URBAN ASTRONOMY IN FOUR PARTS

SUKUMA MKHIZE

JUNE - JULY 2019

A4 ARTS FOUNDATION

Text : Sukuma Mkhize Editor : A4 Press Production : Nisha von Carnap Contributors : Nicolaas van Reenen, Mia Thom, David Brits, Prof. Jeff Murugan Design : Atlantic Press Photography : Kyle Morland Published by A4 Arts Foundation on occasion of Sukuma Mkhize's Artist in Residency June/July

A4 Arts Foundation 23 Buitenkant Street District Six Cape Town

INTRODUCTION

It is very unusual to attempt any detailed appreciation of the NIGHT SKY from within an environment that is heavily light polluted, such as in an Urban/City Space, yet most of us spend the majority of our lives going to school, university, work, paying rent, visiting galleries & going to art fairs in precisely these conditions. Furthermore, we access most of our knowledge about the COSMOS from newspaper press releases, television, social media, semi popular journals, science fiction films and libraries; all readily available within city spaces.

Most of the earlier things I began appreciating about astronomy were things taught in a classroom before I went to look for them. Eclipses (dim as they are) captivated enough to make one seek an explanation. Thinking of planets as rocks suspended in empty space and held thinly by gravity over vast distances was enough to stretch the imagination without wanting to go to the desert.

This is where I think physics holds the higher ground to astronomy. Most of the things one can learn all the way to higher level theoretical work are generally found everywhere around us: why is the daytime sky blue, why are the oceans blue, how are rainbows in soap bubbles? These sorts of queries - classical problems in electrodynamics - have always been around and seemed to require elaborate calculations once you did get into it.



The link between astronomy and physics is simple: when that which we can see and admire in the night sky requires a physical explanation, that's astrophysics. Another way of looking at this is: If physics is immediately accessible, because the things we can study with great detail are everywhere around us – light bulbs, oil puddles, ice cubes, radio transistors (and the links between physics and engineering are plenty) – then the night sky becomes one gigantic laboratory to test out the ideas accumulated from the everyday objects around us. In a way most of physics is urban already. It is fortunate (and somewhat prosaic) that the night sky behaves in this way. It offers the ideas in physics plenty of the extreme conditions from which they can be examined.



URBAN ASTRONOMY

If physics can be understood as a body of knowledge we accumulate within the harsh comforts of the Urban Space from everyday objects around us, can the same be said of the objects found in astronomy? For the most part, the answer to this question is no. The objects in the sky can only be studied in great detail by closely examining the light they emit. Most of them are extremely far away (the closest star system **a centauri** being four **light years**¹ away), making them very faint to the human eye. Astronomers rely on both ground based and space telescopes to absorb this faint light and to further split it into spectra, which is where almost all the physical information is contained.

Astrophysics is a rich experimental science with extremely precise measurements about objects we have no direct experience of, except through the light they emit. The glowing urban sky caused by artificial city lights makes it harder to see the fainter objects we are mostly interested in astrophysics. Urban Astronomy therefore is by default a branch of astronomy which must derive some of the well known results that have been carefully developed in observatories outside light polluted environments.

Definition: Urban Astronomy is a class of astrophysical observations that can be carried out from within heavily light polluted environments.

It is important to bear in mind that some of the cities we live in developed around what used to be observatories (including our own, Cape Town) prior to being enveloped by light pollution. The sky is the same in the city as in the nearby desert, the only difference is how faint can one see. Indeed, some of the most spectacular images of the moon and the night sky have been taken by astronomy enthusiasts located in city spaces. The analogy here is that of dropping the sky and super imposing it onto the urban space, selecting objects that can still be observed within this context.

* Distance light travels in a year, 1 light year = 9.46 thousand billion kilometers. (ACM Transactions on Embedded Computing Systems, Vol. 0, No. 0, Article A4, Publication date: July 2019.)



Cosomological Physics



The constellation of city lights around London, England. Recorded with a digital camera from The International Space Station. ISS Crew, JSC, NASA, Earth Sciences & Image Analysis Lab

A4 ARTS FOUNDATION ARTIST RESIDENCY IN ASTRONOMY

Astrophotography is perhaps the most obvious place where the intersection of Astronomy & Creative Arts occurs. Photography in contemporary culture is mostly associated with the visual arts and astrophysics as physics, however in astro-photography the two combine to provide accounts of the same phenomena that are both compelling to the artist and the physicist.

It is important to also say that the conversation between art and science is not a new one. It is however relatively new in South Africa. Both astrophysics and art are concerned with representations of the physical world in articulations that are understandable in human terms as well as both pointing to the unknown within this pursuit. Collaborations between artists and scientists do seem to offer a fresh way of looking at concepts in both spheres that further pave the way for new discoveries and well informed articulations. To know some of the physics conceptually behind the most spectacular sunset in Camps Bay and appreciate that the physics is somewhat connected to that of the furthest objects seen in the night sky, is one of the most humbling experiences in human life. It's a conversation therefore, between astronomy and art.

