ASTRONOMICAL PHENOMENA IN MUSIC COMPOSITION

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I declare that the research presented here is my own original work and has not been submitted to any other institution for the award of a degree.

Signed: …………………………………………………………………………………

Date: …………………………………………………………………………………
ABSTRACT

Space is the next frontier for humankind. In recent years, its sounds and images have increased in quality due to technological advances, providing rich pickings for composers. This thesis explores astronomical phenomena in music composition with a focus on my composition portfolio. Beginning with the history of astronomy as a source of music inspiration, from Plato to Björk, this paper analyses my portfolio, the composition method and the ways in which space influences can be clearly demonstrated. The portfolio consists of five solo and piano accompanied works, one trio and a music theatre chamber work. Astronomical influences are shown in the use of sounds of nebulae, stars and galaxies based on electro-magnetic waves through a spectrograph, (courtesy of astronomer Paul Francis) and use of space images and concepts. These are incorporated into the compositions as accompanied sound, as a source of pitch material, contours of space images informing melodic shapes, as well as use of astrophysical concepts in a broader sense.
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INTRODUCTION

Outer space is the next largely unexplored realm for our species, creating a wealth of possibilities for music composition through its imagery, sounds and concepts. This thesis discusses my portfolio of compositions inspired by space in the context of pre-existing space-themed works. The pieces range from solo to mixed ensemble and embody various astronomical phenomena such as craters, full moons, skies, planets and the imagined experience of being trapped in a black hole. Some works use electromagnetic waves of various astronomical phenomena as a sonic foundation including pitch material present, made audible by use of spectrograph. My compositional research process is largely intuitive and involves immersing myself in recorded and theoretical source material and experiencing the massive volume of NASA photographs, videos and audio recordings. I imagine I am there, or travelling around the subjects, abstracting the patterns and sensations into an outline of the melodic shape on the page.
I. BACKGROUND AND INFLUENCES

History of Music and Astronomy

In the 6th century BC, Pythagoras identified that the pitch of a musical note is in proportion to the length of the string that produces it. He expanded the idea to include the sun, moon and planets, proposing they all emit their own unique pitch in his theory known as ‘Music of the Spheres’. In 380 BC Plato mused that astronomy and music are “twinned.” In Plato’s Republic¹ he wrote "As the eyes, said I, seem formed for studying astronomy, so do the ears seem formed for harmonious motions: and these seem to be twin sciences to one another, as also the Pythagoreans say”. In 1619 Kepler wrote Harmonics Mundi, or the Harmony of the World, a treatise on his theory of elliptical planetary orbits and linked musical rations to the orbital dimensions and proposed that each planet has a link with a particular musical interval. Since then astronomical objects such as the moon, sun and stars have been a popular topic for music compositions through the ages in all genres. For example, Beethoven’s Moonlight Sonata Op.27 No.2, Holst’s Planet Suite, Pink Floyd’s Dark Side of the Moon, up to Björk’s recent Cosmogony in 2015, a hymn like song about the birth of the universe.

The influence of astronomy can also be seen in the works of contemporary Australian composers such as Michael Smetanin’s Mysterium Cosmographicum (2005) for piano and orchestra based on Kepler’s theories of planetary orbit patterns, Rosalind Page’s Courbe Dominante for flutes and Saturnian sound spectra (2006), Ross Edwards’ Full Moon Dances

(2011) for saxophone and orchestra and Damien Ricketson’s *Ptolemy’s Onion* (1998) for bass flute and string quartet.

Many historical theories on the mathematical and philosophical connections between music and astronomy are inductive, based on the inference of general laws from a particular instance. While notable from a musicological historical perspective, they hold no strong influence on my interpretation of space and music. I have taken an experiential stance, seeking stimulus from the recordings and interpretations of space phenomena that are becoming more and more detailed as technology improves.

**“Space Sounds” – Recording and Interpretation**

Space “sound” is, on the whole, a construct. Sound, as humans experience it, does not travel through space because there is no matter in the vacuum of space to vibrate. Recordings from space that are transformed into sound tend to be mathematical constructions based on visual or electromagnetic data. Even if the captured visual or radio frequencies are likely to be creating sounds at their point of origin, much of the time these frequencies are not within the human range of perception. “Space sound” in this thesis will, therefore, refer to real, recorded phenomena that have been transcribed and the data used as a basis to generate sound within human perception.

The first known “noises from space” occurred during the 1969 Apollo 10 lunar landing when eerie sounds were heard over the radio as the spacecraft passed over the dark side of the
moon, the recording of which was released to the public by NASA in February 2016. Since then various sounds have emerged from space, especially more in the last few decades as space probes have better equipment onboard to measure electromagnetic waves and record radio emissions. Increasingly over the last fifteen years a wealth of sounds has become available, whether from NASA’s Cassini mission in orbit around Saturn finding and recording radio emissions that seem to come from Saturn’s rings, or NASA Solar Dynamics Observatory’s sun sounds.

To my ears, the space sounds are eerie, otherworldly and seem to have origins in nature. There are definite and evolving pitches, often close to the harmonic series (i.e. fifths, fourths, octaves etc.). The manner in which the pitches change and different tone colours emerge remind me of whale sounds and a deep sense of being primal and instinctual and radically detached from society.

