop multiple and radically different versions of cosmological and archival research material, new strands of research, new modes of engaging with, and new readings of, ideas of invisibility, otherness, spectrality, trace, liminality and diasporic cultures, new audio/visual languages and spatial/sonic/visual architectures, and a particular aesthetics in the works.

E

Rhizomatic thinking and identifying rhizomes⁷ (generating multiple lines of flight and connective strands across diverse fields of inquiry, e.g. between flicker noise, jazz and dub music processes, numbers, digital art technologies and astronomical research technologies in *Astro Black*; between invisibility, cosmological research on dark energy, childhood perceptions of darkness, poetry, literature, cinema and improvised music in *Invisible*. The rhizomatic qualities of the term ‘black hole’ and its multiple uses across diverse disciplines were explored in *Astro Black*; those of the cloud figure were explored in *promised lands*, in relation to global migration histories, musical and visual research, and the World Wide Web).

This method allowed us to establish multiple entry and exit points across diverse fields of research, processes and technologies, map new connective strands across disciplines, and create new thematic constellations and modes of engaging with scientific, historical and archival research/data.

⁶ The term ‘ghosting’ is used here specifically in relation to the transformative and trace-producing technologies and processes of dub mixing. Lee ‘Scratch’ Perry stated that ‘dub is the ghost in me coming out’ (Perry in Corbett, 1994:20). See also Martin (1994), George ([1998] 2007:200-210) and Veal (2007:212).

⁷ I apply the term ‘rhizome’ in a threefold way: in its botanical meaning, in its metaphorical use by Carl Gustav Jung ([1961] 1989:2), and particularly as used by Deleuze and Guattari ([1980] 1987) to describe an a-centred, non-hierarchical system, a system ‘without a General and without an organizing memory or central automaton, defined solely by a circulation of states’ (1987:21). For Deleuze and Guattari, a rhizome has no beginning or end; it is always ‘in the middle, between things, interbeing, *intermezzo*.’ (1987:25). A rhizome ‘connects any point to any other point, and its traits are not necessarily linked to traits of the same nature; it brings into play very different regimes of signs, and every nonsign states. [...] It is composed not of units but of dimensions, or rather directions in motion.’ (1987:21) These ideas are further discussed in Appendix A, pp. 27-31, in relation to the research developed for *Astro Black*.

F

(F1) Writing (ideas, fragments, essays, proposals, reports) to develop, contextualize, understand, synthesize, evaluate and expand our research.

(F2) Citationality (extracting and re-assembling fragments from heterogeneous sources).

(F3) Juxtapositions (of eclectic sources via textual/visual montage).

These methods aided the research and development of the works by allowing us to: establish, articulate and clarify aims and objectives, interrelations between theory and practice, and connective strands between past and present work; map new cross-disciplinary connections and thematic constellations; generate new readings of, and modes of thinking about, space(s), cosmic and sonic imaginaries, scientific research, music, migration histories and archival materials; produce funding and exhibition opportunities; develop a particular aesthetics and poetics in the works; generate reflections on, and disseminate knowledge of, the research/artworks.

G

(G1) Sketching (casual, minimal, rough, detailed).

(G2) Mapping (diagrams of ideas, thematic constellations, spaces, materials).

(G3) Drawing plans (of installation spaces, multi-speaker/multi-screen configurations, web architectures).

(G4) Creating graphic scores (translating and reshaping fragments of digital data in dialogue with the graphic/visual language of contemporary music).

The resulting sketches, maps, diagrams, plans and graphic scores helped me develop a visual language for the research and the artworks' sonic and spatial architectures; I used some of these as tools in workshop environments, and shared them with collaborators and

workshop participants (e.g. the graphic scores were used by the musicians' ensemble in *Invisible*) to generate knowledge of, and responses to, research, data and spaces.

H

(H1) Discursivity (an emergent method, in flux, used in my collaborative practice with George and other collaborators/participants). This method allowed us to explore the spaces of difference as possible spaces of creativity and transformation, generate ideas and directions for the works, connect thinking and making, and contributed to a reflective practice. It was used to develop (and in conjunction to) the following methods:

(H2) Creative dialogues and collaborations (with astrophysicists, cosmologists, software designers, musicians, teachers, children, undergraduate students, agencies, curators).

(H3) Relay (dialogic, textual, artistic, technological) and roles exchange.

(H4) Use of workshops (compositional, experimental, pedagogic).

(H5) Interviews (with scientists, musicians, children, undergraduate students).

These methods contributed to generating ideas, thematic constellations and directions for the development of the works, as well as: the materials utilized in the installations and performances (e.g. musicians' interpretations of data, workshop participants' spoken word reflections and poems); knowledge exchange, contamination and dissemination of ideas, tools and forms; textual practice; and the development of new modes of interdisciplinary and art-science collaborative practice, through the interweaving of diverse, multi-cultural and multi- generational perspectives. They also contributed to the following methods:

(H6) Transfer of ideas, technologies and processes across disciplines (by interfacing 'high economy' and 'low economy' processes and technologies, e.g. cutting edge tools from cosmological research and tools from digital art and marginal music forms; and by

migrating tools and methodologies from music, philosophy and science towards multimedia and installation art production). This method allowed us to:

(H7) Devise new frameworks and multiple, hybrid modes/parameters for the sonic and visual translation and transformation of digital data.

(H8) Develop software design (through collaborations with software designer Adrian Ward and astronomer Tim O'Brien, to produce a first series of basic data sonifications and visualizations in *Astro Black* and *Invisible*).

(H9) Website design (for *promised lands.info*, in dialogue with George, I created the site's architecture, layout and components via Photoshop. The design was activated in the World Wide Web through collaboration with website programmer Trinli Gauder).

I

(I.1) Versioning⁸. All of the methods listed above aided us in generating hybrid methods of re-elaboration, and in producing iterations and versions of scientific, historical and archival research materials. Versioning was also achieved through the following methods:

(I.2) Cutting, editing, montage (of sonic, visual and textual materials, to create new assemblages).

(I.3) Sonic experimentation with analogue/digital technologies (e.g. I used tape-speed alterations, time-stretching, multi-filters, feedback networks, granular synthesis and other tools developed by the Groupe de Reserche Musicales in *Astro Black* and *Invisible*).

⁸ My use of this term is based on musical terminology, particularly in reference to the practice of creating multiple instrumental versions of songs, or 'dubs' from existing recordings, developed in Jamaica in the late sixties. Dub, a term also used in cinema (Flow Motion, 2010:49), signals a concern with sonic space, depth of field and spatial architecture. In Jamaican popular music forms, dub versioning is achieved through the use of studio technology, the mixing board, and through processes of sonic reduction (e.g. filtering, the erasure of the voice or melodic/harmonic components) and complexification (e.g. via reverb, echo and delay effects). These processes have informed George's and my approach to sonic production, and have been transferred towards our visual production (hence my use of the term 'version' for both our sonic and visual re-elaborations of astronomical data and photographic archival material).

(I.4) Analogue and digital audio/visual processing (e.g. dub processing through erasure, fragmentation and use of fragments and debris of processes, applied to sonic materials, moving images and photographic archival material, via recording studio technology, and Photoshop, Premiere and After Effects).

(I.5) Following through ‘accidents’ and ‘mistakes’ (e.g. utilizing and processing accidental glitches, cuts and degraded sources in each of the art works).

(I.6) Purposely misunderstanding (e.g. software designer Adrian Ward programmed ‘errors’ in data visualization software to expand the spatial range of movement of data in *Astro Black*. This method also allowed us to formally elaborate questions of knowledge and the unknown in cosmology).

(I.7) Looping (in *Astro Black*, I created multiple sonic loops of different lengths and used them a-synchronously to elaborate ideas of repetition and difference, and generate ever-changing environments. Looped soundscapes were also used in *Invisible*).

(I.8) Tracing, filtering and sculpting frequencies (through Logic, GRM and VST software, analogue sound processors, mixing board and dub-inflected processes).

(I.9) Assembling, layering images and sounds, multi-tracking (polyphonic, polyrhythmic)

(I.10) Dub mixing (equalization, additional effects processing) to add sonic scale and depth and further reshape and elaborate the installations’ soundscapes. This method involved the creation of different layers of pre-mixes, led by George on the mixing board, and myself on engineering, bouncing, multi-tracking, editing and digital re-assembling.

K

(K1) Site-specificity (working in relation and response to architectures, contexts and environments), e.g. shaping the soundscapes in relation to the installation spaces’ specific resonance/reverb qualities, exploring their possibilities (e.g. using underground vents to

house additional sound systems), arranging and mixing in situ, reshaping and re-mixing the works in different locations (e.g. *Astro Black/Astro Dub* was exhibited both as a one-room and as a two-rooms installation). This method was also used to tailor the *promised lands* research for different environments, e.g. web space, performance and subsequent pedagogic contexts.

(K2) Use of multiple sound systems and screens, which aided in generating immersive environments, and in developing the following methods:

(K3) A-synchronicity (eg. in *Astro Black/Astro Dub* multiple a-synchronous systems were used to produce ever-changing audio/visual configurations of repeated loops; this method also allowed us to engage conceptually with the numerical data and scientific research).

(K4) Spatial disorientation/re-orientation (through K1, K2 and K3, and through cross-wiring, e.g. in *Astro Black*, creating multiple diagonal stereo movements across and underneath the installation spaces/floors), to produce immersive and synaesthetic experiences and different modes of perceiving and thinking about Space/spaces. This method was also used in the production of the images for *promised lands*, through I.4 and I.9.

(K5) Installation and performance (through all the methods above). This aided us in gaining knowledge of the spaces and their possibilities, and of the works.

(K6) Collapsing the opposition between installation art and musical performance (e.g. by performing inside the installation spaces and interacting with their audio/visual components, by de-centering the performing area, and by using additional sound speakers surrounding both the performers and the audience, for an immersive experience).

(K7) Presentations, symposiums and seminars, to disseminate and expand on our research/artworks.

CHAPTER 3

CONTEXTUAL REVIEW

3.1 Mutant Creative Universes: Post-Media

Flow Motion's beginnings (1996) coincide with the dissemination of the term 'post-media', which first appeared in a series of articles by Félix Guattari from the mid eighties and early nineties; some of these were published in English in two 1996 collections, Semiotext(e)'s *Soft Subversions* and *The Guattari Reader*, edited by Gary Genosko. Guattari's use of the term 'post-media' was grounded in a larger discourse on and practice of transversality (as discussed in Appendix A), in a belief in the creative and transformative power of art, in concepts of molecular revolution and of minor becoming, and in the experiences of the independent media and the free radios movement of the 1970s. His future-oriented vision foresaw the possibility for a movement away from mass-media culture and the re-routing of emerging technologies towards:

1. The formation of forms of dialogue and collective interactivity and, eventually, a reinvention of democracy;
2. By means of the miniaturization and the personalization of equipments, a resingularization of the machinic mediatized means of expression; we can presume, on this subject, that it is the connection, through networking, of banks of data which will offer us the most surprising views;
3. The multiplication to infinity of 'existential operators', permitting access to mutant creative universes. (Guattari, [1985] 2009: 299-300)¹

Guattari identified the need for a 'third path' or voice complementing those of power and knowledge for the development of a new 'ethico-aesthetic' paradigm:

Only if the third path/voice takes consistency in the direction of self-reference - carrying us from the consensual media era to the dissensual post-media era - will

¹ From the essay 'Postmodern Deadlock and the Post-Media Transition', partially published in *La Quinzaine Littéraire*, No. 246, 1986. The essay comprises excerpts from a paper Guattari gave in Tokyo in November 1985 and in Paris on January 1986 at the European University of Philosophy. The essay was included in a subsequent (2009) expanded edition of *Soft Subversions* by Semiotext(e)/MIT.

each be able to assume his or her processual potential and, perhaps, transform this planet—a living hell for over three quarters of its population—into a universe of creative enchantments. (Guattari, 1996b: 104)²

3.2 Two Lands

In the same year, the *Rhizome* website was established to support artists engaged with digital technology and the Internet. In a post to the website, dated 23rd October 1996, and titled *The Death of Computer Art*, Lev Manovich proposed that there is a fundamental distinction between what he called the ‘Duchamp Land’ (the contemporary art world, galleries, major museums, prestigious art journals) and the ‘Turing-Land’ (the world of computer arts, as exemplified by ISEA, Ars Electronica and SIGGRAPH art shows). For him, the first produces works oriented towards the content, ‘complicated’, with an ironic, self-referential and often literally destructive attitude towards its material, while the second is characterized by directly opposing characteristics: it is oriented towards new, state-of-the-art computer technology rather than content, is ‘simple’ and usually lacking irony.

What we should not expect from Turing-land is art which will be accepted in Duchamp-land. Duchamp-land wants art, not research into new aesthetic possibilities of new media. The convergence will not happen. (Manovich, 1996)

Commenting on this distinction in 2003 he remarked that ‘The logics of “contemporary art” and “digital art” are fundamentally at odds which each other, and I don’t see any easy way around this’ (Manovich, 2003). According to curator Domenico Quaranta, Manovich made the mistake of confusing the idea of art as proposed by the ‘Turing Land’ with the artistic practices which manifested within it (Quaranta, 2010:62). During the first years of the 21st century, this dualism was still thriving within contemporary art institutions, resulting in their difficulty in properly engaging with, integrating and promoting works of artists whose practice had grown in the interstitial spaces, the spaces between these two ‘lands’ and which had carried artistic, cultural and political values developed prior to the

² From the essay ‘Regimes, Pathways, Subjects’ (1992), in J. Crary and S. Kwinter (eds) *Incorporations*, New York: Zone, pp. 16-37. Genosko (1996) traced its first appearance to the ‘Liminaire’, the opening section of Guattari’s *Cartographies schizoanalytiques* (1989), Paris: Galilée.

digital revolution into the new contexts generated by computer technology and the World Wide Web.

In the dichotomy described by Manovich very little space was available for an art practice that sought to explore, from a perspective of complexity, the aesthetic possibilities of new digital technologies while also utilizing destructive strategies towards its materials, and a deconstructive approach towards codified, Eurocentric notions of ‘culture’, ‘space’, ‘place’, ‘subject’ and ‘object’. Even less space was available for art projects and for multi-ethnic art groups that sought to apply these approaches to emerging scientific paradigms, to questions of invisibility and otherness, to cosmological research and data, and which sought to bring them in relation to cosmic imaginaries and migration histories, marginal and black diasporic music forms, contemporary art and cinematic traditions, as we were proposing.

Despite art institutions’ ambiguous relation to new media and digital arts practices, the mid-late 1990s saw the creation of many new platforms which promoted their worldwide emergence and of new media ‘divisions’ within prestigious institutions attracting large funds from private and public companies. An example was The Guggenheim SoHo, which in 1996 curated Mediascape in collaboration with the Zentrum für Kunst und Medientechnologie Karlsruhe (ZKM), and with funding by Deutsche Telekom and ENEL (the Italian national electricity company). The show brought together three decades of video art, with works from established artists like Bruce Nauman and Bill Viola, and a new generation of artists working with emerging technologies. In the same year the Walker Art Center in Minneapolis launched Gallery 9, a commissioning program and online gallery of new media art. In 1997, the contemporary art exhibition Documenta featured net art prominently in a separate ‘Hybrid Workspace’ section. In the UK, new programs for international digital artists included *Deep Screen Diving*, a monthly showcase for artists using screen-based interactive media such as CD-ROM and the internet, organized by Lisa Haskell and held at the Institute of Contemporary Art (ICA) in 1996, and the *Onedotzero* digital film festival, also hosted at the ICA for the first time in 1996. Subsequent programs included the *Digital Equinox*, held at the Custard

Factory in Birmingham in 1998, to which we participated with a live audio-visual performance.

Our first two multimedia installations utilized digital and emerging technologies for visual and sonic production and were held in contemporary art spaces and programs. *The Dub Museum* (1999), exhibited at Camera Austria headquarters in Graz as part of Steirischer Herbst's program *Remake/Remodel: Secret Histories of Art, Pop, Life and The Avant-Garde*, was created in memory of King Tubby, an electrician who pioneered dub music's refiguring of sound space. With this work we sought to evoke dub's pure sense of space through the use of digitally treated atmospherics, environmental sounds, noise static and radio signals; rather than resorting to the generic rhythmic vocabulary of dub, we used the sonic substance of our planetary atmosphere and dub's sonic processes as a means of routing one universe of sound into another.

Our audio-visual installation *Dissolve* (2001), shown at The Space @ Iniva as part of their *Cosmos* season, brought together cosmic and counter-cultural space through a revisiting of Michelangelo Antonioni's movie *Zabriskie Point*. One of the things that drew us to this doomed movie, Antonioni's salute to the 60s counterculture and his biggest commercial failure, was the wish of its protagonist to explode the suffocating dream environment of corporate culture. This wish had a corresponding presence in the film's final, ten minutes long apocalyptic scene, exploding into space capitalism's consumer objects, and transforming these floating objects into abstract forms and purely aesthetic phenomena.

For us this formally innovative movie which, as filmographer Sam Rohdie (1990) noticed, had introduced in narrative film a non-figurative, unfixed subject, 'the subject of the subject dissolved, and that dissolution as the context for something utterly new and unseen' (Rohdie in *Flow Motion*, 2004:232), suggested as yet unexplored possibilities for digital art. For *Dissolve* we utilized and digitally treated fragments of the movie's final scene and scenes of the Death Valley's barren landscape, photographs of Mars (a planet considered by some, e.g. the Mars Society, as a new frontier for capitalist exploitation and possible territory of expansion) and of molecular formations, electronic drones and

mournful Duduk sounds. With this work we sought to produce a kind of elegy for the destruction by the American government of the counterculture that surfaced in the 1960s and re-imagine, at the beginning of the 21st century and of the Bush era, the dissolution of capitalism and its materialist culture.

Amongst the more socially engaged artists and cultural producers active during this period were the collective Mongrel (1997-2008), which for some of its works used both the web and the traditional gallery space to explore an already present discourse around the relation between race, the face and representation (González, 2009). Issues of race, gender and class identity were explored through digital and interactive technologies by London based visual artist Keith Piper. Roshini Kempadoo's on-line and interactive digital artworks explored the interconnected histories of Black British, Caribbean and African Indian diasporas, and questions of migration and belonging. Heath Bunting's works (e.g. *BorderXing Guide*, 2002-3) focused on the development of open democratic communication systems and social structures on the internet and in the public space. From its beginnings in 1992, the Delhi based Raqs Media Collective emerged as one of the most interesting collectives reflecting on and working with new technologies in the intersections of contemporary art, historical enquiry, research and theory.

Net art, a term that emerged by chance in 1995 as a result of a computer glitch,³ quickly spread like a virus. By the end of the century, this term covered a very large range of media, ideas and activities, exploring and exploiting the Internet's peculiar characteristics, its immediacy and immateriality (Greene, 2000; 2004), its decentredness and inter-connective power, and its relation to language and to questions of representation and democratization. Net art productions and discourses particularly developed in Eastern Europe in conjunction with the new political and social conditions deriving from the dissolution of the USSR and the fall of the Berlin Wall. Within this historical context, the Internet provided a wide platform for cultural exchanges.

³ In December 1995 the artist Vuk Cosic opened an email that had been illegibly scrambled in transmission. The term NET.ART was the only piece of legible writing in a mass of code. Cosic began to use this term to describe online art and communication (Greene, 2000).

The newly independent Slovenia, where the term ‘net art’ was coined, emerged as one of the most prolific producers of new media art. In 1994 a group of new media artists and activists living and working in Ljubljana, including Vuk Cosic and Marko Peljhan, initiated the Ljudmila (Ljubljana Digital Media Lab), supported by philanthropist George Soros’ Open Society Foundation. Since 1996 Cosic used ASCII (American Standard Code for Information Interchange) to create works that explored the economy, ecology and archaeology of the media, the intersections between text and computer code and the use of spaces in information. Peljhan developed many participatory networked mapping projects, including the Makrolab (1997-2007), a collaborative project focusing on telecommunications, migrations and weather systems research in an intersection of art and science.

Peljhan also worked with the M.I.R (Microgravity Interdisciplinary Research) initiative, the Yuri Gagarin Cosmonaut Training Centre and the arts-science agency Arts Catalyst to organise a series of parabolic flights with artists and independent researchers in Star City, Moscow, to which Flow Motion participated with the project *Kosmos in Blue* (2001). In this work we explored Russian cosmism, space traveling and the physical effects of zero gravity, music and futuristic space imaginaries in relation to questions of melancholia, alienation and troubled subjectivities, through the work of Nikolai Fedorov, Manfred Clynes and Sun Ra, and with a live performance comprising remixes of Sun Ra’s compositions and radio astronomy sounds (Flow Motion, 2003).

3.3 Art & Science

Our participation in the M.I.R. initiative and the parabolic flights in Star City marked our entry in the art-science field and the beginning of a series of collaborations with Arts Catalyst (2001-5), which included research, workshops, presentations, installations and performances. At the time Arts Catalyst was one of the few agencies working specifically within the emerging art-science field in the UK, who sought to contribute to a critical discourse between contemporary art and science-society issues by curating and

supporting an eclectic range of shows and works⁴. Other curators and researchers working across emerging interdisciplinary and digital art practices during this period include Alice Angus and Giles Lane (Proboscis), Hannah Redler (Science Museum), Peter Ride (DA2) and Helen Sloan (SCAN).

Within this context, we introduced a novel artistic enquiry on the interrelationship between sound and science, darkness and invisibility, space and diaspora, and on the utilization of emerging audio/visual technologies and electronic, dub and improvised music processes for the transformation of astronomical data. Again, this unique conjunction of themes, histories, theories, methods and processes was carving out a distinctive enquiry within the art science field at the time, and producing new modes of cross-fertilization.

Discourses around the emerging art-science practices in the first years of the decade generally revolved around questions of science, technology and visualization practices, with scientific research areas determining the art projects' taxonomy, as in Stephen Wilson's compendium of technology-based and science-inspired art works *Information Arts: Intersections of Art, Science and Technology* (2002). Martin Kemp discussed them in relation to the long history of modeling and visualization shared by artists and scientists (Kemp, 2000). Sian Ede's book *Art and Science* (2005) discusses the art works produced in this field in various ways, but focuses on a shared approach to ideas around beauty and structure through 'surface similarities'. Little discussion at the time was attempting to introduce diaspora voices or utilize a post-structuralist approach within this context.

The 'Two Cultures' argument (Snow, 1959) was still present, shaping institutional discourses, and producing a mutual mistrust, though efforts to bridge the gap were made. The attempts to integrate independent artists within scientific institutions or space

⁴ These included the 1996 group show *Body Visual* (Helen Chadwick, Letizia Galli, Donald Rodney); Ansuman Biswas' *CAT* (1997); *Atomic London*, featuring works on the legacy of atomic power by James Acord, Mark Waller and Carey Young (1998); choreographer Kitsou Dubois' investigations on microgravity (1999-2003); and the *CleanRooms*, with works exploring ideas of contamination, ethics and genetic manipulation by Gina Czarnecki, Neal White and Brandon Ballengee, and Critical Art Ensemble (2003).

agencies were both welcomed by the institutions, often as means to science outreach, and resisted when their works displayed a critical approach. In 2002 Laurie Anderson was appointed as the first and last official NASA artist in residence. Her resulting performance, *The End of the Moon* (2004), created during the Iraq war, critically reflected on the political state of the United States and on its use of technology and space for surveillance and military purposes. Soon after in February 2005, we were invited to participate in the *Workshop on Space Artist's Residencies and Collaborations* (Carnegie Mellon University West, NASA Ames Research Center, California, USA), whose aim was to draw a guideline document for art-science collaborations. The workshop was organized by Lowry Burgess and Frank Pietronigro, research fellows at the Studio for Creative Inquiry at Carnegie Mellon University's College of Fine Arts, and brought together thirty-five artists and scientists to discuss future collaborative work in space.

3.4 Theorizing new media and post-media

In the first years of the millennium, the cultural debates were attempting to formulate, understand and reflect on the formal qualities of new media: for example, Lee Manovich, in *The Language of New Media* (2001), linked it to earlier traditions of film; Rachel Greene's *Internet Art* (2004) analyzed artists' explorations of the aesthetic possibilities of networked communications. The relationship of software, text and language was one of the main objects of inquiry. Florian Cramer linked software art, coding and computer programming to conceptual art and the compositional approaches of Cage and La Monte Young, on the basis of their common material, language and linguistic instructions (Cramer, 2002).

The meanings and definitions of new media were object of discussion and debate, and the search for a suitable theoretical framing continued throughout the first decade of the millennium (Creeber and Martin, 2009:1). The term 'post media' and its aesthetics were re-read and re-formulated in many ways (Krauss, 1999, 2006; Manovich, 2001; Weibel, 2005; Quaranta, 2010). Debates around the 'digital divide' and new media art's position as a 'specialized field of its own', outside the mainstream art world (Bishop, 2012) have

carried on into the second decade of the century. Some argued the divide is institutionally related, and that the use of open networks has introduced an autonomy that has brought about a deeper understanding of the medium and how to exploit it creatively, while also connecting with older traditions critiquing ‘the art establishment’s relevancy and role in governing what is allowed to be seen as the ‘correct’ type of art’ (Garrett, 2012).⁵

As Duchamp had sought to prove with *The Fountain* (Camfield, 1990) art always exceeds institutional frames and theoretical frameworks. New media and digital art are complex, fluid, mutating, dynamic, nomadic and ever-expanding fields. While evolving to an extent within arts institutions, universities and corporations, these new practices have also developed outside and beyond their remit or financial support, within a low economy and through a DIY approach, through the creation and distribution of free software, non-linear dialogue, individual and collective efforts, and independently from mainstream arts distribution channels. Many of these practices are perhaps instances of Guattari’s earlier notion of ‘collective assemblages of enunciation that absorb or traverse specialities.’ (Guattari, 1996a:75).

3.5 Cyberculture and cyberspace

These practices also developed in conjunction with the mutating worlds of cyberculture and cyberspace, and their utopian and dystopian imaginaries. The term cyberculture was first coined in 1963 by Alice Mary Hilton to describe the ‘way of life made possible when an entire process of production is carried out by systems of machines monitored and controlled by one computer.’ (Hilton, 1964:217)

Instead of asking where science and technology should stop, we must ask ourselves - and give much careful thought to our answer - where science and technology, and every other creation of the human mind, should lead! We shall be racing technology to

⁵ This comment by Marc Garrett, co-founder of Furtherfield online arts community, was part of a long online thread of discussions in Artforum in response to Claire Bishop’s article ‘Digital Divide: Contemporary Art and New Media’, featured in *Art Forum*, September 2012. The thread also includes a post by 160B (09.02.12 06:20 pm), probably an artist: ‘The question I would like to ask here, which is probably a naïve one, is: why do you (new media critics, art historians & other specialists) keep creating borders/frames where artists need to be in a camp or the other?’ Available from: <http://artforum.com/talkback/id=70724> [Accessed 13 September 2014].

disaster -and win the race hands down- if we persist, in the age of cyberculture, to assess the worth of a human being and the use of our cybernated tools in terms of the market place. Our hope must be placed in man, and in his age-old dream for a society based upon human values other than buying and selling. (Hilton, 1964:222-3)

Hilton saw, in the abundance produced by the cybernetic revolution the possibility for social change and emancipation, justice and civil liberties, redistribution of wealth and liberation from hard labor, unemployment and poverty. As a member of the Ad Hoc Committee on the Triple Revolution (of ‘Cybernation’, ‘Weaponry’ and ‘Human Rights’), she set forth the argument for Living Certificates entitling all to a basic income; the Committee’s memorandum, sent to U.S. President Lyndon B. Johnson in 1964, proposed that an income be made a constitutional right.⁶ Her views on technology changed after the Vietnam War.

Two decades later, in 1984, Sci-fi writer William Gibson’s debut novel *Neuromancer*, a seminal work of cyberpunk literature, offered a near-future, dystopic imaginary of ‘cyberspace’, a term that in the nineties became synonymous with the World Wide Web:

A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphical representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the non-space of the mind, clusters and constellations of data. Like city lights, receding... (Gibson, 1984:7)

A decade later new imaginaries of cyberspace as a space of emancipation began to emerge and circulate, which re-connected to Hilton’s early vision. An example of these is John P. Barlow’s 1996 *A Declaration of the Independence of Cyberspace*⁷: ‘We will create a civilization of the Mind in Cyberspace. May it be more humane and fair than the

⁶ ‘We urge, therefore, that society, through its appropriate legal and governmental institutions, undertake an unqualified commitment to provide every individual and every family with an adequate income as a matter of right. [...] The problems of joblessness, inadequate incomes, and frustrated lives confront us now; the American Negro, in his rebellion, asserts the demands – and the rights – of all the disadvantaged. [...] behind him stand the millions of impoverished who are beginning to understand that cybernation, properly understood and used, is the road out of want and toward a decent life.’ Ad Hoc Committee, The Triple Revolution. In *International Socialist Review*, vol.24 no.3, Summer 1964, pp.85-89.

⁷ This manifesto, which was posted on thousands websites, was created in response to the Telecommunication Reform Act of February 1996 that the Clinton administration had passed in order to regulate speech on the Internet. Available from: <https://projects.eff.org/~barlow/Declaration-Final.html> [Accessed 10 March 2013].

world your governments have made before'. A year later, in Mexico, The Electronic Disturbance Theater (EDT), a small group of cyber artists, activists and critical theorists established in 1997 by performance artist and writer Ricardo Dominguez, began developing and sharing through the net the theory and practice of Electronic Civil Disobedience.

A new aesthetic sensibility, a new sense of planetary interconnectedness was developing via the web, which, as Guattari had envisaged, was at its best the virtual location of countless minor becomings, the possibility for the sharing of free software and alternative information and for giving a presence to independent groups and productions. This idea of course needs now to be reconsidered in the light of Snowden and the NSA's (National Security Agency) use of the web as a mass surveillance mechanism.

3.6 New sounds from the underground

The 'underground' could be a basement, a cellar, or a more general definition of a place and kind of activity, subterranean, secret, clandestine, experimental, avant-garde; it could be the activity of 'a group or movement organized secretly to work against an existing regime'⁸, or the 'underground maneuvers' of marginal sub-cultures and independent groups operating in the interstices below the main stream's visible surfaces. It is what happened in the mid- and late nineties, in Berlin, in Detroit, in London, and in many home studios all over the planet, hidden locations where machines and digital technology were re-routed for the production of new forms of 'techno' music. Here, computers' mechanical precision was infected by hisses, glitches, bugs, disruptions, discontinuities, moments of anti-production; similar to the descriptions of Deleuze and Guattari's desiring-machines that 'work only when they break down, and by continually breaking down' (Deleuze and Guattari, [1972] 1983: 8). A renewed aesthetics of the machine appeared to be taking form, reversing, subverting the idea of digital technology as clean, efficient and normalizing, and bringing digital machines in dialogue with the body and its

⁸ See Oxford Dictionaries' definition of 'underground'. Available from <http://www.oxforddictionaries.com/definition/english/underground> [Accessed 6 August 2013]

intensities, rhythms and discontinuities, its connections and exchanges with other bodies. These places and new modes of digital practice became the repository of older avant-garde and popular forms and practices (Toop, 1995; Davies, 1996; Reynolds, 1998; Cascone, 2000; Cox, 2003; Cox and Warner, 2004), revisited and reshaped through new technologies⁹. New sounds were created and new musical vocabularies were developed, independently from the big record companies, away from the controlling directives of institutions, out of sight and out of reach of the corporate world. These innovative fringes of techno generated a music of ideas and experimentation, a music of resistance and inclusive spaces of belonging (Schaub, 2009), where any form could be conceived and no normative rule would be upheld. Independent labels Underground Resistance, Axis, Basic Channel, Chain Reaction, Mille Plateaux, Sound Signatures, amongst others, elaborated through rhythm and sound a possibility for re-thinking the world and the relation between (human) bodies and technology, perhaps similar to the one that a new generation in post-war Germany, in combining a spirit of sonic adventure with a desire to transcend Germany's past, had done before them.¹⁰

⁹ Together with the use of vintage 70s and 80s analogue drum machines and synthesisers, many of the techniques and tools of musique concrete and early electronic music were digitally reproduced via sampling machines and newly developed software, including tape speed modification, tape splicing and granular synthesis. New digital techniques included: the alteration of strictly quantized time through software manipulation; the application of extreme time-stretching functions towards the radical transformations of sound sources; and the utilization of MAX, a program written by Miller Puckette at IRCAM in the mid-1980s as the Patchier editor for the Macintosh to provide composers with an authoring system for interactive computer music. In 1996 MAX was re-designed as a free software computer program and was utilized by various experimental techno producers, including Chain Reaction artists Gerhard Behles and Robert Henke (Monolake) who subsequently developed the Ableton Live program.

¹⁰ John Weirziel, from Amun Düül, a group of commune dwelling musicians from Munich, described the context in 1968: 'In those days there were bloody Nazis around all over the place, there was rebellion against them [...] We didn't have guns or the tools to chase them away but we could make music and we could draw audience, draw people with the same understanding, the same desires [...] we didn't want to make English or American music, and we didn't want to make German Klager music, so we had to come up with something new [...] We wanted to be international, and we tried very hard not to be Anglophonic and not to be German. So, Space was one solution.' For Edgar Froese, 'There was no heritage from the country [...] There was nothing else to lose, they lost everything. And so, when we thought about doing music in a different form, there was only the free form you know, the abstract form'. The German artist Redelius, founder of pioneer ambient electronica group Kluster, explains that, in 1974, they had a vision of creating 'a different world with different sounds [...] a way out of the surrounding society'. Can, formed in 1968, combined the influences of the European avant-garde, jazz and minimalism. 'A mental evolution happened at that time' says Jaki Liebrecht, Can's drummer; 'the war was definitely finished and the old ways of thinking had to be destroyed'. Liebrecht was Germany's top jazz drummer until he had an epiphany. 'A guy came to me and said: you must play monotonous [...] I started thinking about it [...] so I started to repeat things. And Ralf Hutter from Kraftwerk, in discussing their work, says: 'The human body has a small electric current – you can see on an ECG [...] that there is no separation between humans and technology, for us they belong together as a unity.' (*Krautrock: The rebirth of Germany*. BBC Four Television, 23 October 2009).

The desire of social change, the aesthetics of synthesized sounds, minimalism, abstract forms and repetition present in seventies' German electronica were revisited in a different context and through new technologies in the 1990s. The difference: 90s' music was driven by an African aesthetics, filtered and re-invented through African-American and Caribbean aesthetics: Hip-Hop, House, Techno, Drum & Bass, Jungle, Dub-Step, all place at their centre polyrhythm. In these music forms each instrument's percussive aspect is prioritized, while the melodies and harmonies, breaks and cuts are held together by the interplay of rhythmic pulsations, augmented and deepened by digital processors. The harmonic structures became circular, drone based, non-progressive, and more inclusive of any sound or noise. The liberation of time and tonality that bebop and free jazz had achieved with live performance and live recording became the impossibly stretched time of digital technology: double speed high hats, sub-bass frequencies, digitally expanded sonic architectures which also contained, retained within themselves, traces of musical ancestry and forms of communication, of African polyrhythms and polyphonies. An Africa re-created, re-articulated through musical science.

During the nineties, invisibility and space became interconnected aspects in the more innovative fringes of techno: records with no faces or names in their covers, with coded inscriptions hidden in their grooves, with no instructions on their correct speed – 33, 45, and any speed in between would work; similarly, our records' production for Berlin label Chain Reaction, under our alter-ego name Hallucinator (George, Mathison, Piva) had no faces and no instructions, they could be and were played at different speeds. This aesthetics had a political dimension. Our first single, *Hallucinator* (1998) had hidden within its grooves the inscription 'In memory of Steven Lawrence'. In an interview, Mad Mike from Detroit's label Underground Resistance talked about wanting to be 'faceless' against the pop artists' trend of using skin lighteners (Banks, 2006). Through titles like *Interstellar Fugitives* (UR, 1998) and pseudonyms like 'Galaxy to Galaxy' (one of Underground Resistance's members), new interplanetary space imaginings, new spaces of cosmic belonging were being produced. A re-thinking of space in sound and new explorations of sonic space were occurring through newly developed music technologies.

By the mid-1990s a new aesthetic had begun to surface at the margins of techno, which we contributed to and which came to be known as ‘techno-dub’. In its early development by Berlin’s label Basic Channel (Mark Ernestus and Moritz Von Oswald) and by the artists in their sub-label Chain Reaction (1995-2003) this musical field was as open and unfixed as the blurred margins and the spaces between dub, minimal, ambient, electronic and club music. Examples of its open forms and compositional approaches can be heard in our EP *Morpheus* (2003), the last release of the label. While moving away from the traditional reggae forms, our music maintained dub’s sense of sonic depth and scale and its rhythmic pulsations. Against a clean, digital sound aesthetics, the tracks foreground the detritus of analogue processes, reshaped through equalization and filtering, multiple delays and reverb, and chains of digital and analogue sound effects. *Morpheus*’ sonic architectures sought to evoke a presence under erasure, a sonic ‘non-I’ (Bachelard, [1960] 1971:13), non-linear and de-structured, reduced and augmented, refigured as a field of elemental forces, a circulation of states, a flux of polyrhythms, sound clouds and shifting atmospheres, a living and morphing sonic space.

At the basis of our Hallucinator productions for Chain Reaction (1998-2003) are the processes of erasure and re-composition developed in the 1970s by Jamaican reggae-dub producers King Tubby and Lee Perry. The tracing of the melodic and harmonic components, the cuts and ‘plunges’ that provide ‘accidents and surprises’¹¹ (Snead, 1984:67), the focus on polyrhythm and the creation of tangential micro-rhythms via live improvisation on sound processors and the mixing board, were our means of maintaining a strong connection with Jamaican and African music forms, while also establishing new connective strands between these and the emerging vocabulary of left-field and experimental techno music.

¹¹ In *Repetition as a Figure of Black Culture* James A. Snead uses Hegel’s description of African culture as ‘a succession of accidents and surprises’ to argue that ‘European culture does not allow “a succession of accidents and surprises” but instead maintains the illusions of progression and control at all costs. Black culture, in the “cut”, builds “accidents” into its *coverage*, almost as if to control their unpredictability. Itself a kind of cultural coverage, this magic of the “cut” attempts to confront accident and rupture not by covering them over but by making room for them inside the system itself.’ (Snead, 1984:67)

The last productions by the Basic Channel family of labels were Rhythm & Sound's classic 'One-Riddim-album' *See Me Yah* (2005) featuring vocals by international reggae artists and a series of subsequent remixes of these songs by various contemporary electronic and club music producers, including Carl Craig, Villalobos and Vladislav Delay, as maxi-singles and a compilation CD. The final track in the compilation was Hallucinator's remix of *See Me Yah* by Willie Williams, a Jamaican roots artist with a special significance in London musical history. Williams' song *Armagideon Time* (1978) was made famous by the Clash, who released a version of the song in 1979 in the b-side of their single *London Calling*. Toop (1994) identified the strong links between dub and the more progressive strands of UK popular music, beginning with the 70s London 'punk/roots reggae equation', from PIL to Jah Wobble, the Slits, Dennis Bovell, Adrian Sherwood and the Clash, to Metalheadz, jungle and dub-step, Massive Attack, Tricky (with whom I toured in the mid 90s) and Asian Dub Foundation. Since the 70s dub never left London; in particular, Jah Shaka's sound system provided, throughout the last four decades, a continuous presence and sonic guidance to many new generations of musicians, and a template for constant innovation, creativity and sonic experimentation. Shaka's monthly events in London, which we regularly attended, were a main source of inspiration for us and deeply influenced our musical production.

For this remix George and I created a new rhythm and explored a classic roots-reggae-dub approach (Veal, 2007: 58-60). The track collapsed song, dislocation and rhythm version, progressively reconfiguring and rendering abstract the song's harmonic and melodic components, and working with the force of the low register to re-articulate its spatial qualities. In the second part of the track, I reduced the *See Me Yah* vocals to a single 'S', a rhythmic and constantly repeating, Zen-style minimalist refrain, around which the other mid and high frequencies were reshaped, transformed and set in motion. With this work we sought to highlight the connections and continuities between contemporary European electronica, sound system culture and the sonic architectures and adventurous approach to technology of 70s reggae-dub, its 'raw' and imaginative reinventions of African roots and its openness to 'endlessly multiplying, mutating, and potentially infinite elaborations over time'. (Veal, 2007: 57)

3.7 Sound Art

The term ‘sound art’ has been used to describe diverse practices, which include sound sculpture, sound installation, sound performance, sound poetry, radio art, computer music and net art. Its early beginnings have been traced to futurism’s noise music (Russolo’s *Intonarumori* and 1913 manifesto *The Art of Noises*), Duchamp’s conceptual art and Dada’s performance art. As installation art, it began developing in the late fifties in the interface between musical composition, media art practice, architectural design and sound spatialization technologies. The most spectacular early example of this new form of spatial art was displayed at the 1958 Brussel’s World Fair Phillips Pavillion, designed by Le Corbusier and featuring Edgard Varèse’s *Poème électronique*, a composition played across hundreds of loudspeakers (Treib, 1996). In 1971 the American artist and percussionist Max Neuhaus coined the term ‘sound installation’. Neuhaus defined sound installation as sound works without a beginning or an end, in which sounds are placed in space rather than time. Through his work Neuhaus characterized sound as an autonomous medium within the field of contemporary art.¹²

In the latter part of the nineties sound art began to emerge and receive curatorial attention. Berlin’s Singuhr Sound Gallery, one of the first galleries devoted to sound art, opened in 1996; during the next eleven years it programmed around 80 exhibits, ranging from sound objects and kinetic sculptures to pure sounding spaces and audio-visual productions. In its conceptual remit the gallery aimed at fulfilling the specificity of sound-space art, of ‘works that are conceived for a certain space and are also realized there’ (Seiffarth, 2012). Its curator, Carsten Seiffarth, summed up the requirements of sound-installation practice: ‘Works with sound, and their presentation, need time, sound and spatial imagination, and empirical experience.’ (Seiffarth, 2012)

The new ideas and aesthetics generated within nineties’ experimental electronica, the availability of new technologies of sound reproduction and spatialization and perhaps also

¹² See Neuhaus’s website. Available from: <http://www.max-neuhaus.info/soundworks/Bio.pdf> [Accessed 11 March 2014]

a desire to inject ‘sensation’ in the gallery space, contributed to a new wave of sound installation art. In the first decade of the 21st century major group exhibitions took place in the UK and abroad. *Sonic Boom: The Art of Sound*, curated by musician and writer David Toop, (London, Hayward Gallery, 27 April- 18 June 2000) was the largest group exhibition of sound art ever staged in the UK, featuring works by 23 artists and groups.

The show was described as ‘post-techno, post-rave, post-ambient sound art’ bringing together ‘the mechanical and the organic, the electronic and the acoustic, the sculptural and the intangible’ (Martin, 2000). Its range was indicative of sound art’s concerns and approaches at the time: from traditional sound sculpture (Max Eastley) to subtly changing ambient soundscapes and visuals (Brian Eno, Paul Schütze); from sonic/voice automata, robotics and electronic toys (Stephan von Huene, Paulo Feliciano and Rafael Toral, Chico MacMurtrie) to electronic and electrical equipment noise (Joe Banks); from sine-tones /minimal techno (Ryoji Ikeda) to video works referencing American social history and rock tradition (Christian Marclay and Sonic Youth’s founder Lee Ranaldo). Interestingly, apart from one of the works, staged outside the exhibition space by Christina Kubisch, one of only two solo female artists featured in the exhibition, there was no sonic space separation, with the different works acoustically interacting and purposely clashing.

A subsequent group exhibition, *Sonic Process: A New Geography of Sound*, curated by Christine van Assche (Macba, Barcelona, and Centre Pompidou, Paris, 16 October 2002- 6 January 2003), in which we participated, took a different curatorial approach exploring the electronic music of the previous ten years from the perspective of its hybridization with the methodologies of the visual arts. The show featured works by Doug Aitken, Mathieu Briand, Coldcut, Renée Green, Huber and Dorfmeister, Mike Kelley, Gabriel Orozco, Scanner and David Shea. The physical organization of the museum space allowed the diverse artists to develop specifically constructed and (almost) self-contained sonic spaces, with the availability of high quality sound equipment and sound absorbers, extended set-up time and a dedicated audio-visual team working with the artists.

With our work, *Ghostdance*, created in response to the Centre Pompidou’s architectural

design, we mapped the double idea of dub as a ‘deterritorialized’ and a ‘deterritorializing’ machine, and dub as a tao of technology, pulverizing and liquefying, reducing and expanding, erasing signals and activating negative spaces, the spaces between signals and events. While departing from reggae forms, we utilized the processes of dub and the physical architecture of the sound system, evoking their sense of expanded sonic space to reflect on the idea of the museum as a permeable architecture. Using external microphones to capture live sounds from the surrounding environment and re-figuring them inside the installation via an array of sound processors and hanging car speakers, *Ghostdance* offered a double movement to Archigram’s imagining of an architecture whose inner space pushes through the skin of its structure (Archigram 1961, in Sadler, 2005:12).

The installation’s sounds and images figured multiple evocations of the Ghost Dance movement, of phonographia and spectrality and of the sound system as a carrier of diasporic cultures (Flow Motion, 2002:224-9, 265). Large sound system cabinets, emptied of their internal components, were transformed into sculptural elements. Images of billows of smoke and the moving shadow of a record player, slowed down and digitally treated, were projected on two sides of the space. Historical audio recordings from sound system dances were emptied from the music, while the spaces between the songs, the sounds from the audience and the environment were refigured as ghostly sonic presences. Ambient recordings of the sounds of Barcelona, the city where the installation first took place, were migrated to the Centre Pompidou, dubbed and mixed with the live sounds of Paris, Native American drums, pulsars, electric interferences and sound equipment noises. These sonic and visual elements were assembled and mixed in the space of the museum to propose a multiple re-reading of the sound system, as a Bachelardian machinery of poetic space, a nomadic ghost machine, a migrating technology and a sonic substance - its hums, clicks and buzzes, the sonic detritus of its components.