The time over my residency was split up in two parts:

1. A four part series of collaborative research meetings held every Wednesday at the Studio at A4 with invited guest artists. Four practitioners joined me at my studio over the six weeks to discuss problems which lie at the interface of astronomy, sound art, sculpture, geometry & physics.

2. My own research work towards astrophysical sound(light) art installations in Urban Space.



The Studio at A4, June/July

MUSIC NOTATION & SOUND ART with Nicolaas Van Reenen - 03 July 2019

From the physical point of view, sculpture is usually encountered in the three spatial dimensions (x, y, z).

Does the obvious connection between sculptures – carved from clay, ceramics, metals, wood – and geometry also extend to sonic sculptures and sound art?

I invite Cape Town electronic music producer, score composer and recording artist Nicolaas Van Reenen of Ex Olympic formerly of the Cape Town based Bateleur, to discuss the relation between Sound Art and Music Notation or that of Geometry & Musical Chords.



S.M in conversation with Nicolaas Van Reenen







Brown paper notes [S.M]

Brown paper notes [S.M]

ASTROPHYSICAL SOUND ANALOGS with Mia Thom - 10 July 2019

This meeting investigates astrophysical processes and their audio visual representations. Interdisciplinary artist Mia Thom translates astronomy data from telescopes, such as the ones at the South African Astronomical Observatory, into audio visual counterparts.

"At this fragile historical juncture, where history itselfboth human and "natural"-seems to be threatened at the material level of the planet, we are in need of a reverse Orpheus figure to inspire a different, less wilfully ignorant orientation to the world. In this case, our anti-Orpheus would not seduce the environment through song but would rather allow himself to be seduced by it, through listening. We might still allow him or her to pick up the lyre, but all the better to play along with the improvised composition always already in progress rather than to dictate it. Such a gesture would stem from an acoustic ethos that reverses—or simply relinguishes—the model in which the human gives a command performance to which the elements arrange themselves in deference" (Pettman, 2017 in Mia Thom's Mind The Gap).

"In *A Field Guide to Getting Lost*, Rebecca Solnit writes about getting lost as a process of transformation:

'Leave the door open for the unknown, the door into the dark. That's where the most important things come from, where you yourself came from, and where you will go' (Solnit. 2005).

Where one may struggle to formulate coherent thoughts on an entity as intangible yet finite as black holes, Voegelin proposes a tactic of repetition and 'chanting' of that which seems incomprehensible.

'Go into public spaces, stand on a step and chant it louder and louder until the context starts to resonate with your voice and meaning starts to emerge from the mobile depth of the words as song' (Voegelin. 2019).

These holes, gaps and voids leave space for strange questions and perhaps even stranger responses" (Mia Thom. Mind the Gap).



Occultation telescopic image on Hahnemuhle German etching paper 69cm x 69cm 2018 [M.T]



S.M In conversatio with Mia Thom

Imagine the lowest note in the universe (Climb into the gap) Swallow it whole Hum the note Bb Slowly descend in octaves until your voice disappears Count to 57

(Sound waves from a Black Hole, Mia Thom)



Notes on Black holes(i, iv) Long exposures on medium format film of various musicians responding in the darkroom to various texts, images and sounds on black holes, falling and getting lost (490mm x 640mm).v Handprint on Hahnemuhle paper 2019 [M.T]



GEOMETRY & SCULPTURE with David Brits - 17 July 2019

Cape Town based interdisciplinary artist David Brits discusses the relation of Geometry & Public Scale Sculpture. In astronomy the study of the very large falls under the discipline of cosmology. In turn the role that Geometry plays in shaping the largest structures found in the night sky is discussed with the Mobius strip providing a toy Universe model and inspiration for both sculpture and astronomy.

"Zaha Hadid famously said that in architecture, a curved building is seven times more expensive than its counterpart made with straight lines. This is because of the 3D technologies employed, the expense of the materials, and the time it takes to manipulate the materials in the desired way. Making sculpture in perfect curves - particularly in carbon fibre - is no different. It is difficult, time-consuming and expensive. It takes a great deal of commitment, fortitude and focus to bring an idea like this to life..." (David Brits).



Flyer Image for Studio Talk 3, A4 Arts Foundation [S.M]



S.M in conversation with David Brits



Geometry is really at the heart of Modern Physics. Every physical law has an associated background within which the particles or fields evolve. This can be shown to be necessarily geometric. In modern physics the laws can be recast in a way that explores the configuration of the system under consideration, if this configuration can be demonstrated to exhibit properties that are well known in other instances. The physics can then be worked out even in situations where the underlying equations governing the system are not explicitly known.

Throughout these weekly conversations, the connections in astronomy and geometry have been hints. These have taken the form of impossible triangles, Mobius strips, Penrose staircases, without providing any formal explanation.

Professor Jeff Murugan from the Laboratory for Quantum Gravity & Strings (director), Head of Department UCT Maths & Applied Mathematics is invited to discuss his work in high energy physics.