**Dr Paul Francis’ Space Sound Collection**

I came across the space sounds of astronomer Dr Francis, an astronomer and lecturer at the Australian National University, during a google search and discovered his online library of

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mp3 files. They are the electromagnetic waves of various astronomical phenomena (eg solar flare, nebulae, passing comet) converted to audible sound with use of a spectrograph. Most of the original source waves are from NASA data. On his website he explains his method of obtaining these sounds, which consists of 9 stages:

“1. Input spectrum. You will need an observed or synthetic digital spectrum covering a wide range of wavelengths.

2. Convert to frequency.

3. Reduce the frequency. The frequency will thus need to be reduced by a factor of around 1.75 trillion.

4. Choose the phases. A phase must be assigned to each frequency bin.

5. Do the Fourier Transform. This spectrum is then converted into a discretely sampled waveform by taking its Fourier Transform.

6. Output the discretely sampled waveform as an ASCII file. The first line should list the sampling rate, while subsequent lines consist of an increasing integer and the sampled flux value (in the range –1 to 1).

7. Convert the ASCII file into a “.wav” file. To make this conversion I use the freeware SoX Sound exchange utility (http://sox.sourceforge.net/).

8. Combine sounds. It may be helpful to combine different sounds, change the volume, record voice-overs etc. I use the Apple Garage-band program.

9. Convert to a compressed format. The “.wav” files are large (1 MB for an 11 sec clip). Converting them to a compressed format dramatically reduces the size with little penalty in quality. “

While over 70% of observations with most research telescopes consist of some form of spectroscopy, which is essential to researching astronomical phenomena, space pictures dominate the general public’s perception of astronomy. In 2014 NASA released a Soundcloud library of space-related sounds\(^6\). Other astronomers, including Prof Donald Gurnett from University of Iowa as well as Dr Francis, have also presented a wide variety of sounds, including the big bang, solar and stellar oscillations and the winds on Titan. In these cases, the signals being converted to sound are acoustic pressure oscillations. When I enquired as to whether I could use Francis’ sounds for my compositions, he was delighted, as the reason he made them public was in the hope of them being used and shared creatively.

**Music Composition and Space Sounds**

The earliest notated acoustic composition I can find that officially uses space sounds is Terry Riley’s *Sun Rings* (2002) for string quartet, choir and pre-recorded sound. With ten movements and lasting one hour thirty minutes, it was premiered by Kronos Quartet at University of Iowa and involved celestial projections\(^7\). The sounds of space came from plasma wave receivers built by Prof Gurnett and flown on a variety of Earth orbiting and planetary spacecraft over a period of 40 years. Also incorporated in the soundtrack were spoken words from astronomers and astronauts. The effect is electrifying and all-encompassing, and somewhat theatrical, with the spoken word element. The movements are:

1 - *Sun Rings Overture*, 2 - *Hero Danger*, 3 - *Beeopterismo*, 4 - *Planet Elf Sindoori*, 5 -


\(^7\) Kronos Quartet, http://www.kronosquartet.org/ (accessed 3/10/2016)
 Though I did not attend a live performance, I have examined a film of excerpts of the premiere on Kronos Quartet’s website, uploaded in 2012. I was impressed by the effectiveness of the interplay between recorded space sounds and acoustic instruments. Each movement displays different and diverse musical and pre-recorded sound palettes. The opening movement, *Sun Rings Overture*, is a collection of NASA operatives’ spoken radio communications accompanying sustained held string pitches, whereas Movement 2, *Hero Danger*, is more acoustically rhythmic and modal using space sounds based on spectrograph data. Movement 7, *The Electron Cyclotron Frequency Parlour*, uses sounds from plasma wave receivers on the Twin Voyager spacecraft collected over twelve years and has very sparse sustained pitches from the quartet. Movement 8, *Prayer Central*, adds choir and uses it as an instrument with frequent use of the syllable “Ahh” rather than actual words. The texture of the choir ensemble blends extremely well with spaces sounds. As is clear from the title of the movements, Riley has a spiritual approach without being specifically religious. I felt an affinity with his style of musical synthesis, his personal spirituality and his astronomical inspirations. He writes in programme notes of the original concert (2002): “Space is surely the realm of dreams and imagination and a fertile feeding ground for poets and musicians. Do the stars welcome us into their realm? ..Do they wish us to come in peace? I am sure of it.”

There are a small number of active ensembles in Australia that have a strong astronomical theme. The Sydney based Syzgy ensemble lead by Colin Bright has performed some space
themed shows with projections of live star data to notated contemporary classical pieces and improvisational passages. In 2013 Melbourne based Andrea Keller and her quartet performed a series of concerts around Australia called “From Ether”\(^8\). This is designed as a live and visceral soundscape that accompanies a film of photographic images, tweeted down to Earth by Canadian astronaut Chris Hadfield working on the International Space Station. USA based Fabrica Music Area, made a four-song EP, titled 80UA, named after the dimensions of the solar system as measured in astronomical units and crafted solely using NASA’s original recordings from their SoundCloud library of space sounds.

In 2015 I formed my own ensemble Ephemera\(^9\) to musically explore celestial landscapes such as pulsars, craters, planetary atmospheres, stars, sun and void, using the space sounds. Merging the sound worlds of jazz, classical and flamenco musicians and using original NASA space footage, the performances create an original sonic and visual experience.