3.8 Artworks

In the final section of this review, I explore works which emerged before, in parallel and after our research, to demonstrate its relations to similar work. The examples are drawn from fine art, art-science, digital art, sound and installation practices, which while distinctive in disciplinary terms, demonstrate a shared thematic focus with the work we produced during the period discussed.

Cosmology's metaphors of darkness made an early appearance in the fine arts in Cornelia Parker's installation *Cold Dark Matter: an exploded view* (1991). The two-part title used the scientific description of an invisible substance believed to exert a gravitational pull on all visible matter in the universe, to play on multiple associations, of darkness, psychological states, and the aftermath of the event. In this work, part of a series inspired by 'cartoon deaths' (Parker 1991), fragments of an exploded garden shed were re-gathered, suspended with wires, and lit with a single light bulb placed at the center of the sculpture, casting shadows on the surrounding walls and creating a play of contrasts, of darkness and light, material and immaterial presence, and a simultaneous sense of stillness and expansion. Taking the cosmological in a different direction, Susan Hiller, in the sound installation *Witness* (2000), engaged with the theme of extraterriality through audio recordings of first person testimonies, sourced from across the world, of encounters with UFOs. These testimonies, relayed through hundreds of tiny speakers suspended at different heights in the gallery and arranged in the shape of a cross and a circle, generated an atmospheric, narrative sonic space, which in its symbolic evocation of Christian cosmology suggests these might be examples of visionary experiences, contemporary renditions of what would have previously been described as encounters with angels (Hiller in Beaven, 2011). *Cold Dark Matter: an exploded view* and *Witness* enable an imaginative encounter with ideas of space, extraterriality and the cosmos, and relate to Flow Motion's use of installation and the fragmentation and spatial reassembling of materials, to imagine how different structures, media, and data sets can set the scene for audience encounters with these themes. However in such works as *Astro Black* and *Invisible* we took a much broader approach to integrating ideas, voices, histories, and

knowledge forms concerned with cosmology, drawing upon diverse fields of research, electronic, acoustic and cinematic renditions of scientific data, and dub based, improvised performance. This cross-cultural approach was reinforced by extended collaborations with astrophysicists, multicultural, English secondary school workshops, German undergraduate film and music workshops. Our concern with exploring different kinds of 'otherness' (cosmological, aesthetic, cultural, social) and integrating the voice of the 'other' in and through our artworks, both in a collaborative sense (as participants in the realisation of the work) and by enabling a platform for marginalized voices, was another key distinguishing aspect of our practice during and after this period.

Amongst the artists who, like Flow Motion, have explored the aesthetics of outer space sounds, atmospherics, electromagnetic interference, machines' sonic debris and ghostly auditory phenomena is Joe Banks (Disinformation). Banks's phonographic recording *Stargate* (1996) used shortwave radio emissions of solar storms, sunspots and solar flares, pre-dating by a decade Semiconductor's art-science project and video work *Brilliant Noise* (2006) which relocated in the art gallery un-treated scientific visual data of solar surface activity. In *Rorschach Audio* Banks focused on questions of perceptual creativity and the illusory in sound (Banks, 2001, 2004) through his research on Electronic Voice Phenomena (EVP). These aesthetics were differently explored in our work *Astro Black*, through the deployment of treated interplanetary and interstellar radio astronomy data, sonification technologies, granular synthesis, dub processes of sonic 'ghosting', the tracing and layering of multi-lingual and multi-tonal vocal recitations of numerical data, and through a focus on liminality, the spectral and the edge of perception in soundscape and moving image production.

Moving to the developing art-science field of the late '90s, Ansuman Biswas, in his performance art work *CAT* (1997) used a comparative approach to questions of knowledge and perception. Biswas used the figure of the Schrödinger's Cat, a famous paradox of quantum physics, and his body as an artistic medium, to explore the methodologies of modern science in relation to the 2,500-year-old Indian science of Vipassana. For ten days Biswas remained sealed within a sound and light-proof chamber,

while attempting to maintain continuous observation of all sensory phenomena, using the art gallery to produce an experience in which he is both the observer and the observed phenomena. In the sound art performance *Invisible*, Flow Motion took an improvisational approach to the questions of knowledge, perception and embodiment. Embodiment in *Invisible* took the form of the musical sextet, comprising Indian classical and jazz musicians, and ourselves. And while our use of ideas and musical idioms rooted in Vedic cosmology relates to Biswas's concern with establishing relations between contemporary, Western science, and pre-modern, Indian science, we also sought to interweave these forms with multiple practices. For example, contemporary cosmological research on dark energy, black diasporic and experimental electronic music, and children's poetry on darkness and the invisible universe. The aim of this approach was to generate a layered and multi-faceted, immersive encounter with diverse modes of knowledge and perceptions of invisible forces and cosmological space.

Kepler's theory of the Music of the Spheres, gravity and interplanetary connections, and interdisciplinary collaborations with scientists, engineers and glass blowers formed the basis of Luke Jerram's audio installation *Tide* (2001). Jerram conceived this work as a sound sculpture and also as an attempt to create 'an accurate, musical astronomical device' (Jerram, no date), and used a high-precision gravity meter, glass spheres and water to generate a direct link between sound, outer space and the space of the art gallery, where these sculptural materials fluctuated, interacted and produced sounds in relation to the changes of the moon's gravitational energy. A decade later, Jeff Talmans' installation *Nature of the Night Sky* (2011), created in collaboration with astrophysicist Daniel Huber (Sydney Institute for Astronomy) also featured audio material generated by the movements of outer space bodies. Based on the technologies of stellar seismology, this artwork solely comprised of scaled and sonified readings of the oscillations of star masses, reassembled in the Bavarian Forest and activated at nighttime. Flow Motion's approach to art-science practice is similar to Jerram's and Talman's works in its use of sound and astronomical research to produce an aesthetic and immersive experience of cosmic interrelations, but is differentiated by a concern with indeterminacy as a collaborative, interdisciplinary strategy. Our focus was not on producing an accurate

reading or representation of data from visible celestial bodies, but on an engagement with scientific research on invisible forces and phenomena between stars and galaxies which elude direct detection, and which had contributed to produce a paradigmatic shift in cosmology. In *Astro Black* and *Invisible*, theories and data emerging from these areas of research were brought into relation with ideas of otherness, difference, chaos and fractality, and to the transformative processes of digital art, dub, electronic music, jazz improvisation and software design, to produce multiple readings and immersive experiences of sonic and cosmological space.

Susan Collins's interdisciplinary project *Tate in Space* (2002-3) explored space constructs and cultural fantasies, questions of corporate identity and social inclusion, and the relation between the illusory and the real (Collins, 2004). In an era when the Tate Gallery was looking to expand its presence as a world-leading venue of contemporary art, Collins used Tate's re-branding and its net art program, architectural design, networking and contributions from scientists, artists, academics and diverse audiences to produce a fictional outer space gallery, as a catalyst and repository of heterogeneous voices, perspectives and practices. Space, interdisciplinary collaborations and architectural design also formed the basis of Thomas Saraceno's artwork *In Orbit* (2013-present). This gigantic floating installation, consisting of a multileveled, spider-web-like steel wire construction, allows audiences to physically experience space as an interconnected network of relations, and was conceived as part of a larger, on-going project for a utopian, aerial city of the future. In *Music and Science Lovers*, Flow Motion approached the idea of space as a place of constantly shifting relations, resonances and oscillations whose sense of topos was, in contrast to *In Orbit*'s utopic future, located in the multicultural present. Unlike Collins's wry take on the relocation of a major art institution in space, our use of net art in *promised lands* focused on the exploration of global histories of migration through interdisciplinary archival research, and the use of phonographic recordings, digital triptychs, and textual montage.

In the first decade of the millennium, the availability of new software and digital technologies, the digitization and on-line dissemination of data and archival material, and

a developing sense of global interconnectedness enabled artists to generate new models of interdisciplinary, multimedia and critical art practices. For example, Lise Autogena and Joshua Portway's *Black Shoals Stock Market Planetarium* (2001) explored the aesthetics of information to reflect on questions of control and prediction of complex systems, such as the economy, and on the nature of ecosystem dynamics and artificial evolution. The work utilized the shifting real-time patterns of the world's stock markets to generate an animated night sky, projected onto a planetarium-style dome, in which the top traded public companies are represented as stars which flicker, cluster together and drift apart in response to the activities of the financial world. These activities also feed an ecology of artificial-life digital creatures, each with a unique programmed 'DNA' code, which evolve and learn to survive within this environment and through the changes in trading patterns. Gavin Baily and Tom Corby's artwork *Cyclone.soc* (2006) approached 'the interdependences of global warming and human behaviour' (Corby, 2011:246) through the live mapping of textual conversations from religious and political newsgroups into satellite meteorological data sets as large-scale installations. Developed at the time of hurricane Katrina, the work re-contextualized archived scientific data modeling the formation of storm fronts, to produce an interactive, sensorial and dynamic experience of interrelated psychological, social and environmental phenomena. If both Autogena and Portway and Corby and Baily's works can be seen as attempts to articulate different ways of using data visualisation within a critical art practice that was primarily visual, *Astro Black* engaged data processes through the figurative language of cosmological discourse, whilst simultaneously integrating them with dub and cinematic processes to produce distinctive sonic and visual forms that referenced and integrated different cultural tropes.

Roshini Kempadoo's online artwork *Virtual Exiles* (2000-2008) and her installation *Ghosting* (2004) approached 'post-colonial narratives, historical legacies and diasporic perspectives' (Kempadoo, 2010:61) and explored questions of memory, race, identity and belonging through the critical use and digital manipulation of archival data, and through interactivity and participatory approaches. In *Ghosting*, an imaginary plantation, fictional characters and multiple, interconnected narratives highlighted the Caribbean's worldwide origins and its roots in slavery, indentureship and migration. The curated site *Virtual*

Exiles used multiple visual, textual and sonic contributions of individuals and groups who have left their country of origin, reflecting on their simultaneous experiences of settlement and displacement, belonging and otherness in their new home countries. In *promised lands* Flow Motion approached similar themes (colonialism and global migration, marginal and diasporic voices) through phonographic extracts, digital art and counter-archival art practice. These interrelated histories and archival materials were further elaborated through textual montages and digitally treated photographic triptychs, which also used meteorological and geological data components, producing a distinctive and layered assemblage of formal, conceptual and sonic parts.

3.9 Summary

Flow Motion's arts practice pursued a distinctive set of issues, in the spaces between (using Manovich's terms) the 'Duchamp Land' and the 'Turing Land'. As discussed above, this work developed dialogues between digital art practices and cinematic traditions, emerging paradigms in the sciences, sonic cosmologies and imaginaries, and marginal and diasporic histories and counter-cultures.

In the following chapters I show how these approaches developed in practice, through artistic re-elaborations of the scientific, historical, critical and cultural.

CHAPTER 4

ASTRO BLACK MORPHOLOGIES: MUSIC AND SCIENCE LOVERS (2004-6)

When I say space music, I'm dealing with the void, because that is of space too [...] So I leave the word space open, like space is supposed to be'. (Sun Ra, 1956, in Szwed, 1998:384)

4.1 About the essay

At the end of December 2002 Flow Motion was awarded a grant by London Arts Board, for the research project *Sounds of Science*, which formed the basis for our *Music and Science Lovers* trilogy of interdisciplinary art works (2004-2011). The themes and motifs developed during the research period (2003) were elaborated in a compressed form in our essay *Astro Black Morphologies: Music and Science Lovers*. The essay was first published online in the Leonardo/OLATS Journal (Flow Motion, 2004) and, in revised form, in MIT's Leonardo Special on Space Art (Flow Motion, 2006: 23-29).¹

4.2 Research aims

Devised as a series of possible histories of science in music, the essay brings into dialogue different modes of knowledge and practice to pose the following questions:

- What cross cultural connections can be made between scientific cosmological research and cultural models of the universe derived from sonic imaginaries, mythologies, and other poetic imaginings?

¹ The essay was first presented as a paper as part of the *7th Workshop on Space and the Arts: "Space: Science, Technology and the Arts"*, co-organized by the European Space Agency (ESA), the International Academy of Astronautics (IAA), Leonardo/OLATS (Observatoire Leonardo des Arts et des Techno-Sciences) and the OURS Foundation, and held at ESTEC - ESA's European Space Research & Technology Centre in Noordwijk, The Netherlands, 18-21 May 2004. During the workshop we also presented the related art project *Astro Black Morphologies/Astro Dub Morphologies* as a work-in-progress, and showed some of the installation's prototype movies. Our participation to the workshop was supported by a British Council grant. Details of the workshop are available online at: http://www.olats.org/space/13avril/2004/mono_index.php [Accessed 3 February 2014].

- What textual approaches (in practice) are suitable to the above in regard to developing interdisciplinary correspondences and translations between arts-based approaches and scientific knowledge?

4.3 Methods employed

A1, A2, A4, A5; B1-2; C1-5; D1-6; E; F1-3; G2; H1, H2, H3, H5, H6; I.1.

4.4 Themes and approaches

The essay was developed through multi and cross-disciplinary (re)readings of scientific and cosmological research, contemporary and pre-modern philosophies, esoterica, biographies, and historical and musicological texts; the listening and analysis of diverse music forms, and environmental and radio astronomy sounds; creative dialogue, textual relay and interviews with astrophysicists; iteration, versioning and the use of fragments, citations and montage, as evidenced in the essay's title and formal structure. Through these methods, new correspondences and thematic constellations emerged, forming the basis for a 'Deep Space Poetics', further elaborated with *Astro Black Morphologies*/*Astro Dub Morphologies* and *Invisible*.

a) Structure and narratives/repetition and difference/iteration and montage

The essay comprises two parts: the first part was written in October 2002 as the introduction to our *Sounds of Science* research proposal to the London Arts Board. The second part sketches some of our research findings and was written at the beginning of 2004, in the early stages of development of the installation's audio/visual components. The essay interweaves three stories; in its original, online form, these were doubled, or sub-divided in six parts, each with a two-part title: the first part repeats, forming a refrain with a constant, slight variation which signals a movement and a continuity across time,

while the second part is different²:

- A story of correspondences between music and science lovers, between sonic and outer space imaginaries, and between cosmic music and the music of the cosmos.
- A story of transformation of matter, identity and form, of process, sonic and scientific experimentations and creative translations.
- A story of the discovery, through noise, of fractality, of cosmic correspondences and of something of the cosmos in the human body and in music.

b) The title/citationality/versioning

The title of the essay also comprises of two parts, and two citations, from the Sun Ra album and poem *Astro Black* (1972) and from Lee ‘Scratch’ Perry’s track *Music and Science Lovers* (1987).³ The word *morphologies* (from the Greek ‘study of shape’) identifies and locates a third, plural voice, us and our developing practice. By 2003 this figure had become our collective virtual name (our email address); in the essay’s title it signals a permutation and a relocation of themes and concerns we had explored in our E.P. *Morpheus*, released under the name Hallucinator by Berlin’s electronic label Chain Reaction in 2003.

² This structure was based on a numerological and musical reading: number 3 is a key number in musical structures (e.g. chords triads); it has symbolic meaning in the work of many composers, (e.g. Mozart’s *Magic Flute*) and is particularly relevant in John Coltrane’s ‘changes’ and his preoccupation with chromatic third relations, perhaps also inspired by spirituality and religious trinities (Demsey, 1996:145). Number 6, in its geometric forms (e.g. the hexagon or the six pointed star) is widely present in nature and art, as well as in Egyptian and esoteric symbolism. The parts I, II, III of the essay were written in 2002; the parts IV, V, VI were written in 2004. The original titles, in the online text, are:

- Possible histories of science in modern music I: pre-histories, sonic & cosmic
- Possible histories of science in music II: cosmic music & the music of the cosmos
- Possible histories of science in modern music III: the universe is in my voice
- Possible histories of science in music IV: the ubiquitous sound
- Possible histories of science in modern music V - sound art, sound transformation: astro black morphologies
- Possible histories of science in music VI - A universal vibration

³ The title also relates to Marsilio Ficino’s treatise *Commentary On Plato’s Symposium on Love* ([1469, 1484] 1985). Ficino’s natural philosophy, influenced by the writings of Plato and the *Corpus Hermeticum* attributed to the legendary Hermes Trismegistus (which Ficino first translated in Latin in 1471), conceived nature as animate and love as cosmic power, *anima mundi*, a force binding the universe and the basis of true knowledge. Ficino’s Neo-Platonism envisaged a musical cosmos, and music as healing force. These ideas can also be traced in Sun Ra (Szwed, 1998:113).

c) The process/multiple voices/the Poetics of (textual) Space

The essay is the result of the intertwining and interweaving of our two voices. My initial research and writings were expanded upon by George, relayed back to me and then forward to him. We listened to songs and instrumentals, to earth-bound, space themed music (jazz, techno, dub, classical and mainstream pop) and to sounds from space (radio astronomy sounds, earthly and interplanetary atmospherics). A narrative of fragments, developed through a textual, discursive and dialogical relay process and through a listening, together and alone, began to emerge and take form and was shaped in its final edit by George. A new, in-between space emerged from this process, a narrative subject, a collective voice, a 'we'.

Einstein and Coltrane, Sun Ra and Mandelbrot, The Five Blind Boys of Alabama and Stockhausen, Moses and St Augustine, Holst and Ollongren, Voss & Clarke and Eugene Stanley, Phil Uttley and us, are some of the voices in the text, refigured as possible conversations, echoes and feedbacks, relations occurring across time, weaving together science and music, history and myth, events in time and events outside time. These voices mix with other voices, past and present, living and dead, with song titles ('Earth People', 'Telstar', 'Star Sailor', 'Rings of Saturn', 'Starman', 'Parallel Universe'), with sounds of planets and space (the Earth, Jupiter, Cygnus X-1); a multitude, human, interplanetary and interstellar, producing music and musical relations, a living, pulsating sound-picture space.

d) Music and cosmic becoming: on Sun Ra

In this essay we chose to foreground Sun Ra, a composer, musical director, poet, scholar and thinker whose oeuvre could represent, more than anybody else in the 20th century, the whole history of cosmology in modern music: a re-writing of the cosmos as music, 're-sounded in the ear of the other' (Flow Motion, 2006:24). His music and writings also provided inspiration for our subsequent project *Invisible* and featured in our web art project *promised lands*.

Ra defined himself as ‘a scientist, I deal with equations. You might say a spiritual scientist and also a cosmo musical scientist’ (Ra in Rusch, 1984: 66). Through the course of his life, he developed a unique, personal, musical and pan-cultural cosmology informed by and formed through a creative recombination of a wide range of sources from diverse disciplines, cultural forms and traditions of thought, past and futuristic, which he refigured as equations, music, mythology, poetry and performance. Ra’s cosmology is summarized in his poem *Astro Black*:

Astro Black Mythology / Astro-timeless immortality [...] The Universe is in my voice
[...] Find your place amongst the stars / Listen to the outer world / Rhythm,
Multiplicity [...] Astro Black and Cosmo Dark (Sun Ra, 1972)⁴

e) Becoming music of the cosmos

Sun Ra’s poetic figuring of cosmic and sonic interconnectedness had, we discovered, close correspondences with a new poetics which emerged in the latter part of the 20th century in the physics of fluctuation processes, within a transdisciplinary field which included technical engineers, mathematicians, biologists, economists and researchers from a variety of disciplines, and which was re-figured by astrophysicists at the dawn of the 21st century as a new sonic cosmology. Common to these different areas of research, as established in our paper, was the detection across diverse systems and phenomena of a ubiquitous fractal pattern of variation, flicker noise.

Somewhere between totally correlated (brown) noise and uncorrelated (white) noise, flicker noise displays the mixture of predictability and surprise that humans find most pleasing in music. This pattern, extensively studied by Benoit Mandelbrot (Mandelbrot, 1977, 1982, 2002) and his colleague Richard Voss (Voss and Clarke, 1975, 1978) was found in musical recordings, the stock exchange variations, the River Nile and the human DNA. It was also recently discovered to be a fractal feature of black holes’ X-ray emissions across galaxies, metaphorically described by astrophysicists as ‘music’ and narrated through sonic and musical analogies (Uttley and McHardy, 2002).

⁴ The first five of these verses were cited, in a different order, in our essay (Flow Motion, 2006:25).

Against the grand narrative of the ‘music of the spheres’, the detection of flicker noise in countless systems and phenomena suggested to us a new, ‘minor’ mode of cosmic and sonic becoming, one actualized across the universe through predictable refrains and unpredictable improvisations. Against the idea of a hierarchical, divinely ordered cosmic music, flicker noise researchers imaged a universe made of intensities and fluctuations, of autopoietic processes based on repetition and difference, iterations and variations, akin to (earthly) music. Flicker noise research related to power spectrum analysis of musical recordings, speech and acoustics studies (Voss and Clarke, 1978) also contributed to a new, expanded perspective on what constitutes ‘music’, which became very valuable for us in the subsequent development of the installation soundscapes.

4.5 Summary of achievements and contributions

Through this essay, which marks the beginning of our dialogue and collaborative practice with astronomers and cosmologists we proposed new and as-yet unexplored cross-cultural correspondences between diverse sonic and cosmic imaginaries, which were rare at the time of publication within the digital arts. In addition we developed writerly approaches that mirror music forms and thematics of translation, iteration, fractality and self-difference discussed in the paper. In particular the essay:

- Made connections and correspondences between contemporary astrophysics’ research and black music forms and sonic cosmologies.
- Developed specific textual methods that prefigured some of the iterative and dubbing techniques seen in the later artworks. This includes the use of repetition and versioning in the text as a transformative method; for example the title *Astro Black Morphologies* connects astrophysics’ enquiry on black holes, its metaphorical and musical figurations of invisible space phenomena (which would form the basis of our first art-science project), and black music forms and cosmic imaginaries. It is also a version, which transforms and renders plural the first line of Sun Ra’s poem, ‘Astro Black Mythology’.

- Our discussion of the detection of flicker noise enabled us to argue for a new, ‘minor’ mode of cosmic and sonic becoming, one actualized across the universe through predictable refrains and unpredictable improvisations.

CHAPTER 5

ASTRO BLACK MORPHOLOGIES/ASTRO DUB MORPHOLOGIES (2004-5)



Figure 1. *Astro Black Morphologies/Astro Dub Morphologies*: Cygnus X-1 data visualization (Flow Motion/Adrian Ward).

Some people call it dub. I call it x-ray music. (Lee ‘Scratch’ Perry)¹

5.1 About the project

Astro Black Morphologies/Astro Dub Morphologies (2004-5) is an immersive multimedia installation and sound art performance², the first of Flow Motion’s *Music and Science Lovers* trilogy of interdisciplinary arts projects on space, music and cosmology developed during our *Sounds of Science* research.

¹ Quoted in *The Dubmasters - X-Ray Music (A Blood & Fire Dub Directory, 1999)* CD Compilation, album notes.

² The project was funded by the Arts Council England (Ref. L090502832, Anna Piva, October 2004, £25,780, Sound Arts, Nationwide Touring), the Science Museum Dana Centre, the John Hansard Gallery, the British Film Institute and Vivid, with in-kind support from Arts Catalyst and SCAN.

5.2 Research aims

The project had its conceptual basis in our construction of correspondences between 21st century cosmology's explorations of the invisible universe, of the spaces between visible phenomena, and the spatial explorations of jazz, dub and electronic music, of digital art and cinema. These correspondences, elaborated in the spirit of transformation and versioning central to improvisation and dub, formed the basis for the creation of a non-narrative, sonic and cinematic space, whose audio/visual components were produced by multiple translations and transformations of digital X-ray data of Cygnus X-1, the first (possible) black hole binary system detected in our galaxy and one of the most studied invisible 'objects' in the history of X-ray astronomy³.

Astro Black/Astro Dub took as a point of departure the discovery by astrophysicists Prof Ian McHardy and Dr Phil Uttley from Southampton University that the patterns of variation detected in the x-ray emissions of Cygnus X-1 corresponded to those of supermassive black holes in distant, active galaxies. These fluctuations, which they postulated as being musical in nature, displayed evidence of flicker noise, a fractal pattern of variation previously detected in many, seemingly unrelated systems⁴. The 'music' existed in the form of thousands of digits, recorded by NASA's Rossi X-Ray Timing Explorer satellite camera. Their findings were presented in a talk titled *The Music of Black Holes*, held in April 2002 at the National Astronomy Meeting in Bristol.

For us this musical analogy signalled the presence of a poetic 'otherness' in scientific discourse, a possible opening towards creative dialogue and collaboration. Our reflections produced these research questions:

- What new poetic and cross-cultural correspondences could be developed through an

³ In 1970 NASA's Uhuru satellite detected the first X-ray evidence of Cygnus-X1. In 1971, Cygnus X-1 was announced as a possible black hole by Charles Thomas Bolton at the University of Toronto, and by Louise Webster and Paul Murdin, at the Royal Greenwich Observatory (Webster and Murdin, 1972:37-38; Bolton, 1972:271-273).

⁴ See the related essay, *Astro Black Morphologies: Music and Science Lovers*, discussed in the previous chapter and included in Appendix B. For further discussion see Appendix A, pp. 19-25.

engagement with Uttley and McHardy's research and Cygnus X-1's data?

- How could the 'music sheet' of science, the numerical text generated by astronomy's recording/camera technology, be re-imagined, re-sounded and experienced?
- How could these correspondences and processes of transformation contribute to the development of new digital and audio/visual languages, and a non-figurative, non-narrative, immersive experience of space exploration?

5.3 Methods employed

A1, A2, A4, A5; B1, B2, B4, B5; C1-5; D1-6; E; F1-3; G1-3; H1, H2, H3, H5, H6, H7, H8; I.1-10; K1-7.

5.4 Themes and approaches

With *Astro Black/Astro Dub* we wanted to bring to the fore process and transformation, and approached the technologies and processes of astronomy, dub, improvised and electronic music, software design, digital art and cinema, as a way of making a sonic and visual experience which highlighted the transversal, transformative and morphological possibilities which one process suggests for the others.

The transfer of tools and methods across disciplines was achieved through creative dialogues, collaborative practice, play, intuition, chance, serendipity, improvisation and experimentation, contributing to produce multiple, hybrid re-readings and new frameworks and 'modes' of translation of Cygnus X-1 data. We explored and re-contextualized the data, in dialogue with Dr Uttley, in collaboration with software designer Adrian Ward (Signwave) and Jodrell Bank astronomer Dr Tim O'Brien, and transformed the digital evidence of a mysterious, deep space phenomenon into a deep, dub space experience.

Various digital tools were used for the development of the installation's components, in relation and in response to the technologies and methodologies of astronomical research and to the narrative and musical correspondences proposed by Dr Uttley. These included: specifically designed sonification and visualization software, created in collaboration with O'Brien and Ward; granular synthesis and other digital tools originally developed by the Groupe de Recherches Musicales in Paris; recently developed VST audio software and a variety of analogue and digital sound processors, which constituted and expanded on the tools for our electronic, dub-inflected music production.

Our translations and transformations of the data were elaborated in relation to 20th and 21st century multi-disciplinary research in flicker noise and the physics of fluctuation processes, in light of poetic, post-colonial and post-structuralist readings of multiplicity, fractality and translation, and of black holes' scientific and cultural metaphors⁵. Ideas about literary and cultural translation (Benjamin, [1923] 1992), numerology (S.C. Singh, 2004), acoustic quanta and micro-sound (Gabor, 1947; Roads, 2001) and modern jazz compositional approaches (Demsey, 1991) inspired and were used towards the processes of digital data transformation. Dub's sonic and cinematic histories (George and Piva, 2010) informed our thinking about the creation of the installation spaces and performances.

5.5 Spaces

The resulting installation comprised of multiple versions of the numerical data, de-segmented, fragmented, sculpted, 'ghosted', and rendered as abstract, multi-screen, a-synchronous projections and multiple, layered and spatialized sonic assemblages. The installation soundscapes were reconfigured in the different exhibition spaces, in relation to their specific acoustics properties. The installation spaces were architecturally reshaped

⁵ These areas of research are discussed in more depth in Appendix A, pp. 16-37, in which I elaborate on some of the research done on black holes, flicker noise and fractals not included in the published texts, and on some of the ways in which new knowledge and narratives emerging from these fields were revisited in the initial development of our project. I have included this appendix to give the reader an insight into, and an example of, our approach to arts practice, and of how various strands of contemporary scientific research, philosophy, poetry, literature, music and cultural studies were re-read and interwoven in our *Music and Science Lovers* series of arts-science projects.

through the construction of semi-circular walls, or of circular, oblong shaped soft enclosures attached to ceilings and metal frames.

Visitors to the installation entered a dark room with projected movies of the visualised data on the walls, the soft enclosures and the floor, with different sound systems playing versions of the dubbed, sonified X-ray data. In addition, sonic traces of the data and of female voices reciting the numerical sequence were woven into a soundscape consisting of treated radio astronomy sounds from our Solar System (Saturn, Jupiter and Earth's planetary atmospheres) and the pulses of the star clusters of the Tucanae constellation. These multiple sonic and visual components, looped and always recurring in different configurations, formed an ever changing, abstract, expanded cinematic space, an immersive, multi-sensory experience of sound, light and colour.

The project was also exhibited as a two-room installation, a format which allowed us to further explore ideas of version and dub, through the creation of a more rarefied, 'lunar' space, with an eight-track soundscape specifically assembled for and mixed in the room, and the use of floor projections.

Dub and improvisation informed the performances that comprised the project's live, real-time component. These performances took place, for two of the exhibits, in the spaces of the installation, collapsing the spatial opposition between art practice and live music. Fragments of the sonified data were played through dub plates, laptop and mixing board; George and I reshaped these sounds live, improvising with various outboard effects in response to each other and to the pre-recorded soundscapes in the room.

The project was first presented as a work in progress in April 2004 at the European Space Agency in Holland as part of the Leonardo/Olats' *Space and the Arts* workshop, with the support of a British Council grant. It was subsequently presented and performed live at Open Source in Tours, France, at the Ventspils International Radio Astronomy Centre in Latvia, and at the Search for Extra Terrestrial Intelligence Institute (SETI) headquarters in

Mountain View, California, with funding from Community Zero and the Carnegie Mellon University's STUDIO for Creative Enquiry.

In 2005, after a successful Arts Council Touring grant application, it was exhibited and performed in the UK, at the John Hansard Gallery in Southampton, the Vivid Gallery in Birmingham (as part of the British Film Institute's *Black World* season) and the Science Museum Dana Centre in London, where it was accompanied by a transdisciplinary symposium on the connections between music, cosmology and digital art titled *Deep Space Poetics*, curated by Flow Motion and chaired by Nicola Triscott (Arts Catalyst) with guest speakers Doug Vakoch (SETI) and Tim O'Brien (Jodrell Bank). In 2007 we performed *Astro Dub Morphologies*, a live re-mix of the installation soundscapes together with other material at the international conference *Re-Presenting Diasporas in Cinema & New [Digital] Media*, organized by Exeter University at Exeter Phoenix Arts Centre.

5.6 Roles and collaborations

Astro Black/Astro Dub was developed and co-authored by Edward George and myself. Key collaborators and partners include Phil Uttley, Tim O'Brien and Adrian Ward, arts-science agency Arts Catalyst (whose contribution included support with the development and with the ACE bid, and project management), new media agency SCAN, the John Hansard Gallery and the Science Museum's Dana Centre. Within the project and these collaborations, my contributions included: providing the initial conceptual framework and research, which was developed and expanded in dialogue with George; initiating the processes of data sonification (with O'Brien), composition and digital transformation, and arranging and editing the various individual and multi-track sonic assemblages which formed the basis for the installation soundscapes. I worked with Ward and George to develop the project's visual components, sourced and organized all the digital tools and sound processing software, provided sound engineering support during the various phases of the mixing process (which was led by George), reassembled the various pre-mixes in their final shape, and took care of the final audio formats in stereo, eight-track and

surround sound. As the main Arts Council England applicant, I also provided some orchestration and wrote up project reports.

5.7 Summary of contributions and achievements

Astro Black/Astro Dub developed a specific cross-cultural approach to art-science and digital/multimedia art practices in the early part of the millennium. In particular the project:

- Contributed to the emerging language of digital arts. It did this by migrating and translating knowledge and tools from contemporary music and science into digital installation practices, through software design, and via hybrid and conceptually driven uses of digital technology and sonification/visualisation techniques.
- Brought together processes and methodologies from diverse, pop and avant-garde musical traditions, and created new correspondences between science and cosmology, jazz and dub, and sound art and cinema.
- Proposed new ways of engaging with scientific data and devised new methods of data transformation that interfaced cosmological research and narratives produced within the high economy of satellite technology with marginal voices and practices emerging from the low economy of digital art and contemporary, left-field and experimental music.
- Used contemporary cosmology's enquiries on invisible space phenomena to reflect on questions of otherness, and brought these in relation to cinema's genealogies, histories and space imaginaries.
- Used ideas, critical tools and deconstructive approaches from contemporary European philosophy, in conjunction with their post-colonial re-elaborations, to engage with scientific narratives and data, an approach which was uncommon, if present at all at the time within the art-science field.

- In particular, the work brought new knowledge to this field through the inclusion of cosmic imaginaries in conjunction with musical and cultural forms from the black diaspora, generating cross-cultural correspondences, which at the time were not yet present in this particular context.

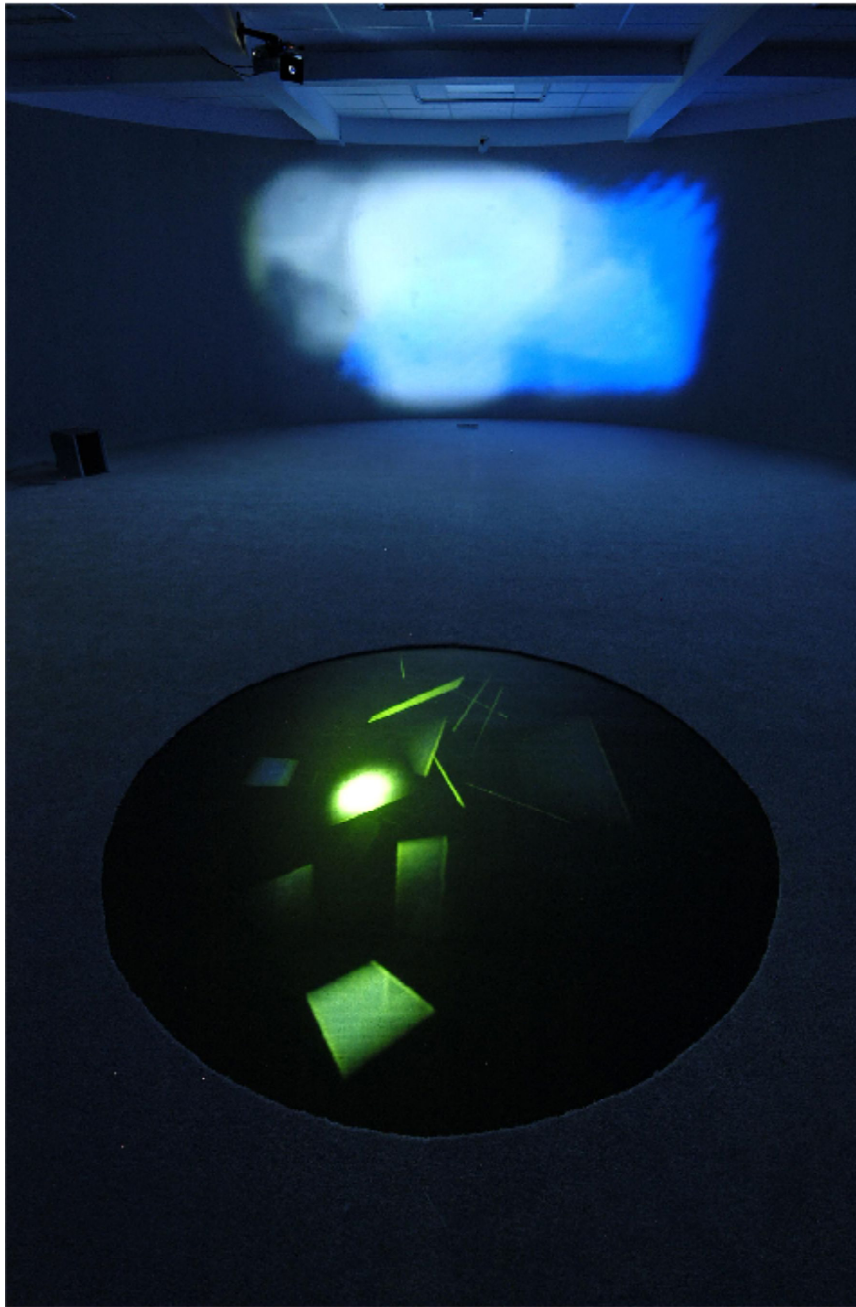
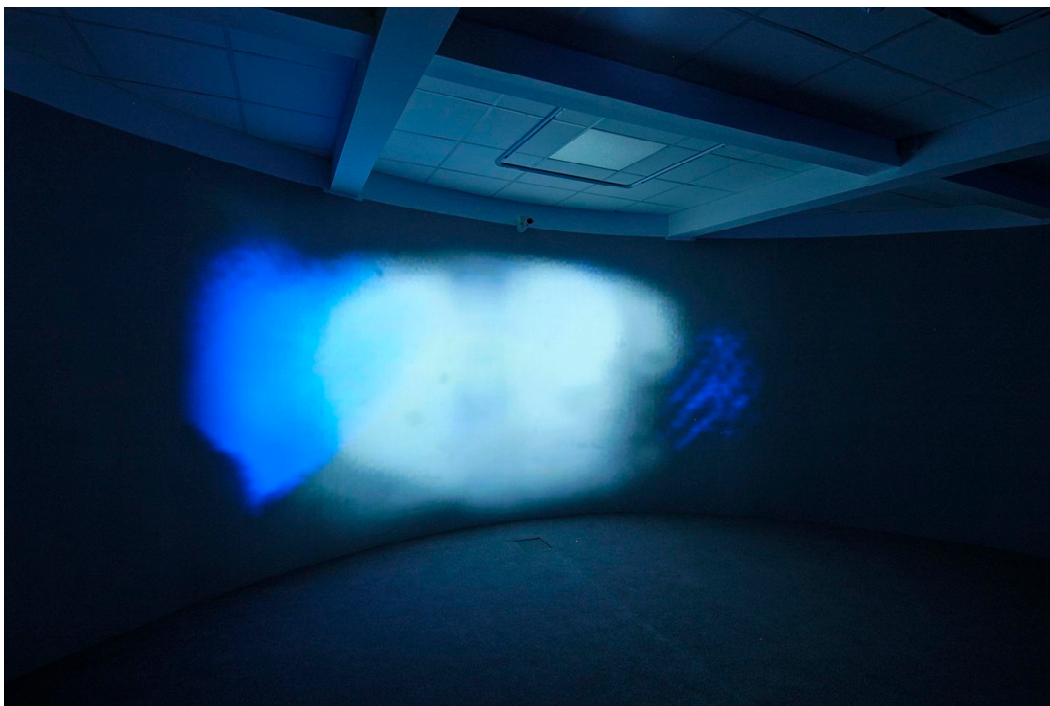
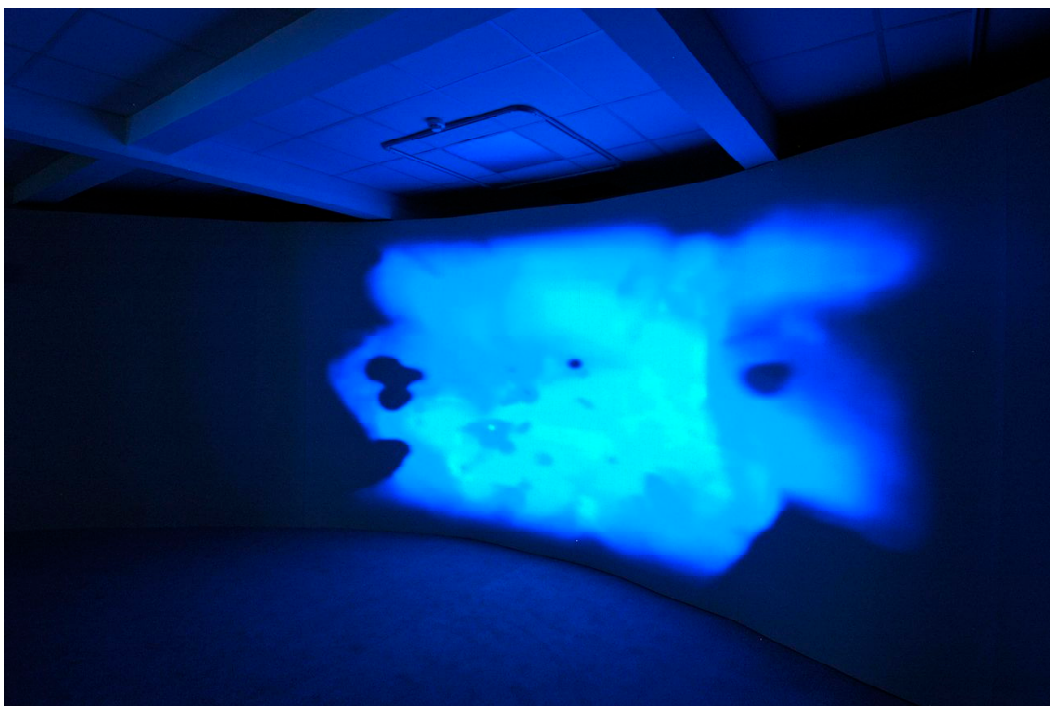
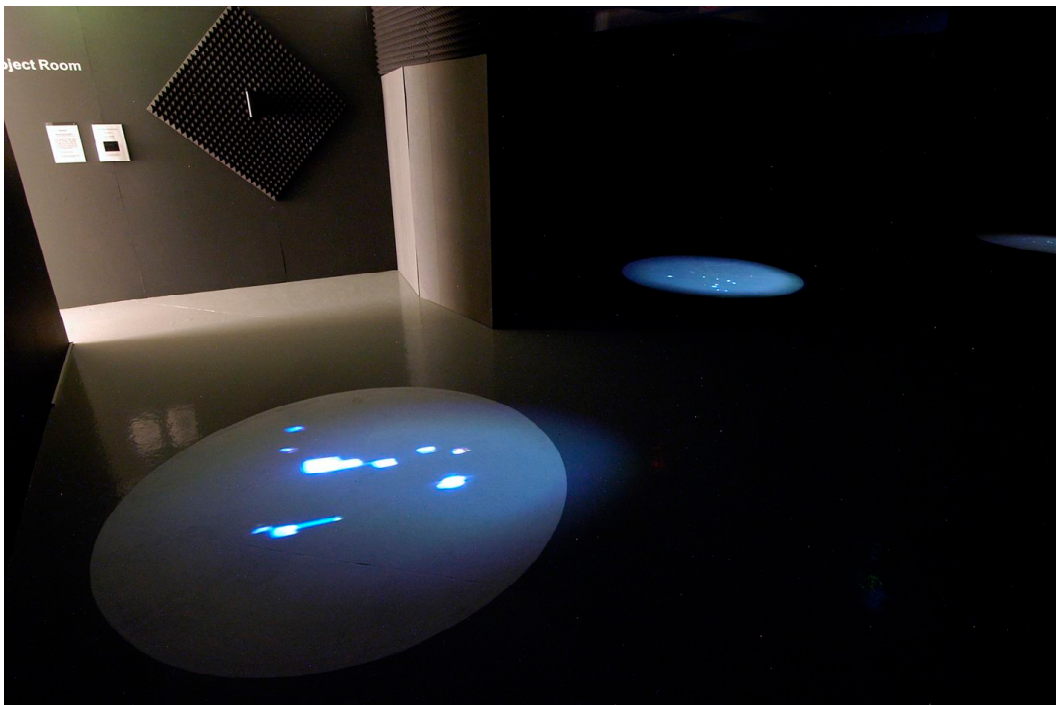
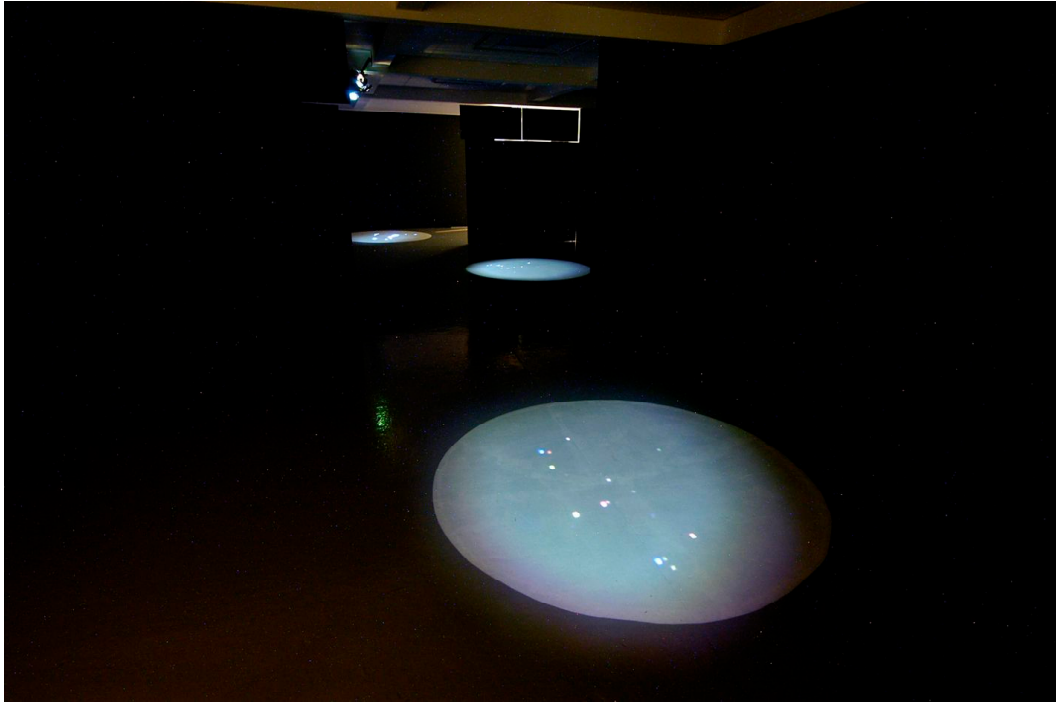


Figure 2. *Astro Black Morphologies/Astro Dub Morphologies: Room One*, John Hansard Gallery (2005). Photo: Steve Shrimpton. Courtesy of John Hansard Gallery.