Brown paper notes [S.M]



Professor Jeff Murugan







S.M in conversation with David Brits

CONCLUSIONS & ACKNOWLEDGEMENT

Before we conclude, I would like to draw the reader to the introduction image. Just exactly what are the blobs in grey and black? They appear so mundane and common place. Yet within the image are far reaching implications for the way we understand the giant structures found in the night sky.

At all times during my working in studio I had both television sets tuned into static. This photograph is of that static. This way of listening to the Universe in the form of CMB photons from some 13.70 billion light years ago informed most of the time spent thinking about Urban Astronomy.

In some sense, these photons which traverse to us in this way, passing through cosmic voids, dark matter potential wells, clusters of galaxies, dead stars, around black holes, dark matter halos, have played and observed the void, and 'image' it back to us daily in the form of static or noise.

Thank you to Mia Thom, David Brits, Nicolaas Van Reenen & Professor Jeff Murugan for the time that each has dedicated in preparation for each meeting & for contributing to the lively discussions.

Special thanks to my colleagues at A4 Arts Foundation for sharing and encouraging the excitement surrounding the work during this time, and for providing the space to think and work on problems that are both extremely challenging and rewarding.

RE FE RENCES

Music Notation & Sound Art

- The Geometry of Musical Chords, Dimitri Tymockzo, Science Vol 313 [S.M]
- Information Arts, Intersections of Art, Science & Technology, MIT Press, Stephen Wilson [S.M]
- Kepler's Discovery https://www.keplersdiscovery.com/[S.M]
- Vibrations & Waves, A. P French, MIT Press [S.M]
 Geometry of Consonance, Dimitri Tymockzo [N.V.R]
- Celestial Harmonies website https://www.keplersdiscovery com/Harmonies.html[N.V.R]
- Geometry & it's Relation to Music; RadioHead Geometries [N.V.R]
- Musical Examples of The Golden Ratio, ϕ delay [N.V.R]
- Sound Visualizers, An Oscilloscope [N.V.R]

Astrophysical Sound Analogs

- Herbert Goldstein, Classical Mechanics 3rd Edition [S.M]
- Carrol Ostlie, Modern Astrophysics [S.M]
- THE RADIUS AND ELLIPTICITY OF URANUS FROM ITS OCCULTATION OF SAO 158687, The Astrophysical Journal, 236:1026-1030, 1980 March 15 [S.M]
- ORBITS OF NINE URANIAN RINGS, J.L ELLIOT et.al, THE ASTRONOMICAL JOURNAL, VOL 86 NO. 3 [S.M]
- The Impossible Triangle, Kavita Dorai [S.M]
- Voegelin, Salome´. The Political Possibility of Sound Bloomsbury Publishing. [M.T]
- Jessie Beier and Jason Walden. 2017. "Sound without Organs: Inhuman Refrains and the Speculative Potential of a Cos- mos-Without-Us" in Sonic Thinking: A Media Philosophical Approach. (ed.) Bernd Herzogenrath. Bloomsbury Academic: New York. [M.T]
- Solnit, Rebecca. 2005 A Field Guide to Getting Lost. [M.T]
- Amy Sharrocks (2013) An Anatomy of Falling, Performance Research, 18:4, 48-55 DOI:10.1080/13528165.2013.814
 68 [M.T]

- Katie Paterson's installation, Earth-Moon-Earth, 2007 Mira Calix, Planets, 2018 [M.T]
- Mercury keeper of borders [M.T]
- James Webb, Visions of the afterlife, 2007 [M.T]
- Vanessa Lorenzo, Always calling home (2018, artist-in residence at the SAAO) [M.T] ACM Transactions on Embedded Computing Systems, Vol. 0, No. 0, Article A4, Publication date: July 2019.

Geometry & Sculpture

- Godel, Escher, Bach An Eternal Golden Braid, D.
 Hofstadter 1979 ISBN:978-0-465-02656-2 [S.M]
- The Feynman Lectures on Physics, Richard. P. Feynman, 1964 Addison–Wesley OCLC:19455482 [S.M]
- Wholeness & Implicate Order, David Bohm, 1980 Routledge ISBN:0-203-99515-5 [S.M]
- S. Barr, Experiments in Topology (Thomas Y. Crowell Company, New York, 1964). [S.M]

Physics & Geometry

- Mechanics 3rd Edition, Volume on Theoretical Physics vol.1
 L. D Landau & E.M Lifshitz, ISBN-13: 978-0750628969
 [S.M]
- Mechanics: From Newton's Laws to Deterministic Chaos (Graduate Texts in Physics) Fifth (5th) Edition, Florien Scheck [S.M]
- Mathematical Methods of Classical Mechanics, V.I Arnold, 1978 Springer, ISBN 978-1-4757- 1693-1 [S.M]
- Cosmological Physics, J. A Peacock, Cambridge University Press ISBN:0-521-42270-1 [S.M]
- Physics & Geometry, J. Murugan, A4 Lecture Notes July 2019 [J.M]