**NASA Space Imagery Resources**

There are many sources of astronomical data, recordings and images, especially from terrestrial origins, and from space agencies such as European Space Agency or the Russian Federal Space Agency. However, the National Aeronautics and Space Administration (NASA) is dominant in recordings made from space and its recent output has been compelling


and of higher quality. Much of the footage, pictures and sounds are open source on NASA website and members of the public have permission to use and share providing there is acknowledgement.
II. MY BACKGROUND AND COMPOSITIONAL PROCESS

My Background

I am a published Australian/British composer, pianist, flautist and teacher based in Sydney. With international classical training at Bristol University and Bath Spa University (UK), Hildesheim University (Germany) and continuing postgraduate composition at Sydney Conservatorium, I have branched into jazz, experimental live theatre, flamenco fusion and improvisation. My compositions weave a tapestry of unique tonal patterns and rhythms creating an original and intuitive musical voice that is a hybrid of my sonic experiences, with a particular focus on astronomical ideas. Since 2011, eight of my compositions have been published by the Australian music publishing house, Wirripang10.

JAZZ

While I was classically trained in childhood, I always had an interest in jazz and began teaching myself from books and CDs in my teens. I went on to study jazz piano at Hildesheim University with Oliver Gross in 2001 and have since performed with various jazz and latin jazz ensembles such as UK based Miami Smoke Machine and Sydney based Martini Rouge jazz quartet and Gypsy jazz duo Les Bagatelles. My jazz experience is apparent in nearly all my compositions through use of extended jazz chords i.e. ninths, elevenths and thirteenths, as a harmonic foundation as well as much use of rubato and individual interpretation.

IMPROVISATION

After hearing Tibetan mulit-instrumentalist Tenzin Cheogal perform in Sydney in 2000, I took lessons with him on improvisation from a Tibetan spiritual perspective, which focuses on intuition and using the sound as a meditative tool. This experience influenced me by shifting my perspective towards the individual experience of spontaneous composition. I believe that for a musician to engage with the composition on a deep level and perform it well, they need to feel they own and can put their personal stamp on it in some way. They can put a very clear stamp on it if they can improvise. Improvisation adds immediacy, intimacy, and the sense that each playing is unique. In most ensembles I have played in, I frequently improvise e.g. jazz quartets, flamenco/tango fusion ensembles, free jazz duos and others. I often include improvised sections in my compositions, and if I am performing them live I will often improvise sections. *Craters of Rhea* has an extended improvised section as do some of my other compositions (not in this portfolio) such as *Buleria Fiero* and *Dinner Party*, also published by Wirripang. Contemporary Australian composer Paul Cutlan[11] discusses the “growing tendency by Australian composers to incorporate improvisation into through-composed music...The composer has to consider how improvisation will affect or contribute to the musical form and how best to integrate improvised elements into a set structure.” I address these issues in my compositions by clearly specifying pitches to be used in improvisation and placing the improvised section about three quarters into the piece, so it is a cadenza-like passage, before the rest of the through-composed composition continues.

FLAMENCO

My flamenco journey started while studying in Hildesheim University, Germany, in 2001, when I joined a tango/flamenco fusion ensemble Faux Pax who performed around Germany and Italy. While living in the UK I joined other flamenco ensembles such as guitarist Tom Dwyer’s trio. After immigrating to Sydney in 2009 I have joined similar ensembles in Australia. A highlight was opening the Adelaide Fringe Festival with Flamenco Australia and performing regularly in 2012 and 2013 with eight-piece group Pena Flamenca, at festivals such as Darling Harbour Fiesta and shows at the Basement, Venue 505 and many others. I have also performed in shows for Alin and Melike’s Persian/flamenco fusion quartet, Arrebato’s jazz/flamenco fusion ensemble and Art of Cadencia tango/fusion shows. Flamenco has directly influenced compositions such as Buleria Fiero and Flamenco Etudes collection for solo flute, which are based on flamenco dances and published by Wirripang (though not in this portfolio). Flamenco tonality often revolves around the Phrygian mode (with flattened and sharpened 3rd) as well as other modes such as Lydian and Aeolian. These modes are prominent in my compositions in this portfolio, especially Full Moon for solo trumpet. The performance aspect showed me that it is thrilling when another element is added to the music - transforming it into another realm. My music theatre chamber piece Dark Genesis was particularly influenced by this transformative aspect.

THEATRE

My live theatre experiences have also influenced my compositional style by demonstrating how exciting having a full narrative with live music can be, how effective a small well-rehearsed ensemble can be and how abstract the narrative can be and still work live. While living in UK 2000-2009 I composed music for theatre projects at Bath Spa University and
Bridgwater Arts Centre as well as for filmmaker Dan Gale on short film *Lavish Gizzards* which was shown at the Bath International Film Festival in 2006. In 2013 I was commissioned by Marquez Laundry Theatre Company to write music for *Fred and Ginger* at Sydney Fringe Festival. I was a character on stage, wrote the music and performed it every night for eight days at Old 505 Theatre. Alicia Gonzalez and I co-devised the piece for the two-piece ensemble. This was intense and moving as I had never acted before, but it showed me how pure music can be taken into another realm if there is a narrative skillfully executed, while also making it more accessible. The narrative was rather abstract, drawing from the Beckett tradition, but there was a kind of resolution by the end. The co-devising process taught me how fluid theatrical writing can be and how abstract “plots” can be and still work on stage. *Dark Genesis* is influenced by this experience in that it has a small ensemble (five instruments and two characters) and has an abstract plot.