Figures 3 and 4. *Astro Black Morphologies/Astro Dub Morphologies*: Room One, John Hansard Gallery (2005). Photo: Steve Shrimpton. Courtesy of John Hansard Gallery.



Figures 5 and 6. *Astro Black Morphologies/Astro Dub Morphologies*: Room Two, John Hansard Gallery (2005). Photo: Steve Shrimpton. Courtesy of John Hansard Gallery.

CHAPTER 6

INVISIBLE (2006-7)



Figure 7. Thorrowgood observatory, Cambridge Institute of Astronomy.

‘Nothing is.’ (Sun Ra, [1966] 1970)

6.1 About the project

Invisible is a sound art installation and performance project about darkness, the invisible universe, childhood and the creative imagination, the second of Flow Motion's *Music & Science Lovers* trilogy of works¹. The project took as its starting point the translation and transformation of dark energy research data sourced from the Cambridge Institute of

¹ *Invisible* was funded by the Arts Council England (Ref 749647, Anna Piva, Visual Arts, 11 July 2007, £21,635), the Science Museum Dana Centre, the Bernie Grant Arts Centre, the Gifted and Talented Program, Manchester University's Jodrell Bank, the Merz Akademie, with in-kind support from Cambridge University's Institute of Astronomy.

Astronomy, and is based around a series of experimental workshops with secondary school children and compositional/improvisational workshops with a quartet of Indian classical and jazz musicians.

6.2 Research Aims

In this project we utilized a process-based, workshop-led approach to explore these questions:

- How might scientific data on dark energy be re-deployed as artistic material within an arts-science setting?
- How might this process inform new experiences and ideas around darkness and the invisible universe?
- What collaborative, interdisciplinary and multi-cultural approaches are suitable to the above and how do these processes help frame the forms the final works take?

6.3 Methods employed

A1, 4, 5; B1-5; C1-5; D1-6; E; F1-3; G1-4; H1-7; I.1-10; K1-7.

6.4 Themes, approaches and outputs

Astronomers, cosmologists, school students and musicians were brought together to explore the possible links between contemporary cosmology's understanding of the invisible universe and children's and musicians' perception of the universe, darkness and invisibility. The pre-figurative, non scientific relationship to animate darkness experienced by children, explored and figured in Indian and black diasporic sonic cosmologies, in the sonic architectures of dub, free jazz, Indian classical and electronic music, was brought into correspondence with astronomy's technologies of observation

and writing and with its recent discovery of an invisible force permeating the universe, believed to be the main cause of its accelerating expansion².

The workshops functioned as production spaces for music and spoken word material that was used, together with the sonified and treated dark energy data and with environmental recordings, in the development of a three-part sound art installation in three observatories at the Cambridge Institute of Astronomy. Using the interiors of the Institute's telescope domes as sound chambers, we transformed the observatories into sound sculptures, each of which foregrounded a radically different use of space and instrumentation, density and emptiness.

The soundscapes' components were further elaborated, remixed and used as the basis for live ensemble improvisations in two sound art performances at the Science Museum Dana Centre and at the Bernie Grant Art Centre, with live interactive data visualizations created by generative designer Adrian Ward.

On September 27, one day after *Invisible* opened at the Institute of Astronomy, the track *Invisible – 0.1 [Hallucinator remix]* was made available online as part of Finetuned's *Signal*, a project featuring new works by artists who engage with sound in their practice. In this version we further explored the idea of expanding space, with sparse and heavily treated elements from one of the three sound sculptures. In a further CD version for the same project we created *Invisible 0.0*, which explored space expansion in a different way:

² In 1998, the Supernova Cosmology Project, led by Saul Perlmutter at Lawrence Berkeley National Laboratory, and the High-Z Supernova Search led by Brian Schmidt of the Australian National University and Adam Riess of the Space Telescope Science Institute announced the discovery of a force that is speeding up the expansion of the universe. (American Physical Society, 2009). After these announcements, cosmologist Michael Turner named this invisible antigravity force 'dark energy' (Turner and Huterer, [1998] 1999). Comparison of the observed expansion with data on the cosmic microwave background radiation led to estimates that in addition to dark matter, dark energy accounts for as much as 75% of the total mass-energy density of the universe. According to Mario Livio from the Space Telescope Science Institute in Baltimore, 'The precise nature of the dark energy is probably the greatest mystery of today's physics. It is generally assumed that this dark energy represents the energy associated with the physical *vacuum*' (Livio, 2003:X).

The dataset we used as the basis for *Invisible*'s sound installation components, consisted of numerical readings and a bi-dimensional map of X-ray photon emissions from Abell 2029, a large cluster of galaxies, one billion light years away in the constellation Serpens and 81 times bigger than the Milky Way. The data, obtained by NASA's Chandra X-ray Observatory, originated from the early days of galaxy formation, and had been used by astronomers at the Cambridge Institute of Astronomy to confirm, independently from previous research by the Supernova Cosmology Project and the High-Z Supernova Search, the existence of dark energy and the expansion of the universe (Allen et al, 2004). Abell 2029 had also been studied to better understand dark matter's density and distribution in the universe.

we returned to the original numerical data and, in collaboration with Julian Weaver, converted it into basic clicks, programmed to slow down according to the basic formula used by astronomers to calculate the expansion of the universe.

The sonified data was also reassembled to provide a sonic atmosphere for painting activities during a one-day *Invisible Workshop* at Manchester University's Jodrell Bank Observatory. Some of the drawings produced by the participants were later projected onto the giant 250-ft wide Lovell Telescope as part of its 50th Anniversary celebrations.

The conceptual scope of the project was expanded with an additional one-week workshop on darkness, invisibility and sound in cinema (*The Invisible Workshop* at the Merz Akademie of Media Studies, Stuttgart, December 2007). During the workshop we created with the students an audio art installation, which was exhibited at the Merz Akademie (2007) and at Artsways' Multichannel 2 festival (2008).

In 2008 *Invisible* was presented at the National Institute for Excellence in the Creative Industries (NIECI) at Bangor University in Wales, where we run the one-day seminar *Invisibility and Darkness in Cosmology and Sound*, and at Resonance FM, as part of the program *Sound and Architecture*.

6.5 Roles and collaborations

The project, which I initiated, was co-authored by George and myself and developed through a dialogical process and a sharing of our respective concerns. As with our previous project *Astro Black*, *Invisible* grew organically on the basis of our creative dialogues, which were later extended to other collaborators and workshops' participants. Together we devised the themes and conceptual framework of the workshops; their structure was quite detailed and precise, while also allowing for openness, improvisation and relay, to include the collaborators' and participants' creative input/output.

My contributions to the project also included the data sonification, transformation and

electronic processing, following and expanding on the methods developed and used for *Astro Black*, and the creation of a series of multi-track assemblages and pre-mixes for the workshops, installations soundscapes and performances which were further elaborated with and mixed by George. I brought together and coordinated communications with the musicians ensemble, created graphic scores with fragments of the numerical data which were used in the collective improvisations, edited and re-assembled the compositional and children workshops' recordings and the environmental recordings, provided studio equipment and sound engineering support for the final mixes and took care of all the electronic transfers, final formats and the project's digital documentation. As the main Arts Council England's grant recipient I also took responsibility for the financial aspect of the project (budget, accounting etc).

Our closest collaborator in the project was Dr. Carolyn Crawford at the Cambridge Institute of Astronomy (IoA). Carolyn sourced the dark energy research datasets that provided the basis for the sonifications, the soundscapes and the performances and made possible the use of the observatories at the IoA. She participated in the workshops and talks, liaised with the IoA press and publicity office, arranged IoA's in-kind contributions and also arranged a meeting and interview with astrophysicist and Berkley professor Saul Perlmutter, leader of the Supernova Cosmology Project and later the co-recipient of the Physics Nobel Prize (2011) for his work on dark energy. Other workshop collaborators included Dr Tim O'Brien, astronomer at Jodrell Bank Observatory, Prof. Reza Tavakol, cosmologist at the School of Physics and Astronomy, Queen Mary University of London, and Steve Hook, Head of the Arts Department at Heston Community School.

Our main musical collaborators were Sukhdeep Singh (tabla), Harmeet Singh (Raj) Virdee (sitar), Harrison Smith (tenor sax and bass clarinet) and Jim Dvorak (trumpet). Additional collaborators included Marc D'Inverno (piano), Charles Bullen (studio sessions sound engineering support and percussions) and Adrian Ward (live interactive software design).

6.6 Summary of contributions and achievements

The project developed a model of art that framed particular opportunities and approaches to the use of cosmological data in art practices engaging in art-science collaborations. In doing so, it expands approaches and knowledge for such work, by developing new approaches to the use of data, innovative methods of public engagement/participation and creative articulations of highly abstract scientific knowledge. In particular the project:

- Bought together processes of collective improvisation, collaboration, participants' memory and perceptions, cross-cultural dialogue, scientific knowledge and creative translations within workshop, gallery, performance and museum settings towards different experiences of cosmological space through cultural activity. As far as we are aware, *Invisible* is the only art-science collaborative project that, working with astronomers, cosmologists, musicians, school children and undergraduate film students, has sought to bring into dialogue, through an experimental and workshop based approach, diverse multi-cultural and multigenerational perspectives around the (then) recent discovery of dark energy, the invisible universe and the metaphorical language used by scientists to describe it. These aspects present a distinctive and new approach to art-science collaborations in their global, multi-cultural and intergeneration synthesis.
- Developed approaches and methods to the aesthetic transformation of astronomical data that constitutes a unique mix of digital sound, jazz, Indian classical, dub and improvised music technologies and architectures, of sites-specific sound sculpture, soundscape design, spoken word and interactive software imaging. This hybrid cultural approach constituted a unique cross-cultural and scientific synthesis that enables new approaches within the arts to the translation and interpretation of cosmological data, that draws upon multiple approaches, global cultural traditions and methodological formulations.
- Generated new correspondences and modes of thinking in the spaces between and across scientific research and arts/music practice, some of which emerged during the

workshops. For example, tabla player Sukhdeep Singh noted that the movement of sparseness and density in the photon's emissions of early galaxy formations evidenced in the data displayed similarities with the sonic movement in classical Indian music improvisation.

- Expanded on cosmology's conceptual frameworks, research and narratives. Dr Crawford told us in a subsequent interview that, before taking part in the project, she 'had never thought of dark energy as an absence'. A child poetically voiced her perceptions of darkness and her new understanding of cosmic invisibility with a question '...Is it there / or is it / imagination / tension / and eventually / creation?'
- Materialized as sonic and visual experience in installation and workshop situations, diverse cosmologies (scientific and non-scientific) and modes of space exploration through digital, electronic and acoustic interpretations of cosmological data, environmental recordings, perceptions, memories and poetic reflections of children, musicians and film students.

In its multiple outputs, and through its process-based and workshop-led approach, *Invisible* generated new aesthetic modes of data elaboration and new forms of cross-cultural, multi-ethnic, art(s)-science(s) collaborative practices. It expanded on and mapped new connections across cutting-edge cosmological research, sound installation and performance art, African American, European and Indian philosophical concepts, music forms and processes, and between ideas and perceptions of darkness and invisibility in the creative imagination, in cosmology, in literature and cinema, and in the lived experience of young people.



Figure 8. *Invisible* at the Science Museum Dana Centre, sound-check, 1st November 2007.



Figure 9. *Invisible* at the Science Museum Dana Centre, performance, 1st November

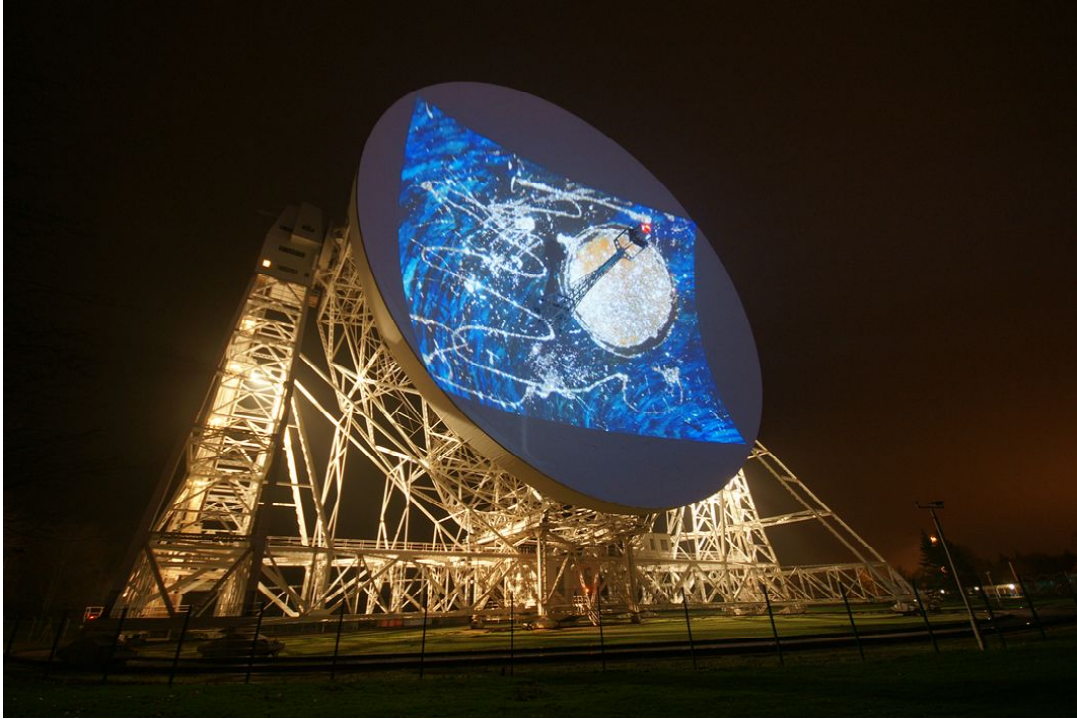


Figure 10. Projection of a drawing from an *Invisible Workshop* participant on the Jodrell Bank's Lovell telescope.



Figure 11. Schmidt Observatory, IoA. Details of telescope and hanging speaker on metal dome.

CHAPTER 7

PROMISED LANDS (2008-10)



Figure 12. *promisedlands.info*, triptych for page 70.

A place in the mind's eye, an opening, an emptiness, a song and a number of places in hundreds, thousands of songs, the promised land is the ground beneath our feet, the recurring motif of our histories of migration, real and mythic, a transcendental figure of speech for the already epic, always almost impossible journey; as layered as the geological strata beneath the land itself, the promised land could be anywhere [...]

(On promised lands, Flow Motion, 2006)

7.1 About the project

promised lands is a virtual art and performance project about music and migration, developed between 2008-2010 during an artist residency at the Institute of International Visual Arts (Iniva). The project explores the biblical trope of the Promised Land through songs and instrumental music, and through textual and visual re-elaborations of contemporary and historical accounts of migration, photographic and documentary archival material, and geological and meteorological data.

7.2 Research aims

1. How can music form the basis for new modes of engagement with global migration

histories, diasporic and marginal cultures, and their diverse imaginaries, poetics and experiences of space?

2. How can the archive, as a form of knowledge that organises or/and rationalises, be subverted in a way that disrupts and exceeds its limits?
3. How can digital/virtual art be utilized to do so?

7.3 Methods employed

A1-5, B1, 2, 4, 5; C1-5; D1-6; E; F1-3; G1-3; H1, 2, 3, 6, 9; I.1, 2, 4, 5, 8, 9; K1, 4.

7.4 Themes and approaches

The Promised Land is the founding trope of real and virtual, possible and imagined migrant adventures, the recurrent motif which confers a larger than life, metaphysical dimension on journeys into newness, towards lands, spaces and futures.

It is a figure of speech and writing, thinking and feeling, faith and necessity, found in countless musical compositions: hymns, anthems, symphonies, instrumentals, songs of the soul, protest songs, propaganda songs, versions of songs and versions of versions, music created for and in spite of migration, for and by the coloniser and colonised, the rich and the poor, kings and queens, slaves and serfs. Together these compositions form a body of migrating music, which make audible, keep in motion and bear witness to histories, memories and experiences of real and imaginary spaces and worlds. They evoke lands of ancestral origin and final destinations, places of belonging and spaces of transition, contested lands and war zones, countries that no longer exist and countries that have yet to – and may never – exist. They resound the Promised Land as multiple, shifting atmospheres and layered geologies, zones of intensity and desire, conflict and suffering, dream and reverie, ambiguity and spectrality.

The sense of movement, transformation and irresolution evoked by this body of music and its histories, inspired our thinking about the creation of a digital space, where the Promised Land's narratives are refigured as multiple planetary and cosmic wonderings, shifting aerial configurations and fragments drifting through different spaces and places, mapping interconnected routes and crossings, taking different forms and meanings, and producing, like music, repetition and difference, variants and versions. We imagined a space where the singular and most indomitable trope in migration histories, empire making fictions and diasporic cultures is fragmented and reshaped as a hundred minor literatures. A possible 'counter-archive' in which linear historical narratives are disrupted through phonographic recordings and textual montage; an archive which visually articulates different senses of time and space, tracing and layering photographic materials, dissolving and reshaping their spatial arrangements and activating their negative spaces. An emptying of space which, while engaging with the fantasies of empty space present in many promised lands narratives, might in turn produce a 'richly filled time' (Chtcheglov, [1953] 2006:5), a time-space repopulated by sounds, clouds, atmospheres and spectral presences.

Promised lands are, as we discovered in our research, haunted places, inhabited by memories of other promised lands, haunted by the vanished and the vanishing, by the forcefully removed, a fading presence which never quite fully disappears, always returning as a ghost, a trace. This atmosphere of haunting and spectrality was explored in our project's visual components and rendered as evanescent, vanishing presence, through the use of digital art technologies and by harnessing the properties and potentialities of the computer screen as a light-emitting medium/canvas.

7.5 Project's outputs

a) promisedlands.info

promised lands was first conceived in 2006 as a two room multimedia installation, audio art performance and presentation. While the installation was not realized due to lack of

financial support, during the Iniva residency we developed a new, virtual art component, which became the project's main output, the image, music and text archival website *promisedlands.info*. The site consists of 100 pages each taking a song, musical composition or song book as an opening towards a new visual and textual reading of the biblical trope of the Promised Land, following its disseminations across five continents (and Mars) and 400 years of diverse strands of migration and colonization.

Of all the compositions we found during our research, the ones that resonated most with us and which we used were the ones intersecting history, mythology and fantasy, past, present and future; and the ones that provided openings onto other narratives, as well as their own. These music pieces lead us to explore a whole range of textual sources: poetry and writings inspired by the idea of the Promised Land, and on the themes of migration, displacement, exile and statelessness; writings on music, history, cinema and theology; archival and official documents, news journalism and NGO reports; scholarly, sacred and visionary writings; biographies, personal testimonies and eye witness accounts; and scientific writings and data on the geological nature and weather patterns of the locations related to these compositions. This research was primarily conducted on-line.

For the visual components of the website we used, as suggested by George, the triptych form, in reference to its history in religious art and as an open narrative device. The website's images attempt to create a visual language for the themes that informed the project: space and movement, distance and deferral, haunting and vanishing, repetition and difference. They convey a dialogue between sound and text, a space between narrative and non-narrative intent: They function both as spaces in which the abstract components of the promised land historiography are given form, and as 'zones of intensity', charged atmospheres, *resonating with* the songs and music, their mnemonic and futuristic components and the layered emotional content they evoke. They suggest a movement away from the representational and towards the virtual, the fantastic, the liminal and the oneiric, pointing to these aspects and dimensions as they are evoked in the songs and music about the Promised Land.

Fragments from photographic archives, canvas textures, maps, satellite images and images of clouds were processed and layered to produce digital fictions, impossible spaces and dreamlike atmospheres, evoking the anonymous and the alien in the familiar. Many layers were used, in various degrees of transparency and opacity, to create depth of field, a sense of distance, time and movement, of animate landscape, and evoke the ambiguous nature of the Promised Land trope. Geological and meteorological visual data and aerial images of the lands themselves were reshaped to conjure a sense of active, living space. Some of these visual sources were used as motifs and reshaped to produce series and versions, and to generate cross-connections across different narratives and histories. The cloud, a recurrent figure in biblical narrative and in migrants' journeys, and the main metaphor for the medium of the World Wide Web, was used across many of the triptychs to image the Promised Land figure as an unfixed topology, a shifting aggregate of multiple, mutating and ambiguous meanings.

b) Performance presentations

The research residency also produced a series of live events, devised as storytelling based performance presentations, the first of which was at the Institute of International Visual Arts (Iniva) in October 2008 while the project was still a work-in-progress. The second performance was held at the International Symposium on Electronic Art (ISEA) in August 2009, with subsequent events at Iniva in the autumn of 2009 and at the Foundation for Art and Creative Technology (FACT), as part of FACT/Tate Liverpool's *Black Atlantic* season in 2010.

In these audio-visual presentations, held in dark cinema spaces, we wove together different strands from the archive. For each of the spaces we chose different sonic materials and created a new narrative web; we read a different script, written by George, and played the related songs and music via a laptop, a record player and a mixing board. For some of the spaces we hired a substantial sound system which allowed us to create an immersive sonic atmosphere. The triptych images created for the web pages were projected in a large screen behind us and were interspersed by extracts of films and

YouTube live performances. These presentations were followed by an extended Q&A and discussion with the audience. Music and stories from the *promisedlands* website were also played and narrated in a radio program on Resonance FM (18 December 2009), as part of the *International Migrant Day* worldwide radio networks celebrations.

c) Workshops

In 2011 and 2012 the *promisedlands.info* site was utilized as the basis of field research studies for a series of workshops at the University of East London (UEL), organized by Giorgia Dona, Professor of Forced Migration and Refugee Studies at UEL. During these workshops we used the site as the basis for discussions and for the creation of new narratives by the students, through further research on musical and archival material, and from the perspective of their personal and family histories, cultural backgrounds and experiences of migration.

7.6 Roles and collaborations

The project was co-authored and collaboratively developed by George and myself. George initiated the idea of the deconstruction of the biblical trope of the Promised Land and the use of literary montage. In the first phase of the residency we worked together and independently to select the musical compositions featured in *promisedlands.info*, and collect and edit various related research materials, and produced together the site's landing page image. After this initial phase, I focussed on the visual and photographic archival research, and on the production of the triptych images, while George focussed on further historical research and the production of the texts for the website. Our respective research was constantly relayed, discussed and integrated in each other's work. After a few months George was also involved in the visual production, while I continued to gather and edit textual materials to generate more narrative strands.

This collaborative process contributed to the layering and interweaving of many different visual and textual elements, and the mapping of new connections between and across

diverse fields of research, and different migration histories. My contribution to the project also include the website design, based on dialogues with George, and the production of the site's layout and individual components via Photoshop, which were activated in the space of the World Wide Web through collaboration with website programmer Trinli Gauder. Iniva provided the library space and financial support towards our residency; Helen Sloan (SCAN) and Gary Stewart (Iniva) supported the project in its various stages of development; in collaboration with FACT and ISEA, Helen Sloan also arranged two of our performance presentations.

7.7 Achievements and contributions

promised lands proposed a creative re-thinking of the idea of the Promised Land, from that of a geographical space of nation and region, singularity and sovereignty, to that of a multiplicity of physical and virtual zones, as present in the soul of the song as in the will of the state, as much above as below the ground, and whose identities and locations shift and change over time.

Our concern with iteration, versioning, the dissolution of forms, the disruption of linear narratives and the possibilities these might offer for the creation of new forms and spaces, was furthered with *promised lands* through an engagement with music, global migration histories, interdisciplinary research and the re-elaboration of archival material through digital art technologies and creative writing. The themes of transformation, space and movement, and the trace and the phantomic, previously explored through installation space and improvised performance, were visually and textually explored in this project in relation to different mediums, the computer screen and the World Wide Web, and as story-telling audio-visual performances. This work is an example of the repetition (of themes, motifs and concerns) and difference (of mediums and fields of artistic and cultural enquiry) that characterises Flow Motion's production.

This project also allowed me to further my art practice through a specific focus on developing modes of digital elaboration of photographic archival material, in dialogue

with and in relation to music, text and textual montage. Visually, the project explored the margins of meaning and representation, echoing the tension between memory and forgetting, documentation and obfuscation present in migration histories, and evoking the Promised Land as a plurality of liminal, spectral spaces, and ambiguous and often conflicting meanings.

In summary the project:

- generated new modes of experiencing and understanding global migration's histories and their multiple space imaginaries through music and virtual art;
- developed new modes of digital elaboration of photographic archival material in dialogue with and in relation to music, text and textual montage, to convey an atmospherics of the otherness that haunts and destabilises photography's claims to truth and presence;
- produced new correspondences and cross-cultural connections around these themes by interweaving diverse forms of knowledge from diasporic and marginal cultures, official historical narratives and people's histories, phonographic and photographic materials, and visual and textual data from scientific research;
- contributed to contemporary art's research on the utilization of archival material within digital media practices, by producing conceptually and aesthetically driven modes of thinking about, and subverting, the form of the archive, through an exploration of the possible interrelations between phonography, migration histories, critical theory, textual montage, digital art and the World Wide Web.



Figure 13. *promisedlands.info*, extracts from the triptychs.



Figure 14. *promisedlands.info*, triptychs for pages 96, 97, 89.

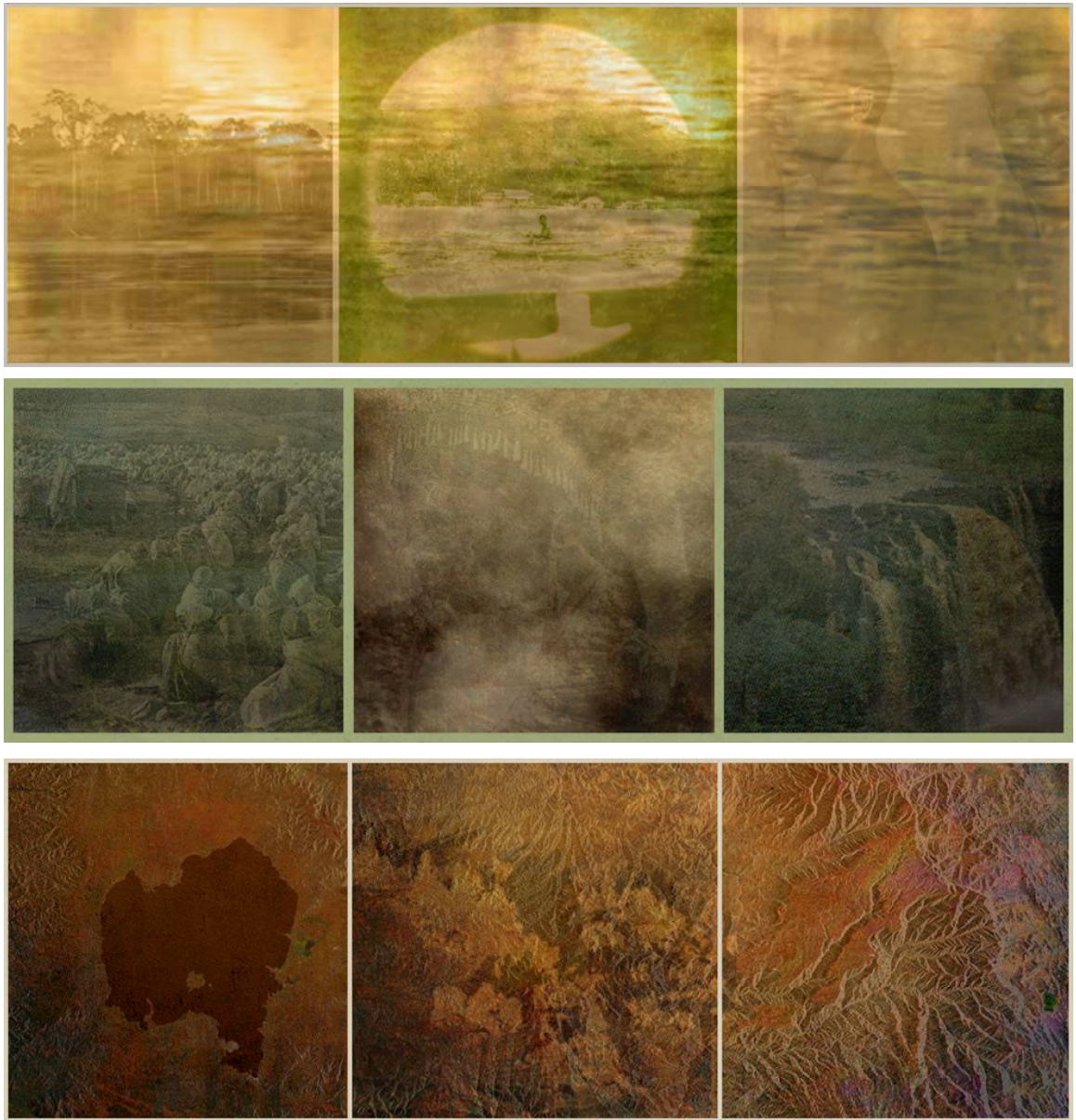


Figure 15. *promisedlands.info*, triptychs for pages 77, 60, 62.

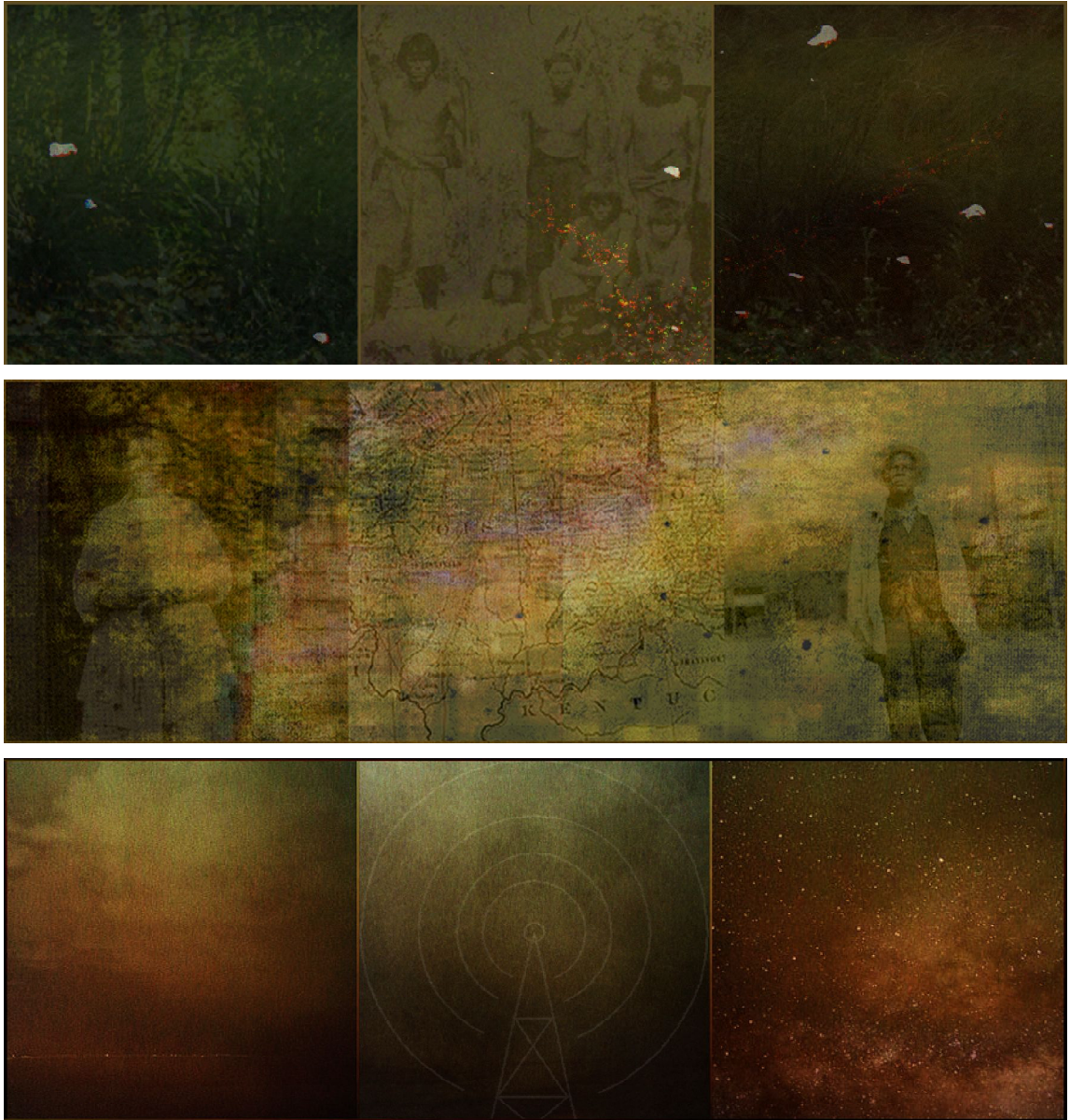


Figure 16. *promisedlands.info*, triptychs for pages 27, 53, 13.

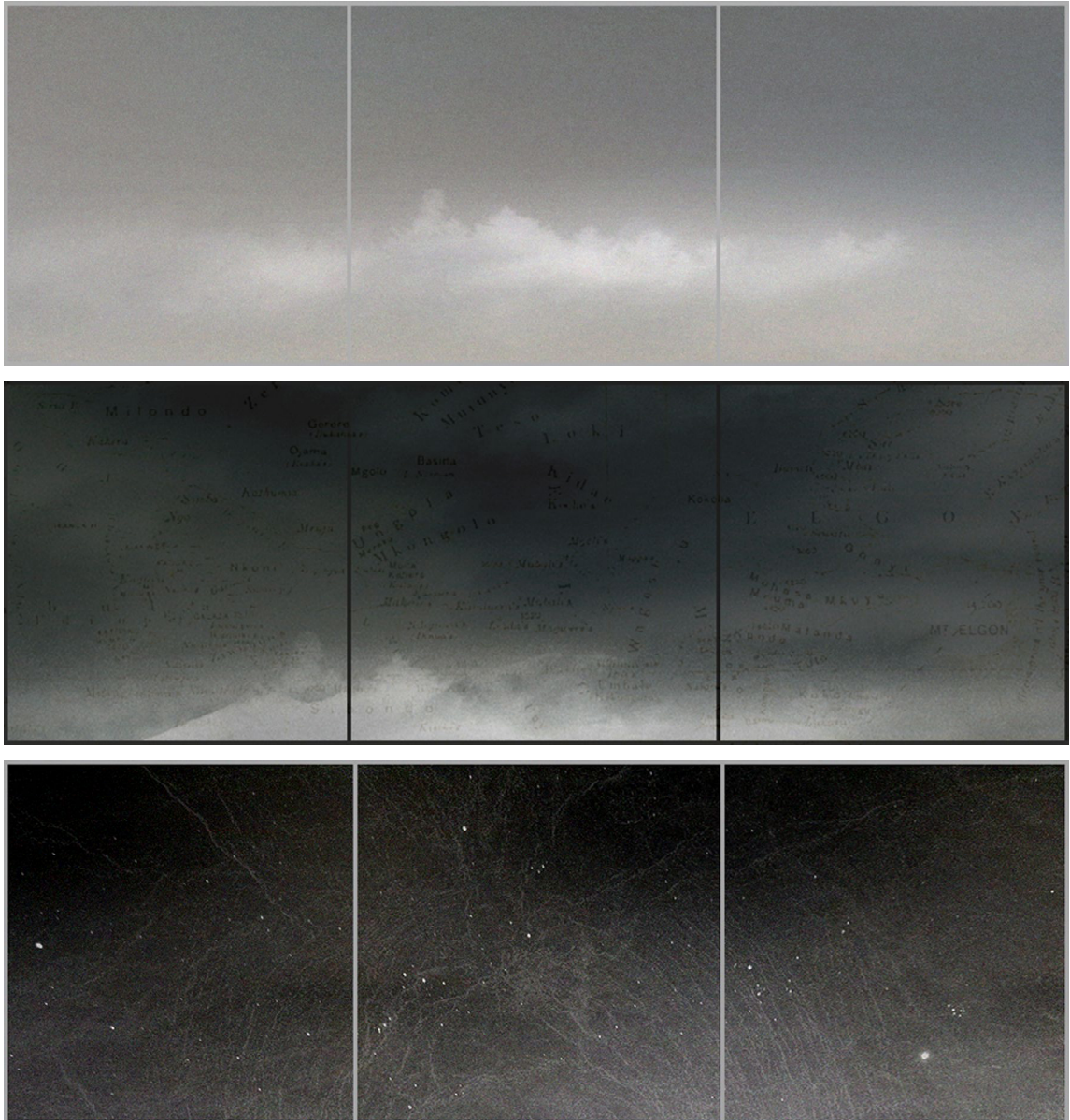


Figure 17. *promisedlands.info*, triptychs for pages 5, 3 and 6.



Figure 18. *promised lands*: performance presentation II, Iniva, London (2009).



Figure 19. *promised lands*: performance presentation, FACT, Liverpool (2010).

CHAPTER 8

MUSIC AND MIGRATION

8.1 About the text

The online archival artwork *promisedlands.info* formed the basis for a subsequent text, *Music and Migration*, which was published in *The Encyclopaedia of Global Human Migration* (Wiley, 2013), to this date the most extensive publication on migration studies.

8.2 Research aims

Through this essay we sought to synthesize some of the research produced in *promised lands*, to make it operate in a new pedagogic context.

8.3 Methods employed

The essay revisits and recombines pre-existing research, which was developed through the methods listed in the previous chapter. The reshaping of this research for the essay was actualized through methods A1, 4; B1, 5; D1-4; E; F1-3; G2; H1-3; I.1; K1.

8.4 Themes and approaches

The essay is prefaced by the lyrics of a Burning Spear's song, *Travelling* (1976), which evokes, through minimalist poetry and dub, both movement and absence, and by a Michael Serres's quote (Serres, 1995) which poetically images human migration as ancient nomadic movement, a 'dasein' existing in the sky, in the atmosphere. Following various narrative threads in the site, the text summarises some of the project's areas of research, themes and concerns:

- The role of the Bible during the formative years of European imperialism in creating a

sonic diaspora from which migrant music forms emerged and were disseminated, through the technologies of lithographic print media and phonography. In particular, Isaac Watts's hymnody (featured in page 100 of our site, the first page of the song list), published in 1707, marks the beginning of the use of original lyrics rather than biblical texts and the idea that anyone, not just the clergy, could write a hymn. Watts's hymns were made popular amongst the slave owners in America as a mean to 'instruct' slaves (C.C. Jones, 1842). The slaves used them to subversive effect and their own spirituals provided the blueprint for a new sonic tradition.

- The idea of the migrant as both a conceptual persona and material reality and of the migrant's body as a musical archive and recording technology where time, place and sonic traditions dissolve and reconfigure, producing a proliferation of forms. Examples of this are the African retentions carried within the tradition of Baptist church musical rituals, also present in Albert Ayler's contemporary avant-garde jazz and improvisational music. They can be heard in his composition *Zion Hill* (1968), featured on page 6 of our *promisedlands.info* website. Dub is highlighted as an example of a music where remembrance, the call to memory and to self-empowerment, is also simultaneously a fragmentation, a tracing and a ghosting, an act of erasure and transformation of the voice, the (sonic) subject.¹

- The idea of the migrant as self-empowering persona and of songs and music as spaces where the mapping and mastering of space, denied to the migrant, is achieved. In sonic reveries, the stateless imagines impossible identities, places of belonging, nation-states which have yet to exist and may never exist, as in the case of the song *Radio Romanista* (2009) by Serbian Roma group Kal, featured on page 13 of *promisedlands.info*.

- The idea of the space of music as a space (of movement) of the spectral, of fantasy and phantasms, the bridge and transition between the living and the life beyond, a movement upward and across, as evoked by Mahalia Jackson in the song *Way Up In Jerusalem*

¹ The interrelation between continuity and change, proliferation and transformation in jazz and dub is discussed in more detail in Appendix A, pp.32-34.

(2004), featured on page 65 of *promisedlands.info*. Music can be a space of apocalypse and of reconciliation of the conqueror and the conquered, bridging the claims and counterclaims of the invader and the indigene. Slovenian industrial group Laibach's conceptual composition *Y'Israel* (2006), featured on page 43 of *promisedlands.info*, incorporates a piece of the Palestinian anthem in Israel's anthem, resounding 'a nation with a double identity' (Laibach in McKibbin, 2007).

- The movement of sound beyond the reach of the migrant, through the technologies of astronomical exploration. The song *Dark was the Night, Cold was the Ground* (1938) by bluesman 'Blind' Willie Johnson was featured in a disc of images, sounds, messages and music from planet Earth, compiled in 1977 and sent into interstellar space aboard the Voyager spacecraft as an example of human culture, for a possible future contact with an advanced alien civilization.

- The evocation of the cosmos as the supreme symbol of migrant displacement and belonging. We used Sun Ra as an example of a cosmic/sonic imaginary which reverses, disrupts and dissolves official narratives of the Black African diaspora. Against the 'truth' of history and of slave narratives, against the loss of memory and humanity of the Middle Passage, Ra re-imagined himself as a myth, an alien, a member of the extraterrestrial race or the angels' race. He ascribed to himself a double place of origin (Saturn and Egypt) and traced, through his 'Astro Black Mythology', a new continuum between an ancient African past of culture and civilization, and a futuristic, outer space music (Szwed, 1997; Lock, 1999).

The essay ends (an end that could also be a beginning) with part of the narrative featured in the last of our website's song list (page 1), opened by a Sun Ra composition, *Next Stop Mars* (1963). This planet featured as the fictional home for a colony of African Americans in Ray Bradbury's collection of sci-fi short stories *Martian Chronicles* (1950). Mars is also, I discovered, both the designated promised land and possible future destination of some native Americans, and home to a region actually named Promised Land, apparently in homage to Martin Luther King, where rich mineral components

promise further geological explorations and possible, future commercial exploitation.

Sun Ra and Mars featured in our first, as yet unrealized, three-part project about 20th and 21st century space imaginaries, *Space is the Place* (2000). In this project we wanted to counter the idea of Space as the ‘ultimate frontier’, a space of manifest destiny, conquest, militarization and capitalist exploitation, with Ra’s imagining of Space as a place of belonging, a past-future destination, a place of human emancipation and sonic reverie.

Ra’s composition featured as the last and first of our website’s musical excursions. For us, Ra is perhaps the most resonant example of an interplanetary, interstellar ‘dasein’, of the fluid movements across, between and beyond time and space, past and future, Earth and sky, history and fantasy, memory and myth, which characterize many sonic-diasporic imaginaries, migrant reveries and music(s) of migration.

8.5 Summary of contributions

This paper enabled the articulation of an extended discourse around themes of migration and the interrelation between music, migration histories, biblical narrative, black diasporic and marginal cultures as derived from the *promised lands* art project.

In developing an outgrowth of this discourse the text further articulates how music and (counter) archival art practice/research can contribute to generate new modes of engagement with, and research in, global migration.

CHAPTER 9

CONCLUSION

This research makes contributions to understandings of how digital multi-media artworks and art-science collaborations can treat subjects concerning cosmological space, and its interactions with wider cultural and social phenomena including race, diaspora and migration. The nature of these contributions include: 1) distinctive models and methods of practice through integration of diverse media forms and approaches within the same work, e.g. dub, cinematic and digital arts traditions; 2) contributions into the treatment and themes of art-science practices through a conceptual fusing of science, esoteric histories and marginal voices to produce experiences and artworks that are novel in their treatment of content as integrated in awareness of the multi-cultural present; 3) the use of scientific knowledge and in particular data as an ‘artistic medium’ capable of integration into heterogeneous art and media platforms and thematic approaches.

The commentary has elaborated on the ways in which the methodological design and methods utilized in this research show how these diverse creative approaches, concepts and knowledge-bases were able to be systematically integrated to forward work.

Additional appendices also provide further description and analysis of the conceptual frameworks and processes through which the works were developed and actualized, which due to space requirements cannot fit within the main commentary. In the following section I return to the questions explored in this research to highlight how and where they were addressed, and end with some final reflections on my collaborative art practice, and on the process of writing this thesis.

9.1 How the research questions were explored

Q1. How can diverse knowledge bases and practices be connected to interrogate and expand on scientific and received cultural framings of cosmological space?

In *Music and Science Lovers I and II*, which included *Astro Black* and the related essay, and *Invisible*, the exploration of Q1 began with a focus on recent cosmological research stating that 96% of what comprises the universe is invisible, unknown, and cannot be comprehended through the current laws of physics¹. In *Astro Black* and *Invisible* we used the digital data and the linguistic metaphors (of ‘dark energy’, ‘quintessence’, ‘the music of black holes’) which emerged from these areas of cosmological research and developed methods of translating and transforming scientific data to produce a ‘Deep Space Poetics’ comprising new ways of experiencing this material and by extension cosmology. From a methodological perspective this work was underpinned by cross-cultural dialogues between scientists, musicians, artists and young people, in an extended collaborative community.

In doing so this approach generated new readings, reflections on and experiences of cosmological space, invisibility and invisible cosmic forces through research and the production of multi-media art installation and sound art.

The exploration of Q1 then took the form of an interweaving of a range of perspectives and practices, inclusive of, and expanding on scientific research on the invisible universe and the physics of fluctuation processes, the cosmic imaginaries of the black diaspora, pre-modern and contemporary sonic cosmologies, and ideas and processes of dub, jazz, Indian classical and electronic music, as well as digital art and cinema through *Astro Black* and *Invisible*. Q1 was also addressed by integrating ideas around ‘otherness’, understood in our work as unknowable cosmic phenomena, racial dialectics, and disruptive and transformative force, the other of (and in) language, music and art. The works engaged with the philosophies of difference, with the ‘exotic objects’ of cosmological research and with the ‘others’ generated by Western metaphysics and Eurocentric culture. Difference, otherness and the other featured as key aesthetic components of the works, and also as the means by which they were produced. Crucially, these works are the result of a space of difference, the product of cross-cultural, dialogical and collaborative practice and experiential sharing with an/other, and with many others.