**LANDSCAPE**

I spent my early childhood in rural Somerset, UK, born to an Australian mother and English father. The pastoral setting of south west England created an imprint of the importance of landscape, while the vivid Australian land provides a striking contrast in texture and mood. While astronomy has always fascinated me, having bought a telescope when I was thirteen with all my saved money, it is the celestial landscapes in particular that draw me in. This impression of spatial vastness reflected musically is apparent throughout my portfolio, with many specific references to astronomical terrain. Australian composers who are deeply affected by the expansive Australian landscape and who have inspired me are Peter Sculthorpe, Anne Boyd and Ross Edwards.
IMPRESSIONSIM

My solid classical training has also nurtured a love of Debussy. Significant features of my music that can be linked to Debussy are: use of parallel chords using fifths and fourths, lyrical melodies that evade a steady beat, exploring the subtle nuances of instrumental timbre, and shifting time signatures.

My Compositional Process

My compositional process is based on improvisation and connected to my personal spirituality and meditation on extra-musical ideas. Contemporary Australian composer Margery Smith\(^\text{12}\) writes “The positive experience of improvisation is a mandate for a creativity of infinite possibilities.” I have used several approaches to trigger improvisational ideas; viewing space imagery and imagining I am present in the picture, exploring pitch material from space sounds and exploring astronomical concepts within musical textures.

Pieces in the portfolio based on viewing space imagery are *Craters of Rhea* for double bass and loop pedal, *Full Moon* for solo trumpet, *Aurorae Sinus* for flute, trumpet and double bass, *Mars* for double bass and piano and *Sky Pieces* for solo piano. I imagine the mood and vision of the place and at times mimic the landscape contour in the melodic lines.

Other works are based on exploring the pitch material from space sounds by looping the sounds meditating on the pitches and their origin. Works that arose from this approach

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include *Floating in Space* for solo flute and sections of *Dark Genesis* for mixed ensemble. I listen to the sources frequently and test what I have written against the sounds. The aim is not to harmonise, but to use the sounds as a stage for the piece to play across.

Always at some point in the process I go to the piano and, through improvisation, find a series of melodic shapes, fragments, chords that fit together. I then notate the score in Sibelius and start structuring the piece with practical considerations for instruments in mind. Following this I make multiple drafts and workshop the ideas with musicians to develop a coherent and effective composition.
III. ANALYSIS OF WORKS

1. FLOATING IN SPACE for solo flute and nebulae

I wrote this piece after discovering the space sounds compiled and produced by Dr Paul Francis, discussed above. The *Nebulae* track was particularly evocative and inspired me to write a piece for myself to play, accompanied by these sounds, as a meditation on the nature of void in space using the best instrument to invoke a calm state of mind through breathing — the flute. In this sense I have been influenced by the basic tenets of Zen Buddhism, specifically the blowing technique of the Japanese end-blown bamboo flute *shakuhachi*, as a means to meditate on nothingness, or void, which is closely linked to my personal spirituality. Musicologist Jay Keister\(^\text{13}\) states: “The Fuke sect of Buddhists practiced a form of shakuhachi meditation known as *suizen*, or blowing Zen”. *Suizen* is the concept of self-realisation through meditation on nothingness during improvisation. Features of shakuhachi Zen improvisation include lack of steady pulse, fragmented melodies, pitch bends and use of a pitch collection roughly similar to the Western minor pentatonic scale. It also widely uses sustained notes due to the importance of controlled deep breathing. Similarly *Floating in Space* has all these features with the addition of the backdrop of space sounds.

When listening to, for example, *Nebulae*, two main pitches can clearly be heard: Middle C, C above Middle C and F above Middle C, which is has some of the main pitches from the harmonic series starting on F as the fundamental. I have used these two pitches as tonal

centres of the piece. I decided to open the piece with fifteen seconds of the nebulae sounds because they themselves are quite lyrical and calm: there is a flow of overlapping fragments of melody, which sets up the atmosphere for the piece effectively. Following this, a held low F subtly emerges with twelve slow beats of crotchet = 40 bpm with a pause and pitch bend downwards, followed by two grace notes crushed up to a held middle D, setting the tone for a theme of stillness and tranquility with occasional flurries of movement as shown in Example 1.

Example 1: Floating in Space, Bars 1-11

The melody develops with fragments appearing and reappearing in various guises. For example, the accelerando semiquaver flutter tongue motif, shown in Example 1.1, returns in Ab then back to Db later in the piece.
Example 1.1: *Floating in Space*, Bar 17

The fragments gradually build in intensity through dynamics and faster rhythmic activity until the climax of the piece, which occurs around the middle, bar 27, as shown in Example 1.2, and builds a melodic narrative around F – Db – C. The tension around the minor sixth interval is particularly evocative and poignant, being an imperfect consonance. Sound therapist Simon Heather\(^{14}\), quoting composer and sound healer Kay Gardner, writes “The minor 6\(^{th}\) creates a feeling of poignancy”. Indeed, many composers have used this interval to great melancholic effect such as the opening interval in Chopin’s *Valse* Op 64 No 2 or in Francis Lai’s *Love Story* main theme.

Example 1.2: *Floating in Space*, Bars 27-28

Structurally the piece is based on melodic fragments that recur and develop throughout in an improvisatory style. A large portion of the pitches are from F minor pentatonic scale (F, A\(_b\), B\(_b\), C and E\(_b\)) with the addition of Db and B.

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2. **CRATERS OF RHEA** for solo double bass and loop pedal

*Craters of Rhea* was written with regular consultations with Elsen Price, a virtuosic double bass player who specialises in new music and extended techniques. We worked together as a duo and often performed entirely improvised sets together. This experience informed the composition as I knew we both believed in an integrated approach to the composer-performer relationship. Also I knew that there would be very few technical limitations, that he had a loop pedal and was keen to use it. For these reasons the piece is highly diverse musically, uses loop pedal and has a structured improvisation section.

Rhea is the second largest moon of Saturn and has been highly cratered by passing asteroids. It has an icy rocky surface made up of 25% rock and 75% water ice. From afar it looks perfectly spherical, though measurements from NASA’s Cassini mission show that its shape is triaxial, so slightly oval-shaped due to variations in liquid and gravity levels at its core. I have tried to reflect these aspects musically. The opening passage, shown in Example 2, features quintuplets and leaps of a perfect fifth, diminished sixth and augmented octave. The dissonant leaps, falling quintuplet shapes and irregular rhythms mirror the shape of Rhea’s craggy terrain shown in Image 1. Section A (bar 1-32) develops by using same rhythmic material sequentially from different pitches, adding double stops and an accelerando half way through.

![Example 2: Craters of Rhea, Bars 1-4](image_url)

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Structurally it has a loose A-B-C-B-D-Improvisation-A-Coda form, as the opening theme A and theme B return in various guises. Section B (bar 33-41) uses glissandi in double stops of thirds, fifths and sixths shown in Example 2.1, symbolising the variations in liquid and gravity at its core, which I have musically interpreted as fluctuating sliding pitches.

Example 2.1: *Craters of Rhea*, Bars 34-35

Section C (bars 41-62) is a soulful and intense melody representing the yearning for knowledge about this icy mystery inspired by this picture from NASA’s Cassini Mission, shown in Image 1.1. It marks a distinctive change in character and provides a section where the performer can really indulge in vibrato and lyrical playing, connecting with the
mythological aspect of the name Rhea, who in Greek legend was the daughter of the earth
goddess Gaia and the sky god Uranus.

![Image 1.1: Rhea’s horizon from NASA’s Cassini Mission (2014)](image)

Following this Section B partially returns (bar 63-72) with a playful staccato ending. Section
D (bar 73-102) marks again a striking change in style as the loop pedal is utilized with 2
different voices in parallel perfect 5ths in C Major. The open and disarming nature of the
parallel fifths is what attracted me to writing them consecutively as I wanted the tension
created to dissolve in some way. The performer is invited to improvise within set pitch
parameters which is essentially F Lydian mode with a flattened third as shown in Example
2.2. Over these chords Section A returns in part (bar 103-118) this time a pizzicato version.
Example 2.2: *Craters of Rhea*, Bars 71-94

The Coda (bar 199-end) represents the resolution of anguish and struggle in the rest of the piece. It is a melody in C Major over the same parallel fifths on loop pedal as the previous section. The sound of the open fifths, for me, epitomizes nature and sunrise, and was inspired by this picture of Rhea with the light of Jupiter reflecting, as seen in Image 1.2, which puts all the anguish of the first sections into perspective and allows us to see the big picture.
3. **AURORAE SINFUS for flute, double bass and trumpet**

*Aurorae Sinus* is a massive crater which appears as a dark feature in the southern hemisphere of Mars and forms part of a feature visible from Earth with telescopes known as the "eye of Mars". I wrote this piece imagining I was standing alone in the middle of it, trying to capture the tranquil and yet alien landscape of the enormous crater that is Aurorae Sinus, as shown in Example 3.
This piece was originally conceived for string quartet but due to the instrumentation of a new ensemble I was working with, I re-devised it for flute, trumpet and double bass, discovered with a few minor changes it worked very well. The composition opens with staggered entries of all three instruments playing sustained notes and fragments often in semitone intervals, creating a sparse and enigmatic atmosphere, as shown in Example 3 focusing on the fundamental sounds of each instrument. These fragments are developed further concluding in with a crescendo three semitone cluster in bar 16.
Then, as if turning around a corner of the red dust bowl and seeing the sky, the piece transforms into a haunting and somewhat lonely flute melody, roughly in C Phrygian mode with a sharpened third. A triplet trumpet fragment enters as if in response at the end of the flute phrase, as can be seen in Example 3.1.

Both of these motifs are developed using different pitch centres and different instruments for the rest of the piece. For example, the same melody outline occurs in the double bass part from bar 26, this time starting on F and ending in a double stop, with the first interval being a
perfect fifth instead of perfect fourth, shown in Example 3.2. The difference between the perfect fifth and perfect fourth is significant as the space between the notes is reduced and suggests restriction and limitation, a turning away, a reclusive gesture.