¹ See p.71 of this commentary, note 2.

This interweaving was achieved, in *Astro Black* and the related essay, through the development and invention of specific approaches derived from deconstruction and iterative and dubbing techniques (e.g. repetition and versioning) as transformative methods, and, in *Astro Black*, through improvisation, sonic and visual experimentation, layering and montage. It was achieved, in the text, by discussing the detection of flicker noise and fractality in diverse systems and phenomena, in a way that enabled us to argue for a ‘minor’ mode of cosmic and sonic becoming, one actualized across the universe through predictable refrains and unpredictable improvisations. It was achieved, in *Invisible*, through interdisciplinary, multi-cultural and multi-generational workshops, which produced new transdisciplinary perspectives around contemporary cosmological research. It was achieved, in each of these works, by using indeterminacy as a key aspect of our collaborations, and through a focus on liminality and the spaces between.

This approach was uncommon within the art-science field of the early 21st century, and generated multiple cross-cultural correspondences. In answering Q1 Flow Motion’s work showed how connections between cosmological research and diasporic music forms and processes, between astrophysics’ metaphorical and musical figurations of invisible space phenomena, and ideas of invisibility in cultural (musical, literary and cinematic) forms can be used to develop new modes of expressions of the cosmological.

Namely, we discovered through this approach that the mapping and creative elaborations of diverse knowledge bases and practices can form the basis for the creation of novel experiences of cosmological space and also new modes and models of practice.

Q2. What are the aesthetic possibilities for translating and transforming scientific data derived from cosmological science?

In *Astro Black* we addressed Q2 by using numerical data on black holes derived from contemporary astronomical research, and brought this data into contact with cinema, critical theory and philosophy, and production methods from music, digital art, multimedia installation and sound art performance. In doing so we learnt how to use data

to generate moving images and soundscapes using software design, filtered through hybrid digital and analogue technologies, sonification and visualization techniques and further elaborated through the use of polyphonic, multi-lingual vocal recitations. Through these translations and integrations we discovered how scientific data can be repurposed as ‘artistic material’ with plasticity. This knowledge enabled us to understand how scientific data has a capability that goes beyond ‘informing’ art production, but can be integral to it in a material sense through a multiple layering, tracing and re-assembling into sonic, spatial and visual screen-based configurations.

In *Invisible*, Q2 was further explored through a process-based approach and multiple activities which included the translation and transformation of dark energy research data through interdisciplinary and experimental workshops, and cross-cultural ensemble musical improvisations. This included the production of poetry and spoken word materials from children and undergraduate students, environmental recordings and soundscape design, which were then elaborated as site-specific sound installation and as improvised sound art performance.

In particular, the works explored (and we learnt) how multi-faceted engagements with music and sonic architectures could enable an understanding of how scientific knowledge and data can provide the basis for an aesthetic experience of the enigmas and ‘sonic patternings’ in the cosmos. In *Astro Black* and *Invisible*, we took this idea forward using the science of sonic frequencies to propose and develop a poetics of space, informed by and potentially informative of contemporary cosmological discourse and scientific research. In *promised lands*, we also discovered how music can be understood as a collective dynamic that operates as a carrier of memory, reverie, knowledge and diasporic cultures, and a mean of engagement with histories and experiences of migration. *Promised lands* is discussed in more detail in relation to Q3 in the following sections.

To summarise, the aesthetic enquiry and unique interdisciplinary assemblage of concepts, research fields, technologies and artistic processes present in *Astro Black* and *Invisible*

enabled specific modes, thematic opportunities in terms of artwork content, and methods of practice including:

- The transfer, development and utilization of methods developed within black diasporic music forms and experimental electronic music to cinematic processes, software design and other digital technologies, for the production of contemporary art. Methods of looping, deformation, noise and dub processes provided sonic models that we learnt to translate into visual and cinematic forms to develop and reshape scientific and other knowledge forms.
- The conceptual framing of these methods using deconstructive practices in reading and writing which informed and enabled us to re-think morphological processes in sound and image making and editing. That is, we learnt how conceptual models from certain theoretical traditions can correlate to practice-based approaches in the way they enable iterative and layered approaches to content.
- The utilization of the ‘high technologies’ of astronomy in conjunction with the low economy technologies of digital art. Through this we learnt how data can be translated from science to art giving it a plasticity and expressive potential as art material. We also learnt how scientific data from black holes shows that space has a ‘sonic’ correspondence with the body, that enabled us to understand how this could be turned to the development of a poetics of the cosmos through art-making.

This approach to translating data and archival resources was also a key method developed in *promised lands*, as discussed in the next section.

Q3. *How can spatial approaches from sonic, visual, and installation practices (framed as ‘multimedia’) be used to re-articulate diverse imaginaries, poetics, and experiences of space exploration?*

As argued above, *Astro Black*, its related text and *Invisible* also produced a new, ‘Deep Space Poetics’ through novel thematic approaches and methodological innovation.

This involved a thematic and conceptual scrutiny of the limitations and possibilities of scientific data and knowledge as a means to articulate the invisible spaces between visible astronomical ‘objects’, the spaces of ‘non-meaning’ (the unknowable or unknown from a philosophical point of view), and the locations of detritus, trace and spectrality as correlates in sonic, cinematic and interstellar spaces.

This was carried through into *promised lands*, where Q2 was extended to a research on modes of utilization and elaboration of archival data. Here music, historical and scientific materials, textual montage, digital and virtual art processes were used to produce visual and sonic forms through which we learnt to develop a thematics of global histories of migration and diasporic and marginal cultures.

Taking forward the aesthetic tropes developed in previous work, i.e. spatial layering, erasure and ‘ghosting’, ideas around liminality and spectrality enabled us to focus on the work’s pictorial space. This involved deconstructing photographic material as a means to develop visual evocations of otherness, atmosphere and highly layered soft landscapes suggestive of collective memories and acts of ‘spectral’ remembrance (e.g. multiple overlaid photographs). This use of a poetic and aesthetic mode of enquiry of black diasporic culture in conjunction with philosophy’s language of deconstruction, erasure and the trace was unusual in art-science and digital art projects at the time, and opened up a thematic possibility that had been largely unexplored.

A core element of this was a weaving together of series of thematics around the concept of ‘space’ including:

1. Sonic space and cosmological space, deep space and dub space, cinematic space and installation space.
2. Space as conceptualized by diverse, pre-modern and contemporary cosmologies.
3. Outer space conceived both as the object of scientific enquiry and as the space of the

- imagination and poetic reverie, transcendence and belonging.
4. Living space, both as a sonic imaginary and a scientific concept, conceived as dynamic, expanding, fractal, interconnected and multi-dimensional.
 5. Real and imagined spaces; new lands, 'empty' and emptied spaces; boundaries, frontiers and their imagined dissolutions.
 6. Space and movement, the main tropes of migration, in relation to questions of diaspora and cultural migration.
 7. Transversal and improvisatory spaces, conceived as spaces of transformation and collective creation, and as openings to the unknown and the unpredictable.
 8. Dialogical and emerging spaces, collaborative spaces, indeterminate spaces, possible spaces, the dimensions activated in the movement beyond the logic of the 'excluded middle'².

In *promised lands* we interwove some of these figures (in particular 2, 3, 5, 6) with other concepts of space/s: as evoked in the musical output of migration; 'soft' landscape and psychogeography; 'impossible' pictorial spaces, oneiric and haunted spaces; and cyberspace as a multifaceted, virtual location of interconnected transitory formations, of official and unofficial histories of migration and colonization, and marginal voices and minor literatures. These ideas were then re-elaborated through sonic, visual and textual elements, traced, layered and re-composed within a single exploratory work or space in its own right. In the supplementary *Music and Migration* paper, these modes of engagement with ideas around global migration, space in all its variations and promised lands were further elaborated in textual form giving the thematics further mobility and visibility.

² The law of the excluded middle is one of the basic axioms of classical logic. It states that there exists no third term, which is at the same time A and non-A (in Latin, 'tertium non datur', no third is given). Implicit in this axiom is the clear distinction between (and dialectic of) 'subject' and 'object', and the complete separation between reality and the knowing subject. Barasab Nicolescu, a theoretical physicist and one of the main advocates of transdisciplinarity, argued that this axiom has been put into question by quantum physicists, who have theoretically and experimentally shown that at a quantum level there exist pairs of mutually exclusive contradictories (e.g. particle-wave and continuity-discontinuity) and that the observed phenomena are not independent from the observer. In 1976 Nicolescu formulated the idea that there are different levels of reality (e.g. the quantum level, the galactic vacuum, the zones of 'discontinuity' and the spaces between and beyond phenomena) (Nicolescu, 2010:23). For him transdisciplinarity allows the passage from one level of reality to another, beyond the logic of the excluded middle, and between, across and beyond disciplines (Nicolescu, 1996, 1997, 2000, 2010). A similar idea had been proposed by Werner Heisenberg, one of the key developers of quantum mechanics and best known for his formulation of the 'Uncertainty Principle'. In a 1942 manuscript, Heisenberg stated that reality is 'the continuous fluctuation of the experience as captured by consciousness. In that sense, it can never be identified to a closed system', and deduced that 'One can never reach an exact and complete portrait of reality'. (Heisenberg in Nicolescu, 2010:28). Therefore, for both Heisenberg and Nicolescu, 'the rigid distinction between exact and human sciences has to be abandoned' (ibid.).

In summary, *promised lands* functions as counter-archival work of virtual art materials that draws together black diasporic modes of poetic and aesthetic enquiry, the biblical trope of the Promised Land and its disseminations and iterations, imaginaries of ‘outer space’ and histories of migration. In doing so we were able to articulate a poetics of ‘space’ in the digital arts and in the multi-cultural present, using a process of thematic correlation between highly diverse areas/histories/knowledge-bases that brought a multiplicity of voices to the fore in highly distinctive ways.

9.2 Final considerations

The works I have discussed in this thesis developed new connections between emerging digital art practices, European art and cinema traditions, and African American, Caribbean, Indian classical and experimental electronic music practices. These traditions and practices were interwoven with contemporary cosmological research on the invisible universe, diasporic histories and marginal cultures, thus producing new and unique thematic constellations, hybrid modes of artistic re-elaboration of scientific data and historical/archival material.

The works comprise diverse concepts, poetics and experiences of space, which were collaboratively assembled through processes of iteration and versioning, indeterminacy and interdisciplinarity, hybrid techniques of data elaboration, and distinctive, site-specific and conceptually driven approaches to spatial, sonic and visual architecture, to articulate the idea of a fluid and constantly transforming, inclusive and interconnected cosmos.

I have shown how the works exemplify new ways in which the space and output of art practice can function as an integrated medium for cosmological reflection and reflection on cosmology. I have also evidenced how the works locate ideas and questions of space in the multi-cultural present, through a multiplicity of ‘minor’ sonic, scientific, aesthetic, poetic, marginal and diasporic perspectives and perceptions of space and invisible cosmic forces, and intertwined histories of human migration, to produce inclusive, immersive and multifaceted encounters with space, cosmological science(s), and global cultures.

BIBLIOGRAPHY

Ad Hoc Committee (1964). 'The Triple Revolution'. *International Socialist Review*, 24 (3), pp. 85-89.

Adejumo, T. and Adebamowo, M. (2012). 'Environmental Harmony And The Architecture Of 'place' In Yoruba Urbanism'. In Hernández, S. and Trebbia, C.A. (eds.), *Design and Nature VI: Comparing Design in Nature with Science and Engineering*. Southampton: WIT Press, pp. 73-86.

Alliez, E. and Goffey, A. (eds.) (2011). *The Guattari Effect*. London/New York: Continuum.

Allison, B. (1992). *Allison Research Index of Art and Design*. Leicester: Leicester Expertise (CD ROM).

Artaud, A. ([1947] 1976). 'To Have Done with the Judgment of God: A Radio Play'. In Sontag, S. (ed.), *Antonin Artaud: Selected Writings* (trans. H. Weaver). New York: Farrar, Straus and Giroux, pp. 555-571.

Bachelard, G. ([1958] 1994). *The Poetics of Space* (trans. M. Jolas), 6th ed. Boston: Beacon Press.

----- ([1960] 1971). *The Poetics of Reverie: Language, Childhood, and the Cosmos* (trans. D. Russell). Boston: Beacon Press.

Bailey, D. (1992). *Improvisation: Its Nature and Practice in Music*. New York: Da Capo Press.

Banks, J. (2001). 'Rorschach Audio: Ghost voices and perceptual creativity'. *Leonardo Music Journal*, 11, pp. 77-83.

----- (2004). 'Rorschach Audio: Art and Illusion for Sound'. *Strange Attractor Journal*, 1, pp. 124-159.

Bangura, A. K. (2012). 'From Diop to Asante: Conceptualizing and Contextualizing the Afrocentric Paradigm'. *The Journal of Pan African Studies*, 5 (1) pp. 103-125.

Barrow, J. D. (2001). *The Book of Nothing*. London: Vintage Books.

Barthes, R. (1977). *Image, Music, Text* (trans. S. Heath). London: Fontana Press.

Benjamin, W. ([1923] 1992). 'The Task of the Translator' (trans. A. Zorn). In Arendt, H. (ed.), *Illuminations*. London: Fontana Press, pp. 70-82.

----- ([c1927-40] 1999). *The Arcades Project*. Tiedemann, R. (ed.) (trans. H. Eiland and K. McLaughlin), 2ⁿ ed. Cambridge, MA: Harvard University Press.

Berardi, F. (2011). 'Repression, Expression, Depression'. In Alliez, E. and Goffey, A. (eds.), *The Guattari Effect*. London/New York: Continuum, pp. 186-202.

Bhabha, H. (1994). *The location of culture*. London /New York: Routledge

Bishop, C. (2012). 'Digital Divide: Contemporary Art and New Media'. *Artforum*, Fiftieth Anniversary Issue (September), pp. 434-41.

Bolton, C. T. (1972). 'Identification of Cygnus X1 with HDE 226868'. *Nature* 235 (5336), pp. 271-273.

Borgdorff, H. (2011). 'The Production of Knowledge in Artistic Research'. In Biggs, M. and Karlsonn, H. (eds.), *The Routledge Companion to Research in the Arts*. London/New York: Routledge, pp. 44-63.

----- (2012). *The Conflict of the Faculties: Perspectives on Artistic Research and Academia*. Leiden: Leiden University Press.

Bosteels, B. (2001). 'From Text to Territory: Félix Guattari's Cartographies of the Unconscious'. In Genosko, G. (ed.), *Deleuze and Guattari: Critical Assessments of Leading Philosophers Volume 2*. London: Routledge, pp. 881–910.

Bourriaud, N. (2002). *Relational Aesthetics* (trans. S. Pleasance and F. Woods). Dijon: Les Presses du Réel.

Bradley, F. (2000). *Sonic Boom: The Art of Sound*. Exhibition catalogue. London: Hayward Gallery.

Braxton, A. (1985). *Tri-Axium Writings, Volumes 1-3*. Hanover, NH: Synthesis Music/Frog Peak Music.

Brunette, P. and Wills, D. (eds.) (1994). 'The Spatial Arts: An Interview with Jacques Derrida'. In *Deconstruction and the Visual Arts: Art, Media, Architecture*. Cambridge: Cambridge University Press, pp. 9-32.

Cage, J. (1961). 'Lecture on Nothing'. In *Silence: Lectures and Writings*. Middletown: Wesleyan University Press, pp. 109-127.

Calder, L. and Lahav, O. (2010). 'Dark Energy: how the paradigm shifted'. *Physics World*, 23, pp. 32-37.

Camfield, W.A. (1990). 'Marcel Duchamp's Fountain: Its History and Aesthetics in the Context of 1917'. In Kuenzli, R.E. and Naumann, F.M. (eds.), *Marcel Duchamp: Artist of the Century*. Cambridge, MA: MIT, pp. 64-94.

Capra, F. (1983). *The Turning Point*. London: Harper Collins.

Cascone, K. (2000). 'The Aesthetics of Failure: "Post-digital" Tendencies in Contemporary Computer Music'. *Computer Music Journal*, 24 (4) (Winter), pp. 12-18.

Chtcheglov, I. ([1953] 2006). 'Formulary for a New Urbanism'. In Knabb, K. (ed. and trans.), *Situationist International Anthology*, revised and expanded edition. Berkeley, CA: Bureau of Public Secrets, pp.1-7.

Clark, T., Morse, A.N., Virgin, L.E. and Hockley, A. (2002). *The Dawn of the Floating World (1650-1675)*. Exhibition Catalogue. London: Royal Academy of Arts.

Cline, D. B. (2003). 'The Search for Dark Matter'. *Scientific American* (March), pp. 52-59.

Coleman, O. and Derrida, J. ([1997] 2004). 'The Other's Language: Jacques Derrida Interviews Ornette Coleman, 23 June 1997' (trans. T.S. Murphy). *Genre* (Summer), University of Oklahoma, pp. 319-28.

Collettivo A/traverso (1976). *Alice e' il Diavolo: sulla strada di Majakovskij, testi per una pratica di comunicazione sovversiva*. Capelli, L. and Saviotti, S. (eds.). Milan: Edizioni L'Erba Voglio.

Collins, S. (2004). 'The Actual and the Imagined'. In Zapp, A. (ed.), *Networked Narrative Environments as Imaginary Spaces of Being*. Manchester/Liverpool, Manchester Metropolitan University/FACT, pp. 45 – 61.

Corbett, J. (1994). *Extended Play: Sounding Off from John Cage to Dr. Funkenstein*. Durham/London: Duke University Press.

----- (1995). 'Writing Around Free Improvisation'. In Gabbard, K. (ed.), *Jazz Among the Discourses*. Durham/London: Duke University Press, pp. 229–36.

----- (ed.) (2006). *The Wisdom of Sun Ra: Sun Ra's Polemical Broadsheets and Streetcorner Leaflets*. Chicago: WhiteWalls.

Corbett, J., Elms, A. and Kapsalis, T. (eds.) (2006). *Pathways to Unknown Worlds: Sun Ra, El Saturn and Chicago's Afro-Futurist Underground, 1954-68*. Chicago: WhiteWalls.

Corby, T. (2012). 'Systemness: Towards a Data Aesthetics of Climate Change'. In Marsching, J.D. and Polli, A. (eds.), *Far Field: Digital Culture Climate Change, and the Poles*. Bristol: Intellect; Chicago: University of Chicago Press, pp. 237-250.

Cox, C. and Warner, D. (eds.) (2004). *Audio Culture: Readings in Modern Music*. New York: Continuum/Bloomsbury.

Creeber, G. and Martin, R. (eds.) (2009). *Digital cultures: understanding new media*. Maidenhead: Open University Press.

David, C. and Chevrier, J.F. (1997). *Politics/Poetics: Documenta X - The book*. Ostfildern-Ruit: Hatje Cantz.

Deleuze, G. ([1964] 2000). *Proust and Signs* (trans. R. Howard). Minneapolis: University of Minnesota Press.

----- ([1983] 1986). *Cinema I: The Movement-Image* (trans. H. Tomlinson and B. Hobberjam), 5th ed. Minneapolis: University of Minnesota Press.

Deleuze, G. and Guattari, F. ([1972] 1983). *Anti-Oedipus: Capitalism and Schizophrenia* (trans. R. Hurley, M. Seem, R. Lane), 10th ed. Minneapolis: University of Minnesota Press.

----- ([1975] 1986). *Kafka: Toward a Minor Literature* (trans. D. Polan), 7th ed. Minneapolis: University of Minnesota Press.

----- ([1980] 1987). *A Thousand Plateaus: Capitalism and Schizophrenia* (trans. Brian Massumi), 11th ed. Minneapolis: University of Minnesota Press.

----- ([1991] 1994). *What is Philosophy?* (trans. H. Tomlinson and G. Burchell). New York: Columbia University Press.

Demsey, David (1991). 'Chromatic Third Relations in the Music of John Coltrane'. *Annual Review of Jazz Studies* 5, pp. 145-80.

De Beauvoir, S. ([1949] 2010). *The Second Sex*. (trans. C. Borde and S. Malovany-Chevallier). London: Vintage/Random House.

Denzin, N. K. and Lincoln, Y.S. ([1994] 2000). 'Introduction: The Discipline and Practice of Qualitative Research'. In Denzin, N. K. and Lincoln, Y.S. (eds.), *Handbook of Qualitative Research*, 2nd edition. Thousand Oaks, CA: Sage Publications, pp. 1-28.

Derrida, J. ([1967] 1978). 'The Theater of Cruelty and the Closure of Representation'. In *Writing and Difference* (trans. A. Bass). Chicago: Chicago University Press, pp. 167-195.

----- ([1967] 1978). 'Structure, Sign, and Play in the Discourse of the Human Sciences'. In *Writing and Difference* (trans. A. Bass). Chicago: Chicago University Press, pp. 278-293.

----- ([1968] 1982). 'Différance' (trans. A. Bass). In *Margins of Philosophy*. Chicago: University of Chicago Press, pp. 1-27.

----- (1988). *Limited Inc.* (trans. A. Bass and S. Weber). Evanston, Illinois: Northwestern University Press.

----- ([1997] 2004). 'Play – The First Name, 1st July 1997' (trans. T.S. Murphy). In *Genre, Summer*, University of Oklahoma, pp. 331-40.

Dery, M. ([1993] 1994). 'Black to the Future: Interviews with Samuel R. Delany, Greg Tate and Tricia Rose'. In Dery, M. (ed.), *Flame Wars: The Discourse of Cyberculture*. Durham, NC: Duke University Press, pp. 179-222.

Deslippe, P. (2011). 'Introduction'. In Atkinson, W.W. (Three Initiates), *The Kybalion: The Definitive Edition*. London: Penguin, pp. 1-44.

Diop, C. A. (1974). *The African Origin of Civilization: Myth or Reality?* Chicago: Lawrence Hills Books.

Dosse, F. (2010). *Gilles Deleuze & Félix Guattari: Intersecting Lives*. New York: Columbia University Press.

Du Bois, W.E.B. ([1903] 2007). *The Souls of Black Folk*. Edwards, B. H. (ed.). Oxford/New York: Oxford University Press.

Duchamp, M. ([1973] 1989). *The Writings of Marcel Duchamp*. Sanouillet, M. and Peterson, E. (eds.). New York: Da Capo Press.

Droscher, W. and Hauser, J. (2012). 'Emerging Physics for Gravity-Like Fields'. In Modanese, G. and Robertson, G. A. (eds.), *Gravity-Superconductors Interactions: Theory and Experiment*. Bentham Science Publishers, pp. 229-270.

Ede, S. (2005). *Art and Science*. London and New York: I.B. Tauris & Co.

Ellison, R.W. ([1952] 1995). *The Invisible Man*. New York: Vintage.

Emmerling, L. (2003). *Jackson Pollock: 1912-1956*, J. Steinbrecher (ed.). Cologne: Taschen Basic Art.

Ficino, M. ([1469] 1985). *Commentary on Plato's Symposium on Love* (trans. J. Sears).

Dallas, Tx: Spring Publications.

Fanon, F. ([1952] 1967). *Black Skin, White Masks* (trans. C. L. Markmann). New York: Grove Press.

Flow Motion (2002). 'Version fantôme'. In *Sonic Process - Une Nouvelle Géographie des Sons*. Exhibition catalogue. Paris: Éditions du Centre Pompidou, pp. 224-229.

----- (2004). 'Dissolve'. In Tawados, G. (ed.), *Changing States: Contemporary Art and Ideas in an Era of Globalization*. London: Institute of International Visual Arts, pp. 230-233.

Floyd, S.A. Jr. (2002). 'Ring Shout! Literary Studies, Historical Studies, and Black Music Inquiry'. *Black Music Research Journal*, 22, pp. 49-70.

Foucault, M. ([1972] 1977j). 'Intellectuals and power'. In Bouchard, D. (ed.), *Language, Counter-Memory, Practice: Selected Essays and Interviews* (trans. D. Bouchard and S. Simon). New York: Cornell University Press, pp. 205-217.

Gabor, D. (1947). 'Acoustical quanta and the theory of hearing'. *Nature*, 159 (4044), pp. 591-594.

Genosko, G. (ed.) (1996). *The Guattar Reader*. Oxford/Cambridge: Blackwell.

----- (2000). 'The Life and Work of Félix Guattari: From Transversality to Ecosophy'. In Guattari, F. *The Three Ecologies*, London/New Brunswick, NJ: Athlone Press, pp.106-159

----- (2002). *Félix Guattari: An Aberrant Introduction*. New York: Continuum.

George, E. ([1998] 2007). '(ghost the signal)'. In Eshun, K. and Sagar, A. (eds.), *The Ghosts of Songs: The Film Art of The Black Audio Film Collective*. Liverpool, Liverpool University Press; Liverpool: Foundation for Art and Creative Technology, pp. 200-210.

George, E. and Piva, A. (2010). 'Astro Dub Morphologies'. *Journal of Media Practice*, 11 (1), pp. 47-58.

----- (2012). 'Imag(in)ing the Universe: Cosmos, Otherness, and Cinema'. In Maty Ba, S. and Higbee, W. (eds.), *De-Westernizing Film Studies*. London: Routledge, pp. 19-33.

Gibson, W. (1984). *Neuromancer*. New York: Ace Books.

Glissant, E. (1997). *Poetics of Relation* (trans. B. Wing). Ann Arbor: University of Michigan Press.

Goddard, S. (2007). 'A Correspondence Between Practices'. In Barrett, E. and Bold, B. (eds.), *Practice as Research: Approaches to Creative Arts Enquiry*. London/New York, Tauris, pp. 113-122.

González, J.A. (2009). 'The Face and the Public: Race, Secrecy and Digital Art Practice'. *Camera Obscura* 70, 24 (1), pp. 37-65.

Goodrick-Clarke, N. (2008). *The Western Esoteric Traditions: A Historical Introduction*. Oxford/New York: Oxford University Press.

Gourgouris, S. (2006). 'The Dream-Reality of the Ruin'. In Hanssen, B. (ed.), *Walter Benjamin and the Arcades Project. Walter Benjamin Studies Series, vol. II*. New York: Continuum, pp. 201-224.

Gray, C. (2007). 'From the ground up: encountering theory in the process of practice-led doctoral research'. In *In Theory? Encounters with Theory in Practice-based PhD*

research in Art and Design. AHRC Postgraduate Conference, De Montfort University & Loughborough Universities, UK, 26 June 2007. Conference Proceedings.

Gray, C. and Malins, J. (2004). *Visualizing Research: A Guide to the Research Process in Art and Design*. Ashgate: Aldershot.

Greene, R. (2000). 'Web Work: A History of Internet Art'. *Artforum*, 38 (May), pp. 162-167.

----- (2004). *Internet Art. World of Art*. London: Thames & Hudson.

Grotstein, J. (1990). 'Nothingness, Meaninglessness, Chaos, and the 'Black Hole' I'. *Contemporary Psychoanalysis*, 26, pp. 257-290.

Guattari, F. ([1977] 1984). *Molecular Revolution: Psychiatry and Politics* (trans. R. Sheed). Harmondsworth: Penguin Books.

----- ([1979] 2011). *The Machinic Unconscious*. Los Angeles, CA: Semiotext(e); Cambridge, Mass./London: MIT.

----- ([1986] 2009). 'Postmodern Deadlock and the Post-Media Transition'. In *Soft Subversions*. Lotringer, S. (ed.) (trans. C. Wiener and E. Wittman), revised edition. Los Angeles, Ca: Semiotext(e), pp. 291-300.

----- (1989). 'The Three Ecologies'. *New Formations 8: Techno-Ecologies* (Summer). London: Lawrence & Wishart, pp. 131-147.

----- ([1992] 2011). 'The Vertigo of Immanence - Interview with John Johnston'. In Alliez, E. and Goffey, A. (eds.), *The Guattari Effect*. London/New York: Continuum.

----- (1995). *Chaosmosis: An Ethico-Aesthetic Paradigm* (trans. J. Prefaris and P. Bains). Bloomington/Indianapolis: Indiana University Press.

----- (1996a). *Soft Subversions*. Lotringer, S. (ed.) (trans. D.L. Sweet and C. Wiener). New York: Semiotext(e).

Häuser, J. and Dröscher, W. (2012) 'Emerging Physics for Gravity-Like Fields'. In Modanese, G. and Robertson, G.A. (eds.), *Gravity-Superconductors Interaction: Theory and Experiment*. Bussum: Bentham Science Publishers, pp. 269-319.

Haraway, D. (1991). 'Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century'. In *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge, pp. 149-181.

Hawking, S. (1988). *A Brief History of Time*. New York: Bantam Books.

Hickman, R. (2008). 'A Glossary of Research Terms in Arts Education'. In Hickman, R. (ed.), *Research in Art & Design Education: Issues and Exemplars*. Bristol: Intellect, pp.187-196.

Hilton, A.M. (1964). 'Cyberculture - The Age of Abundance and Leisure'. *Michigan quarterly review*, 3 (4), pp. 217-229.

Horvath, J. E. (2009). 'Dark matter, dark energy and modern cosmology: the case for a Kuhnian paradigm shift'. *Cosmos & History*, 5 (2), p. 287.

Horowitz, M. (2014). *One Simple Idea: How Positive Thinking Reshaped Modern Life*. New York: Crown Publishers.

Johnson, J.B. (1925). 'The Schottky effect in low frequency circuits'. *Phys. Rev.*, 26, pp. 71-85.

Joselit, D. (1992). 'Duchamp's Monte Carlo Bond Machine'. *October*, 59 (Winter), pp. 9-26.

Jung, C.G. ([1965] 1989). *Memories, Dreams, Reflections*. Jaffé, A. (ed.). New York: Vintage Books.

Kemp, M. (2000). *Visualizations: The Nature Book of Art and Science*. Oxford/New York: Oxford University Press.

Kempadoo, R. (2010). 'Interpolating screen bytes: Critical commentary in multimedia artworks'. In *Journal of Media Practice*, 11 (1), pp. 59-80.

Khan, H. I. (1996). *The Mysticism of Sound and Music*. Boston/London: Shambhala Dragon Editions.

Klimontovich, Y.L. (1995). 'Anomalous Brownian Motion. Equilibrium and Nonequilibrium Natural Flicker Noise and Residual Time Correlations'. In *Statistical Theory of Open Systems*. Dordrecht: Kluwer Academic Publishers, pp. 421-449.

Krass, M. (2000). *Quintessence: The Mystery of Missing Mass in the Universe*. New York: Basic Books.

Krauss, R. (1999). *A Voyage on the North Sea: Post-Medium Condition*. New York: Thames & Hudson.

----- (2006). 'Two Moments from the Post-Medium Condition'. *October*, 116 (Spring), pp. 55-62.

Kreiss, D. (2012). 'Performing the Past to Claim the Future: Sun Ra and the Afro-Future Underground, 1954-1968'. *African American Review*, 45 (1-2) (Spring/Summer), pp. 197-203.

LaBelle, B. and Roden, S. (eds.) (1999). *Site of Sound: Of Architecture and the Ear*. Los Angeles: Errant Bodies Press.

LaBelle, B. (2006). *Background Noise: Perspectives on Sound Art*. New York and London: Continuum.

Lahav, O. and Massimi, M. (2014). 'Dark energy, paradigm shifts, and the role of evidence'. *Astronomy & Geophysics*, 55 (3) (June), pp. 3.12- 3.15.

Lévi-Strauss, C. ([1962] 1966). *The Savage Mind* (trans. G. Weidenfeld and Nicolson Ltd). London: Weidenfeld and Nicolson.

Lewontin, R. (2001). *The Triple Helix: Gene, Organism, and Environment*. Cambridge, Mass./London: Harvard University Press.

Livio, M. (ed.) ([2001] 2004). *The Dark Universe: Matter, Energy and Gravity (proceedings of the Space Telescope Science Institute Symposium)*. Cambridge: Cambridge University Press.

Lock, G. (1988). *Forces in Motion: The Music and Thoughts of Anthony Braxton*. New York: Da Capo Press.

----- (1999). *Blutopia: Visions of the Future and Revisions of the Past in the Work of Sun Ra, Duke Ellington, and Anthony Braxton*. Durham/London: Duke University Press.

Malins, J., Gray, C., Bunnell, K. and Wheeler, E. (1995). *Appropriate Research Methodologies for Artists, Designers & Craftpersons: Research as a Learning Process*. The Centre for Research in Art & Design, Gray's School of Art, pp. 1-11.

Mandelbrot, B. ([1975] 1977). *Fractals: Form, Chance and Dimension*. San Francisco: W. H. Freeman.

----- (1982). *The fractal geometry of nature*. San Francisco: W.H. Freeman.

----- (2002). *Gaussian Self-Affinity and Fractals. Globality, The Earth, 1/f Noise, and R/S*. New York/Berlin/Heidelberg: Springer Verlag.

Manovich, L. (2001). *The Language of New Media*. Cambridge, MA: MIT Press.

Manzo, L. and Brightbill, N. (2007). 'Towards a Participatory Ethics'. In Kingdon, S., Pain, R. and Kesby, M. (eds.), *Connecting People, Participation and Place: Participatory Action Research Approaches and Methods*. London: Routledge, pp. 33-40.

Marx, K. ([1858] 1973). 'Notebooks VI: 43-44, VII: 1-3'. In *Grundrisse: Foundations of the Critique of Political Economy* (trans. M. Nicolaus). Penguin/New Left Review, pp. 690-712.

Maturana, H. and Varela, F. ([1973] 1980). *Autopoiesis and Cognition: The Organization of the Living (Boston Studies in the Philosophy and History of Science)*. Dordrecht: Reidel Publishing.

Merchant, C. (1980). *Death of Nature: Women, Ecology, and the Scientific Revolution*, San Francisco: Harper and Row.

Meyer, L. (1956). *Emotion and Meaning in Music*. Chicago: University of Chicago Press.

Mitchell, S. (trans.) (1988). *Tao Te Ching: A New English Version, with Foreword and Notes*. New York: Harper & Row.

Mumford, L. (1967), *The Myth of the Machine (Vol. I): Technics and Human Development*. New York: Harcourt, Brace and World.

Negri, A. (2001). 'On Gilles Deleuze & Félix Guattari'. In Genosko, G. (ed.), *Deleuze and Guattari, Critical Assessment of Leading Philosophers*. London/New York: Routledge, pp. 1182-1197.

Neuhaus, M. and Loock, U. (1994). 'Interview [Milan, 1990]'. In *Max Neuhaus, Sound Works, Volume I, Inscription*. Ostfildern-Stuttgart: Cantz, pp. 122-135.

Neuhaus, M. (1994). 'Notes on Place and Moment, 1992'. In *Max Neuhaus, Sound Works, Volume I, Inscription*. Ostfildern- Stuttgart: Cantz, pp. 97-104.

Nicolescu, B. (1996). *La Transdisciplinarité*. Rocher: Paris.

----- (2010). 'Methodology of Transdisciplinarity - Levels of Reality, Logic of the Included Middle and Complexity'. *Transdisciplinary Journal of Engineering & Science*, 1 (1), December, pp. 19-38.

Nietzsche, F. (2001). *The Gay Science*. Williams, B. (ed.) (trans. J. Naukhoff and A. del Caro). Cambridge: Cambridge University Press.

Nordstrom, S.N. (2015). 'Anti-Methodology: A delightful Monstrous Daughter'. In *Proceedings and abstracts of the 8th International Deleuze Studies Conference, Daughters of Chaos, Practice, Discipline, A life*. Stockholm.

Oliveros, P. (2000). 'Quantum Listening: From Practice to Theory (to Practice Practice)'. *MusicWorks*, 76 (Spring), pp. 37-46.

Panek, R. (2011). *The 4 Percent Universe*. Oxford: Oneworld Publications.

Piva, A. and George, E. (2003). 'Flow Motion: Out There'. In *Space Art. Festival @rt Outsiders 2003, Anomalie Digital_Arts N° 4*. Exhibition catalogue. Orléans: Editions Hyx et Anomalie digital art, pp. 125-129.

- Quaranta, D. (2010). *Media, New Media, Postmedia*. Milan: Postmediabooks.
- Ra, S. (2005). *The Immeasurable Equation: The Collected Poetry and Prose*, Geerken, H. and Wolf, J., L. (eds.). Nordstedt: Waitawhile/Books on Demand
- Ra, S. and Abraham, A. (no date). 'Saturn "II" Research'. In *Chicago Jazz Archive, Special Collection Research Center*. Chicago: University of Chicago Library.
- Raunig, G. (2010). *A Thousand Machines* (trans. A. Derieg). New York/Los Angeles: Semiotext(e)/MIT Press.
- Relph, E. (1976). *Place and Placelessness*. London: Pion.
- Rees, M. (2000). *Just Six Numbers: The Deep Forces That Shape The Universe*. New York: Basic Books.
- Reynolds, S. (1998). *Energy Flash: a Journey Through Rave Music and Dance Culture*. London: Picador.
- Roads, C. (2001). *Microsound*. Cambridge, Mass.: MIT Press.
- Rodgers, M. (2012). 'Contextualizing Theories and Practices of Bricolage Research'. *The Qualitative Report*, 17. T&L Art, pp. 1-17.
- Rohdie, S. (1990). *Antonioni*. London: BFI Publishing.
- Rubin, V.C. ([2001] 2004). 'A Brief History of Dark Matter'. In Livio, M. (ed.), *The Dark Universe: Matter, Energy and Gravity (proceedings of the Space Telescope Science Institute Symposium)*. Cambridge: Cambridge University Press, pp. 1-13.

Rusch, R.D. (1984). *Jazztalk: The Cadence Interviews*. Seacusus, New Jersey: Lyle Stuart, Inc.

Russolo, L. ([1916] 1986). *The Art of Noises* (trans. B. Brown). New York: Pendragon Press.

Sadler, S. (2005). *Archigram: Architecture without Architecture*. Cambridge, Mass.: MIT Press.

Said, E. W. *Orientalism* (1978). New York: Pantheon.

Sartre, J.P. ([1957] 1991). *The Transcendence of the Ego: An Existentialist Theory of Consciousness* (Trans. F. Williams and R. Kirkpatrick). New York: Hill and Wang.

Schön, D. (1983). *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books.

Schrag, C. O. (1992). *The Resources of Rationality: A Response to the Postmodern Challenge*. Bloomington/Indianapolis: Indiana University Press.

Singh, S.C. (2004). *Let the Numbers Guide You*. Alresford/New York: O Books.

Snead, J. A. (1984). 'Repetition as a Figure of Black Culture'. In Gates, H. L. (ed.), *Black Literature and Literary Theory*. New York: Methuen, pp. 59-80.

Snow, C.P. (1959). *The Two Cultures and the Scientific Revolution*, 7th ed. London/New York: Cambridge University Press.

Szwed, J. (1993). 'Insert notes'. In Sun Ra and his Solar Arkestra, *Soundtrack to the Film Space is the Place*. Evidence ECD 22070-2.

----- (1997). *Space is the Place: The Life and Times of Sun Ra*. New York: Pantheon Books.

Tan, P. (2015). 'Architecture After Crisis'. In Pohl, E. B., Nájera, C. R. and Tan, P. (eds.), *Adhocracy Athens. From making things to making the commons*. Barcelona, Athens: dpr-barcelona, Onassis Cultural Center.

----- (2015). 'Transversal Materialism: On method, artifact and exception'. In Graham, J. (ed.), *2000+: The Urgencies of Architectural Theory*. New York: GSAPP Books.

Thomassen, B. (2009). 'The Uses and Meanings of Liminality'. *International Political Anthropology*, 2 (1), pp. 5-27.

Thompson, P. (2011). 'Art as research and its methodologies: approaches to process and practice in a PhD creative writing'. In *Proceedings of Society for Research into Higher Education. Annual Research Conference*, 7-9 December 2011.

Thorne, K. (1994). *Black Holes and Time Warps: Einstein's Outrageous Legacy*. New York: W.W. Norton & Company.

Todorov, V. (1975). *The Fantastic: A Structural Approach to a Literary Genre*. New York: Cornell University Press.

Toop, D. (1995). *Ocean of Sound: Aether Talk, Ambient Sound and Imaginary Worlds*. London: Serpent's Tail.

----- (2000). 'Sonic Boom'. In *Sonic Boom: The Art of Sound*. Exhibition catalogue. London: Hayward Gallery Publishing, pp. 107-121.

Treib, M. (1996). *Space Calculated in Seconds: The Philips Pavilion*. Princeton, NJ:

Princeton University Press.

Triscott, N. and La Frenais, R. (eds.) (2005). *Zero Gravity: A Cultural User's Guide*. London: The Arts Catalyst.

Tuan, Y. (1977) *Space and Place: The Perspective of Experience*. Minneapolis/London: University of Minnesota Press.

Turner, M. and Huterer, D. (1999). 'Prospects for Probing the Dark Energy via Supernova Distance Measurements'. *Phys. Rev. D* 60, 081301.

Turner, V. ([1969] 1977). *The Ritual Process: Structure and Anti-Structure*. Ithaca, NY: Cornell University Press.

Van Assche, C. (2002). *Sonic Process - Une Nouvelle Géographie des Sons*. Exhibition catalogue. Paris: Éditions du Centre Pompidou, pp. 13-23.

Van Gennep, A. ([1960] 2004). *The Rites of Passage*. London: Routledge

Varela, F. and Maturana, H. (1972). 'Mechanism and Biological Explanation'. *Philosophy of Science*, 31 (3) (September). Chicago: University of Chicago Press, pp. 378-382.

Varese, E. and Wen-chung, C. (1966). 'The Liberation of Sound'. *Perspectives of New Music*, 5 (1) (Autumn – Winter), pp. 11-19.

Vattimo, G. (1989). *La Societa' Trasparente*. Milan: Garzanti.

Veal, M.E. (2007). *Dub: Soundscapes and Shattered Songs in Jamaican Reggae*. Middletown, CT: Wesleyan University Press.

- Veneciano, J. (2004). 'Louis Armstrong, Bricolage and the Aesthetics of Swing'. In O'Meally, R., Edwards, B. and Griffin, F. (eds.), *Uptown conversation: the new jazz studies*. New York: Columbia University Press, pp. 256-277.
- Virno, P. (2001). 'General Intellect'. In Zanini, A. and Fadini, U. (eds.), *Lessico postfordista: dizionario di idee della mutazione*. Milan: Interzone/Feltrinelli, pp. 136-150.
- Voss, R.F. and Clarke, J. (1975). '1/f noise in music and speech'. *Nature*, 258, pp. 317-318.
- Wagenmakers, E.J., Farrel, S., Ratcliff, R. (2004). 'Estimation and Interpretation of 1/f noise in human cognition'. *Psychonomic Bulletin Review*, 11, pp. 579-615.
- Watson, A. (1992). *An Exploration of the Principle of Chance on the Creative Activity known as Sculpture*. Unpublished PhD thesis. Robert Gordon University/CNAA.
- Webb, J. and Brien, D.A. (2011). 'Addressing the "Ancient Quarrel": Creative Writing as Research'. In Biggs, M. and Karlsson, H. (eds.), *The Routledge Companion to Research in the Arts*. London /New York: Routledge, pp. 186-203.
- Webster, B. L. and Murdin, P. (1972). 'Cygnus X-1-a Spectroscopic Binary with a Heavy Companion?'. *Nature*, 235, pp. 37-38.
- Wilhelm, B. and Baynes, C.F. (trans) ([1950] 1987). *The I Ching*. Wilhelm, H. (Preface), Jung, C. G. (Foreword). 22nd ed. Princeton, NY: Princeton University Press.
- Whitehead, A.N. ([1929] 1978). *Process and Reality: An Essay in Cosmology*. New York: Free Press.
- ([1938] 1968). *Modes of Thought*. New York: Free Press.

Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. Cambridge, Mass./London: MIT Press.

Yam, P. (1992). Noisy Nucleotides. *Scientific American*, 267 (3) (September), pp. 23-27.
Zwicky, F. (1937). 'On the Masses of Nebulae and of Clusters of Nebulae'. *Astrophysical Journal*, 86, p. 217.

ONLINE REFERENCES

Allen, S.W., Schmidt, R.W., Ebeling, H., Fabian A.C. and van Speybroeck, L. (2004). 'Constraints on dark energy from Chandra observations of the largest relaxed galaxy clusters'. *MNRAS*, 353, pp. 457-467. Available from:
<http://mnras.oxfordjournals.org/content/353/2/457.full.pdf> [Accessed 5 June 2014].

American Physical Society (2009). 'This Month in Physics History. January 1998: The accelerating expansion of the universe'. *APS News Archives*, 18 (1). Available from:
<http://www.aps.org/publications/apsnews/200901/physicshistory.cfm> [Accessed 6 June 2014].

Artforum (2012). *Digital Divide: Contemporary Art and New Media. A discussion related to the September 2012 In Print article*. Available from:
<http://artforum.com/talkback/id=70724> [Accessed 13 August 2014].

Banks, M. (2006). 'Underground Resistance: An Interview with Mad Mike Banks'. *Slices Magazine* [DVD], 3, 28, September. Available from:
<http://www.detroitmusic.tv/underground-resistance-interview> [Accessed 11 December 2013].

Barlow, J.P. (1996). *A Declaration of the Independence of Cyberspace*. Available from:
<https://projects.eff.org/~barlow/Declaration-Final.html> [Accessed 10 April 2013].

Beaven, K. (2011). *Susan Hiller: Witness - behind the scenes*. Available from: <http://www.tate.org.uk/context-comment/blogs/susan-hiller-witness-behind-scenes> [Accessed 15 August 2015].

Biswas, A. (1999). C.A.T. In *Art and Science Discussion Papers*. Available from: <http://www.f davidpeat.com/forums/artsci/paperscat.htm> [Accessed 16 March 2014].

Bonaventura, P. (2002). *Floating Worlds*. Available from: <http://www2.tate.org.uk/intermediaart/entry15469.shtm> [Accessed 2 July 2015].

Bond, P. and Mitton, J. (2002). 'Music of the Black Holes: they all play the same tune'. Royal Astronomical Society, 9 April. Available from: <https://www.ras.org.uk/search/article-archive/434-pn02-09-nam3> [Accessed 13 September 2013].