Example 3.2: *Aurorae Sinus*, Bars 26-28, double bass part

The essence of this piece is about an inner dialogue confronting the possibility of being alone in the universe. It ends with a question mark, an unresolved tritone F-B with a perfect fourth, an E, in the flute part on top.

4.  *MARS* for double bass and piano

*Mars* was originally written and published for tuba and piano, but as I was working frequently with double bassist Elsen Price, I decided to re-imagine it for double bass and piano after the success of *Craters of Rhea*. With a few minor alterations, it worked well because the earthy and rich tone colour of the double bass seems to reflect the Martian landscape quite effectively. I was envisaging NASA’s Curiosity Mars Rover, as seen in Picture 3, driving over Martian boulders along the red plains.
Part 1 is called *Red Dirt* and is in ABA form with the opening theme using bold, almost heroic ascending semiquavers. The piano part represents the red lumpy soil and the double bass part symbolises a bumpy and energetic ride along it as can be seen in Example 4.

The piece continues developing these themes by using similar rhythmic motifs beginning on different pitches, finally resolving to the tonic C in bar 19. After a short piano interlude, the
double bass returns this time with a lyrical and contemplative melody with entirely new material in the melody line, but retaining a similar piano part as seen in Example 4.1.

![Figure 4.1: Mars, Bars 27-30](image)

The melody builds in intensity over the piano line, as if rippling over it, as can be seen in Example 4.2.

![Example 4.2: Mars, Bar 41-43](image)
Following this, the initial theme returns, this time with added volume and deeper bass piano octaves, making the sound richer and fuller than the first time. The ending is grounded, full and sincere.

Part 2 is called *Red Mysteries* and has a rather different character of stillness and introspection. When writing this section, I was reflecting that Mars largely remains a mystery to humans and holds many secrets. In many ways it is a meditation on not-knowing. The cornerstones of the opening melody are A – Eb, a tritone, that leans on and explores the discord created through repetition of the interval as can be seen in Example 4.3.

![Example 4.3: Mars, Bars 62-63](image)

Part 3, titled *Red Children*, insists on a playful resolution to the work and is only two minutes long. I was imagining a distant future of human colonies on Mars and the aesthetic of human beings trying to colonize a place that was not designed for them. It is marked “Agitato” with crotchet equaling 192 with a driving repetitive piano line that stays buoyantly staccato throughout. The double bass enters with a syncopated chromatic melody at bar 93 then
continues in an agitated, fragmented fashion, as if a child lumbering along in a spacesuit, as shown in Example 4.4.

Example 4.4: Mars, Bars 95-97

The phrase ends with a distinctive triplet crotchet motif, as shown in Example 4.5.

Example 4.5: Mars, Bars 98-100

This eight bar melody is developed by interchanging the lines between piano and double bass as well as changing the tonal centre. Finally, and triumphantly, the work ends with an approximate rhythmic unison rendition of the main eight bar theme between piano and double
bass, ending with the distinctive triplet crotchet motif recurs on a cluster chord with D in the bass, as seen in Example 4.6.

![Example 4.6: Mars, Bars 147-149]

5. **FULL MOON for solo trumpet**

Full Moon was originally written for solo clarinet, but as I decided to re-devise it for solo trumpet as I was working regularly with William Gilbert, a Sydney based jazz trumpeter. With frequent consultations and his suggestion to add a large amount of reverb during performance, it worked very well.

I was inspired to write this piece after seeing some footage from NASA’s Grail mission to map the moon in 2012. The moon seemed serene, ghostly, unhuman, impartial. I have tried to capture this essence in the music. The opening melody is very slow and thoughtful, meandering, featuring slow ascending septuplets shown in Example 5, as if walking and relatively weightless on the moon itself.
The following Section B (bar 7-11) moves faster and is lighter and more optimistic using many perfect fourth intervals and using outlines of a number of extended jazz chords such as Bar 7, in Example 5.1, roughly outlining the Dm♭6♭9 chord.

Section C (Bar 13-18) uses slow sliding notes as the energy pulls back again and the flight of fancy is gone.
Section A returns at the end, reiterating the deep stillness and void as viewed beyond the horizon away from planet Earth as shown in Image 4.

Image 4: NASA image of the moon (2012)

6. **SKY PIECES for solo piano**

*Sky Pieces* is a collection of eight piano miniatures one-two minutes in length, embodying different aspects of Earth’s sky such as clouds, wind and distant horizons. It was my first serious attempt at a set of pieces after being asked by Wirripang, to expand a single piano piece into a book of eight separate pieces the intermediate – advanced pianist. My inspiration for these pieces was Claude Debussy. His charismatic melodies and dream-like atmospheres in the context of modal tonalities, harmonies involving parallel sevenths/fifths/fourths and rhythmic pulse ambiguity, is something I aspired to. *Sky Pieces* certainly has lyrical melodies,
often modal in tonality, some using ostinato, with a single theme developing in an improvisatory dream-like manner.

The first, *Soar*, was an improvisation around Am sus4 (A minor triad with D) and B♭M7 (B♭ major triad with A) which was later notated. The left hand part remains largely the same throughout, alternating between these two chords in demisemiquaver arpeggiated forms. The title *Soar* refers to the right hand melody soaring ever higher into stratospheric piano realms over the rolling hills of the left hand part, which are indeed mountainous in shape as can be seen in Example 6.

![Example 6: Soar, Bars 7-8](image)

The second, *Cloud*, is the most reverie-like of the collection, drifting in and out of melody fragments briefly only for them never to return, as if daydreaming while gazing at clouds and pondering their shapes. It is based on a C major chord in left hand over the C# major chord in
right hand – a fleeting experiment with bitonality, exploring the dissonant semitone intervals created, shown in Example 6.1. Higher octave right hand melodies float above with a highly shifting pulse with multiple time signature changes.

Example 6.1: Cloud, Bar 1

_Distant Horizon_ is the third and is a slow, contemplative and meandering piece concerned with memory and acceptance which is symbolized by the slow tempo, crotchet equals 49 bpm, and frequent pauses for thought and reflection. Parallel sus4 seventh chords (mostly minor sevenths and sometimes augmented fourths) form the basis of the melodic and harmonic content as shown in Example 6.2.

Example 6.2: _Distant Horizon_, Bar 1
The subversive rhythmic effect of quintuplets, sextuplets and triplets over duplets, as well as grace notes and pauses contributes to an ambiguous pulse, shown in Example 6.3.

Example 6.3: Distant Horizon, Bar 5

The fourth is Wind and uses ostinato-like pattern in the left hand that chromatically weaves up and down perfect fifth intervals while the right hand melody is based on consecutive mostly tritone intervals shown in Example 6.4.

Example 6.4: Wind, Bars 1-4

The piece develops using an ostinato E Phrygian mode semiquaver pattern in the right hand and melody in the left hand using similar rhythms to the previous right hand melody. Following this, consecutive sus4 seventh chords (mostly minor seventh intervals and perfect fourths) build to an optimistic ending on E sus4 seventh, shown in Example 6.5.
Example 6.5: *Wind*, Bars 33-36

*Breeze* is the fifth and opens with a floating melody over two chords Dm♭6 (D minor triad with the addition of a flattened sixth) and A♭+6 (A♭ augmented triad with major sixth), a rolled chord written out in demi-semi-quavers, which can be seen in Example 6.6, and evolves into left hand led melody, with similar right hand chords as the first section. What follows is an improvisatory development with a steady two chords arpeggiated in the left hand while the right hand melody soars into the next octave.
The sixth piece of the collection is *Blue Skies* and is a shamelessly optimistic piece articulating the bright blue of Earth’s atmosphere. It centres around an E Lydian (with a flattened third) shaped ostinato which is developed through inversion and staggered entries between the left and right hand, shown in Example 6.7. It briefly transitions to a G tonal centre midway through, quickly returning to E. Building in excitement by ascending and accelerating towards the end, this piece concludes in a positive exclamation.

*Glow in the Fog* is the seventh and was written in a similar vein to *Cloud* using many rolled chords and avoids a steady pulse with many pauses. Slow and contemplative, it embodies the
opaque nature of Earth’s atmosphere. Based around Dm-6 rolled chord in various inversions, it uses *una corda* to add a subtler tone colour in more delicate sections, shown in Example 6.8.

![Example 6.8: Glow in the Fog, Bars 1-2](image)

The final piece in the collection is *Leaf in the Wind*, a highly agitated intense piece. Throughout the whole piece there is a left hand 4 quaver ostinato pattern using the intervals of a perfect fifth and diminished fifth, seen in Example 6.9, sometimes transitioning into different tonal centres, but mostly around A.

![Example 6.9: Leaf in the Wind, Bars 20-23](image)
Over this ostinato the right hand initially has fragmented melodies, which increases in activity. Following this is the climax of the piece, a series of parallel seventh chords played fortissimo, shown in Example 6.91.

Example 6.91: Leaf in the Wind, Bar 27

7. **DARK GENESIS** – *a sci-fi audio-visual music theatre chamber work for mixed ensemble* - soprano, tenor, flute, piano, violoncello, double bass, trumpet and soundtrack

*Dark Genesis* contributes to the chamber music theatre genre, also incorporating a pre-recorded audio element. Identifying its genre has been an ongoing process of exploration. Initially I intended to write a sci-fi opera, but practical and artistic reasons led to it being devised for five instruments and two voices and lasting twenty-two minutes.

I was inspired by a number of brilliantly executed and very modern performances from Sydney Chamber Opera Company in 2013-2016; Peter Maxwell Davies’ *The Lighthouse*, JS Bach’s *Ich Habe Genug* and Jack Symond’s *Nunc Dimittis*, Fausto Romitelli’s *Index of Metals*, Elliot Gyger’s *Fly Away Peter*, and more recently Jack Symond’s *Notes from the Underground*. Specifically, I was impressed by the experimentation with new music, the
interface between music and theatre, the intimacy of a small ensemble and the electricity on stage when artistic collaborations are effective.

I knew a librettist and director who was interested in collaborating with me, Michal Imielski. As a NIDA directing graduate and award winning director of films and experimental theatre, he has also written numerous scripts for film and theatre. We agreed it should be science fiction as neither of us had ever heard or seen a sci-fi opera and had a genuine desire to try something different.