Braxton, A. and Heffley, M. (2001). *Anthony Braxton: The Third Millennial Interview with Mike Heffley*. Available from: http://www.academia.edu/2314587/Anthony_Braxton_The_Third_Millennial_Interview [Accessed 21 August 2013].

Britt, R.R. (2002). 'The Music of Black holes'. *Space.com*, 9 April. Available from: http://www.space.com/scienceastronomy/astronomy/blackhole_music_02-0409-1.html. [Accessed 15 April 2003].

Brown, N. (2000). 'Sonic Boom'. *Frieze Magazine*, 54 (September-October). Available from: http://www.frieze.com/issue/review/sonic_boom/ [Accessed 3 October 2014].

Butler, S. (1870). 'The Book of the Machines'. In *Erewhon*. Available from: <https://www.marxists.org/reference/archive/butler-samuel/1872/erewhon/> [Accessed 3 May 2014].

Camenzind, M. (2010). *Modern Cosmology Graduate Course*. Available from: http://www.lsw.uni-heidelberg.de/users/mcamenzi/Day_1_Cosmology_2010.pdf [Accessed 27 August 2013].

Chandra X-ray Observatory (2003). *Abell 2029: Hot news for cold dark matter*. Press release. Available from: <http://chandra.harvard.edu/photo/2003/abell2029/> [Accessed 6 November 2013].

Chatterjee, P. (2007). *The Black Hole of Empire*. Stanford University Presidential Lecture, 7 November. Stanford Humanities Center Video Archive. Available from: <https://www.youtube.com/watch?v=Hz8oN6lIF-k> [Accessed 3 October 2013].

Cole, I. (2009). 'Suspending Frictions: A Conversation with Cornelia Parker'. *Sculpture magazine*, 29 (5). Available from: http://www.sculpture.org/documents/scmag09/june_09/parker/parker.shtml [Accessed 9 June 2015].

Collins, S. and Rellie, J. (2004). *Discussion about Tate in Space with Susan Collins and Jemima Rellie*. Available from: http://www.dshed.net/sites/digest/04/content/week2/tate_in_space.html [Accessed 2 July 2015].

Columbia Electronic Encyclopaedia (2011). *Rhizome Definition*. 6th ed., Columbia University Press. Available from: <https://www.questia.com/read/1E1-rhizome/rhizome> [Accessed 22 January 2013].

Cosic, V. (no date). *3D ASCII, An Autobiography*. Available from: http://www.ljudmila.org/~vuk/ascii/vuk_eng.htm [Accessed 19 March 2014].

Cox, C. (2003). *How Do You Make Music a Body without Organs? Gilles Deleuze and Experimental Electronica*. Available from: <http://faculty.hampshire.edu/ccox/Cox-Soundcultures.pdf> [Accessed 14 May 2013].

Cramer, F. (2002). *Concepts, Notations, Software, Art*. Available from: http://www.netzliteratur.net/cramer/concepts_notations_software_art.html [Accessed 16 September 2014].

Davis, E. (1997). *Roots and Wires: Polyrythmic Cyberspace and the Black Electronic*. Available from: <http://www.techgnosis.com/cyberconf.html> [Accessed 4 July 2014].

Descartes, R. ([1644] 2003). 'Principles of Philosophy Part IV, Of The Earth'. In *Selections from the Principles of Philosophy of Rene Descartes (1596-1650)* (trans. J. Veitch). Available from: <http://www.gutenberg.org/ebooks/4391> [Accessed 7 August 2014].

Garrath, M. (2012). *Digital Divide: Contemporary Art and New Media. A discussion related to the September 2012 In Print article* [forum post]. Available from: <http://artforum.com/talkback/id=70724> [Accessed 13 August 2014].

Graves, B. (1998). 'Edward W. Said's "Liminal Intellectual"'. In *Political Discourse - Theories of Colonialism and Postcolonialism*. Brown University. Available from: <http://www.postcolonialweb.org/poldiscourse/said/said3.html> [Accessed 6 October 2014].

Guattari, F. and Vilar, S. (1992). *De la pluridisciplinarité a la transdisciplinarité*, Barcelone-Paris. Available from: <http://www.cliniquedelaborde.com> [Accessed 5 June 2013].

Hébert, K.S. (2012). 'Ku Klux Klan in Alabama from 1915-1930'. In *Encyclopaedia of Alabama*. Available from: <http://www.encyclopediaofalabama.org/face/Article.jsp?id=h-3221> [Accessed 25 March 2014].

Hoskote, R. (2004). *Nemo/ No-man/ Nomad: Collegial Reflections on the Raqs Media Collective*. Available from: <http://www.raqsmediacollective.net/images/pdf/5f2c5803-52cc-4e3f-8493-c9695bd0bc95.pdf>. [Accessed 25 March 2014].

ICA (1996). *Towards the Aesthetics of the Future/Deep Screen Diving*. Bulletin. Available from: <http://www.hmgt.co.uk/ica/OldWEBSITE/Bulletin/talks/deepscreen.html> [Accessed 18 September 2014].

Institute of Physics (2013). *A Whirling Dervish puts physicists in a spin*. Available from: http://www.iop.org/news/13/nov/page_61971.html [Accessed 8 January 2014].

Ippolito, J. (1996). *Guggenheim Soho: Mediascape*. Available from: <http://artnetweb.com/guggenheim/mediascape/text2.html> [Accessed: 17 September 2014].

James, G.G.M. ([1954] 2009). *Stolen Legacy, the Greeks Were Not the Authors of Greek Philosophy, but the People of North Africa, Commonly Called the Egyptians*. New York: Philosophical Library. Available from: *The Journal of Pan African Studies*, <http://www.jpnafrican.com/ebooks/eBook%20Stolen%20Legacy.pdf> [Accessed 7 August 2013].

Jerram, L. (no date). 'Luke Jerram Artist'. In *Writings of Tide*. Available from: http://www.lukejerram.com/sites/lukejerram/files/uploads/tide_writings.pdf [Accessed 12 July 2015].

Jones, C. C. (1842). 'The Religious Instruction of the Negroes in the United States'. In *Documenting the South. Rare Book Collection*. University of North Carolina, Chapel Hill. Available from: [http:// docsouth.unc.edu/church/jones/jones.html](http://docsouth.unc.edu/church/jones/jones.html) [Accessed 27 February 2012].

Kal, T. (ed) (2014). *Afrofuturism*. Available from: <http://afrofuturism.net/> [Accessed 2 August 2014].

Kaye, B. (2011). 'Chapter 1: Subject Groups, Disciplinary Power, Transversality: How Madness becomes Conventional When the Mad Convene'. *International Journal of Baudrillard Studies*, 8 (2) (July). Available from:
http://www.ubishops.ca/baudrillardstudies/vol8_2/v8-2-kayethesisch1.html [Accessed 12 June 2013].

Kelly, S. (2005). *The Transversal and the Invisible: How do you really make a work of art that is not a work of art?* Available from:
http://www.republicart.net/disc/mundial/kelly01_en.htm [Accessed 2 June 2013].

Lycouris, S. (2000). 'The documentation of practice: framing trace'. In *Working Papers in Art and Design I*. University of Hertfordshire Available from:
www.herts.ac.uk/__data/assets/pdf_file/0003/12288/WPIAAD_vol1_lycouris.pdf
[Accessed 20 November 2014].

Manovich, L. (1996). 'The Death of Computer Art'. *Rhizome*, October 23. Available from: <http://rhizome.org/discuss/view/28877/> [Accessed 17 August 2014].

----- (2001). *Post-media Aesthetics*. Available from: http://manovich.net/content/04-projects/030-post-media-aesthetics/29_article_2001.pdf [Accessed 17 August 2014].

----- (2003). *Don't Call it Art: Ars Electronica 2003*. Available from:
<http://manovich.net/index.php/projects/don-t-call-it-art> [Accessed 17 August 2014].

Marinetti, F.T. ([1909] 1973). *Manifesto of Futurism* (trans. R.W. Flint) Available from:
<http://www.italianfuturism.org/manifestos/foundingmanifesto/> [Accessed 25 September 2014].

Martin, J. (2000). *Sonic Boom - The Art of Sound: Exhibition Review*. Available from:
<http://www.musicweb-international.com/SandH/2000/may00/SonicBoom.htm> [Accessed 3 October 2014].

Martin, K. (1995). 'Scientist Meets the Ghost Captain'. Sleeve notes, *Macro Dub Infection Volume 1*. Compilation CD. Virgin Records, AMBT 7. Available from: <http://www.uncarved.org/dub/macro.html> [Accessed 7 May 2013].

McKibbin, A. (2007). 'Anthemic Electronica – An Interview with Laibach. *Artist Direct News*, May 5. Available from: <http://www.artistdirect.com/nad/news/article/0,,4096360,00.html> [Accessed 5 May 2009].

Naqshbandi Sufi Order (no date). *Whirling*. Available from: <http://www.naqshbandi.asn.au/whirling.html> [Accessed 8 January 2014].

NASA (2004). *Chandra Opens New Line of Investigation on Dark Energy*. Press release, 18 May. Available from: <http://chandra.harvard.edu/photo/2004/darkenergy/> [Accessed 16 February 2014].

Newton, J ([c.1680] 2010). 'Keynes MS. 28'. In Newman, W.R. (ed.), *The Chymistry of Isaac Newton*. Available from: <http://purl.dlib.indiana.edu/iudl/newton/ALCH00017> [Accessed 6 May 2014].

Nicolescu, B. (2000). 'Transdisciplinarity and Complexity: Levels of Reality as Source of Indeterminacy'. *Bulletin Interactif du Centre International de Recherches et Études transdisciplinaires*, 15 (May). Available from: <http://ciret-transdisciplinarity.org/bulletin/b15c4.php> [Accessed 15 June 2013].

----- (1997). *The Transdisciplinary Evolution of the University. Condition for Sustainable Development*. Available from: <http://ciret-transdisciplinarity.org/bulletin/b12c8.php> [Accessed 15 June 2013].

Oral History (2011). 'Interview with Lee Krasner, Nov. 2 1968'. In *Archives of American Art*, April. Available from: <http://www.aaa.si.edu/collections/interviews/oral-history-interview-lee-krasner-12507> [Accessed 3 December 2013].

Ottenhoff, S. (1996). *The Sixties, Chicago and the AACM*. Available from: <http://www2.kenyon.edu/projects/ottenhoff/aacm/paper.htm> [Accessed 18 May 2014].

Poincaré, H. (1905). *Science and Hypothesis* (trans. W. J. Greenstreet). London/New York: Walter Scott Publishing Co. Available from: http://en.wikisource.org/wiki/Science_and_Hypothesis [Accessed 7 March 2013].

Public Broadcasting Service (no date). *Dried Scott case: the Supreme Court decision, 1857*. Available from: <http://www.pbs.org/wgbh/aia/part4/4h2933.html> [Accessed 2 May 2014].

Quaranta, D. (2011). 'The Post-Media Perspective'. *Rhizome*, 12 January. Available from: <http://rhizome.org/editorial/2011/jan/12/the-postmedia-perspective/> [Accessed 14 September 2014].

Parker, C. (no date). 'Cold Dark Matter: An Exploded View 1991'. Available from: <http://www.tate.org.uk/art/artworks/parker-cold-dark-matter-an-exploded-view-t06949/text-audio-transcript> [Accessed 9 September 2014].

Radical Culture Research Collective (RCRC) (2007). *A Very Short Critique of Relational Aesthetics*. Available from: <http://transform.eipcp.net/correspondence/1196340894> [Accessed 25 June 2013].

Ramshaw, S. (2006). 'Deconstructin(g) Jazz Improvisation: Derrida and the Law of the Singular Event'. *Critical Studies in Improvisation*, 2 (1). Available from: <http://www.criticalimprov.com/article/view/81/179> [Accessed 8 October 2013].

Raunig, G. (2005). *A Few Fragments on Machines* (trans. A. Derieg). Available from: <http://eipcp.net/transversal/1106/raunig/en> [Accessed 30 July 2013]

Schaub, C. (2009). 'Beyond the Hood? Detroit Techno, Underground Resistance, and

African American Metropolitan Identity Politics'. In *FIAR (Forum for Inter-American Research)*, 2 (2) (October). Available from: <http://www.interamerica.de/volume-2-2/schaub/> [Accessed 21 March 2014].

Seiffarth, C. (2012). 'About Sound Installation Art'. In *Kunstjournalen B-post 2012*. Available from: http://www.kunstjournalen.no/12_eng/carsten-seiffarth-about-sound-installation-art [Accessed 12 September 2014].

Serres, M. and Kunzru, H. (1995). *Art and Music. Michael Serres Interview*. Available from: <http://www.harikunzru.com/art-and-music/michel-serres-interview-1995> [Accessed 6 June 2014].

Shankar, R. (no date). *On Appreciation of Indian Classical Music*. The Ravi Shankar Foundation, 2009-13. Available from: <http://www.ravishankar.org/-music.html> [Accessed 5 November 2013].

Siegfried, T. (2013). *50 years later, it's hard to say who named black holes*. Available from: <https://www.sciencenews.org/blog/context/50-years-later-it%E2%80%99s-hard-say-who-named-black-holes> [Accessed 25 January 2014].

Tejusoso, O. (1997). 'The JAZZ connections'. *Glendora Review: African Quarterly on the Arts*, 2, (2), pp. 74-83. Available from: African e-Journals Project. <http://digital.lib.msu.edu/projects/africanjournals/html/issue.cfm?colid=251> [Accessed 7 May 2014].

Toop, D. (1994). 'A-Z Of Dub'. *The Wire*, 123 (May). Available from: <http://www.thewire.co.uk/in-writing/essays/a-z-of-dub> [Accessed 8 December 2013].

Vivekananda, S. ([c.1896] 1947). 'Cosmology (Practical Vedanta 11)'. In: *Complete Works of Swami Vivekananda*. Available from: <http://www.vivekananda.net/PDFBooks/PracticalVedanta.pdf> [Accessed 5 March 2014].

Walcott, D. (1992). *The Antilles: Fragments of Epic Memory*. Nobel Lecture, December 7. Available from:
http://www.nobelprize.org/nobel_prizes/literature/laureates/1992/walcott-lecture.html
[Accessed 4 May 2014].

Wallis Budge, E. A. (trans.) (1895). *The Papyrus of Ani (The Egyptian Book of the Dead), 1240 BC*. Available from: University of Pennsylvania – African Studies Center.
http://www.africa.upenn.edu/Books/Papyrus_Ani.html [Accessed 4 May 2014].

Weibel, P. (2005). *Die Postmediale Kondition*. Exhibition catalogue. Graz: Neue Galerie Graz am Landesmuseum Joanneum, pp. 6-13. Available in English from:
<https://estrategiasimagem.files.wordpress.com/2010/04/29170167-the-postmedia-condition-a-condicao-pos-midia-peter-weibel-1.pdf> [Accessed 11 October 2014].

Wray, S. (1998). *The Electronic Disturbance Theater and Electronic Civil Disobedience*. Available from: <http://www.thing.net/~rdom/ecd/EDTECD.html> [Accessed 19 September 2014].

Yongo, M. (2014). *What is Afrofuturism?* Available from:
<http://mediadiversified.org/2014/01/01/what-is-afrofuturism/> [Accessed 2 August 2014].

Younge, G. (2004). 'Alabama clings to segregationist past'. *The Guardian*, 30 November. Available from: <http://www.theguardian.com/world/2004/nov/30/usa.schoolsworldwide>
[Accessed 25 March 2014].

ARTWORKS

Bailey, G. and Corby, T. (2006). *Cyclone.soc* [installation]. Available from:
<http://www.reconnoitre.net/cyclone/index.php> [Accessed 2 August 2015].

Biswas, A. (1998). *C.A.T.* [performance]. Available from:

<http://www.artscatalyst.org/artist/ansuman-biswas> [Accessed 2 August 2015].

Bunting, H. (2002 – 2003). *BorderXing Guide* [online artwork]. Available from:

<http://www2.tate.org.uk/intermediaart/borderxing.shtm> [Accessed 18 March 2014]

Collins, S. (2002). *Tate in Space* [online artwork]. Available from:

<http://www2.tate.org.uk/space/> [Accessed 2 August 2015]

Flow Motion (1999). *The Dub Museum* [installation]. Unpublished documentation.

----- (2001). *Dissolve* [installation] Available from:

http://www.iniva.org/exhibitions_projects/2001/flow_motion_dissolve [Accessed 1 March 2014]

----- (2002). *Ghostdance* [installation] Available from:

<http://www.arpla.fr/canal2/figureblog/wp-pdf/sonicprocess.pdf> [Accessed 1 March 2014]

Harwood@Mongrel (2000). *Uncomfortable Proximity* [online artwork]. Available from:

<http://www2.tate.org.uk/netart/mongrel/home/default.htm> [Accessed 17 March 2014]

Hiller, S. (2000). *Witness* [installation]. Available from:

<http://www.tate.org.uk/whats-on/tate-britain/exhibition/susan-hiller/room-guide/witness>

Hokusai K. (c. 1829-32). *Under the Wave off Kanagawa*. [woodblock print]. Available

from: <http://www.metmuseum.org/collection/the-collection-online/search/45434>

[Accessed 8 August 2013]

Kempadoo, R. (2000). *Virtual Exiles* [online artwork]. Available from:

http://www.roshinikempadoo.co.uk/gallery_22559.html [Accessed 1 August 2015]

- (2004). *Ghosting* [installation]. Available from:
http://www.roshinikempadoo.co.uk/photo_249676.html [Accessed 1 August 2015]
- Jerram, L. (2001). *Tide* [installation]. Available from: <http://www.lukejerram.com/tide/>
[Accessed 1 August 2015]
- Parker, C. (1991). *Cold Dark Matter: An Exploded View* [installation]. Available from:
<http://www.tate.org.uk/learn/online-resources/cold-dark-matter>
- Peljhan, M. (1994-2007). *Makrolab*. Available from: <http://v2.nl/archive/works/makrolab>
[Accessed 19 March 2014]
- Piper, K. (1991). *Surveillances' (tagging the other)* [video animation]. Available from:
<http://www.keithpiper.info/statement.htm> [Accessed 16 March 2014]
- Portway, J. and Autogena, L. (2001). *Black Shoals Stock Market Planetarium*
[installation]. Available from: <http://www.blackshoals.net/> [Accessed 1 August 2015]
- Russolo (1914). *Intonarumori* [installation]. Available from:
<http://www.medienkunstnetz.de/works/intonarumori/> [Accessed 12 September 2014]
- Saraceno, T. (2013). *In Orbit* [installation]. Available from:
<http://tomassaraceno.com/projects/in-orbit/> [Accessed 1 August 2015]
- Talmans, J. (2011). *Nature of the Night Sky* [installation]. Available from:
<http://www.jefftalman.com/nightsky.html> [Accessed 1 August 2015]

FILMS

Sun Ra: Space Is the Place (1974). Directed by J. Coney. [VHS] New York: Rhapsody Films.

Sun Ra: A Joyful Noise (1980). Directed by R. Mugge. [VHS] Mug-Shot Productions.
New York: Rhapsody Films.

Last Angel of History (1995). Directed by J. Akomfrah. [DVD]. New York: Icarus Films.

Zabriskie Point (1970). Directed by M. Antonioni. [DVD]. Los Angeles: Metro-Goldwyn-Mayer (MGM).

TELEVISION PROGRAMMES

Krautrock: The rebirth of Germany (2009). Directed by B. Whalley. BBC Four, 23 October, h. 21:00.

DISCOGRAPHY

Burning Spear ([1975] 2001). 'Travelling'. In *Spear Burning*. LP. Pressure Sounds, PSLP 33.

Clash, The (1979). *London Calling and Armagideon Time*. Vinyl, 12". CBS, 12 8087.

Coltrane, J. and Coltrane, A. (1968). *Cosmic Music*. LP. Impulse!, MIPL 515.

Coltrane, J. (1998). *Living Space*. LP. Impulse!, IMPD-246.

Disinformation (1996). *Stargate*. LP. Ash International. ASH 3.2.

Dixon, T./Population One (1994). *Unknown Black Shapes*. LP. Utensil, UT 004.

Hallucinator (2000). *Messenger*. In Teshigawara, S., *Absolute Zero*. CD compilation. Charrm, CHARRM28.

----- (2003). *Morpheus*. Vinyl, 12". Chain Reaction, CR-35.

Mitchell, R. ([1968] 1994). *Sound*. LP. Delmark Records, DE-408.

Oliveros, P., Dempster, S. and Panaiotis (1989). *Deep Listening*. CD. New Albion, NA 022.

Pablo, A. (1977). *Vibrate Onn*. Lee Perry (producer). Vinyl, 7". Black Art, ART 20.

Perry, L.S., & the Dub Syndicate (1987). 'Music and Science Lovers'. In *Time Boom X De Devil Dead*. LP. On-U Sound, ON-U LP 43.

Ra, S. (1957/2009). *Super-Sonic Jazz*. LP. El Saturn Records, SR-LP-0216.

----- ([1962-1963] 1992). *Cosmic Tones for Mental Therapy/Art Forms Dimensions Tomorrow*. CD. Evidence, ECD 22036.

----- ([1966] 2005). *Nothing Is*. CD. ESP, ESP-DISK 1045.

----- ([1972] 1977). 'Cosmo-darkness'. In *Sun Ra, Live in Egypt, Vol. 1. (Nature's God) (Dark Myth Equation Visit)*. LP. El Saturn Records/Thoth Intergalactic, LP-1272.

Ra, S. (1973). *Space is the Place*. LP. Blue Thumb Records, BTS 41.

Rhythm & Sound w/ Willi Williams (2006). 'See Mi Yah (Hallucinator Remix)'. In *Rhythm & Sound – See Me Yah Remixes*. CD compilation. Burial Mix, BMXD-1.

The Dubmasters - Various Artists (1999). *X-Ray Music (A Blood & Fire Dub Directory)*. CD Compilation. Blood & Fire, BFCDS 904.

Underground Resistance (1998). *Interstellar Fugitives*. 3 LPs. Underground Resistance, UR-045.

Varèse, E. ([1958] 1972). 'Poème Electronique'. In *The Varèse Album*. LP. Columbia Masterworks, MG 31078.

Williams, W. ([1977] 1982). *Armageddeon Time*. Studio One, SOLP-0131.

Xenakis, I. ([1958] 1997). Concret PH. In: *Electronic Music*. CD. Electronic Music Foundation, EMF CD 003.

----- ([1959] 2005). Analogique A+B. In *Iannis Xenakis - Music For Strings*. CD. Mode Records, mode 152, Edition Iannis Xenakis, vol. 6.

ONLINE LINKS FOR PUBLISHED WORKS [Accessed 21 October 2014]

ASTRO BLACK MORPHOLOGIES: MUSIC AND SCIENCE LOVERS (online text)

http://www.olats.org/space/13avril/2004/te_flowmotion.html

ASTRO BLACK MORPHOLOGIES/ASTRO DUB MORPHOLOGIES

http://www.sciencemuseum.org.uk/smap/collection_index/flow_motion_astro_black_morphologies.aspx

<http://www.hansardgallery.org.uk/event-detail/100-flow-motion-astro-black-morphologies/>

<http://www.artscatalyst.org/astro-black-morphologies-flow-motion>

INVISIBLE

http://www.sciencemuseum.org.uk/smap/collection_index/flow_motion_invisible.aspx

<http://www.ast.cam.ac.uk/public/past.events/invisible>

<http://www.finetuned.org/hallucinator.html>

<http://www.youtube.com/watch?v=SHZVYkIfrlA>

<http://www.youtube.com/watch?v=7yDT6-vI6Ys>

PROMISED LANDS

<http://www.promisedlands.info>

http://www.iniva.org/events/2009/promised_lands_part_1

http://www.iniva.org/events/2009/promised_lands_part_2

<http://www.artinliverpool.com/?p=16529>

http://www.iniva.org/about_us/news/flow_motion_at_fact

http://en.wikipedia.org/wiki/Liverpool_and_the_Black_Atlantic

MUSIC AND MIGRATION

<http://onlinelibrary.wiley.com/doi/10.1002/9781444351071.wbeghm379/abstract>

ADDITIONAL LINKS [Accessed 20 October 2014]

FLOW MOTION

<http://ph.qmul.ac.uk/engagement/flow-motion>

http://www.spacearts.info/en/db/get_group.php?id=2

**LANDSCAPES OF THE INVISIBLE:
SOUNDS, COSMOLOGIES AND POETICS OF SPACE**

ANNA PIVA

APPENDIX A (I-IV)

APPENDIX A

TABLE OF CONTENTS

INTRODUCTION	2
(I) ON TRANSVERSALITY	3
1. Transversality	3
2. Transversality, transdisciplinarity and the post-media era	6
(II) TRANSVERSALITY, MACHINES AND THE SPACES BETWEEN	10
(Music and Science Lovers: Resonances)	15
(III) BLACK HOLES, MUSIC, FLICKER NOISE AND FRACTALITY	16
1. Figures of otherness: space voids and exotic ‘objects’	16
2. Black Holes and Psychoanalysis	19
3. Warping Effects	19
4. The Music of Black Holes	19
5. Flicker Noise and Fractals/Living Space and Living Art	21
6. Fractality, Chaos and the Poetics of Relation	26
7. Rhizomes/transversal movements	27
8. Repetition and difference: flicker noise, jazz and dub	29
9. Cosmic Music/The Liberation of Sound	33
10. Morpheus, Morphologies, Metamorphosis	34
11. Imagining a Cosmos	35
(IV) ON SUN RA	39
1. Sun Ra: context and research	40
2. Language, Vibration and Hermeticism	46
3. Myths, Mathematics, Words and Music	48
4. Beginnings, endings, and new beginnings...	50

INTRODUCTION

This appendix comprises four parts. In Part I and Part II I further address key ideas that informed our methodological design, including Guattari's development of transversality and its relation to transdisciplinarity and the post-media era, and Deleuze and Guattari's use of concepts of machine, assemblage and autopoiesis. In Part III, I describe how these ideas were utilized in Flow Motion's work, as part of the development of our *Music and Science Lovers* trilogy, and in particular, the research that led to the production of *Astro Black*. In Part IV I discuss the ideas and music of the composer Sun Ra and his influence on our work.

(I) ON TRANSVERSALITY

I hold my hand to the future.

(Guattari, 1995:134)

1. Transversality

Transversality is a noun deriving from the adjective ‘transversal’ (from the Latin *transverses*, meaning 'lying across'), used in geometry to describe a line cutting a system of lines. As a philosophical concept, it made one its first appearances in 20th century French philosophy in Sartre’s critique of Husserl’s ‘Transcendental Ego’, which Sartre proposed be replaced with a notion of ‘consciousness which unifies itself, concretely, by a play of “transversal” intentionalities which are concrete and real retentions of past consciousness’ (Sartre, [1957] 1991:39; Schrag, 1992:150; Genosko, 2002:59).

This concept was subsequently extensively developed by psychoanalyst/philosopher/activist/ecologist Félix Guattari, in his writings, beginning with the 1964 essay *De La Transversalité*, in his work at the La Borde psychiatric clinic, and in his collaboration with Gilles Deleuze. It became the mainspring of his prolific conceptual machine (Bosteels, 2001:892), a mode of motion, of thinking, of being, described by David Cooper, in his introduction to Guattari’s text *Molecular Revolution* as ‘[...] an intellectual mobility across discipline boundaries and above all the establishment of a continuum through theory, practice and militant action’ (Cooper, 1984:2).

The concept of transversality mutated and expanded in its movement between Sartre and Guattari, from its use within a subjectivist framework of existential philosophy, and a past-present orientation, to its relocation within a plural and ‘polyphonic’¹ notion of subjectivity, one which is not constituted by ‘a dominant, determining factor’ or ‘universal causality’ (Guattari, 1996:193). In Guattari’s new conceptual framework, transversality was identified as the unconscious source of action in the group, carrying the

¹ Guattari traced his use of this term to Bakhtin’s literary analysis of Dostoyevsky’s novels (Guattari, 1995:15).

group's desire (Guattari, 1984:22). It also acquired extension, becoming an invisible dimension, a region of ambiguity, an in-between zone. As noted by Cooper (1984), Guattari's writing itself issues from this sort of inter-space and is directed back again into these 'spaces between'. While this concept continued to mutate and expand, something of it always remained the same. In an interview with John Johnston (1992) Guattari described its movement and transformation as a constant passage from one level to another, always re-introducing, from different perspectives and in different contexts, these questions:

How is one to pass between heterogeneous poles? How is one to find a transversality between these poles? How is one to develop abstract machines which are not universals but which, on the contrary, move in the direction of heterogeneity? (Guattari, 2011:26-7)

Guattari first utilized this concept as a tool 'to overcome both the impasse of pure verticality and that of mere horizontality' (Guattari, 1984:18) within institutional structures. He saw transversality as a dimension opposite and complementary to the structures that generate pyramidal hierarchies and sterile ways of transmitting messages, a dimension present within groups that, in trying to accept the meaning of their practice, establish themselves as 'subject groups'. These are defined by Guattari as groups that can 'both hear and be heard', while dependent groups (subjected groups) are determined passively from the outside and through self-preservation mechanisms, 'magically protect themselves from a nonsense experienced as external. In so doing, they are rejecting all possibility of the dialectical enrichment that arises from the group's otherness' (Guattari, 1984:22).

For Guattari the move away from the binarism and fixity of the hierarchical/vertical and serial/horizontal planes also corresponded to a move away from structuralism², and against any totalizing discourse. In order to elude the tyranny of binarisms, couplets, and

² Italian theorist and activist Franco Berardi explains that 'The relationship between structure and desire is the essential element leading Guattarian schizoanalytic thinking out of the orbit of Lacanian Freudianism. Desire cannot be understood starting from structure, as a possible variant that depends on the invariant of the psychic matheme. Creative desire produces infinite structures, and also those that function as repressive apparatuses.' (Berardi, 2011:189)

also of triads, Guattari proposed the formula '3 plus n' (Guattari, 1989:93), with the addition of this 'nth term' signifying 'the opening onto multiplicity'. (Guattari, 1995:31).

The ultimate meaning of structuralism is binary alteration. The ultimate meaning of machinic filiations is a sort of surrealism, residues, detritus, witness to the impossibility of 'reducing' desiring machines coded flows (singular infinitives). (Guattari, 1984:260)

In his overview of Guattari's use of the conceptual tool of transversality, Genosko (2002) identifies its key aspects as being:

mobility (traversing domains, levels, dimensions, the ability to carry and be carried beyond); *creativity* (productivity, adventurousness, aspiration, laying down lines of flight); *self-engendering* (autoproduction, self-positing subjectivity), territories from which one can really take off into new universes of reference (Genosko, 2002:55).

For Bradley Kaye (2012), transversality is guided by a thought of contingency, possibility and what is to come. From this perspective, Kaye contends that transversality is not based on a set of principles and rules that determine a 'correct' outcome; it valorizes the creative process rather than the end result, and it is through this process that self-discovery happens. It does not require a set of pre-conditions, and it can happen at any time – or not. Additionally, Kaye argues that 'Traversing existential territories creates an open flow that breaks down the axioms of micro-fascism' (Kaye, 2012).

Thus, in its relocation within the polyphonic subject, the group and the social, transversality becomes a collective, future oriented dimension. Guattari called for the development of a new 'ecosophy' encompassing the three ecologies of mind, the social and the environment, an ecological praxis that he defined as a search to identify 'a discordant repetition, information of particular intensity which summons up other intensities to form new existential configurations' (Guattari, 1989:136). Writing from the premise that nature is inseparable from culture, Guattari argued we have to learn to think 'transversally' in order to be able to understand the interactions between 'ecosystems, the mechanosphere, and the social and the individual universes of reference' (Guattari,

1989:135). His hope was that the development of these three types of ecological praxis might lead to a future redefinition and re-focussing of the goals of ecological activities and of emancipatory, feminist and anti-racist struggles, towards the production of new subjectivities and ‘modes of knowledge, culture, sensibility, and sociability - the future foundations of new productive assemblages’ (Guattari, 1989:138).

2. Transversality, transdisciplinarity and the post-media era

Guattari’s work and aesthetics were based on a creative combination of different traditions, concepts, thinkers and issues, on practical concerns, and activism. He was very clear on the inevitability of the movement towards transdisciplinarity and the necessity of the development of a new meta-methodology for what he called ‘the post-media era’, and of a movement beyond the impasse of Postmodernism, where:

[...] a curious mix of enrichment and impoverishment, is plainly evident: an apparent democratization of access to data and modes of knowledge, coupled with a segregative exclusion from their means of development; a multiplication of anthropological approaches, a planetary intermixing of cultures, paradoxically accompanied by a rising tide of particularisms, racisms and nationalisms; and a vast expansion in the fields of technoscientific and aesthetic investigation, taking place in a general atmosphere of gloom and disenchantment. (Guattari, 1996:95)

Guattari contended that the irreversible movement towards transdisciplinarity was generated by a force whose very existence necessarily transformed how interrelations between living systems, social structures and psychical processes are conceived (Genosko, 2002:24), a movement which he saw evident in the complexities generated within the IT revolution. These complexities were for him potential vectors of re-singularization, attractors of social creativity, suggesting the possibility of new and minor becomings. Guattari saw emerging technologies and the new information and communication machines not just as means to convey representational contents, but also as contributing to ‘the fabrication of new *assemblages* of enunciation, individual and collective’ (Guattari, 1996:96). His eco-philosophical perspective envisaged a complex and interdependent world producing a new field of relations and compositions that cannot

be evaluated in a reductive or unidimensional way. Guattari argued that this complexity required the elaboration of a new approach and that a genuine meta-methodology was needed in order to challenge existing power/knowledge formations. He also believed that it required a rethinking of the relations between the science, society, politics, ethics and aesthetics, towards a 'transdisciplinarity that mixes heterogeneous axiological dimensions and produces a rhizomic movement of deterritorialization' (Genosko, 2002:23-4).

In 1992 Guattari wrote, with Sergio Vilar, a letter to UNESCO, in which they proposed a set of relevant issues and points to be considered in respect to the development of transdisciplinarity. Far from advocating a reduction of the different fields of knowledge, their approach was elaborated both on the basis of complexity and on the evidence of the emergence of virtual, heterogeneous and evolving fields and new data processing systems. They identified the need to develop openings 'towards' and 'for' dialogue, 'not just amongst disciplines which are connected, but eventually amongst those apparently most distant' (Guattari and Vilar, 1992), and considered the elaboration and application of interdisciplinarity as a first degree of complexification of knowledge and practices, a phase enabling transdisciplinarity. In their letter Guattari and Vilar proposed a research programme focused/centred on an international institution, such as UNESCO, prepared to tackle global interdependent complexity. They saw interdisciplinary practices as a means to critique and counter 'self-sufficient and omnipotent scientific positions that hurtle, despite themselves, towards a dead end' and argued that:

The history of philosophy, science, technology, always takes place within the context of/in relation to many cross-fertilizations, not only between different philosophical and scientific currents but also between methodology and rational thought, between art and technology, between the most playful of imageries and the most exact of calculations. (Guattari and Vilar, 1992)³

In his final work, *Chaosmosis*, Guattari proposed the development of a new 'ethico-

³ Translated from the document in French, *Réflexions/Ecrits/Félix GUATTARI, De la pluridisciplinarité à la transdisciplinarité, Félix GUATTARI - Sergio VILAR / Barcelone-Paris, Septembre 1992*. [online]. Available from the La Borde Clinic website, <http://www.cliniquedelaborde.com> [Accessed 24 June 2013]. The document's main points are summarized by Gary Genosko (Genosko 2002:25-6).

aesthetic' paradigm, which sees the production of subjectivity as 'a processual, polyphonic Being singularizable by infinitely complexifiable textures, according to the infinite speeds which animate its virtual compositions' (Guattari, 1995:51). Here the concepts of deconstruction, polyphony and the decentering of the subject are re-articulated in relation to art and to the science of chaos.

Every aesthetic decentring of points of view, every polyphonic reduction of the components of expression passes through a preliminary deconstruction of the structures and codes in use and a chaomic plunge into the materials of sensation. Out of them a recomposition becomes possible, an enrichment of the world (something like enriched uranium), a proliferation not just of the forms but of the modalities of being. (Guattari, 1995:90).

This text was to be Guattari's testament; its value, for the purpose of transdisciplinary art, is more relevant today – in the post-media era he foresaw – than ever. In relation to the work of Flow Motion, his work raises the question: why does art feature so prominently in his vision of the future? His answer, and his legacy, comes with two key questions thrown back at us:

How are the new fields of the possible going to be fitted out? How are sounds and forms going to be arranged so that the subjectivity adjacent to them remains in movement, and really alive? (Guattari, 1995:133)

At the very end of the book, he warned against its reduction, against the use of art towards an 'aesthetic of the Socius' (Guattari, 1995:134). It could be argued, however, that this did in fact happen in the 1990s with what came to be known as 'the compensatory gestures' of 'Relational Aesthetics'⁴ where 'Through little services rendered, the artists fill in the cracks in the social bond' (Bourriaud, 2002:36). This statement is open to number of interpretations: is Bourriaud suggesting that the artist should be considered as a plasterer? Or is he suggesting that the work of the artist is what holds society together? In 1992 Guattari reiterated his own viewpoint in an interview:

⁴ Critical voices on relational art include: Claire Bishop (in *October* in 2004 and in *Artforum* in 2006), Grant Kester (in *Conversation Pieces*, 2004, and in *Artforum* in 2006), Stewart Martin (in *Third Text*, 2007) and Julian Stallabrass (in *Art Incorporated*, 2004). These sources are listed by Radical Culture Research Collective (RCRC) (2007). Available from: <http://transform.eipcp.net/correspondence/1196340894> [Accessed 25 June 2013].

I only refer to art as a paradigm that underlines three types of problem: that of processual creativity, of the permanent calling into question of the identity of the object; that of the polyphony of enunciation; finally, that of autopoiesis, that is to say, the production of nuclei (foyers) of partial subjectification. [...] And art is a sort of avant-garde, like a military commando unit, at the heart of the problematic – modern art since Marcel Duchamp, in particular, which responds to the radical question of enunciation. (Guattari, [1992] 2011:30)

This radical question is still with(in) us, still an important question for arts practices that operate in the spaces between, and which, due to their very nature, are resisting legibility or clear identification. But, as Kelly (2005) notes, ‘This refusal while running serious risks of invisibility, marginalisation, or inoperability, however also becomes a condition for an opening out of another logic, or system of valorisation’. Such practices have to acknowledge and work with(in) the paradox. As with a Lee ‘Scratch’ Perry mix, we start, stop and start again, we are always just about to fall apart, chaos is never far away; but we carry on, remembering Guattari’s words:

It is my hypothesis that there is nothing inevitable about the bureaucratic self-mutilation of a subject group, or its unconscious report to mechanisms that militate against its potential transversality. They depend, from the first moment, on an acceptance of the risk — which accompanies the emergence of any phenomena of real meaning — of having to confront irrationality, death, and the otherness of the other. (Guattari, 1984:23)

‘I hold my hand to the future’ (Guattari, 1995:134). Guattari’s perspective motivates us to go forward. Augustus Pablo and Lee Perry instruct us to *Vibrate On*. Sun Ra helps us imagining the shapes of art and music to come. John and Alice Coltrane show us a place we can belong to. Duchamp’s sense of the possible helps us to keep that ‘widow onto something else’ wide open.

(II) TRANSVERSALITY, MACHINES AND THE SPACES BETWEEN

Between things does not designate a localizable relation going from one thing to the other and back again, but a perpendicular direction, a transversal movement that sweeps one *and* the other away, a stream without beginning or end that undermines its banks and picks up speed in the middle.

(Deleuze and Guattari, [1980] 1987:25)

The desiring machines operate in the spaces between [...] which are the spaces where things are *agencées*.

(Cooper, 1984:2)

Transversality in our practice has multiple genealogies, some of which can be traced in the cultural milieu generated by the emancipatory struggles of the feminist, civil rights, students and workers movements, and in the meeting and crossing of different liberationist aesthetics, from free jazz and the open works of the black avant-garde to the echoes of Dada, the Situationist International and Fluxus. Our practice also draws inspiration from the critical methodologies and the multiple openings generated by post-structuralism, Derrida's deconstruction and the Deleuzian-Guattarian machine, the convergence of the body without organs¹ and transversality which produced *Anti-Oedipus* (1972) and, eight years later, *Mille Plateaux* (1980)². The first of these two volumes of *Capitalism and Schizophrenia* offered a 'deterritorialization' of psychoanalysis and politics, and a radical re-thinking of questions of power, desire, production and creativity, inspiring and influencing many of the movements and collectives in the Italian counter-culture of the mid-seventies, from Autonomia to the collective A/Traverso, from Radio Alice and the free radios movement to the movement of 1977, the year in which Guattari's essay *Molecular Revolution* was first published. Within this socio-cultural context, which I encountered during my teenage years, transversality became a key

¹ The term 'body without organs' originates from Antonin Artaud's radio play *To Have Done with the Judgment of God* (1947): 'When you will have made him a body without organs, then you will have delivered him from all his automatic reactions and restored him to his true freedom.' (Artaud, 1976: 571)

² The first chapter of *Mille Plateaux* (Rhizome: Introduction) was first published in 1976, and appeared in revised form in this book in 1980.

conceptual tool for the development of new modes of artistic intervention and activism, still echoing in the 21st century as examples of innovative media practices.³

It could be argued that these seminal texts were/are open systems in which writing operated in its most connective ways, always moving transversally along multiple planes and lines of flight, like the movement of desire itself, ‘making use of everything that came within range, what was closest as well as farthest away’ (Deleuze and Guattari, [1980] 1987:3). They exploded language, de-structured the world of signs and offered a re-routing, via language, of one of 20th century main figures, the *machine*.

René Descartes first popularized this figure in the seventeenth century as a metaphor for describing the body and the world (Lewontin, 2001:3). In *Principles of Philosophy* (1644), Part IV, 188, Descartes stated:

I have hitherto described this earth and generally the whole visible world, as if it were merely a machine in which there was nothing at all to consider except the shapes and motions of its parts. (Descartes, 2003)

Descartes’s metaphor, reductionist method, mind-body dualism theory and mechanistic worldview underpinned the development of modern science, the Industrial Revolution, Capitalism and the modern European empires (Merchant, 1980; Capra, 1983).

³ An example is the work of the Bologna collective A/traverso, which explored different forms of language and media, and developed a ‘Mao-Dadaist’ approach towards ‘subversive communication’ (Collettivo A/traverso, 1976). Their fanzines and radio productions re-routed political content within an avant-garde aesthetic, assembling heterogeneous and clashing materials through textual and graphic cut-up and montage, linguistic contaminations, music, poetry and spontaneous intervention. Dadaism’s concern with breaking the separation between art and life was revisited by the collective to generate new connections between art and politics, and points of intersection between the different experiences of feminists, gays, workers and students. Their Radio Alice programs mixed free jazz, rock, electronic and Indian music, surrealist literature and Majakowskij’s poetry, political bulletins and live telephone interjections from the listeners. Examples of their radio programs can be found in the Collettivo A/traverso book *Alice e’ il diavolo. Sulla strada di Majakowskij. Testi per una pratica di comunicazione sovversiva* (1976). In 1977, following to a wave of repression, the killing by the police of a left-wing militant and a student, and a nation-wide revolt by the students’ movement, the radio was shut down. The police destroyed all its contents and its members were charged with instigating the riots by means of false information. These events led to a manifesto against the repression signed by key French intellectuals, including Simone de Beauvoir, Jean Paul Sartre, Michel Foucault, Deleuze and Guattari, Julia Kristeva, Roland Barthes and others. A subsequent Convention against Repression held in Bologna in September 1977, resulted in a peaceful three-day ‘invasion’ of the city, by around 100,000 people, to which I participated. Flow Motion revisited the events of 1977 in *Dissolve*, a companion text to the audio-visual installation of the same name, commissioned by Iniva in 2001. The essay was published in 2004 in the Iniva anthology *Changing States: Contemporary Art and Ideas in an Era of Globalization*, edited by Gilane Tawados (Flow Motion, 2004:230-233).

Drawing on a variety of ideas and concepts from diverse disciplines, Deleuze and Guattari further contributed to challenge this worldview through the creation of a new and complex ‘machinic’ ontology, a cosmology encompassing the individual and society, nature and culture, macro and micro-worlds, the molar and the molecular, and the multiple planes and dimensions of existence. Some of the key ideas and works they revisited and re-elaborated were Karl Marx’s analysis of the relationship between capitalism, machines, labour and society⁴, the concept of ‘machinic autopoiesis’ advanced in 1970 by biologists Francisco Varela and Humberto Maturana, and Samuel Butler’s satirical work *Erewhon* (1872), in which he challenged the boundaries between machines and animals and considered machines as living and evolving systems⁵.

Deleuze and Guattari also drew from the work of various artists and composers, including Marcel Duchamp/Rose Sélavy’s ‘desiring machines’ (Deleuze and Guattari, [1972] 1983:22; Joselit, 1992:12-24) and ‘ready-made’ concept, which they re-routed to describe birds’ artistic behaviour (Deleuze and Guattari, [1980] 1987:316), Paul Klee’s visual-aesthetic machine capturing and harnessing invisible cosmic forces (1987:310, 342-4) and Edgard Varese’s sonic cosmology and his pre-figuring of the new machines of sound and the synthesizer⁶. They emphasized that their use of the word machine is not metaphorical

⁴ In particular, see Marx’s 1858 ‘Fragment on Machines’, in *Grundrisse*, Notebooks VI-VII. (Virno, 2001; Negri, 2001; Raunig, 2005, 2010). Deleuze and Guattari also drew from Lewis Mumford’s concept of the social machine and of archaic empires as ‘mega-machines’ (Mumford, 1967, 1970; Deleuze and Guattari, [1972] 1983:141)

⁵ In *Mechanism and Biological Explanation* ([1970] 1972) Varela and Maturana proposed a different concept of the machine from Descartes’ and identified new connections between machines and biological systems. They argued that ‘what specifies a machine is the set of component’s interrelations, regardless of the components themselves’ (1972:378) and that both a machine structure and a biological system are defined by their dynamic relations and not by their material components per se or just by the properties that define them as physical entities. They introduced the concept of ‘autopoietic machine’ to describe a closed system similar to Wiener’s cybernetic model, and made a distinction between ‘allopoietic’ machines, which produce something other than themselves, and autopoietic machines, which engender their own organization and boundaries. Autopoietic machines are autonomous and have an individual character; they are independent from an external observer; their internal processes combine to define their unity and identity; they have no inputs or outputs and any internal change due to an external perturbation is subordinated to the maintenance of the system’s organization. (Maturana and Varela, [1973] 1980:80-81). Deleuze and Guattari re-elaborated Varela and Maturana’s concept in many of their works, and proposed the idea of autopoietic machines as open systems (see note 6). This idea was pre-figured in 1872 by Samuel Butler in *Erewhon* (‘The Book of the Machines’). In *Anti-Oedipus* Deleuze and Guattari quoted at length Butler’s work, describing it as ‘a profound book’ in which (their italics) ‘*He shatters the vitalist argument by calling in question the specific or personal unity of the organism, and the mechanist argument even more decisively, by calling in question the structural unity of the machine*’ ([1972] 1983:284-5).

⁶ See *A Thousand Plateaux*’s chapter ‘On the Refrain’: ‘We thus leave behind the assemblages to enter the age of the Machine, the immense mechanosphere, the plane of cosmicization of forces to be harnessed. Varese’s procedure, at the dawn of this age, is exemplary: a musical machine of consistency, a *sound machine* (not a machine for reproducing sounds), which molecularizes and atomizes, ionizes sound matter, and harnesses a cosmic energy. If this machine must

(1983:41, 251) and argued that machines are open systems, living, dynamic, mutant and heterogeneous entities whose multiple components (abstract and material, energetic and organic, semiotic and diagrammatic) interrelate and assemble in different configurations through rhythm and refrains to form a ‘collective dance’ (Guattari, 1995:35).⁷

It is at the intersection of heterogeneous machinic Universes, of different dimensions and with unfamiliar ontological textures, radical innovations and once forgotten, then reactivated ancestral machines lines, that the movement of history singularizes itself. (Guattari, 1995:41)

Deleuze and Guattari placed machines at the centre, displacing and unfixing the ‘subject’, which they saw as ‘forever decentered, *defined* by the states through which it passes’ (1983:20). With this new machinic ontology they radically departed from structuralism, philosophical dualisms and the logic of the excluded middle. The figure of the machine became devoid of any association to the mechanistic model of reality and ‘their’ world became ‘our’ world, an interconnected world where ‘Everything is a machine’ (1983:2,8), a ‘system of interruptions or breaks’, where ‘every machine is related to a continual material flow (*hyle* [Greek: matter]) that it cuts into’ (1983:36), an endless flux of different states of desiring-production where the desiring-machines and the body without organs are ‘at bottom one and the same thing, one and the same multiplicity’ (1983:326). From their perspective, history should not be interpreted as evolution, or as a series of ‘structures separated by signifying breaks’:

What was composed in an assemblage, what was still only composed, becomes a component of a new assemblage. In this sense, all history is really the history of perception, and what we make with history is a matter of a becoming, not the subject matter of a story. (Deleuze and Guattari, 1987:347)

have an assemblage, it is the synthesizer [...]: its synthesis is of the molecular and the cosmic, material and force, not form and matter.’ (Deleuze and Guattari, 1987:343)

⁷ Guattari explained this concept at length in the chapter ‘Machinic Eterogenesis’ of his last book *Chaosmosis* (1995) where he listed, amongst others, Neolithic and agrarian machines, Urban mega-machines, writing machines, nomadic machines, metallurgic and new war machines, capitalist machines, royal state machines, commercial and banking machines, navigational machines, monotheistic religious machines, deterritorialized musical and plastic machines, scientific and technical machines (1995:41). He argued that machines are proliferative, traverse different levels of existence and connect to multiple flows to assemble virtual as well as concrete fields; their boundaries are not fixed and their autonomy accommodates diverse mediums of alterity and transformative powers: ‘Just as scientific machines constantly modify our cosmic frontiers, so do the machines of desire and aesthetic creation’ (1995:54).

In the next part of this appendix, I return to the early phase of development of Flow Motion's trilogy of works *Music and Science Lovers*, and discuss some of the ways in which these ideas were used in our engagement with the new knowledge and narratives emerging from contemporary cosmological research in the initial development of our project *Astro Black*. I have included this chapter to give the reader an insight into, and an example of, our approach to arts practice, and of how various strands of contemporary science, philosophy, poetry, music, visual art, popular culture and cultural studies were re-read and interwoven in our research.

(Music and Science Lovers: Resonances)

Everything is a machine.

Celestial machines, the stars or rainbows in the sky, alpine machines— all of them connected to those of his body. The continual whirr of machines.[...] Lenz has projected himself back to a time before the man-nature dichotomy, before all the co-ordinates based on this fundamental dichotomy have been laid down. He does not live nature as nature, but as a process of production.

(Deleuze & Guattari, 1983:3)

I shall argue that *much in nature is ruled by what used to be called pathology*.

(Benoit Mandelbrot, 2002:5)

There is a rhythm of process whereby creation produces natural pulsation, each pulsation forming a natural unit of historic fact.

(Alfred North Whitehead, [1938] 1968:88)

The boundary is permeable between tool and myth, instrument and concept, historical systems of social relations and historical anatomies of possible bodies, including objects of knowledge. Indeed, myth and tool mutually constitute each other.

(Donna Haraway, 1991:164)

They say that history repeats itself, they say that history repeats itself, repeats itself. But history is his story. It's not my story. What's your story? [...] I have many names; many names [...] some call me Mr. Ra, others call me Mr. Re, you can call me Mr. Mystery.

(Sun Ra, *A Joyful Noise*, 1980)

The naming of the world, which is an act of creation and re-creation, is not possible if it is not infused with love.

(Paulo Freire, in Gray, 2007)

Break a vase, and the love that reassembles the fragments is stronger than that love which took its symmetry for granted when it was whole.

(Derek Walcott, 1992)

(III) BLACK HOLES, MUSIC, FLICKER NOISE AND FRACTALITY

1. Figures of otherness: space voids and exotic ‘objects’

I have never seen a black hole. Nobody has.

(Thorne, 1994:57)

Confinement to the Black Hole...to be reserved for cases of Drunkenness, Riot, Violence, or Insolence to Superiors.

(British Army Regulation, 1844, in Barrow, 2001:36)

The first area of cosmological research George and I explored for our *Music & Science Lovers* trilogy of works was the study of black holes. Invisible, refractory of all light, these mysterious space-time phenomena are believed to exist at the centre of most galaxies, including our own Milky Way, and in countless locations throughout the universe. But their existence cannot be proven: they are still theoretical constructs, developed to explain what happens when the core of a star contracts and collapses under its own massive gravity.¹

According to scientific theories, black holes are surrounded by a boundary region called an ‘event horizon’; beyond this region the space-time is so sharply curved that no light can escape. Speculations on what might happen inside black holes include the idea that all the in-falling matter will eventually reach an almost infinitely dense point called the ‘singularity’. Here all known laws of physics break down, leaving space for a number of interesting theories and conjectures explored both in cosmology and science fiction, as,

¹ Earlier precursors of the concept of a black hole have been traced to Rev. John Michell’s prediction, in 1784, of the existence of ‘dark stars’ (Rubin, 2001:1), and to Simon Pierre LaPlace (1796). Following Einstein’s general theory of relativity, theories of collapsed stars were developed by Karl Schwartzschild (1916) and, in the 1930s, by Subrahmanyan Chandrasekhar (1931-35) and Robert Oppenheimer (1939) amongst other physicists. These theories were revisited and further developed in the 60s, when the term ‘black hole’ was coined (see note 3). In 1972, the intense source of x-rays in the constellation Cygnus, called Cygnus X-1, was the first black hole to be identified. (Thorne, 1994)

for example, the possibility that black holes might generate or provide exits to other universes (in which case, they are called ‘white hole’). British cosmologist Sir Martin Rees wrote that singularity ‘actually signifies that conditions transcend the physics that we know about’ and described it (perhaps echoing the apocalyptic narrative of Abrahamic religions/cosmologies) as ‘the end of time’ (Rees, 2000:42). In his multimillion best seller *A Brief History of Time* Stephen Hawking wrote: ‘Such objects are what we now call black holes, because this is what they are: black voids in space’ (Hawking, 1988:82). Which raises the question: how can a ‘void’ be defined as an ‘object’?

Much of the literature on black holes, such as the majority of outreach literature found on the ‘exotic’ sections of astronomy and cosmology websites, and in popular science literature is full of linguistic ambiguities, metaphors, and anthropomorphic descriptions. A brief study of these descriptions points to the layered imaginary carried by this term; an archaeological dig reveals a strata and a possible beginning in military vocabulary, pointing not to outer space but to an earthly location on the outposts of the British Empire. The term ‘black hole’ was already used in the 18th century as a military slang for the lock-up or detention cell in a barracks (Barrow, 2001:36). The mythological rendition of what happened in Bengal in the controversial incident of 1756, the ‘official’ story of the Black Hole of Calcutta penned by Thomas Bavington McColey² and made popular in Britain since 1840, has been identified as the probable origin of the scientific use of the term ‘black hole’.³

It could be argued that some commentators’ anthropomorphic descriptions of a black hole seem to echo earlier descriptions of indigenous people inhabiting the outposts of empires,

² See Chatterjee, P.(2012). *The Black Hole of Empire: History of a Global Practice of Power*, Princeton University Press. In a 2007 lecture at Stanford University, Partha Chatterjee described this story as a founding myth of the British empire, and pointed out it was completely discredited in the 21st century by Cambridge historians. Available from: <https://www.youtube.com/watch?v=Hz8oN6lIF-k> [Accessed 20 January 2014].

³ The term ‘black hole’, informally used by scientists and commentators since the early 1960s, was authorized as an official term in 1967 by astrophysicist John Wheeler, who chose it in preference to the original, cumbersome and pr-unfriendly term ‘completely collapsed gravitational object’. Science writer Marcia Bartusiak has traced the origin of the scientific use of the term ‘black hole’ to the physicist Robert Dicke who, while talking about gravitationally collapsed objects to a seminar in Princeton in 1960 or 1961, described the objects as ‘like the Black Hole of Calcutta’. Martin McHugh, who is working on a biography of Dicke, told Bartusiak that Dicke’s children remember that “when something was lost at the Dicke household, Dicke would shout out, ‘Ah, it must have been sucked into the black hole of Calcutta’ (in Siegfried, 2013).

beyond the boundaries of the ‘civilized world’. Black holes are commonly described as savages, monsters, hungry creatures devouring matter, killers, cannibals, dark and menacing, terms which seem to conjure up magnified and inverted versions of the spear-wielding, savage and murderous Selenites of Georges Melies’s 1902 silent film *A Trip to the Moon*.⁴

2. Black Holes and Psychoanalysis

In 1990, the term black hole found its way into the psychoanalytical lexicon through American psychoanalyst James Grotstein. Following from his work with psychotic and borderline patients, and borrowing from Sartre, Klein and Winnicott and others, Grotstein formulated the notion of the psychological ‘black hole’ and linked it to the astrophysical concepts of event horizon, singularity and altered space-time, to convey the intrapsychic experience of ‘The awesome force of powerlessness, of defect, of nothingness, of "zero-ness" expressed, not just as a static emptiness but as an implosive, centripetal pull into the void’ (Grotstein, 1990:258-9).

Grotstein’s framework refigured Freud’s death instinct (1920) as a dialectics of meaninglessness (the disowned parts of the psyche, ‘the ghosts of abandoned meaning’) and nothingness (‘the signified’, the apocalyptic experience of dread, of ‘ultimate horror’), and the psychotic behaviour as an extreme attempt to ward off the black hole and succumbing to its gravity (Grotstein, 1990:258-9). For Grotstein, the black hole phenomenon denotes

Not merely the psychotic catastrophe and the cataclysmic repression, implosion and disorganization which heralds its onset, but it also represents the altered imploding, distorting, and perversely reconstructing laws of the new, perverse (and reverse) domain of madness. (Grotstein, 1990:388)

⁴ See for example Charles Q. Choi, Space.com contributor, who described black holes as ‘gigantic cosmic monsters’, ‘exotic objects whose gravity is so strong that not even light can escape their clutches’, ‘supermassive beasts that reside at the hearts of galaxies’, ‘cannibals’, ‘rogues’ (Choi, 2013). Available from: <http://www.space.com/15941-strangest-black-holes-universe-countdown.html> [Accessed 21 August 2014]

3. Warping Effects

In the 1990s, 'black hole' also found its way into the vocabulary of music critics and commentators, from Mark Dery (1993), the American cultural critic who coined the term 'Afro-Futurism', to British writer and Wire journalist Ian Pennman, and musician, producer and journalist Kevin Martin, who used it to describe dub's deep sonic architectures and 'warping' effects. Through this term, dub's deconstructions and reshaping of musical forms were refigured as an implosion of meaning and an altering of space and time perception. Dery's essay described the 'reggae dub' music of Jamaican producer Lee 'Scratch' Perry as sounding 'as if it were made of dark matter and recorded in the crushing gravity field of a black hole' (Dery, [1993] 1994:182). The sleeve notes of the compilation CD *Macro Dub Infection Volume One* (Virgin, 1995), written and selected by Martin, end with a quote by Pennman: 'People get warped by Dub and reggae and they never recover.' As with Dery's earlier essay, here the example par excellence of this warping is Lee Perry. In the notes Martin describes dub, and Perry's *Blackboard Jungle Dub* as such: 'If Dub is a journey through time and space, then 'Blackboard Jungle Dub' is a black hole where the rational and irrational implode'.

These are just some examples of how, in the latter part of the 20th century the figure of the black hole, which is still *just* a theoretical construct, was disseminated. With its power to evoke altered states, dread and the abyss, the loss of self and meaning, extreme warping effects, the permanent scrambling of information, the end of time, the dissolution of subjects and objects, it began to proliferate in everyday language and caught people's end-of-millennium imaginaries.

4. The Music of Black Holes

While searching through scientific papers in late 2002 for the purpose of finding interesting research on the invisible universe and black holes and UK astrophysicists with whom we might collaborate, George and I came across a Royal Society press release (Mitton and Bond, 2002) titled *Music of the Black Holes: They all play the same tune*.

The press release documented a talk by astrophysicists Ian McHardy and Phil Uttley from Southampton University, held in April 2002 at the National Astronomy Meeting in Bristol. In the talk, Prof McHardy and Dr Uttley announced their discovery that the patterns of variation detected in the X-ray emissions of black hole X-ray binary systems in our Milky Way galaxy corresponded to those of supermassive black holes in distant, active galaxies. In the press release Dr Uttley said:

The X-ray variations of active galaxies and BHXRBs can be likened to music, showing small variations - single notes - on short time-scales, and larger variations - whole key changes - on longer time-scales. What we are finding with our Rossi X-ray Timing Explorer satellite is that the time-scales for these note and key changes to take place are about a million or more times longer in active galaxies than in black hole X-ray binary systems. In other words, take the tune played out in X-rays by a black hole X-ray binary and slow down the tape by a factor of a million or so and you get the kind of variations we are seeing in active galaxies. [...] The tape speed setting is the only major difference, and it's governed by the black hole's mass. (Uttley in Mitton and Bond, 2002)

In another article published on the same day by Space.com⁵, Dr Uttley was quoted as saying that: 'the music of a black hole is generated in the region just outside the black hole proper, where incoming matter is accelerated to near-the-speed-of-light' (Uttley in Britt, 2002). In other words, these X-ray emissions were detected in *the space between* visible galaxies formations and invisible deep space phenomena believed to be black holes, and are considered to be the debris of the turbulent processes of matter accretion generated by the black hole's enormous gravitational force.

McHardy and Uttley's studies of these X-ray readings by the RXTE satellite, described in the article as 'the sheet music of science', revealed that these deep space fluctuations were fractal on an intergalactic scale, showing evidence of a pattern of variation called 'flicker noise' occurring across the universe. More musical analogies were made in the article to describe these changes in fluctuations, or 'state transitions':

⁵ The article dated 9 April 2002 is no longer available at Space.com. Documentation can be found in R.R. Britt's *The New History of Black Holes: 'Co-evolution' Dramatically Alters Dark Reputation* (28 January 2003). Available at: <http://thebookofbeginnings.com/sources/8/TheCo-EvolutionofBlackHolesandGalaxies.pdf>
The article is also available at <http://sonoran-sunsets.com/naturemusic.html>. [Accessed 8 July.2014].

The study further revealed that at any given moment, various black holes are playing different styles of music; instead of some organized celestial symphony, there is a cacophony of differing styles playing out all over the galaxy. And every few weeks, a stellar black hole switches musical styles, undergoing a distinct transition from one pattern of variability to another. (Britt, 2002)

Dr Uttley explained that astronomers think that these 'state transitions', which last several weeks, may represent changes in the mode of accretion caused by changes in the rate of fuel supplied to the black hole, and gave another musical analogy: 'Taking the musical analogy a step further, you could liken the new state to a different musical style' (Uttley in Britt, 2002). He was also quoted as saying that the music of a black hole could be called 'improv', and referring to the work of contemporary composer Iannis Xenakis, who had used flicker noise to randomly generate stochastic music: 'You could use the variations in the X-ray output of black holes to produce just this sort of music' (ibid).

Dr Uttley's enthusiastic evocation of sonic processes and musical technology, his refiguring, in discussing his research, of black holes' state transitions as 'key changes' and 'improvisation', of flicker noise and fractals as 'slowing down tapes' and in relation to stochastic music, were far removed from the sort of analogies and metaphors common at the time amongst science commentators and writers. Even in the press releases and articles mentioned above, their writers did not resist the temptation to turn black holes into 'monsters', 'cannibals', having 'feeding frenzies' together with their 'smaller cousins'. But there was no anthropomorphism or hyperbolic language in Uttley's descriptions: just a 'musicalizing' of nature, of deep space phenomena, of intergalactic, fractal relations, and of scientific processes. Uttley's re-routing of sonic vocabulary within the context of his and McHardy's research also suggested another correspondence, or a reversed and complementary reading, of music and sound technology as possible technologies for scientific and cosmological enquiry.

5. Flicker Noise and Fractals/Living Space and Living Art

While doing further research on flicker noise and fractals, I discovered Uttley's 'tape speed' analogy was built on Benoit Mandelbrot's previous description of 'scaling sounds'

(Mandelbrot, 1977). Uttley later told us their methods of research were based on the same methods used in the 1970s by Mandelbrot and his colleagues, Voss and Clarke, whose research on flicker noise was based on audio power spectrum analysis according to spectral density and autocorrelation functions. (Voss and Clarke, 1978)

In 1925 Johnson first detected flicker noise in slow fluctuations of cathode emission in electronic tubes (Johnson, 1925:71). In the years that followed, it was found that this strange ‘noise’ appeared again and again in many different electrical devices (Klimontovich, 1995:421). In the course of the 20th century, and particularly since the 1970s, this pattern of variation was observed in countless, seemingly unrelated systems, as a fluctuation occurring both over short time spans and over many decades. These findings generated great interest in the physics of fluctuation processes, in a variety of fields and from many different perspectives. The significance of these observations is clearly stated by Mandelbrot, the founder of fractal geometry and one of the main researchers in the field: ‘Much in the works of Nature and Man is ruled by what past mathematicians boastfully called “pathology”.’ (Mandelbrot, 2002:23)

In the 1970s Mandelbrot, Voss and Clarke found evidence of flicker noise in, amongst others, the stock exchange variations, the variations of the river Nile currents, in the music of Bach and Scott Joplin, and in the intervals between radio programs. Voss was quoted as saying that ‘in most cases, the physical reason for this long range power law behaviour remains a mystery’ (cited in Klimontovich, 1995:421). Boston University physicist Eugene Stanley, who discovered that DNA sequences show fractal correlations, echoed his view: ‘There is some magical phenomenon going on that we do not understand’ (in Yam, 1992 and Flow Motion, 2004). More recently, flicker noise was also detected in the analysis of serial correlations in cognitive tasks (Wagenmakers et al, 2004).

Somewhere between totally uncorrelated ‘white noise’ and highly correlated ‘brown noise’, flicker noise (or ‘pink noise’) displays the mixture of predictability and surprise that humans find most pleasurable in music. In *Emotion and Meaning in Music* (1956),

Leonard Meyer proposed that when listeners hear music, they intuitively and unconsciously follow the flow of what has been happening, and they predict what will happen. If there is too much sameness, they may become bored. Or they may get frustrated if the music is too difficult to predict.

What I found most interesting about flicker noise, was that it seemed to bridge, and trace over, the division between ‘living’ and ‘non living’ systems, between humans and machines, bodies and stars, nature and culture, the elementary and the cosmic. It suggested a transversal ‘becoming music of the world’, not dissimilar to that evoked by Deleuze and Guattari, and by Varese and Messiaen (Deleuze and Guattari, 1987:308-9); it also suggested a blurring of the distinction between biological systems and machines not unlike the one evoked by Samuel Butler in *Erewhon* (1872), by Varela and Maturana’s concept of ‘machinic autopoiesis’ (1970) and by Donna Haraway in *Cyborg Manifesto* (1985).

McHardy and Uttley’s discovery (2002), considered in the wider, multidisciplinary context of flicker noise research, had been poetically evoked thirty years earlier by Sun Ra in his 1972 *Astro Black* poem, written three years before Mandelbrot officially coined the name fractals: ‘The universe is in my voice [...] Find your place amongst the stars/ listen to the outer space/ rhythm, multiplicities’. These scientific findings had also given a renewed meaning to John Coltrane’s posthumously released album *Living Space* (1998).

Human bodies and electrical devices, black holes and the stock exchange market, human made music and the intervals between radio stations, the river Nile currents and the human DNA, deep space phenomena and human behaviours - all share the same, ubiquitous pattern of variation, the same ‘pathology’, the same ‘mystery’, metaphorically described as ‘noise’. Their fluctuative processes, in their mixture of predictability and surprise, suggested to us that this noise, this ‘disturbance’ is the expression of an inherent creativity occurring throughout the universe, and also, with Uttley’s and McHardy’s findings, the evidence of an interconnected, fractal, rhythmic and fluid living space.

During a private meeting with Mandelbrot, organized by Hannah Redler at the Science Museum Dana Centre in 2004, he explained to me that flicker noise and fractals research signalled a major change in the sciences: what was once considered an aberration by the ‘smooth sciences’, he had mathematically proven to be a defining and consistent feature of the universe’s diverse phenomena. Much of Mandelbrot’s work on fractals was the result of collaborations with artists; he had a keen interest in non-linear visualization and sonification processes, and utilized art as a mode of scientific enquiry. Fractals have been popularised by computer graphics since the 1970s and by the end of the 20th century they were virtually everywhere, from computer screen savers to web videos. Mandelbrot spoke to me of his interest in co-researching with an artist the work of Japanese master Katsushika Hokusai, whose famous woodblock print *Under the Wave off Kanagawa* (*Kanagawa oki nami ura*, c. 1829-32) seemed to him a clear image of the fractality that exists throughout nature, giving strength, from an early 19th century artistic perspective, to his idea and quest for the development of a ‘rough science’.



Katsushika Hokusai, *Under the Wave off Kanagawa* (c. 1829-32). Woodblock print.

Recalling his earlier difficulties in the scientific environment in a then recently published collection of papers, he wrote:

A consistent criticism described me as a troublemaker seeking “exotic” or even “esoteric” or “pathologically behaved” solutions, and wilfully introducing complexity where none existed. In fact, each divergence provided additional evidence of the need to invoke wild randomness and variability. (Mandelbrot, 2002:23).

Nature is never singular, static or linear. Nature is always multiplicity, always a dynamical, complex plurality.

In 2002, a team of scientists led by physicist and artist Richard Taylor conducted an investigation on Jackson Pollock’s paintings. Pollock liked to work on the floor, a method akin to the one used by the Indian sand painters, feeling that, in this way, he could literally *be* in the painting. His concern was ‘with the rhythms of nature...I work inside out, like nature’ (in Emmerling, 2003:48). His most direct statement on the nature of his art – we could call it a declaration, uttered in reply to Hoffman’s question ‘do you work from nature?’ was: ‘I am nature’ (in Krasner, 1968).⁶ His statement was officially ‘validated’ when Taylor announced the results of their investigation in the *Scientific American*:

We started our investigation by scanning a Pollock painting into the computer; we then covered it with a computer-generated mesh of identical squares. [...] Our analysis examined pattern sizes ranging from the smallest speck of paint up to approximately a meter. Amazingly, we found the patterns to be fractal. And they were fractal over the entire size range— the largest pattern more than 1,000 times as big as the smallest. Twenty-five years before their discovery in nature, Pollock was painting fractals. (Taylor, 2002:118)

⁶ Oral history interview with Lee Krasner, Nov. 2 1968. (2011). In *Archives of American Art*, Smithsonian Institution, April. Available from. <http://www.aaa.si.edu/collections/interviews/oral-history-interview-lee-krasner-12507> [Accessed 3 December 2013]

6. Fractality, Chaos and the Poetics of Relation

The aim of science is not things themselves, as the dogmatists in their simplicity imagine, but the relations between things; outside those relations there is no reality knowable. (H. Poincaré, 1905:xxiv)

Mandelbrot considered his work to be as much a philosophy as a mathematical construct. His research on fractals, and his refiguring of nature and culture found keen ears with Deleuze and Guattari, whose works incorporated and reshaped the scientific notions of chaos and fractality, as well as the astrophysical notions of black holes and event horizon. Amongst the critical voices who further developed these themes and tropes, one in particular was very inspirational for me: the Martinican poet and thinker Edouard Glissant. In his 1990 collection of essays *Poétique de la Relation* (*Poetics of Relation*, 1997), Glissant refigured the science of Chaos and fractality as the poetic images of a creolized *chaos-monde*, an *echo-monde*, and a *tout-monde*, invoking a science and a poetics whose forms of knowledge are constructed out of an engagement with the dynamic, the relational and the chaotic.

We were circling around the thought of Chaos, sensing that the way Chaos itself goes around is the opposite of what is ordinarily understood as ‘chaotic’, and that it opens onto a new phenomenon. Relation, or totality in evolution, whose order is continually in flux and whose disorder one can imagine forever (Glissant, 1997:133).

In this text, Glissant identified two opposite directions and movements in contemporary science and technology. One movement re-activates what he calls ‘projective linearity’, and sets things up for the ‘discovery and conquest, which are one and the same, of the galactic spaces’ (1997:136). This is the linear projection of the conqueror, obsessed with origin (of the creation of the world), filiation and legitimacy, hence still deeply entwined with an idea of God. Moving in the opposite direction, ‘which is not one’, is a science of enquiry, an ‘experimental meditation (a follow-through) of the processes of relation, at work in reality’. Its orientation leads to following through ‘anything fluid and various and moreover, uncertain (ungraspable) yet fundamental in every instance and quite likely

full of instances of invariance' (1997:137). In the expanse/extension resulting from its renunciation of linearity's potent grip, in its re-discovery of the 'abysses of art' and the 'interplay of various aesthetics', the science of Chaos produces for Glissant a scientific knowledge that reconnects with 'poetry's earlier ambition to establish itself as knowledge' (1997:137-8).

In light of these philosophical and poetic readings of contemporary science, and in the context of the multi-disciplinary studies on fluctuating phenomena and fractals, flicker noise could be considered, I felt, as a rhizome, a means of traversing various strands of scientific research as well as knowledge and technologies from different artistic and musical traditions. The presence of this fractal pattern of fluctuation in countless and diverse systems suggested a reverse reading of fractality, and that flicker noise could be considered not just, as commonly intended, as evidence of self-similarity, but also of *self-difference*: a multiplicity of intensity flows, of trans-formations, a plural becoming actualized through refrains and improvisations, a minor, de-mythologized mode of becoming music, or becoming 'noise', of the cosmos.

7. Rhizomes/transversal movements

I apply the term 'rhizome', in relation to our multiple readings of cosmological narratives, numerical data of spectral intensities from deep space, and data evidence of intergalactic, fractal correspondences, in a threefold way: in its botanical meaning, in its metaphorical use by Carl Gustav Jung, and in its reading by Deleuze and Guattari. In botany, a rhizome is a:

Fleshy, creeping underground stem by means of which certain plants propagate themselves. Buds that form at the joints produce new shoots. Thus if a rhizome is cut by a cultivating tool it does not die, as it would a root, but becomes several plants instead of one. (Columbia Electronic Encyclopaedia, 2011)

Underground rhizomes contain nodes that can develop into new plants, and their buds can remain dormant or develop into aerial shoots. Carl Gustav Jung used the metaphor of the rhizome to describe the invisible dimension of life:

Life has always seemed to me like a plant that lives on its rhizome. Its true life is invisible, hidden in the rhizome. The part that appears above the ground lasts only a single summer. Then it withers away—an ephemeral apparition. [...] The rhizome remains. (Jung, 1989:2)

Whatever might appear, at any moment, in ‘any-space-whatever’ (Deleuze, [1983] 1986:110), as a thought or a constellation, event or phenomena, by chance or as the result of a process or a ‘cut’, is part of this endless flux producing living systems, living spaces and living art. Each fragment, debris, cutting or dormant bud, each narrative or work of art contains the possibility for a new life, or ‘after-life’ (Benjamin, 1992:73), for a new reading, translation or/and transformation.

Deleuze and Guattari used the term rhizome ([1980] 1987) to describe an a-centred, non-hierarchical, non-signifying system that allows for multiple entry and exit points: a system ‘without a General and without an organizing memory or central automaton, defined solely by a circulation of states’ (1987:21). A rhizome has no beginning or end; it is always ‘in the middle, between things, interbeing, *intermezzo*.’ (1987:25)

Unlike trees or their roots, the rhizome connects any point to any other point, and its traits are not necessarily linked to traits of the same nature; it brings into play very different regimes of signs, and every nonsign states. [...] It is composed not of units but of dimensions, or rather directions in motion. (1987:21).

Flicker noise, a ubiquitous phenomena whose discovery, like many other scientific discoveries, happened by chance, was the rhizome that provided new correspondences and modes of thinking about fractality and translation, noise and spectrality, repetition and difference, cyclical recurrence and improvisation, predictability and chance, useful and used for the elaboration of *Astro Black Morphologies/Astro Dub Morphologies*’ components. Cyclical repetition and chance would become main features in the

installation, actualized in the a-synchronic, ever-changing, looped combinations of the installation components and assemblages.

Numbers (conceived as text/open system for the production of multiple meanings and forms in science, music and art) and digital technology (conceived as a sort of *inconscient machinique*⁷, the repository of different modes of sonic, artistic, mathematical, scientific and philosophical elaboration) were the common denominators that allowed for transversal movements amongst different disciplines, methodologies and processes of transformation.

8. Repetition and difference: flicker noise, jazz and dub

As previously discussed, the presence of flicker noise in countless systems, from black holes to music, from the stock exchange to the River Nile, from human DNA to human patterns of behaviour, suggested to us the evidence of an inherent creativity in the universe: a *process* (Whitehead, [1929] 1978) and a *mode of production* bridging living and non-living systems, nature and culture, generating diversity and multiple forms through repetition and difference, predictable rhythms and unpredictable ‘improvisations’.

This universal, fractal process and mode of production in nature and culture, actuated, as evidenced by 20th century science, through cyclical repetitions and unpredictable changes, is a core practice and aesthetics in jazz, where numerical-harmonic cycles (for example, the I-IV-V, 12 bars blues cycle) are both carriers of cultural reference and identity, and the basis for improvisation, harmonic transformations, and countless proliferations. Modern jazz, in its improvisational approach to composition and musical production, takes numbers, which identify specific steps in a given musical scale or chord progression, as the basis for processes of substitution and harmonic, polyphonic and poly-rhythmic expansion, opening up cycles and sequences to a wide range of musical

⁷ This is a creative re-reading of Guattari’s concept and 1979 text, *Inconscient machinique*, (Paris: Editions Recherches)

possibilities and permutations. Examples can be heard in John Coltrane's 'changes', a chromatic third relations system for harmonic substitution of, amongst others, the II-V-I (supertonic-dominant-tonic) progression or 'turnaround', used in his 1960 album *Giant Steps* (Demsey, 1991). A key aspect of this approach is the way in which numbers and numerical sequences function both as indicators of precise proportions and relations of sonic frequencies, as vehicles for ideas and cultural forms, and as an 'open' system providing the basis for reshaping and formal innovation.

These compositional and improvisational modes and processes of harmonic substitution and expansion provided the inspiration for developing modes of utilization of digital technology, and re-routing tools from the tradition of contemporary electronic music towards the creation of a first set of radically different versions of the RXTE numerical readings of Cygnus-X1's spectral intensities. I used these digital tools, which included filtering, granular synthesis, multiple feedbacks, reverbs and delays, and compositional approaches to transform and re-assemble the sonified numerical data, generate pentatonic scales, harmonic substitutions, pauses and 'empty' spaces, 'scatter' and extend the sonified signals, and produce tonal overlappings and chords.

Repetition and difference also feature as core elements in dub. Dub's constellation of meanings begins with a re-naming, and then a doubling, a 'mechanical' reproduction, signalling the beginning of multiple processes of transformation⁸. In cinema, 'dubbing' is a process of substitution, transfer and addition, a technology born out of the need to enhance the film's narrative purpose, allowing for the inclusion of the actors' voice and for creating the illusion of depth of (sonic) field. As a musical process, whose roots can be traced back to Jamaica in the late 1960s and to sound system culture, 'dub' emerged by chance (Flow Motion, 2010:49), an accidental act of erasure (of the voice). Reggae-dub consists predominantly of remixes and often radical reshaping of existing musical recordings, which generate, like jazz, both cultural continuity and innovation. These

⁸ The earliest use of the verb 'dub' has been traced to the 11th century, late Old English meaning of 'make a knight', from *dubbian*, 'knight by striking with a sword'. The word might derive from the Old French (11c.) verb *aduber*, 'adorn, equip with arms' (Online Etymology Dictionary, 2013). Another, more recent use of the word 'dub', might have an origin in early 1920s US film production, to describe the processes of copying Vitaphone sound discs, or/and post-synchronising the actors' voices (Steer in Flow Motion, 2010:48)

reshapings are achieved primarily through ‘the creative manipulations afforded by multitrack recording and sound processing’ (Veal, 2007:63), which include the erasure and tracing of the melodic components, the cutting in and out of signals via the mixing board, and the extended use of effects as re-compositional tools, for the production of a deeper and more expanded acoustic space⁹.

Dub’s sonic architectures both reduce and complexify, strengthening and rendering minimal the main rhythmic structures of a musical piece while also fragmenting and tracing its mid-high signals and producing new, fluid poly-rhythms through the use of equalization and sound processors – in particular, reverb, echo and delay. Dub is, as Lee Perry described it, an ‘X-ray music’ (1999), bringing to the fore, deepening and augmenting the ‘bones’ of music - the drum and the bass - and dissolving its flesh, destabilizing, dislocating and transforming its melodic/harmonic components into translucent, unstable and mutating ‘sound clouds’. Dub mixing, with its unexpected cuts and ‘plunges’, often creates zones of de-structured intensities, tangential and transversal rhythmic flows, meticulously engineered in their frequency spectrum. These transversal flows, decoupled from reggae-dub rhythmic structures, featured as core components in *Astro Black*, where the data was morphed into a-synchronous, decentred, cyclical pulsations and movements of sound and light.

Dub’s double history, as cinematic and music process, was reflected in *Astro Black* through the creation of a deep and expanded acoustic and visual space where these two histories, de-structured and resounded, meet and interface with astronomy’s cinematic technology, the RXTE satellite camera and its readings of deep space, and where the scientific metaphor of an inaudible, deep space music is rendered as multiple, spatialized soundscapes and moving images. Dub ‘s processes for the engineering of acoustic space and depth of sonic field informed the making of the soundscapes that comprised the installation components and the spaces in which the installation and performance took place, as well as our thinking around the idea of a possible ‘Deep Space Poetics’.

⁹ These can be heard in our Hallucinator dub remix of roots reggae singer Willie Williams’s song *See Me Yah* (2006, Burial Mix). This track is an example of a re-mixing style and use of studio technology, which follows the trajectory first developed by Jamaican producers King Tubby and Lee Perry.

I envisaged an immersive space solely comprising traced and treated, fragmented and looped, layered and a-synchronically spatialized versions of Cygnus X numerical sequence. A deep time and an audio-visual architecture borne out of the simultaneous, ever-changing interplay of different sonic and visual cycles, out of fragments of translations generated in different phases and moments of experimentation, from the early sonifications and visualizations to the latest dubs. A present time-space constituted by repetition and difference, by the tracing of different events - from the primordial events captured and segmented by the RXTE satellite camera to the recent past events of our various readings of the data – and open to new configurations and future re-readings.

‘It is only after matter has been sufficiently deterritorialized’, wrote Deleuze and Guattari, ‘that it itself emerges as molecular and brings forth pure forces attributable only to the Cosmos’ (1987:309). Against linearity and linear narratives, *Astro Black* imagines the dissolution of (sonic and visual) subject and object, melodic progression and formal musical structure, meaning and narrative purpose in diegetic space, trans-forming the data into a multiplicity of spatialized, cyclical events, constantly reoccurring in different relations, or relations of difference. Against closed structures and meanings, *Astro Black* would transform the data into fluctuating noises and feedbacks, pulses and circularities, abstract, liminal, slow moving fragments, floating sound-clouds and clouds of colour, evoking elemental and mutating states of matter, liquid and gaseous atmospheres, and electrical disturbances. These signals were spatially arranged and meticulously fine-tuned, brought together through an interplay of precision and chance, of different ‘sciences’ elaborating the different frequencies in the electromagnetic spectrum.

A space of electricity and ghosts, a dub space tracing and transmuting data readings of events from a deep space stellar past into a present of ‘ghosted’ sounds and images, traces of processes, mutated and mutating. A deep, multilayered acoustic time-space, a non-narrative, expanded cinema of sounds and lights, a space and an experience in which new, inner and outer space imaginaries might emerge.

9. Cosmic Music/The Liberation of Sound

Sound invades us, impels us, drags us, transpierces us. It takes leave of the earth, as much in order to drop us into a black hole as to open us up to a cosmos.

(Deleuze and Guattari, 1987:348).

In *A Thousand Plateaus*, Deleuze and Guattari revisited the themes of metamorphosis and transformation in relation to deterritorialization and becoming, flow and intensity, the molecular and the cosmic, and to music:

The same thing that leads a musician to discover the birds also leads him to discover the elementary and the cosmic. Both combine to form a block, a universe fiber, a diagonal or complex space. Music dispatches molecular flows. [...] the question in music is that of a power of deterritorialization permeating nature, animals, the elements, and deserts as much as human beings. (Deleuze and Guattari, 1987:309)

Their reading of music echoed Edgard Varese's idea of what music could be, which he discussed in his essay *The Liberation of Sound* (1966), an edit of lectures given in 1936 and 1939, in which he prefigured both electronic music and dub's morphological processes and sonic architectures, made possible by sound technology.

When new instruments will allow me to write music as I conceive it, the movement of sound-masses, of shifting planes, will be clearly perceived in my work [...]. Certain transmutations taking place on certain planes will seem to be projected onto other planes, moving at different speeds and at different angles. There will no longer be the old conception of melody or interplay of melodies. The entire work will flow as a river flows. (Varese, 1966:11)

Varese anticipated many of Deleuze and Guattari's concepts of 'deterritorialization'. He rendered 'minor' both the classical composition and the composer, substituting the word 'music' with 'organized sound' and describing himself not as a musician or composer, but as a 'worker in rhythms, frequencies, and intensities'. He defined acoustical arrangement in terms of 'zones of intensity', and form not as a 'point of departure, a pattern to be followed, a mold to be filled', but as 'the result of a process' (1966:16). Drawing from

physics, geometry, geography, chemistry and crystallography, he developed a new musical vocabulary and described music as an ‘Art Science’.

There is an idea, the basis of an internal structure, expanded and split into different shapes or groups of sound constantly changing in shape, direction, and speed, attracted and repulsed by various forces. The form of the work is the consequence of this interaction. Possible musical forms are as limitless as the exterior forms of crystals. (Varese, 1966:16)

Varese’s, and Deleuze and Guattari’s ideas about what music is, or could be, offered us a conceptual framework in rethinking dub and electronic-techno music processes as both a deterritorialized and a deterritorializing machine, a tao of technology, reducing and expanding, erasing signals and activating ‘negative’ spaces, the spaces between signals and events – an idea already present in our previous work *Ghost Dance* (2002-3).

10. Morpheus, Morphologies, Metamorphosis

Our 2003 E.P. *Morpheus* for the Berlin label Chain Reaction, mapped these ideas within a musical field which we contributed to since the late 1990s, and which came to be known as ‘techno-dub’. *Morpheus*, a name whose Greek root is *morphe*, shape, and whose meaning is ‘he who forms or moulds’, was a title I chose to image a techno-dub machine of mutation and change, shape-shifting and transformation. *Morpheus*’ sonic architectures evoke, in the tradition of dub, a presence under erasure, a ‘subject’ de-structured, reduced and augmented, becoming pulsations and polyrhythms, cycles and circularities, sound clouds and shifting atmospheres; a fluid morphology, a topology of sounds and a living, morphing sonic space.

One of the tracks, *Waterline* (a title chosen by George) was developed around a study/assemblage I had done in 2000, of radio-astronomy audio signals of ‘disturbances’ occurring in Io’s magnetosphere as a result of Jupiter’s strong gravitational force. For this study, I had re-shaped the sonic debris of the interaction between these two celestial bodies through a number of processes, which included sampling and looping, time-

stretching and tape-speed alterations, counter-point and multi-tracking, and reverb and delay. A sketched, re-figured, re-imagined atmosphere, which George and I revisited in 2003, and around which other sounds were constructed and circulated, and given a centre of gravity, an orbit and an angular momentum: a 'heart beat' pulse, a bass drum sample with which George created a double beat, and a bass line, my tribute to Burning Spear, which revisited his *Door Peep shall not enter*, released 40 years earlier¹⁰. We organized the keyboards and low to mid percussive samples so as to break down and re-compose, appear and disappear, coalesce and dissolve with each cycle, each rotation, with other high mid and high percussive sounds shimmering above them, evoking rhythmic splashes of water. A plane, a planet or a place, an alien landscape whose name, *Waterline*, a line marking the level reached by a body of water, evoked geological evidence of its presence and the possibility of past, or future, life; or perhaps a boundary location, a shoreline, a point of departure or arrival. It also suggested nautical technology, the capacity of a ship to contain weight and to float, its suitability to withstand a journey at sea; a floating world, a journey with an unknown destination, which had (and has always) already begun.

In *Reverie*, the last track in our *Morpheus* E.P., this plane/space morphed into a slower rhythm, becoming gentle waves, becoming a friendly sea, becoming a flute melody, becoming a bird's cry, becoming a gentle breeze, becoming sound clouds, becoming flocks of birds...

11. Imagining a Cosmos

At the end, imagining a cosmos is the most natural destiny of reverie. (Bachelard, [1960] 1971:23)

For Gaston Bachelard, reverie is an in-between space where the material and the immaterial meet and are brought into relation, and where new worlds take shape.

¹⁰ The song features in his 1973 album *Studio One Presents Burning Spear*. 'Door peep shall not enter, this a holy land. Where wise and a true man stand, sipping from the cup of peace. Chant down Babylon. Give thanks and praise! I. I. I, I...'

‘In times of great discovery’, he writes, ‘a poetic image can be the seed of a world, the seed of a universe imagined out of a poet’s reverie’ (Bachelard, 1971:1). These imagined worlds ‘determine profound communion of reveries’, and poets ‘lead us into cosmos that are perpetually renewed’ (Bachelard, 1971:22). Bachelard argued that reverie and its poetic imagery give us a concrete experience of that world which Western metaphysics has separated from the material world and has rendered distant; they reconnect us with the world of the soul and of love, a love whose wholeness is restored because ‘The reality of love is mutilated when it is detached from all its unrealness’ (Bachelard, 1971:8).

In our reverie, a world takes form, and this world allows us to expand our being. It is a state of enchantment, a state which ‘gives the I a non-I which belongs to the I [...] it is this “*my non-I*” which lets me live my secret of being in the world.’ (Bachelard, 1971:13).

This renewal was re-figured by poet Derek Walcott, in his 1992 Nobel prize speech, as a reassembling of fragments which is born out and glued by love:

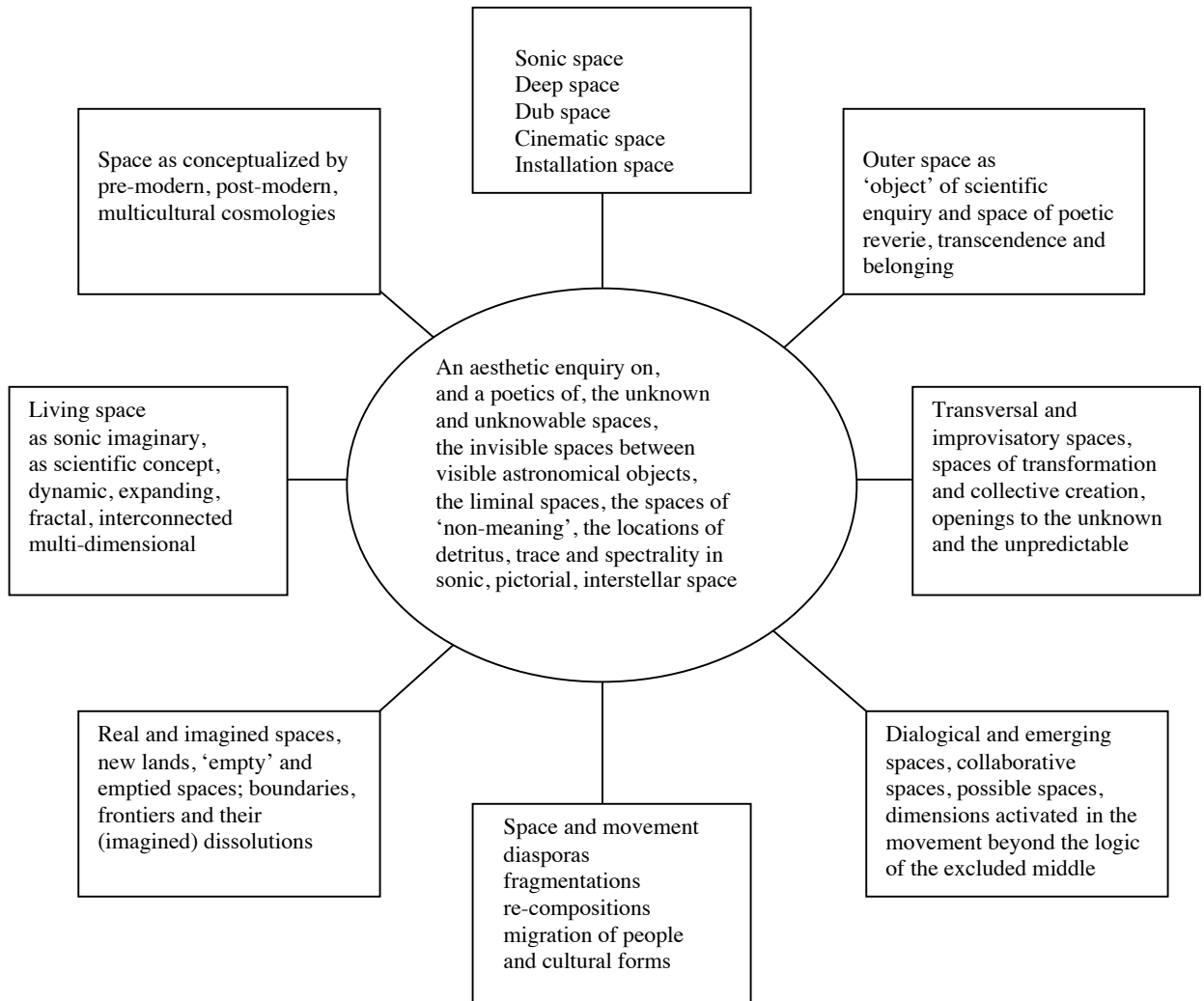
Break a vase, and the love that reassembles the fragments is stronger than that love which took its symmetry for granted when it was whole. [...] It is such a love that reassembles our African and Asiatic fragments, the cracked heirlooms whose restoration shows its white scars. And this is the exact process of the making of poetry, or what should be called not its "making" but its remaking. (Walcott, 1992)

‘Imagination’ writes Bachelard, ‘attempts to have a future [...]’. There is *futurism* in any dreamed universe’ (Bachelard, 1960:8). Like Bachelard, and unlike the Italian futurists, Walcott and Glissant’s poetics envisage a cosmos, a world and a totality, which are not totalitarian. Their poetics, perhaps unlike Bachelard’s, do not detach themselves from the abyss, the traumatic, collective memory of the Middle Passage and the experience of violence; unlike the Italian Futurists’ poetic and political exaltation of violence (Marinetti, 1909), Glissant and Walcott’s poetics establish a relation to violence, and transform it: ‘Relation comprehends violence, marks its distance. It is passage, not primarily spatial, that passes itself off as passage and confronts the imaginary’ (Glissant, 1997:188). It could be argued that, perhaps similarly to Deleuze and Guattari’s philosophy, or Sun Ra’s poetry and music, these poetics seek to establish an ethico-

aesthetic paradigm which calls forth ‘a people yet to come’ (Deleuze and Guattari, 1994: 108), a ‘correlate of creation’ (1994: 110) aimed at ‘freeing life wherever it is imprisoned’ (1994:171).

We migrated and reshaped many of these ideas and aesthetics in our *Music and Science Lovers* series of works, in our new engagement with cosmology and X-ray data, with black holes, flicker noise research and their emerging poetics, and later, with dark energy research, its data and its new theories about space. The idea of a double movement of becoming, the becoming ‘elemental’ of music and the transversal becoming music of the cosmos, was revisited and relocated in the art-science context and the art gallery, for the development of multiple modes of data translation and transformation, and for the creation of a ‘Deep Space Poetics’.

DEEP SPACE POETICS



(IV) ON SUN RA

PRELUDE

Dred Scott case: the Supreme Court decision

In March of 1857, the United States Supreme Court, led by Chief Justice Roger B. Taney, declared that all blacks - slaves as well as free - were not and could never become citizens of the United States. The court also declared the 1820 Missouri Compromise unconstitutional, thus permitting slavery in all of the country's territories.

The case before the court was that of Dred Scott v. Sanford. Dred Scott, a slave who had lived in the free state of Illinois and the free territory of Wisconsin before moving back to the slave state of Missouri, had appealed to the Supreme Court in hopes of being granted his freedom.

Taney - a staunch supporter of slavery and intent on protecting southerners from northern aggression - wrote in the Court's majority opinion that, because Scott was black, he was not a citizen and therefore had no right to sue. The framers of the Constitution, he wrote, believed that blacks "had no rights which the white man was bound to respect; and that the negro might justly and lawfully be reduced to slavery for his benefit. He was bought and sold and treated as an ordinary article of merchandise and traffic, whenever profit could be made by it."

Referring to the language in the Declaration of Independence that includes the phrase, "all men are created equal," Taney reasoned that "it is too clear for dispute, that the enslaved African race were not intended to be included, and formed no part of the people who framed and adopted this declaration".

Abolitionists were incensed. Although disappointed, Frederick Douglass, found a bright side to the decision and announced, "my hopes were never brighter than now." For Douglass, the decision would bring slavery to the attention of the nation and was a step toward slavery's ultimate destruction.

(Source: Public Broadcasting Service,
<http://www.pbs.org/wgbh/aia/part4/4h2933.html>)

Who then is this? It is Ra, the creator of the name[s] of his limbs [...] It is Ra in his rising in the eastern horizon of heaven [...] “I am Yesterday; I know Tomorrow.”

(*The Book of the Dead*, Plate 7, trans. E.A. Wallis Budge, 1895)

I have many names; many names [...] some call me Mr. Ra, others call me Mr. Re, you can call me Mr. Mystery.

(Sun Ra, *A Joyful Noise*, 1980)

1. Sun Ra: context and research

My revisiting of Flow Motion’s project *Astro Black Morphologies/Astro Dub Morphologies* for this commentary in 2014 is marked by two anniversaries: it is the 10th anniversary of its first public presentation at the European Space agency and of the publication of the companion essay *Astro Black Morphologies: Music and Science Lovers* in the Leonardo on-line journal. In these works we chose to foreground Sun Ra, a composer, musical director, poet, scholar and thinker whose *oeuvre* could represent, more than anybody else in the 20th century, the whole history of cosmology in modern music; a re-writing of the cosmos as music, re-sounded ‘in the ear of the other’ (Flow Motion, 2006:25). Sun Ra was also an inspiration for our previous project *Kosmos In Blue* (2001) and our performance at the Cosmonauts’ Club in Star City, near Moscow, which included the remix of one of his compositions, *Mayan Temples* (1990), as well as our subsequent projects *Invisible* (2006-7) and *promised lands* (2008-10), where we chose Ra’s composition *Next Stop Mars* (1963) as the number 1 page in our web art archive.

2014 also marks the 100th anniversary of Sun Ra’s arrival on planet Earth. Born in 1914 as Herman Poole Blount in Birmingham, Alabama¹, re-born in 1952 under the legal name

¹ At that time Birmingham was ‘perhaps the most segregated town in the world’ (Nelson, 2014). Alabama was the birth place of the Ku Klux Klan, a hate organization which first appeared following the Civil War. It disbanded after 1870 and remained inactive until 1915. In 1916, two years after Sun Ra’s birth, Alabama’s first Klavern, as local Klan organizations were known, was established in the city of Birmingham. The Klan expanded state wide during the early 1920s and claimed to have more than 150,000 members in Alabama. ‘Most Klansmen were white middle-class Protestants whose beliefs in white supremacy motivated their support for the social control of African Americans, immigrants, labour unions, and other groups who threatened their privileged position in American society. [...] By 1925, more than 2.5 million Americans had joined the Ku Klux Klan, making it one of the largest membership organizations in American history’ (Encyclopaedia of Alabama, 2012). In 1963 tensions escalated in Birmingham when the Southern Christian Leadership Conference (SCLC) and the Congress on Racial Equality (CORE) became involved

of Le Sony'r Ra (Ra, the ancient Egyptian sun god) and (by his own declaration, as considered below) unborn in Saturn sometime in a primordial stellar past, as extra-terrestrial and member of the angels race, Sun Ra was without a doubt 20th-century American music's most consistent, significant advocate of a star bound, earth-based cosmic music (Piva and George, 2003).

Through the course of his life Ra developed a unique, personal, musical and pan-cultural cosmology, informed by and formed through a creative recombination of a wide range of sources from diverse disciplines, cultural forms and traditions of thought, past and futuristic, which he re-figured as equations, music, mythology, poetry and performance. Ra's interests included, amongst others, Egyptian philosophy, numerology, etymology, linguistics, the Bible, theosophy, Gnosticism, Hermeticism, Renaissance art and natural philosophies, contemporary astronomy and science fiction. It was a non-academic, non-institutional, transdisciplinary research whose range and depth built and expanded on the esoteric and hermetic traditions and knowledge circulating within 19th- and early 20th-century Black Masonic Lodges, in light of the rise of the Black Nationalist, Civil Rights and New Thought movements, new scientific and technological developments and the Space age, prior and in parallel to the Black Arts Movement and the 1960s counterculture, the new African American avant-garde and the development of free jazz.

In 1951, after moving to Chicago Ra founded the Thmei Research group with fellow traveller, manager and x-ray technician Alton Abraham, with whom he also formed in 1957 the independent record label El Saturn Research, one of the first musicians' owned labels. The first two tracks on the A-side of the label's first album release, *Super-Sonic Jazz* (1957), recorded in 1956, are *India* and *Sunology*. The first two tracks featured on

in a campaign to register African Americans to vote and after an agreement between civil rights demonstrators and the city leaders to start integrating public spaces. On the 15 September 1963 the 16th Street Baptist Church in Birmingham, a rallying point for civil rights activities and a meeting place for civil rights leaders such as Martin Luther King, Jr. was bombed by members of the United Klans of America. The explosion at the African-American church, which killed four girls, marked a turning point in the Civil Rights Movement and contributed to support for the passage of the Civil Rights Act of 1964. Segregation has continued to be implemented in Alabama until the 21st century. A statute banning interracial marriage in the state of Alabama was struck down only in 2000 by 59% to 41%, with a majority of whites voting against the change. In November 2004, 49 years after civil rights activist Rosa Parks was arrested for 'civil disobedience' in Montgomery, Alabama for refusing to give up her seat in the 'colored' section to a white passenger, a referendum was held to amend the constitution, with a majority of votes in support for keeping 'separate schools for white and coloured children' as part of the constitution. (Younge, 2004)

side B are *Kingdom of Not* and *Portrait of the Living Sky*. These titles signal the beginnings of a cosmological map which Ra continued to draw and expand in the following thirty-seven years across hundreds of compositions, marking the movement of African and Indian mythologies and philosophies, knowledge and cosmic consciousness through continents and millennia into his present and his music. In the linear notes of the second release, the 1957 LP *Jazz by Sun Ra* (later re-released as *Sun Song*) Ra wrote: 'You see, music paints pictures that only the mind's eye can see. Open your ears so that you can see with the eye of the mind.' (Ra, 2005:448)

Ra's scholarly research, his weaving together through music of myth and mystery, philosophy and mathematics, science and sci-fi, ancient Egypt and Outer space were focussed around a project of cultural revision aimed at disentangling himself and other African Americans from the 'truth' of historical and institutional narratives (Lock, 1999:51), the loss of memory and the de-humanizing effects of the Middle Passage, the vicious effects of slavery on race relations in contemporary American society, and the effects of racism and segregation on African Americans' sense of self-identity and self-worth. Racism was 'a negation that pervaded every aspect of life of a black person' (Bangura, 2012:112). In his groundbreaking collection of essays *The Souls of Black Folk*, first published in Chicago in 1903, the sociologist, social and political activist, educator and poet William Edward Burghardt Du Bois described the dichotomy of the Black soul due to racism as such:

It is a peculiar sensation, this double-consciousness, this sense of always looking at one's self through the eyes of others [...]. One ever feels his two-ness, - an American, a Negro: two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder. (Du Bois, [1903] 2007:8)²

The white erasure of black history was a heated debate during the 1950s among African American activists, leading to a revision which produced texts like George G.M. James's

² In the opening line of the *The Souls of Black Folk*' second essay ('Of the Dawn of Freedom') Du Bois wrote that 'The problem of the twentieth century is the problem of the color-line' (Du Bois, [1903] 2007:15). Professor Abdul Karim Bangura argued that Du Bois's seminal work, aimed at raising his people's awareness of their potential to transform their reality, would lay the foundation for generations to come' (Bangura, 2012:110).

Stolen Legacy, the Greeks Were Not the Authors of Greek Philosophy, but the People of North Africa, Commonly Called the Egyptians (1954). In this text, James argued that Egypt was the greatest education centre of the ancient world. Referring to 'Plato in the Timaeus who tells us that Greek aspirants to wisdom visited Egypt for initiation, and that the priests of Sais used to refer to them as children in the Mysteries' (James, [1954] 2009: 34), he contended that Greek philosophy is based on ideas and concepts that were borrowed without acknowledgement from the Egyptians.

On the other side of the Atlantic, the Senegalese historian, physicist, Egyptologist and philosopher Cheikh Anta Diop, a student of, amongst others, Gaston Bachelard, had began a monumental project of rehabilitation of African culture and a re-assessment of its role in the development of European civilization through an in-depth research of Ancient Egypt. In 1956 he announced at the First International Congress of Black Writers and Artists that:

We have come to discover that the ancient Pharaonic Egyptian civilization was undoubtedly a Negro civilization. To defend this thesis, anthropological, ethnological, linguistic, historical and cultural arguments have been provided. (Diop, 1974:ix)³

One of Diop's main aims was 'to define an image of a modern Africa reconciled with its past and preparing for its future' (Diop, 1974:xvi). His groundbreaking work and his rationalist, scientific approach helped correct two major errors of history, or we could say, helped dismantle two major falsifications: the denial of Ancient Egypt's major contribution to European culture and the exclusion of Pharaonic Egypt from Black Africa, bringing to light the Eurocentric lie of the 'primitive Negro', which had legitimized both the colonization of Africa and the slave trade. In the introduction to *The African Origin of Civilization: Myth or Reality?*, a collection of texts published between 1954 and 1967, Diop argued that:

The moral fruit of their (the Ancient Egyptians') civilization is to be counted among

³ Originally published in *Presence Africaine*, number 8-10, June-November 1956, p. 339.

the assets of the Black world. Instead of presenting itself to history as an insolvent debtor, that Black world is the very initiator of the ‘western’ civilization flaunted before our eyes today. Pythagorean mathematics, the theory of the four elements of Thales of Miletus, Epicurean materialism, Platonic idealism, Judaism, Islam, and modern science are rooted in Egyptian cosmogony and science. (Diop, 1974:xiv)

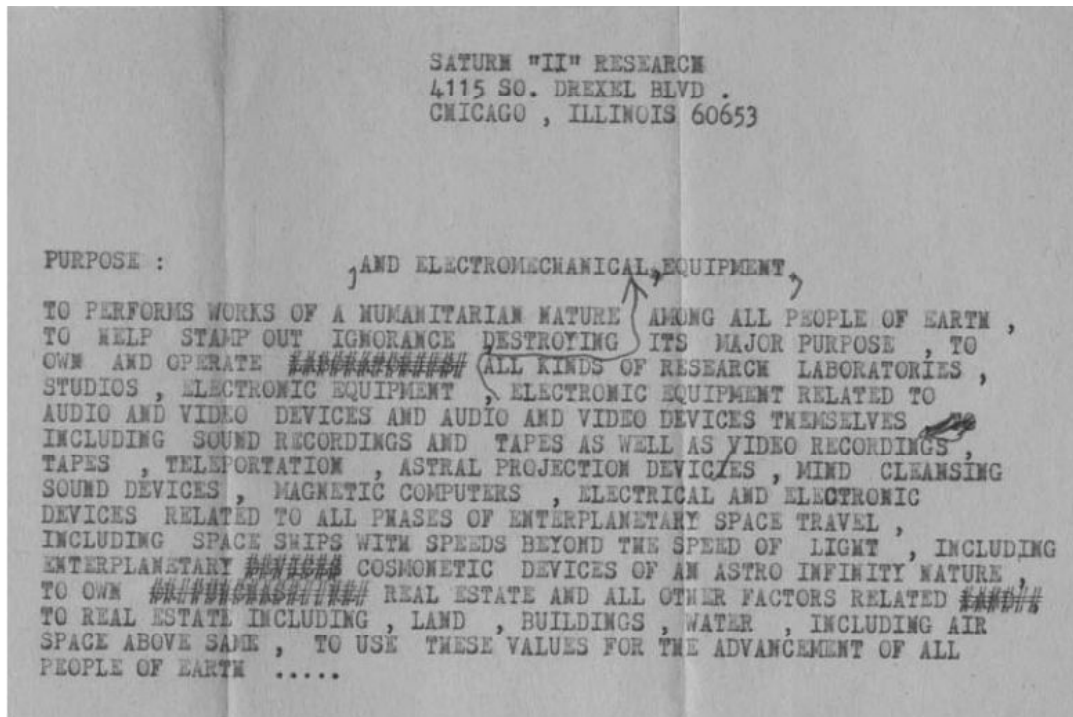
Back in the US, the sense of social estrangement of African Americans was given an apocalyptic voice by Elijah Muhammad in his description of a mythic future for ‘The Lost-Found Nation of Islam in the Wilderness of North America’, the ‘Asian-Black Nation’ originating in Abraham of the Old Testament and the ancient tribe of Shabaz. In his 1965 *Message to the Blackman in America* Muhammad invokes the prophet Ezekiel to picture a ‘mother plane’, a spaceship, a deadly weapon and an already existing secret technology for a future which, like that of Ra, points to outer space.

The present wheel-shaped plane known as the Mother of Planes, is one-half mile by a half mile and is the largest mechanical man-made object in the sky. It is a small human planet made for the purpose of destroying the present world of the enemies of Allah. (Muhammad in Wessinger, 2011:36)

Ra invokes through his space chants a different revolutionary future, refigured as cosmic change: ‘The satellites are spinning/a better day is breaking/The galaxies are waiting/for planet Earth awakening/We sing the song to a great tomorrow’ (1971); he speaks of music as ‘a shield of beauty’, protecting the world from destructive cosmic forces (Ra in Lock, 1997:48).

Ra expanded the reclaiming of black culture and humanity to a planetary and extra-planetary scale: his and Abraham’s Saturn ‘II’ research mission was, quoting their words,

‘to perform works of a humanitarian nature among all people of Earth, to help stamp out ignorance destroying its major purpose, to own and operate all kinds of research laboratories [...] and audio and video devices themselves including sound recordings and tapes, as well as astral projection devices, mind cleansing sound devices, magnetic computers, electrical and electronic devices related to all phases of enterplanetary space travel, including spaceships [...]’ (Ra and Abraham, no date)



Saturn "II" Research. Courtesy of the Chicago Jazz Archive, Special Collection Research Center, University of Chicago Library.

‘Sun Ra refused to accept a fixed identity [...] he resisted closure’ (Szwed, 1998:387).

Breaking the tyranny of history (‘History is his story. It's not my story’, Ra said in the 1980 documentary *A Joyful Noise*), while also refusing to be categorized within any particular political or religious affiliation, Ra re-invented himself as a myth. He inscribed himself within an alternative, continuous timeline connecting ancient Africa and in particular pharaonic Egypt, which he identified as the source of philosophy and culture, with a stellar past-future and with outer space. He gave himself a double origin, extraterrestrial and pre-‘historical’ (Saturn and Egypt) and became un-born, non-human, an alien and a member of the ‘angels race’. He located the origin of his ‘awakening’ in the mid-thirties, with a dream, a vision and a physical transmutation:

My whole body changed into something else. I could see through myself. And I went up ... I wasn't in human form ... I landed on a planet that I identified as Saturn ... they teleported me ... They talked to me ... the world was going into complete chaos ... I would speak [through music], and the world would listen. That's what they told me. (Ra in Szwed, 1998:28–29)

Years later, the 1971 film *Space is the Place* features Ra, wearing Egyptian costumes (borrowed from a local Masonic temple) and landing with his spaceship, fuelled by music, in a black youth community centre in Oakland. Here he summons up a group of incredulous and mocking teenagers who ask him ‘Are you for real?’ with these words:

I’m not real. I’m just like you. You don’t exist, in this society. If you did, your people wouldn’t be seeking equal rights. You’re not real; if you were, you’d have some status among the nations of this world. So we’re both myths. I do not come to you as reality. I come to you as myth, because that’s what black people are: myths. (Sun Ra, 1971)

2. Language, vibration and hermeticism

Ra’s use of language and communication, etymology and linguistics, his radical re-reading of the Bible, his constant play of words and use of paradoxes, his musical, rhythmic use of repetition and call and response in conversation, song, poetry and prose writing, were aimed at disrupting and deconstructing mental structures and historical references, and at opening new modes of perception of the self and the world.

Szwed argues that Ra’s practice of re-naming (himself and also his musicians) is reminiscent of the similar Rastafarian principle of ‘word-sound-power’ (Szwed, 1998:104).⁴ According to Sterling Stuckley, the importance of names in West African societies, from where most African American slaves originated, derives from the identification of a man’s name ‘with his very soul, and often with the soul of his ancestors’ (cited in Lock, 1997:48). Quoting the *Egyptian Book of the Dead*, G.G.M. James identified the name, or ‘Ren’, as ‘one of the soul’s nine indivisible attributes, essential for the preservation of a Being. [...] The Egyptians believed that in the absence of a name, an individual ceased to exist.’ (James, 1954:90).

⁴ This idea is similar to the Vedic concept of *Naad*, or *Naam* in the Guru Granth Sahib, the Sikh holy book. Common to the religions and cultural traditions of Hinduism, Tibetan Buddhism and Sikhism is the practice of mantra, the rhythmic repetition of a particular syllable, word or sequence of sounds on the basis of their sonic, or *naad* energy. In Naad Yoga the syllable ‘Ra’ is believed to be the sonic expression of the energy of the sun (S.S.Singh, 2004). Ra is also the root sound for raag, or raga (RA-GA), a modal scale or series of five or more notes in classical Indian music. Raga literally means colour, which is a property or frequency of light.

‘My measurement of race is rate of vibration – beams, rays’ (Ra, 2005 467).

Ra’s statement, in its musicality and off-beat science, poetically and paradoxically refigures the hermetic and yogic cosmic principle of vibration (see also Ra’s 1977 album *The Soul Vibration of Man*), one of the seven axioms listed in the *Kybalion*, the anonymous exegesis of the hermetic teachings attributed to the mythical Egyptian god of wisdom Tehuti/Thoth or, in its Greek incarnation, Hermes Trismegistus (trice-greatest), believed to be a contemporary of Moses.

The *Kybalion* was first published in 1908 by the Yogi Publication Society, housed in the Masonic Building (the very first skyscraper built in Chicago) and anonymously authored by ‘The Three Initiates’. An underground work, never registering in mainstream culture, the *Kybalion* is probably the best-selling occult book of the twentieth century (Horowitz, 2014). Recent research (Deslippe, 2011) attributes it to William Walker Atkinson, a lawyer, publisher and unaffiliated occultist whose texts, written under various pseudonyms, became very influential in New Thought circles in Chicago in the first decades of the 20th century. The *Kybalion* also circulated amongst some black nationalists and Afrocentrists, who considered it an authentic retention of ancient Egyptian wisdom (Deslippe, 2011; Horowitz, 2014). The text merges supposedly ancient Egyptian models of esotericism, yogic philosophy, modern psychology and science, continuing a long esoteric tradition of anonymous constructions and interpretations of axioms and principles attributed to Egyptian mystery schools, Pythagorean teachings and Vedic traditions of thought.

This mythology was already present in the Arabic world with the *Emerald Tablet*, an alchemy text written around the sixth century and also attributed to Tehuti/Thoth/Hermes Trismegistus (Goodrick-Clarke, 2008:34); it continued in the Middle ages and was revived through the work of translation and re-visitation by Italian Renaissance intellectuals like Marsilio Ficino, who first translated the *Corpus Hermeticum* in Latin in 1471. In the subsequent centuries, the *Emerald Tabled* continued to be the object of study of many European scholars and natural philosophers, including Francis Bacon and Isaac

Newton ([c.1680] 2010). In 1906, the *Corpus Hermeticum* was translated in English by G.R.S. Mead, a close associate Madame Helena Blavatsky, the founder of the Theosophical Society, whose work was also an influence on Sun Ra (Szwed, 1993). In his introduction to *The Kybalion: The Definitive Edition* (2011), Deslippe argues that the early Hermetic writings were often written anonymously and by small groups or unaffiliated individuals and that, before they became the object of fascination of Florentine nobility in the Renaissance or of moneyed British occultists, these texts were ‘popular’ and were meant for subaltern people and marginal seekers, those outside established cults or places of power.

3. Myths, Mathematics and Music

The neglected mathematics of MYTH is the equation differential potential impossible potential potential potential otherness alter-ness. (Ra, 2005: 468).

Bassoonist/multireedist James Jacson, a student of Zen Buddhism before joining Sun Ra, identified strong similarities between Zen teachings and practices and Ra's use of seemingly absurd replies to questions (Szwed, 1998:385). Drummer Art Jenkins admitted that ‘Sun Ra's ‘nonsense’ sometimes troubled him for days until inspiring a sort of paradigm shift, or profound change in outlook.’ (Szwed, 1998:387)

From a different perspective, Ra’s linguistic and textual operations could be likened to what Donna Haraway described as ‘cyborg’ writing, by authors whose use of text is about:

[...] the power to survive, not on the basis of original innocence, but on the basis of seizing the tools to mark the world that marked them as other. The tools are often stories, retold stories, versions that reverse and displace the hierarchical dualisms of naturalized identities. In retelling origin stories, cyborg authors subvert the central myths of origin of Western culture. (Haraway, 1991:175)

For Sun Ra, as for Diop and James, one of these myths was the Eurocentric myth of a Greek (read ‘white’) origin of philosophy, science and mathematics. For Graham Lock,

Ra's many references to mathematics, from his 1984 live recording *Strange Mathematics*⁵ to his remark to Lock in 1990 that mathematics 'provided the key to immortality', 'begin to make a lot more sense once you discover the word's derivation from the ancient Egyptian concept of Ma'at, which referred to, among other things, the cosmic principle of balance and harmony.' (Lock, 1999:225)

Ra defined himself as 'a scientist, I deal with equations. You might say a spiritual scientist and also a cosmo musical scientist' (Ra in Rusch, 1984:66). Ra's equations are open texts, inscribed in his poetry and in the titles of his compositions, becoming alive in music and performance. The most famous of these, *Space is the Place*, is a deep philosophical statement,⁶ a proposition expressed mathematically and translated in many languages, as song, rhythm, refrain, physical gesture, circular dance, theatre and film. It is an equation that, in its sensual portrayal of an open space, of interplanetary and interstellar journeys, clearly refutes and dismantles any notion of physical confinement such as those imposed in segregated US society.⁷

Sun Ra belongs to a long line of 20th-century composer-mystics, which includes, amongst others, Schoenberg, Cecil Taylor, Stockhausen, Messiaen, Ornette Coleman and Anthony Braxton. Unlike many of his European avant-garde music correspondents Ra positioned his mystical and artistic concerns in the social and the collective, in space travel and 'the ultra modern' (Szwed, 1998:387); his cosmic music was framed within a liberationist aesthetic, underpinned by notions of inter-subjectivity, African-derived polyrhythm, and the practice of collective improvisation.

⁵ In Sun Ra, *Live at Praxis '84*, Golden Years of New. The album also includes the track *Rhythmic Equations*.

⁶ It could be argued that the quest for a definition of space and place is one of the most relevant inquiries of modernity and post-modernity, in philosophy, mathematics, physics, cosmology, sociology, urbanism and environmental studies; it is perhaps one of the oldest and most important quests in human history. Space has been considered as an extension (Newton to Einstein), as a liberating Void containing all (Pico, Bruno), as absolute space (Newton) or relative space (Mach to Einstein), as curved space and continuous n-dimensional manifold (Riemann), and so on. Place has been defined as the result of human agency, as a cultural landscape constituted and perceived by the meanings people attribute to them (Tuan, 1977), as a physical location becoming the centre of felt values through the interaction between people and landscape (Relph, 1976) or, as in the case of Yoruba urbanism, the result of mimesis and cosmometry, the reflection of cosmological views and environmental harmony (Adejumo and Ademamowo, 2012).

⁷ In the specific case of African American history, C.V. Woodward uses the word 'place' to emphasize the idea of confinement, and states that 'Slavery was only one of several ways by which the white man has sought to define the Negro's status, his 'place', and assure his subordination' (cited in Lock, 1997:71).

Ra's musical cosmology, which has inspired countless composers and groups, from John Coltrane to the AACM (the Association for the Advancement of Creative Musicians, Chicago), George Clinton and Funkadelic, Flying Lotus and Jamal Moss, was an alchemical fusion of traditional jazz big band arrangements and finely directed improvisations, avant-garde compositions and experiments with innovative sonic and recording devices. His music was played by Sun Ra and the Arkestra (Ra's still active big band, a galaxy of stars, which has included throughout its history many members and collaborators and three generations of musicians) through acoustic jazz instruments, traditional African and Indian instruments, electronic instruments, newly invented sound producing devices, and was performed as an expanded, exhilarating theatre of sound and light, dance and poetry. Ra's perspective as a musical director conceived each member of the Arkestra as a unique sonic character, a unique star-sound, recognizing status and creative potential in each of his musicians.

Astro Black American / The Universe is in my voice [...] Find your place amongst the stars / Listen to the outer world / Rhythm, Multiplicity [...] Astro Black and Cosmo Dark (Sun Ra, 1972)

Ra's cosmology is summarized in his poem *Astro Black* – a cosmic vision which, as we discovered during our *Sounds of Science* research, had close correspondences with a new poetics emerging in the latter part of the 20th century in the physics of fluctuation processes, in a multi-disciplinary field which included mathematicians, biologists, technical engineers, economists and researchers from a variety of disciplines. At the dawn of the 21st century, this new poetics was reconfigured by UK astrophysicists Ian McHardy and Phil Uttley, in their 2002 talk *The Music of Black Holes*, as a new sonic cosmology.

Beginnings, endings, and new beginnings...

I first saw Sun Ra and the Arkestra's live performance in Conegliano, a small town in northern Italy in 1980, just a couple of years after the dissolution of the counterculture.

It was the beginning of the ‘Winter years’, as Guattari (1996) called them, the repressive and depressive climate that followed the events of 1977, which we revisited in our essay *Dissolve* (Flow Motion, 2004). With the coming together of futuristic electronic noises and traditional big band Swing, driving rhythms and dance, poetry and chanting, colourful Egyptian costumes and abstract light projections, their live performance seemed to be a collective theatre of cosmic proportions, simultaneously dead serious and humorous, extending from the distant past to a distant future. It was an event which suspended, for a brief but for me still resonant moment, the oppressive reality we were experiencing in that particular historical context. I remember the Arkestra dancing in an anti-clockwise circle, a practice that carried on the ‘ring shout’ tradition of African dance and African American churches, brought to the US by African slaves (Floyd, 2002)⁸. June Tyler was leading the band in the refrain ‘Space is the Place’, a mantra, a mathematical formula repeated for what seemed to be an eternity.

That concert was one of a series of concerts devised by Daniele Toniolo and Paolo Spedicato and organized by the *Collettivo di Comunicazione Sonora*, some older friends who had organized, through tremendous enthusiasm and dedication and with extremely scarce resources, a series of innovative performances that also included, in 1978, The Art Ensemble of Chicago. On this occasion, as a young teenager, I had the opportunity to spend time with these musicians before and after the concert, to socialize and absorb as much as I could of their presence and their words as well as their incredible music.

The Art Ensemble was one of various groups that had formed within the now 50 years old Association for the Advancement of Creative Musicians (AACM), a Chicago organization born in 1965, the year which also saw the assassination of Malcolm X and the rise of social conflicts and racial struggles in the US. This organization, which

⁸ This is also a practice in the Stomp Dance of many Native American tribes and in Sufi Whirling Dervishes dance (Sema). Discussing the origins of this practice by Sufi mystic poet Rumi, the Naqshbandi Sufi Order of Australia explains that ‘Rumi spoke of Sema as a symbol of the cosmos. The revolving body copies the motion of the universe, just like the rotating planets and the turning of the Galaxies’ (Naqshbandi Sufi Order, no date). Available from <http://www.naqshbandi.asn.au/whirling.html> [Accessed 8 January 2014]
In 2013, physicists Guven, Hanna and Muller discovered that a force that intricately links the rotation of the Earth with the direction of weather patterns in the atmosphere plays a crucial role in the creation of the hypnotic patterns created by the skirts of the Whirling Dervishes. See the online press release by the Institute of Physics, *A Whirling Dervish puts physicists in a spin*. Available from: http://www.iop.org/news/13/nov/page_61971.html [Accessed 8 January 2014]

included innovative composers and groups such as pianist Muhal Richard Abrams, saxophonist Roscoe Mitchell, The Experimental Group, trumpeter and 'space harp' inventor Kelan Phil Cohran (a member of the Sun Ra Arkestra from 1959-61) and saxophonist and philosopher Anthony Braxton, sought to establish new independent spaces for the contemporary African American avant-garde, promoting free jazz and social help. The AACM artists adopted the motto 'Great Black Music: Ancient to the Future', emphasizing their connection to ancient African music, the roots of jazz, as well as a new, futuristic approach to sonic architectures, furthering the direction established by Sun Ra in the previous decades. Lester Bowie, trumpeter with The Art Ensemble of Chicago, acknowledged Sun Ra's influence and legacy in an interview in 1997, saying:

Sun Ra went from the 30's with Fletcher Henderson's music to today and he never tried to be commercial and was always into the music, he was into space, into thought, language, culture. Sun Ra inspired us, he was like our father. We would watch Sun Ra in those days and say to ourselves, oh! Sun Ra was doing these things and we saw him continue all the way to the time he died [...]. (Bowie in Tejuoso, 1997)

Breaking from the conventions of New York free jazz, AACM musicians' creative focus was the interaction of sound and space: Roscoe Mitchell's album *Sound* (1966) was a fine example of this new approach to jazz composition. Chicago record producer Chuck Nessa explained the AACM musical innovations in this way:

The big thing at the time prior to them was energy music, you know, all out blowing. The AACM in general was concerned with how to organize sound and how to use these sounds, and energy was just part of this. We have all of these techniques now, and how do we organize them? They composed and improvised with this in mind. I think that is their primary contribution, it was the organization and use of all of these techniques. (Nessa in Ottenhoff, 1996)

The success of Roscoe Mitchell's *Sound* attracted the attention of Down Beat and other publications to the new musicians' organization in Chicago; as a result of this interest and subsequent success, the AACM was able to focus on social concerns of the black population of Chicago along with their original purpose of finding work for avant-garde jazz musicians. Sam Ottenhoff contends that with the AACM the words 'Chicago jazz'

became synonymous with creativity and radicalism, 'just as the words "Chicago politics" conjure socialism, communism, and radicals' (Ottenhoff, 1996); this is the way in which the AACM musicians were perceived in Europe. In the seventies and eighties the Art Ensemble of Chicago, co-founded by Roscoe Mitchell in 1969, was still breaking new grounds and defining new directions in contemporary music, still radical in their approach to space, improvisation, composition and performance; as with Sun Ra and Anthony Braxton, it had acquired a fairly large and enthusiastic audience in Italy.

Looking back at their performance in 1978, I remember the sense of kinship and brotherhood, of shared politics and understanding, perhaps naïve but nevertheless real, that many of us in Italy felt with them at the time. Our society was in the grip of a wave of repression, oppressed by draconian anti-terrorist legislations and a deep economic crisis. In this context, the new avant-garde sounds and space architectures coming from these African American musicians from Chicago were received as a breath of fresh air, a sign and a more positive vision of a possible present and future, the artistic expression of a desire to create and organize, through music, new environments and spaces of collectivity. The Art Ensemble's avant-garde music, their polyrhythms and wide spatial arrangements, their new, open-ended figurations of Africa reached my heart and mind more than any Cage or Stockhausen ever could, then or now. Their music and stage appearance, with African robes and painted masks, scientists coats and plain gentlemen clothes, evoked both an ancient past and a possible future, a coming together of art and spirituality, music and science - an alternative universe, an expanded sonic space and an open, all-inclusive social space.

Sun Ra's performance in 1980, along with a memorable performance by reggae artist Burning Spear at the Rainbow in London in 1981, left an indelible mark, opening my world and allowing me to perceive new dimensions and new possibilities in music, and in thinking and experiencing space *through* music. Many new synapses developed from these early encounters and experiences, producing a deep and long lasting effect on my subsequent musical and artistic trajectory. It was through these musicians that I first began to understand the relation between sound and space. Through their music and live

performances I sensed, in a very direct way, that there was a deep connection between music and cosmology; that there could be a relation between social consciousness and cosmic consciousness, and that these two planes were not mutually exclusive but complementary; that this relationship could be actualized anywhere, in any space, and that any space could be transformed through sound and music. These musicians were a guidance in a liminal and transformative stage of my life; it was during those years and following to these encounters that I began to play music.

Throughout the early 80s, other friends in Bologna organized more concerts by Sun Ra and the AACM artists, including various solo and ensemble projects by saxophonist, composer and philosopher Anthony Braxton, who acknowledged Ra's influence, praising his vision and commitment:

Sun Ra is not a joke! People would like to think of him as a joke, but he has understood something, something very serious . . . Because he has already demonstrated a viewpoint that could take into account the whole planet and the galactic perspective of things. This is a man who understands the world of abstract consciousness and the mystical dynamics of music. . . . Thanks to Sun Ra I would begin to understand different levels of responsibility, and not be afraid to move towards the visionary or to think of Earth culture. (Braxton in Lock, 1988:154)

Many years later, during our first meeting in late 1995, George and I discovered a common interest in Sun Ra's music, and in the possibilities that Ra's hybrid of African American compositional and improvised Jazz, European avant garde, lo-fi electronica and studio recording experimentations still suggested for the present and the future. We also discovered a common interest for reggae/dub artists Burning Spear and Lee Scratch Perry. George was at the time a member of the Black Audio Film Collective (1982-98), a UK documentary film group whose body of work produced new ways of engaging with the past, present and possible future of black popular and political culture in Britain. The BAFC had just finished filming *The Last Angel of History* (1995), a documentary which George wrote, researched and presented, and which explored the interface between black science fiction and Afro-diasporic music, from Robert Johnson to Sun Ra, George Clinton and Lee Perry, as well as contemporary UK drum & bass and Detroit techno. The film

featured interviews with, amongst others, Ishmael Reed, Samuel Delany, George Clinton, Derrick May, Goldie, Four Heroes, astronaut Bernard Harris and Star Trek actress Michelle Nichols.

Two years earlier, in 1993, Ra had left planet Earth. On the same year the American cultural critic Mark Dery, in the essay *Black to the Future: Interviews with Samuel R. Delany, Greg Tate, and Tricia Rose*⁹, coined the term ‘Afrofuturism’ and described it as:

A speculative fiction that treats African-American themes and addresses African-American concerns in the context of 20th-century technoculture—and, more generally, African-American signification that appropriates images of technology and a prosthetically enhanced future (Dery, 1993:736, 1994:180)

Dery saw the sci-fi genre as the perfect vehicle to narrate the experience of those who, for him, were and are ‘the descendants of alien abductees; they inhabit a sci-fi nightmare in which unseen but no less impassable force fields of intolerance frustrate their movements [whilst] official histories undo what has been done’ (Dery, 1994:180). Dery identified Sun Ra as key figure in Afrofuturism, together with producers and artists George Clinton (Parliament-Funkadelic) and Lee Perry. Afrofuturism, defined by Alondra Nelson as ‘African-American voices with other stories to tell about culture, technology, and things to come’ (Nelson, 2002:9) has been a primarily US-centric conception, though Dery had included in his list of Afrofuturists a Jamaican, Lee Perry. Beginning with Dery’s essay, a new field of cultural and academic studies began to develop, which ‘retroactively identified, documented and integrated historical instances of Afro-futurist practice’ (Tal, 2014)¹⁰. Today Afrofuturism is reaching beyond Dery’s initial remit, encompassing writers, artists and musicians from the continent of Africa as well as those of its diaspora, and seeking to explore, in the words of artist and educator Denenge Akpem, ‘what blackness could look like in the future’ (Akpem in Yongo, 2014).

⁹ Dery’s essay was first published in *South Atlantic Quarterly* 92, 1993: 735-78, and re-published in 1994 in the anthology *Flame Wars: The Discourse of Cyberculture*

¹⁰ See Tali Kal’s website, which features a fairly comprehensive list of critical and academic articles about or related to Afrofuturism, still in the process of being compiled. Available from: <http://afrofuturism.net/criticism/> [Accessed 2 August 2014].

After many years of critical dismissal, Sun Ra's monumental body of work and his vision have been acknowledged in many ways. An exhibition, *Pathways to Unknown Worlds: Sun Ra, El Saturn & Chicago's Afro-Futurist Underground, 1954-68*, curated by John Corbett, Anthony Elms and Terri Kapsalis, took place at the Hyde Park Art Center in Chicago, October 1, 2006 - January 14, 2007. Two books on the work and writings of Sun Ra have been published by White Walls, distributed by the University of Chicago: *Pathways to Unknown Worlds: Sun Ra, El Saturn and Chicago's Afro-Futurist Underground, 1954-68* (Corbett, Elms and Kapsalis, eds., 2006) and *The Wisdom of Sun Ra: Sun Ra's Polemical Broadsheets and Streetcorner Leaflets* (Corbett, ed., 2006).

Together with John Szwed's seminal book *Space is the Place: the Lives and Times of Sun Ra* (1997), Graham Lock's *Blutopia* (1999) sought to dismantle the then predominant critical view of Sun Ra, offering a new, informed perspective on his work and the work of Duke Ellington and Anthony Braxton, celebrating 'these artists and the imaginative power of the tradition they represent' (Lock, 1999:212). While re-reading *Blutopia* recently, over three decades after my first encounters with the music of Ra and Braxton and ten years after George and I made *Astro Black Morphologies/Astro Dub Morphologies*, the end paragraph of this book really resonated with my feelings about these incredible musicians:

The places that they conjure in their musics – impossible alternative universes shaped by black mythology, black history, black metaphysics – could yet turn out to be black holes, in which our little local universe of Western materialism will be swallowed up – leaving us in a sea of music and color. (Lock, 1999:212).

This metaphor suggested another dimension to Sun Ra's poem *Astro Black*, a poem which for us had literal correspondences with cosmological science's new discovery, at the dawn of the 21st century, of a 'music of black holes' and of human and intergalactic, fractal and musical relations. This metaphor found an echo in our desire to resound Ra's cosmic vision, and to imagine a new 'Deep Space Poetics' through the transformation of the numeric data evidence of cosmic interconnectedness into a non-narrative, expanded cinema of sound and light.

APPENDIX B (PUBLISHED TEXTS)

Astro Black Morphologies: Music and Science Lovers

Flow Motion

I remember talking about Einstein with John Coltrane while we were having an egg cream at the drug store on St. Mark's Place & Second Avenue. Actually, he was talking about numbers and their relationship to music, how intervals affected certain kinds of chords and how they could be used to create a different order in music. He brought up the theory of relativity. To him it meant that many things already existing had a relationship in music, and it was up to the musician to discover these relationships and express them musically. I saw Coltrane for the last time in March 1967 at the hotel & food store on Broadway and Fifty Seventh Street. He picked up the same subject of relativity almost exactly where we broke off our previous conversation. More than anything else, I remember him saying, "The universe is expanding."

—David Aronson [1]

POSSIBLE HISTORIES OF SCIENCE IN MODERN MUSIC

Prehistories, Sonic and Cosmic

The story of modern music in the past 100 years could be told as the history of a dialogue between the sonic and the cosmic, whose prehistory extends as far back as Pythagoras. It is in Pythagoras's thought, influenced by ancient Egyptian pedagogy, that we find the idea that the orbit of each of the seven planets produced a particular note according to its distance from the earth. Pythagoras called this *Musica Mensura*, usually translated as "Music of the Spheres."

Here was a sound so harmonious and rarified that ordinary ears were unable to hear it, the cosmic music that Plato of Alexandria tells us Moses heard when he received the Ten Commandments on Mount Sinai, the same sound St. Augustine believed the dying heard in their final breath, revealing to them the transcendental truth of the cosmos. For Plato, writing in the *Timaeus*, the harmonious, mathematical nature of Pythagorean cosmology reflected the harmonious relations of proportion that informed the creation of the universe, and its correlative, the creation of "one visible living being, containing within itself all living beings of the same natural order."

Twentieth-century music forms, from the jazz of Sun Ra and John Coltrane to the techno-electronica of Underground Resistance, have continued the grand Pythagorean tradition of conceiving the cosmos as purely metaphorical space, a sonic dimension of spiritual transcendence.

"One bright morning/Tell fly away, fly away" [2], "My ship set sail, my star-jet in the sky" [3]: the story of modern music, from the Negro spiritual of the Five Blind Boys of Alabama to the Ethiopianist logotheta of Lee "Scratch" Perry, can be told as a history of the cosmos as the darkness into which black music projected its quest for freedom, from slave ships to sun ships, segregation to post-colonialism.

Twentieth-century black music's concern with the cosmos was rooted in a liberationist aesthetic. This cosmos of racial yearning may have been, in a manner of speaking, the same as that evoked by Stockhausen in his *Moment*, "a musical miniature of the cosmos, just as it is a magnification into the acoustic time field of the unified structures of the harmonic vibrations in notes themselves" [4], a cosmos contiguous or parallel to dub music's thunder-and-lightning evocation of Old Testament elementalism.

Fig. 1. *Astro Black Morphologies*: detail of installation at the John Hansard Gallery, Southampton, U.K., 3 April–14 May 2005. (© Flow Motion/Adrian Ward, 2005. Photo: Steve Sharpton, courtesy of John Hansard Gallery) Generative design-based visualizations of X-ray data from Cygnus X1.



ABSTRACT

A compressed series of possible histories of science in modern music, the text outlines the themes of poetic and historic correspondences between music, cosmology and the body that informed the making of *Astro Black Morphologies/Astro Club Morphologies*, a multimedia installation and live soundtrack performance by Flow Motion in which data from possible black hole Cygnus X1 is transformed into an immersive electronic sound and image environment.

Flow Motion, c/o Steve Perry, Flat 5, 25 Brompton Road, London W14 9PL, U.K. E-mail: astromorphologies@flowmotion.com

Richard George, 40 Brompton Road, 10th Floor, London W14 9PL, U.K. E-mail: astromorphologies@flowmotion.com

Based on a paper presented at "Space Science, Technology and the Arts" (15th Workshop on Space and the Arts, European Space Research and Technology Centre (ESA ESTEC), Noordwijk, the Netherlands, 19–21 May 2004).



Fig. 2. *Aster Black Morphologies*, detail of installation at the John Hansard Gallery, Southampton, U.K., 5 April–14 May 2005. (© Flow Motion/Adrian Ward, 2005. Photo: Steve Shrimpton, courtesy of John Hansard Gallery) Generative design-based visualizations of X-ray data from Cygnus X1.

Whatever the case, our musical interstellar space has, in the past hundred years, become a busy place, from Gustav Holst's pre-World War I *Planets*, inspired by Alan Leo's book *What is Astrology?*, to Juan Arkin's post-Cold-War-era *Deep Space*, inspired by Dennis's *Deep Space* radio show of the 1990s.

Cosmic Music and the Music of the Cosmos

The story of modern music could be told as a history of space exploration, a history of the cosmos as purely sonic, representa-

tional space; an audiophilic screen—the cosmos as sound-picture space, a successful adventure of colonization, an overcrowding, even. Think of all those voices, all those sounds, over all those radio-phonic days and nights, still drifting through space.

Think of the names, think of the music: Joe Meek's "Telstar," Tim Buckley's "Saraswati," George Clinton's "Cosmic Slop," Jeff Mills's "Rings of Saturn," Rool Keith's "Earth People," David Bowie's "Starman," Ed Rush and Optical's "Wormhole," 4 Hero's "Parallel Universe," John

and Alice Coltrane's "Cosmic Music," San Ra's "Cosmic Tones for Mental Therapy"; the list could be endless. Now scientists are doing it too, an example being Dutch astronomer and computer scientist Alexander Ollongren's proposal for communicating music to extraterrestrials through interstellar messages, using Indonesian gamelan music.

So thoroughly seductive is modern music's idea of space as sonic imaginary that we could be forgiven for not wondering whether the cosmos had a music of its own. We know now that it does, beginning with the ground beneath our feet. The Earth hums, producing an inaudible, 4.6-billion-year drone that gives LaMonte Young an interesting organic precedent.

Scientists call Earth's planetary sounds *noctis*, whistles and idlers. Jupiter has its music too. "NASA's Cassini Space probe is picking up an eerie melody as it approaches Jupiter," reported *space.com* in December 2002. Cassini was picking up low-frequency sounds that, when converted into audible waves, "suggest[ed] the strain of some alien folk tune."

This new knowledge of cosmic sounds finds its earliest precedent in Karl Jansky's discovery of a source of radio noise from the center of our galaxy in 1932, the year 0 of modern astro-sonics. Jansky's discovery gave birth to a golden age of invisible light astronomy, and to an entirely new way of understanding the universe.

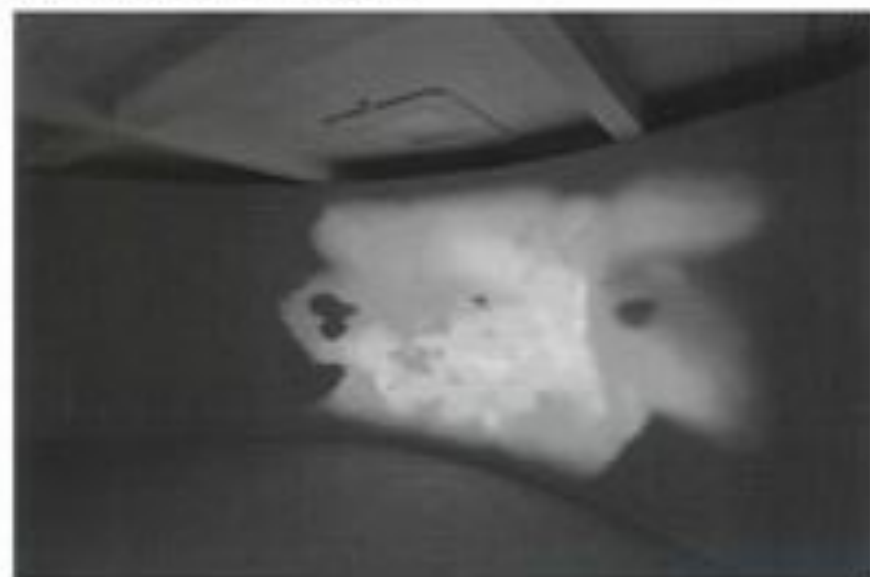
THE UNIVERSE IS IN MY VOICE

The story of astronomy in modern music could be the story of the discovery of the cosmos, or something of the cosmos, in the body.

Not an hour, if a few years, away from where John Coltrane and David Arman discussed on the expanding nature of the music and the challenge physics suggested for music, a short, round black man from the planet Saturn stood on the corner at the crossroads of 125th and Lenox in Harlem, listening to the music in the busy four-way stretch of heavy traffic and to the sounds above the clouds, beyond the stars.

He was Coltrane's friend San Ra. "Trane knew Ra from Chicago, and he finally started visiting our studio on West 82nd Street. San Ra gave him literature on outer space and we talked tenor while I showed him some of the things the band and myself were doing at the time," said Ra's saxophonist John Gilmore. "Trane really wanted to play avant-garde

Fig. 3. *Aster Black Morphologies*, detail of installation at the John Hansard Gallery, Southampton, U.K., 5 April–14 May 2005. (© Flow Motion/Adrian Ward, 2005. Photo: Steve Shrimpton, courtesy of John Hansard Gallery) Generative design-based visualizations of X-ray data from Cygnus X1.



music, but he didn't get the foundation until he listened to Sun Ra a lot" [5].

The story of cosmology in modern music could have as its central protagonist the figure of Sun Ra. After all, Ra's 40-year legacy of compositions are an Olympian testament to 20th-century music's attempt to re-sound the cosmos in the ear of the other, from the perspective of a visitor who viewed and experienced Earth and humans longing from a distant planet too harsh for human life.

To hear him tell it, Sun Ra, a.k.a. Mr. Ra, a.k.a. Mr. Mystery, a.k.a. Herman Blount, who first visited Earth in 1914 as an African American in Birmingham, Alabama, was, he said, named by the Cosmos after the sun god of ancient Egyptian myth, Ra, kin by name at least to Amen Ra, the supreme god of ancient Thebes, whom the priests of Thebes declared to be one and the same as the widely worshipped sun god Ra.

Amen Ra was adopted by the Greeks, who called him Ammon and identified him with Zeus, and by the Romans as Jupiter, the planet whose four moons were first observed by Galileo in 1609, 11 years before Blount's African ancestors were first brought to America. Sun Ra also described himself as "a scientist, I deal with equations. You might say a spiritual scientist and also a cosmic musical scientist" [6].

It was as if Ra were trying to inscribe into his newly renamed self, to ingest into the body of this new self, as much of the universe of history, mythology and scientific inquiry as he could, exhaling the cosmos re-sounded as music composition. Perhaps it was this pan-cultural, transdisciplinary cosmology that he alluded to in a 1972 composition: "Astro-black mythology/Astro-timeless immortality/Find your place among the stars/listen to the outer world; the universe is in my voice" [7].

THE UBIQUITOUS SOUND

The story of physics in modern music could begin with an echo.

Benoit Mandelbrot has said,

If you look at many shapes in nature—clouds, trees, small parts are the same as big parts: that's the definition of fractals. I used to be extraordinarily involved with music, especially opera. And then I became aware of my creation. Now fractals are everything [8].

The story of physics in modern music could begin with an echo, or the invention of the reverb, delay or echo unit.

It could begin with noise itself, a bang, a hiss, a flicker or Mandelbrot's discovery

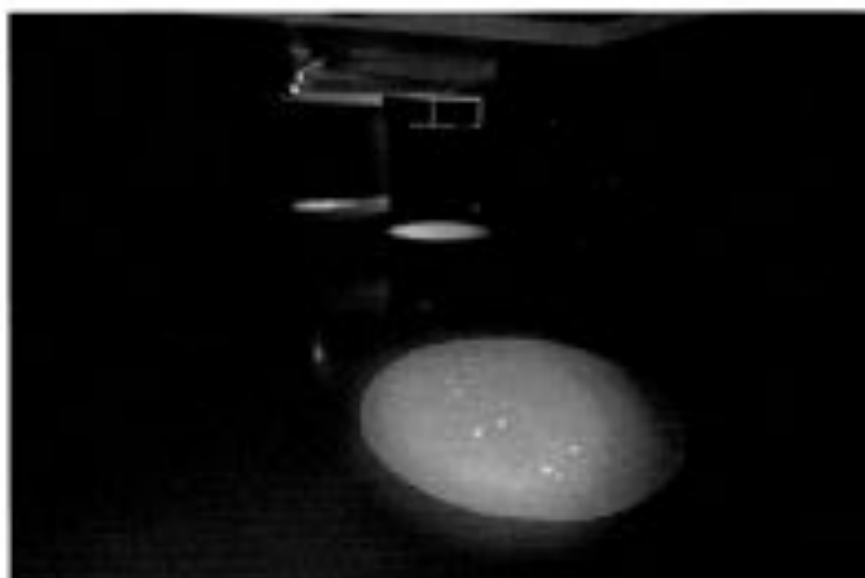


Fig. 4. *Astro-Black Morphologies*, detail of installation at the John Hansard Gallery, Southampton, U.K., 5 April–14 May 2003. (© Flow Motion/Adrian Ward, 2003. Photos: Steve Shorington, courtesy of John Hansard Gallery) Generative design-based simulations of X-ray data from Cygnus X1.

of flicker noise in systems as seemingly unrelated as the fluctuations of the stock exchange and the annual records of flood levels of the river Nile.

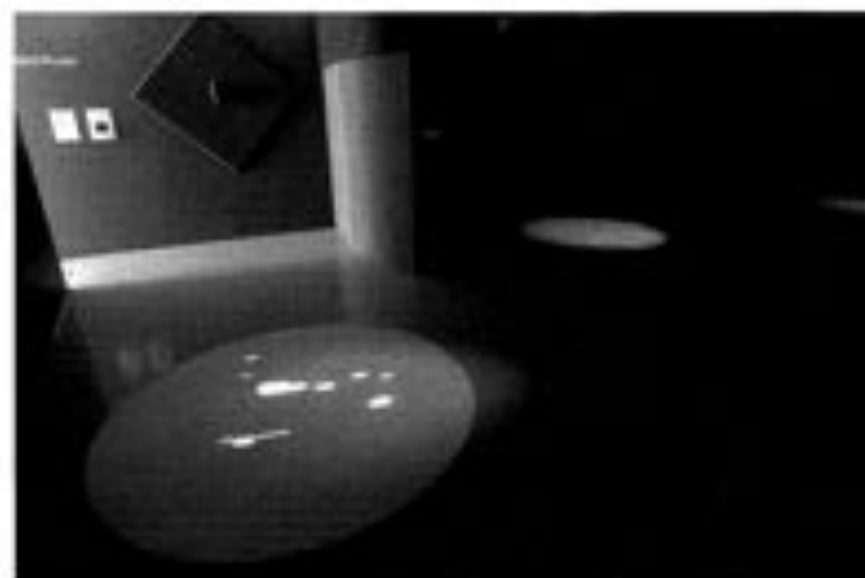
It could start almost anywhere, along the Nile or on a radio, as when Mandelbrot's colleagues Richard Voss and John Clarke, channel-surfing A.M. radio in 1975, listening for 12 hours to "musical selections, as well as announcements and commercials," found evidence of flicker-noise patterns and discovered that flicker noise is the wave form most suggestive of

music's loss of structure, memory and variation over time.

Flicker-noise patterns, Voss and Clarke found, were less chaotic-sounding than white noise and less regimented than brown noise. Situated between the two but unlike either one, flicker noise shares music's founding pleasure principle of balance of order, predictability and surprise.

Voss and Clarke obtained their findings by passing recordings by Bach, Scott Joplin, Milton Babbitt, Eliot Carter, Stockhausen and Betty John through a band-

Fig. 5. *Astro-Black Morphologies*, detail of installation at the John Hansard Gallery, Southampton, U.K., 5 April–14 May 2003. (© Flow Motion/Adrian Ward, 2003. Photos: Steve Shorington, courtesy of John Hansard Gallery) Generative design-based simulations of X-ray data from Cygnus X1.



pass filter, squaring the voltages and then "passing the signal through a low pass filter with a cut off frequency of 20 hertz. The resultant low frequency voltage fluctuations were then subjected to an autocorrelation function to determine the relationship of these fluctuations over time" [9].

The story of modern music could be told as a moment in a history of transformations of matter, identity and form, using the technologies of myth, science and sound, a story of morphology and process, in which physicists, as well as radio engineers and musicians, are scientists of sound.

SOUND ART, SOUND TRANSFORMATION: ASTRO BLACK MORPHOLOGIES

The story of modern music could also be called the Poetics of Space. It could be a story about time and process, about improvisation, the suspension of closure and what they might tell us about our world and the cosmos. This story may have something to do with the discovery in 1926 by Charles Thomas Bolton and a team of scientists of Cygnus X1, a (possible) black hole, in our galaxy, light-years away from Earth.

Cygnus X1 has become the source of a new opening for dialogue between electronic music and astronomy. In 2002 scientists Ian McHardy and Phil Uttley at Southampton University announced that data readings of X-ray debris from

Cygnus X1 were implicitly musical in structure.

The patterns of variations they observed in the X-ray output of Cygnus X1, detected by NASA's Rossi X-Ray Timing Explorer Satellite, had a direct correspondence with those of super-massive black holes in distant galaxies. Uttley compared this electromagnetic output to improvised music, with short and long time variations analogous to musical notes and bars with transitions from one pattern of variation to another similar to changes in musical style.

Music, mnemonic patterns, correlation in pattern variation, flicker noise: different variations of the same theme, the same ubiquitous phenomena.

This musicalizing of scientific process and the musical nature of its source raised a few questions for us: What could this music sound like? What openings could it suggest for sound art? How could we re-sound this newly discovered music of the cosmos?

We met with Uttley in February 2003, and he gave us some of his research data: thousands of digits representing the "light curve" for Cygnus X1, obtained by recording the X-ray flux in time steps of $\frac{1}{10}$ of a second: a method of observation with a musical parallel in granular synthesis and its process of subtraction, discontinuation and reconfiguration of sonic matter.

When taken to extremes, granular synthesis creates an expanded sonic picture populated by signal traces and empty spaces, a process of negation not unlike

dub music's process-based technologies and techniques for subtracting, reshaping and re-sounding sound sources.

We collaborated with astrophysicist Tim O'Brien at Jodrell Bank Observatory and converted the data from text into audible phenomena expressed as both intensities and frequency variations. We then used granular synthesis and dub's trace-producing processes as morphological tools for the production of a series of possible re-soundings of Cygnus X1's distant, ancient music. This process provided the basis for our installation and sound art performance, *Astro Black Morphologies/Astro Dub Morphologies* (Figs 1-6, Color Plate A). (The installation and performance has been staged at the John Hansard Gallery, Southampton, U.K., and the Science Museum's Dima Centre, London.)

Granular synthesis suggests that the space around an object is no less rewarding than the object. Dub suggests that the object, a space as much as the space around it, is no more than a trace in the making. The story of modern music could be the story of the engineering of absence into form.

A UNIVERSAL VIBRATION

If I were not a physicist, I would probably be a musician. I often think in music. I live my daysdreams in music. I see my life in terms of music.... I get more joy in life out of music.

—Albert Einstein, 1929 [10]

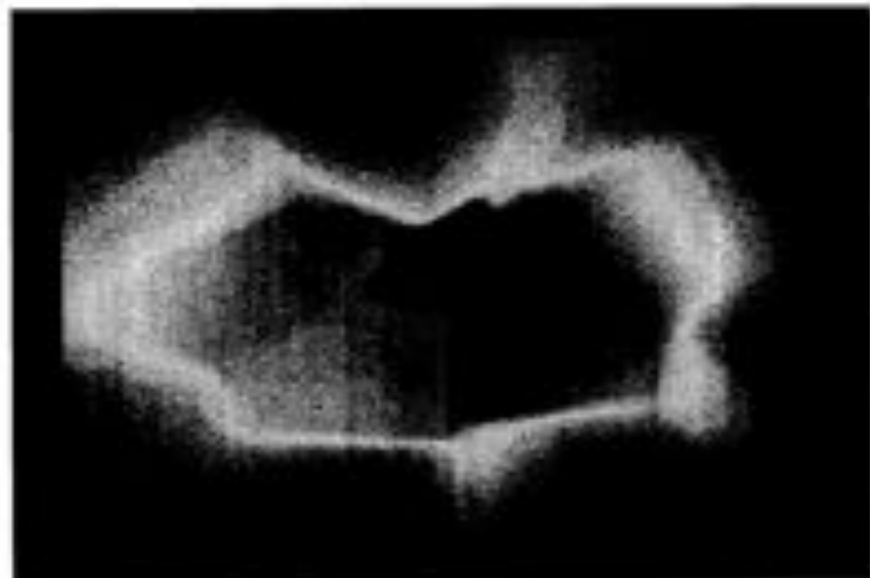
The story of science in music could be that of a universal vibration in the form of a mystery. Thinking about the presence of flicker noise in X-ray output of Cygnus X1, we wondered whether music was ubiquitous in nature.

Not exactly. Uttley explained that "music is a pun, an aspect of nature, a process, and flickering type variability is common in nature; because music is an aspect of nature, you see flickering in music as well" [11].

Perhaps the reason, or at least part of the reason, we are drawn to music can be explained by the discovery by Boston University physicist H. Eugene Stanley's research group. In 1992 it showed that flicker noise is also discernible in human DNA: something of the common and its music, inscribed in the body at the cellular level.

The problem is that scientists have not developed a reliable model to account for the wide-ranging presence of flicker noise, from black holes to DNA, from the

Fig. 6. *Astro Black Morphologies*, screenshot of generative design-based visualizations of X-ray data from Cygnus X1. (© Flow Motion, Adrian Ward, 2003)



music of Stockhausen to the body of Sun Ra. The reason for the ubiquity of flicker noise remains a mystery. As Stanley put it to *Scientific American*, "There is some magical phenomenon going on that we just do not understand" [12].

To compound the mystery, flicker noise has also been found in recent studies of human behavior. Psychologists Eric-Jan Wagenmakers, Simon Farrell and Roger Ratcliff at the University of Amsterdam have discovered that "recent analyses of serial correlations in cognitive tasks have provided preliminary evidence for the presence of long range serial dependence known as flicker noise" [13]. They also tell us that to this date, no general explanation for the universality of flicker noise has been widely accepted.

Nonetheless, it seems safe to say that music presents in its sound an intimate part of ourselves, which we also find in the cosmos, to which we are in turn connected by music. Flicker noise seems to be a universal vibration that connects musi-

cal, science, the body and the cosmos in an ever-expanding loop extending from the here and now to thousands of light-years into the past and whose feedback produces endless proliferations of music and relations of musicality between musicians, artists and scientists, and new cosmic openings for sound-art practice.

References

1. Quoted in J.E. Thomas, *Chance: the First Three Books* (Da Capo Press, 1973) p. 100.
2. The Original Five Blind Boys of Alabama, "I'll Fly Away," *The Norton, Norton/Specialty SPCL 7041-2* (1980).
3. Lee "Scratch" Perry & the Dub Syndicate, "Blackness," from *Time Bomb: I De Dread Dread* (FAB 5590002) (2001).
4. Karlheinz Stockhausen, *Musicus Strips*, WD 802672 (1993).
5. Thomas [1] p. 100.
6. Robert D. Koch, Joseph D. Keane, NJ Lyle Sun et al., (1984), quoted in David A. Matthews, "The Cosmic-Music Experiments of Sun Ra" (1990) www.cosmic-music.net/ra/ra.htm.

7. Sun Ra, "Jazz-Black," *Jazz-Black Impulse* 16-0153 (1973).

8. Brent Marshall, interview with Jeffrey Gauthier, *WuF* No. 8 (August 1994) p. 95.

9. R.F. Yoon and J. Clarke, "1/f Noise in Music and Speech," *Nature* 256 (November 1973) pp. 505-506.

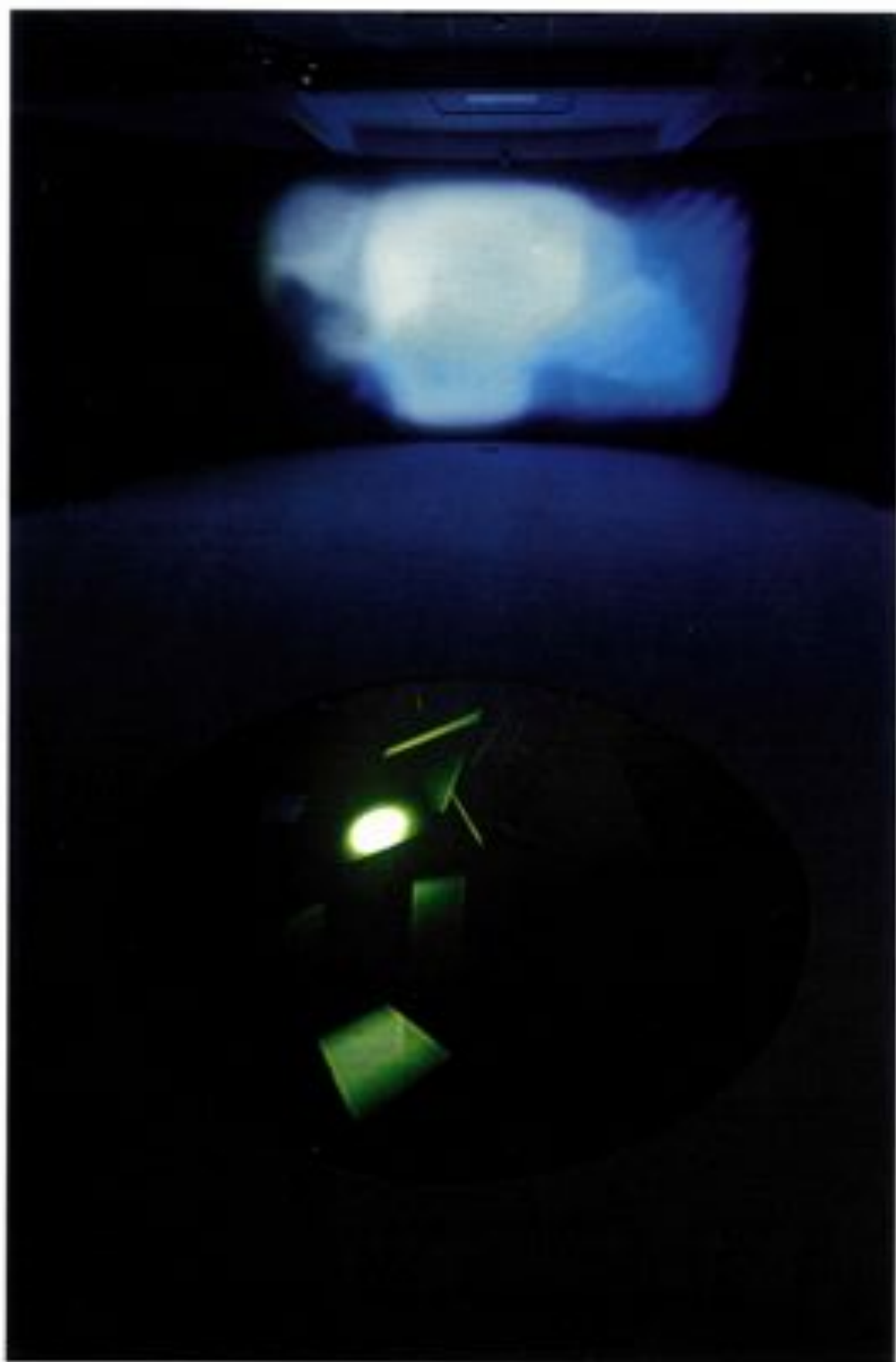
10. "What Life Means to Einstein: An Interview by George Johnson," *Scientific American* (26 October 1999).

11. Phil Valley, interview with Peter Motion, 2005.

12. Philip Tarr, "Noise Nucleolides," *Scientific American* 287, No. 3, 35-37 (September 1999).

13. E.J. Wagenmakers, S. Farrell and R. Ratcliff, "Variations and Implications of 1/f Noise in Human Cognition," *Northwestern University, Australia, Psychonomic Bulletin & Review* 11 (2004) pp. 579-675.

Flux Motion are London-based artists Anna Poon and Eddie Group. Their work has been exhibited and performed at the Barcelona Museum of Contemporary Art, the Pompidou Centre, Paris; the International Institute of Visual Art, the Schweizer Herbst Arts Festival in Austria; the Yari Gagosin Cinnamon's Club, Moscow; Sadler Wells's Lilian Baylis Theatre; the John Hansard Gallery, Southampton; and the Science Museum Dana Centre, London.



Flow Motion/Adrian Ward, *Astr Black Morphologies*, detail of installation at the John Hansard Gallery, Southampton, U.K., 3 April–14 May 2005. (© Flow Motion/Signwave, 2005. Photo: Steve Shrimpton, courtesy of John Hansard Gallery) Generative design-based visualizations of X-ray data from Cygnus X1.

Music and migration

Edward George and Anna Piva

Introduction

This essay looks at the role of the Bible during the formative years of European imperialism in creating a sonic diaspora from which migrant music forms emerged, aided by the technologies of lithographic print media and phonography.

The text traces the idea of the migrant as a conceptual persona and material reality, the idea of the migrant's body as a musical archive and recording technology, and the role of radio and astronomical technology in mapping spaces beyond the reach of the stateless and the displaced.

We explore the *sound* of music as a space of reconciliation and apocalypse, of impossible identities and nation-states which have yet to exist and may never exist; a space in which migrant reverie becomes cultural property.

Returning to the idea of the migrant as self-empowering conceptual persona, we look at the evocation of the cosmos as the supreme symbol of migrant displacement and belonging.

Music and migration

Oh we've been travelling
More than two thousand miles
...
The sun so red hot
Hotter than hot
...
Let me tell you
This is the song we were singing
Coming along, oh yes ("Travelling," Burning
Spear, Jamaica, 1976)

Yes, we have always been travelling. Maybe we were born in the centre of Africa and we left Africa to go to Europe, to Asia, to America and so on. I think that the human species is always travelling, we are the *dasein* in the sky, not in the

land. (Michel Serres, in conversation with Hari Kunzru, Paris, 1995; Kunzru 1995)

The migration of forms: history and religion

The translation of the Bible from Latin to modern European languages between the 13th and 15th centuries coincided with the spread of Christianity across the world; the Bible also introduced the trope of the promised land into migrant discourse, providing migrant music with an indomitable poetic metaphor, its central, recurring theme (George & Piva 2011).

Against previous histories of the migration of music by word of mouth over relatively discrete expanses by migrants, nomads, and wanderers, the voyages of the founding figures of European expansion and the subsequent slave trade gave the movement of musical forms an unparalleled reach. The invention of the telescope is as significant a moment in the technologies of the migration of sonic forms as John Wycliffe's translation of the Bible from Latin into vernacular English in 1382.

Seafaring explorers to Africa and the Americas were accompanied by missionaries and it was through their efforts that psalmody, the music of the Bible based on the Book of Psalms, made its way into the world beyond Europe (Gillingham 2008: 128). Portuguese Catholics were among the first missionaries to make incursions into sub-Saharan Africa, arriving in Guinea-Bissau as early as 1445. Congo became a Christian kingdom in the late 1400s. The spread of Christianity in the Americas following the arrival of Christopher Columbus in 1492 is well documented (Robinson 2003; Lippy et al. 2008).

The first complete English language collection of psalms, *The Whole Book of Psalms Collected into English Metre*, by Thomas Sternhold and John Hopkins, was published in England in 1562, and featured texts from the Psalms

"Set forth and allowed to be Sung in all Churches, of all the People together, before and after Morning and Evening Prayer; and also before and after Sermons; and moreover in private Houses, for their godly Solace and comfort: laying apart all ungodly Songs and Ballads, which tend only to the nourishing of Vice, and corrupting of youth" (Sternhold & Hopkins 1812) The book was so popular it remained in print well into the 19th century; the final edition being published in 1828, by which time its popularity had extended beyond Britain and had become a standard text in churches in the southern states of North America.

The publication of Isaac Watts' *Hymns and Spiritual Songs* in 1707 marks a break with Sternhold and Hopkins' exclusive use of biblical texts in religious vocal music. Regarded as a founding figure of English hymnody, Watts was the author of over seven hundred religious songs, and was the first truly popular hymn writer. His appeal lay in his use of original lyrics rather than biblical texts, his use of personal subjectivity in his song writing, and, above all else, his idea that anyone, not just members of the clergy, could and should pen a hymn.

Watts' hymns were also popular in Britain's American colonies, particularly among slave owners. In his book *The Religious Instruction of the Negroes in the United States* (1842) Presbyterian minister and plantation owner Charles Colcock Jones described the value of Watts' work for both the church and the slave owners, who were forced, if only by the fact of proximity, to listen to songs laden with what must have been alien sounding, and perhaps threatening retentions that survived the passage from Africa: "One great advantage in teaching them (slaves) good psalms and hymns, is that they are thereby induced to lay aside the extravagant and nonsensical chants and catches and hallelujah songs of their own composing" (Jones 1842: 266).

On the other side of the racial divide Watts' hymns were used to subversive effect. It was through his songs that slaves were introduced to the idea that biblical narrative could form

the basis of a sacred music. The earliest generation of African American ministers took seriously Watts' question, that if, "ministers of the gospel in our day are to acquire and improve the gifts of knowledge, prayer and preaching by reading, meditation and frequent exercise . . . [w]hy then should it be esteemed sinful, to acquire a capacity of composing a spiritual song?" (Watts 1813: 19). Ministers and deacons began composing their own spirituals.

Watts' view of Africans was consistent with his view that Britain alone was the nation of God's divine elect (Watts 1818: 84). Africans, he wrote in his sermon, "The Scale of Blessedness: or, Blessed Saints, Blessed Saviour, & Blessed Trinity, Ps 1xv.4." were "poor savages," the reason for whose "dismal estrangement from God was "because it pleased thee, whose counsels are unsearchable" (Watts 1812: 173).

Nonetheless, Watts' hymns provided the blueprint for a new sonic tradition, the Negro spiritual, and it was through this new form that the sons and daughters of enslaved Africans would voice their desire for freedom to audiences throughout the white world. Jones, however, was pretty clear that teaching such songs to slaves was in no way an endorsement of the abolition of slavery (Jones 1842: 193).

Jones certainly would not have thought well of the efforts at archiving the plantation songs of America's slaves by a group of abolitionists. *Slave Songs of the United States* (1867), compiled by William Francis Allen, Charles Pickard Ware, and Lucy McKim Garrison is the first African American songbook. Songs and fragments of songs contained in this collection surfaced in later songbooks compiled by African American authors. For example, the refrain of an anonymous author's composition, "O brothers, don't get weary," returns in the song "There's A Great Camp Meeting In The Promised Land" in the Fisk Jubilee Singers' songbook *Jubilee Songs as Sung by the Jubilee Singers of Fisk University* (1872). This song resurfaces in another important anthology, *American Negro Songs and Spiritual* (1940), compiled by John W. Work, a musicologist and musician who in 1946 became the Fisk Jubilee Singers' musical director.

In summary, music migrates through writing, disseminates, and creates a diaspora of sound through and across texts. Aloys Senefelder's invention of the lithographic printing technique in around 1796 (Senefelder 1968) is as significant a technology in the migration of sonic forms as Edison's phonographic machine of 1877 (Steffen 2005: 25) and Berliner's phonographic disc and gramophone which appeared a year later. These technologies were central to the success of the Fisk Jubilee Singers' ambassadorial role in taking the early music of African America across the Atlantic to Britain, where they first performed in 1873, and more recently to Africa, where a contemporary incarnation of the group performed at Ghana's 50th anniversary celebrations in 2007.

Migrating music, migrant body

"The body is a symphony of rhythms" (Strogatz 2003: 1). The migrant, a conceptual persona and a material reality, arrives with perhaps little more than the clothes on her back and a body through which dreams, ideas, and memories flow. It is in the body and its rhythms that the migrant creates an archive of songs in lieu of the past fading in the distance behind her and the future fading into view. In the beginning, in the body's beginning, before the word, was rhythm.

Imperfect, irreplaceable archive, the body functions in migration as its own end, its own beginning and as a recording technology through which time, place, and sonic traditions dissolve and reconfigure in an indomitable production and proliferation of forms. For example, in the music of avant garde jazz composer Albert Ayler, musicologist Robert Palmer heard the voices of the Dan people of the Ivory Coast and Liberia, and in these voices Palmer heard African American singing evangelist Joseph "Blind" Willie Johnson's, whose 1938 recording "Dark was the Night, Cold was the Ground" traveled further than most migrant compositions (Palmer 1978). Astronomer Carl Sagan featured the song on a disc of images, sounds, messages, and music from planet Earth, compiled in 1977 for aliens in the very

distant future and installed on the *Voyager* spacecraft: "The spacecraft will be encountered and the record played only if there are advanced space faring civilizations in interstellar space. But the launching of this bottle into the cosmic ocean says something very hopeful about life on this planet" (NASA 2010).

At the same time, however, the sound of music maps and masters the very spaces from which the body of the migrant is prohibited. Through the technologies of radio and phonography the displaced evokes the end of wandering. Through phonography the migrant imagines a radio station for a homeland: in the song "Radio Romanista" (2009) the Serbian Roma group Kal imagines a national radio station for the stateless Roma – and by implication, perhaps, a Roma state. The hope of music is the hope of the almost vanquished and the hope of the dead that, if not now then perhaps later, someone will listen: the BBC broadcast in 1945 of "Hatikva," the future anthem of the state of Israel by Jewish survivors of the Bergen-Belsen concentration camp reinforced the necessity of the formation of the state of Israel.

Similarly, through the radio of the stateless, the music for a state which has yet to exist and may never exist, becomes part of a language of possibility: Kamal Boullata notes that in radio broadcasts of the intermittent Palestine Liberation Movement following the Israeli/Palestine Six Day War "one of the first songs to be aired over the radio was 'Beladi'" (Boullata & Rosen 1974):

Palestine, your people shall not die.
It shall defy silence . . . (Darwish et al. 1974)

Composed by Said Darwish, with words by exiled Egyptian nationalist Mustafa Kamel, "Beladi" (aka "Biladi") was, in 1967, a tentative, unofficial anthem of Palestine. In 1979 the song was revised and adopted as the national anthem of Egypt.

Migration in music

Migration in the spaces of music takes place in worlds which can exist only in compositional, acoustic space, in the space of the body, the

imagination, worlds which, in the case of dub (a musical genre and a sound mixing process) and its preoccupation with erasure, space, and the dissolution of the voice, mirror the fate of the migrant. The animate emptiness created by dub mixing reduces the voice of the migrant, the transplanted African, to a trace of her former self, returning to sound as a fleeting apparition, performing, becoming, a call to the rescue of memory. In Burning Spear's "Walking in dub," the dub version of his composition "Travelling" rhythm, the song's motor of movement, is stripped to its barest components, an outline, intimating movement and silence, in which the voice enters: "We've been travelling, More than two thousand miles, More than two thousand miles . . ." (Spear 1976b) and exits into silence, forming a memory in its absence, of its presence and the image of movement, of walking . . .

It is in the space of music, its world of words and sounds, that private reverie becomes cultural property. Music provides an opening into public space for the otherwise impermissible apocalyptic phantasms and fantasies of, for example, the seven million or so African Americans who, between 1916 and 1970, migrated from slavery and segregation in the American South to relative freedom in the cities of the West Coast and the North.

In the landscapes of gospel music's narratives, in Mahalia Jackson's "Walk in Jerusalem" (Jackson c.1956), the migrant's journey is incomplete save for its impossible end, the resolution of the body's movement beyond death, the evocation, by those torn out of time, of the end of time, a journey beyond death whose final form of movement is to embark on a crossing of the water which separates the land of the dead from the land beyond death: "When I get down to the river, I'm gonna stick my sword in the sand, For I spy the ol' ship of Zion Who took a-many to the Promised Land."

An impossible journey, whose final destination is a spectral Jerusalem, location of suffering's resolution, "Way up in Jerusalem, when I die":

Where there ain't no dying there
Where the saints shoutin' victory

Oh, they singin', Lord, everywhere
I hear the voice of friends I've known
They been gone on, gone on to Glory
Well, well a long time ago
They been waitin'
They been watchin' (Jackson c.1956)

In the space of music, a space of fantasy and phantasms, the reconciliation of the conqueror and the conquered, the claims and counter-claims of the invader and indigene, are achieved by a reconciliation of conflicting compositions. "Y'Israel" (2006), a speculative anthem by Slovenian conceptual artists Laibach for an Israel of dissolved Israeli-Arab tensions, incorporates the anthems of the state of Israel and Palestine.

In the space of music, a memorial space of fantasy and futurity, the borders of rational discourse are dissolved, and the displaced imagine impossible nation-states, reimagine points of origin and identity. Laibach's deadpan conceptualism extends to the group presenting themselves as citizens of the imaginary NSK state, a "state in time" with no physical referent, but with passports that could be purchased from the group (Laibach 2010). The passport of Alabama-born jazz composer Sun Ra claimed him as an indigene of the planet Saturn. In Ra's oeuvre (1948 to 1993) the cosmos is the origin and destination of the displaced African. "Astro Black Mythology . . . the universe is in my voice" (Ra 1972), declares Ra, and in that voice is the melancholy of exile and the thrill of the wanderer.

The case of Sun Ra

Sun Ra, born Herman Poole Blount in 1914, claimed the name Ra was "the oldest name known by man to signify an extra-terrestrial being" (Stowe 2003). The preoccupation in the music of the stateless, the migrant, the displaced, with the cosmos as the supreme symbol of self-(re)invention and belonging begins with Sun Ra.

In Ra's music the conceptual persona is the liberating, counter-rational truth of the migrant's existence: it offers a re-sounding of the rationalist historiography of forced migration, a

shifting of the physical location of African American origin to a conceptual intersection of science fiction, mythology, and pre-Christian, African history. It also recasts Ra as a doubly displaced, self-made myth, in an act of reinvention in which his former self, the negro descendant of slaves, is rejected as a fiction of the sentient (white) world, a sign of its ability to confer meaning on migrant presence and prehistory, while eliding its own migrant histories.

Ra the migrant is an *impossible* migrant, a lone figure from a distant planet hostile to human life, and whose lineage is simultaneously ancient terrestrial and extraterrestrial. This migrant's journey is across the universe, "from planet to planet" (Ra 1956/2000); destinations vary: "Next stop Mars!" (Ra 1963/2000).

Conclusion

Migrants' music, an effect of human migration and the coming together of a range of technologies, is the product of bodies in motion, of the body's archival and recording capacities – of the body as its own musical instrument and its capacity for orchestrating the movement of the self in space.

In music, through music, the migrant propels an idea of herself – in place of, ahead of, her body and her time – into space, into possible spaces of human settlement, into spaces only possible in – and through – music, into the uninhabitable spaces of our cosmos.

Migrant music offers an opening onto futures which in turn offer substance to its speculative fantasies of migration's end: who would have thought that "Next stop Mars" would find its correlative in the announcement by US president Barack Obama that Mars would become the destination of human exploration by the mid-21st century (Amos 2010), a small section of which has been named the Promised Land (Wilson 2007)?

SEE ALSO: Arts, music, and migration; Cross-cultural bonds; Cultural and social memory; Culture and migration, a critical assessment; Transculturalism

References and further reading

- Allen, W. F., McKim Garrison, L., & Pickard Ware, C. (1867) *Slave Songs of the United States*. Electronic edition, Documenting the South. University of North Carolina at Chapel Hill. 2000. At <http://docsouth.unc.edu/church/allen/allen.html>, accessed Feb. 27, 2012.
- Amos, J. (2010) Obama sets Mars goal for America. BBC News, April 15. At <http://news.bbc.co.uk/go/pr/fr/-/1/hi/sci/tech/8623691.stm>, accessed Feb. 27, 2012.
- Boullata, K. & Rosen, M. (1974) *Palestine Lives! Songs from the Struggle of the People of Palestine* [liner notes]. Paredon Records (PAR01022), USA, Smithsonian Center for Folklife and Cultural Heritage.
- Burning Spear (1976a) Travelling. Clocktower Records (CT317), USA.
- Burning Spear (1976b) Walking in dub. Clocktower Records (CT318), USA.
- Darwish, S. & Kamel, M. (1974) Beladi. In Al Fat'h, *Palestine Lives! Songs from the Struggle of the People of Palestine*. Paredon Records (PAR010220), USA.
- George, E. & Piva, A. (2010) Introduction. In *Promised Lands*. At www.iniva.net/pl/intro/, accessed Feb. 27, 2012.
- Gillingham, S. E. (2008) *Psalms through the Centuries, Volume 1*. Malden, MA: Wiley-Blackwell.
- Hull, J. M. (2008) Isaac Watts and the origins of British imperial theology. *International Congregational Journal* 4(2), 59–79. At www.johnmhull.biz/Articles2/IsaacWatts2.html, accessed Feb. 27, 2012.
- Jackson, M. (c.1956) Walk in Jerusalem. In *Essential Mahalia Jackson* (2004). Columbia Records/Legacy (89067), USA.
- Jones, C. C. (1842) *The Religious Instruction of the Negroes in the United States*. Documenting the South. Rare Book Collection. University of North Carolina at Chapel Hill. At <http://docsouth.unc.edu/church/jones/jones.html>, accessed Feb. 27, 2012.
- Kunzru, H. (1995) Michel Serres interview (1995). harikunzru.org. Dec. 17, 2008. At www.harikunzru.com/michel-serres-interview-1995, accessed Feb. 27, 2012.
- Laibach (2010) Ausstellung Laibach Kunst 1980–2010 Red District Black Cross. At www.laibachkunst.com/symposium-programme.php, accessed Feb. 27, 2012.

- Lippy, C. H., Choquette, R., & Poole, S. (1992) *Christianity Comes to the Americas, 1492–1776*. New York: Paragon House.
- NASA (2008) What Is the Golden Record? National Aeronautics and Space Administration. At <http://voyager.jpl.nasa.gov/spacecraft/goldenrec.html>, accessed Feb. 27, 2012.
- Palmer, R. (1978) *Albert Ayler: The Dedication Series/Vol. VII: The Village Concerts* [liner notes]. Impulse/Abc Records (LP IA-9336/2), USA.
- Ra, S. (1956/2000) We travel the spaceways. In *We Travel the Spaceways* (1956) Saturn (HK 5445), USA; *Evidence* (1992) (22038), USA.
- Ra, S. (1972) Astro Black. In *Astro Black*. Impulse (AS-2295), USA.
- Ra, S. & his Myth Science Arkestra (1963/2000) Next stop Mars. In *When Angels Speak of Love* (1963). Saturn (1966), USA; *Evidence* (2000) (22216-2), USA.
- Robinson, B. A. (2003) Past genocides committed against Native Americans. Ontario Consultants on Religious Tolerance. Oct. 12. At www.religioustolerance.org/genocide5.htm, accessed Feb. 27, 2012.
- Senefelder, A. (1968) *Complete Course on Lithography: The Classic 1819 Treatise*. New York: Da Capo.
- Seward, T. F. (ed.) (1872) *Jubilee Songs As Sung by the Jubilee Singers of Fisk University, Nashville Tennessee*. New York: Bigelow & Main.
- Steffen, D. J. (2005) *From Edison to Marconi: The First Thirty Years of Recorded Music*. Jefferson, NC: McFarland.
- Sternhold, T. & Hopkins, J. (1812) *The Whole Book of Psalms Collected into English Metre*. Oxford. churchofgodmusic.org. 2001. At www.cgmusic.org/workshop/oldver_frame.htm, accessed Feb. 27, 2012.
- Stowe, D. (2003) From Ephrata (F-Ra-Ta) to Arkestra. Michigan State University. At www.esoteric.msu.edu/VolumeV/Arkestra.htm, accessed Feb. 27, 2012.
- Strogatz, S. (2003) *Sync: The Emerging Science of Spontaneous Order*. New York: Hyperion.
- Szwed, J. F. (1997) *Space is the Place: The Lives and Times of Sun Ra*. New York: Pantheon.
- Watts, I. (1707) *Hymns and Spiritual Songs*. Project Gutenberg. Aug. 31, 2004. At www.gutenberg.org/ebooks/13341, accessed Feb. 27, 2012.
- Watts, I. (1812) The scale of blessedness: or, blessed saints, blessed saviour, & blessed trinity, Ps 1xv.4. In *The Works of the Rev. Isaac Watts D.D. in Nine Volumes*, vol. 1. Leeds: Edward Baines.
- Watts, I. (1813) On the improvement of psalmody. In *The Works of the Rev. Isaac Watts D.D. in Nine Volumes*, vol. 9. Leeds: Edward Baines.
- Watts, I. (1818) Psalm 47. In *Psalms of David Imitated in the Language of The New Testament and Applied to the Christian State and Worship*, p. 84. Project Gutenberg. Aug. 12, 2004. At www.gutenberg.org/catalog/world/readfile?fk_files=1490519&pageno=84, accessed Mar. 4, 2012.
- Wilson, J. (ed.) (2007) Three years on Mars: opportunity's story. Jan. 23. At www.nasa.gov/multimedia/podcasting/jpl-mer-20070122-vodcast.html, accessed Feb. 27, 2012.