Over the next six months Michel gave me three versions of his script to work from. Part of the libretto reflected traditional gender roles which I thought were not appropriate for a futuristic piece. For example, the female character always being in the weak position, the “damsel in distress” and the male lead always coming to the rescue in a rather patriarchal manner. Though this work was not an opera, it follows in the tradition of dramatic music work which is linked to opera, and from the outset informed by the operatic vocal aesthetic. It is widely known that historical “great” operas usually have a set of defined female archetypes, the mother, the prostitute and the virgin. For instance main characters that are prostitutes in classic operas include: Violetta in Verdi’s La Traviata, Carmen in Bizet’s Carmen and Manon in Massanet’s Manon. The UK’s Royal Opera House magazine journalist Kate Hopkins\footnote{Hopkins, Kate, Women Behaving Badly: Opera’s Greatest Femme Fatales, UK Royal Opera House Magazine Online 6/12/2013, http://www.roh.org.uk/news/women-behaving-badly (accessed 12/8/2016)} argues that many femme fatale characters, such as prostitutes, “challenge established morals, champion pleasure and insist on living life on their own terms. A large number of them meet
unhappy ends.”. The UK Guardian’s music critic Charlotte Higgins\(^\text{16}\) asks “Is opera the most misogynistic art form? They stab themselves, throw themselves on funeral pyres, go mad and die. From Aida to Lulu, opera is extravagantly cruel to its female characters.” Though modern opera is more reflective of modern society, there are still often underpinnings of patriarchy in the storylines. Higgins goes on to analyse a number of prominent contemporary operas trying to find a plot that is different, but fails. While there are certainly more prominent and strong female characters, but they are often punished for it in some way, while male characters are allowed to be your everyman, the standard, the normal perspective. She asks “Isn’t it time the divas were free to sing to their own tune?”

As I picked and pulled apart bits of his script, a narrative emerged. Experience of space sounds, as discussed earlier, led me to the concept of detachment and dislocation from society and culture. In this sense I undertook to shape a libretto that challenges certain gender norms. I wanted the male and female characters to engage in equal behaviors and vocal lines. As well as the lack of archetypal power dynamic, I wanted the main protagonist to be the woman and for her story to be central and have the most resolution. I pieced together sections of his scripts and to my relief, Imielski thought the new script worked.

Whilst composing, initially for large ensemble, then smaller, it became clear it wasn’t a chamber opera exactly, it was more connected to the tradition of experimental music theatre, such as Schoenberg’s *Pierrot Lunaire* (1912). This is because it is rather short (approximately twenty-two minutes) and for comparatively small ensemble and the audio-visual element was

very strong, almost like another character, on which much of the plot development hinged. Sprechstimme and interplay between spoken and sung words evoke a dream space, which is also linked in mood to Schoenberg’s moonstruck clown Pierrot. My choice of instrumentation is similar to Schoenberg’s. His ensemble was soprano, piano, flute, cello, violin, and clarinet, and mine is soprano, tenor, piano, flute, cello, double bass and trumpet, as shown in Table 1.

The differences are that I also have tenor character, instead of clarinet I have trumpet and instead of violin I have double bass. However, the tone colours created are similar. In many ways it is a mini-orchestra with great scope for large sounds and possibilities for subtle intimacy with such a wide diversity of timbres.

<table>
<thead>
<tr>
<th><em>Pierrot Lunaire</em> Instrumentation</th>
<th><em>Dark Genesis</em> Instrumentation</th>
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</thead>
<tbody>
<tr>
<td>Soprano</td>
<td>Soprano</td>
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<td>Tenor</td>
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<td>Flute</td>
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<td>Piano</td>
<td>Piano</td>
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<tr>
<td>Violoncello</td>
<td>Violoncello</td>
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<td></td>
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</tr>
<tr>
<td>Violin</td>
<td>Double Bass</td>
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<td></td>
<td></td>
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<tr>
<td>Clarinet</td>
<td>Trumpet</td>
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Table 1
While *Pierrot Lunaire* is atonal in form and a hallmark of the early twentieth century Viennese expressionist lineage, it does not use the twelve-tone method. There are clear pitch patterns in use for each section (for example, in his *Nacht* section is based on a ten note motif). In a not dissimilar way, *Dark Genesis* has sections of apparent atonality and sections which are clearly modal, discussed further below.

Over one hundred years after *Pierrot Lunaire*, composers have continued to expand the repertoire for similar instrumentation such as Henry Cowell’s *Red Silence* (1915), Carl Ruggles’ *Vox Clamans in Deserto* (1924) and Hanns Eisler’s *Palmström* (1925). Fast forward forty years to 1967 and the work was still such a seminal influence in London that the “Pierrot Players” ensemble was formed. Remembering the group in 1987, Peter Maxwell Davies writes\(^{17}\): “There emerged a group of friends, willing to spend many hours of unpaid time with two inexperienced conductors, rehearsing difficult new works. Thanks to The Pierrot Players I learned the basics of instrumentation as never before, and the rudiments of theatrical craft—not to mention, out of frightening necessity, how to conduct. The group has been the most important music experience of my life to date.” The ensemble performed many compositions in a similar vein such as Maxwell Davies’s *Antechrist*, and Harrison Birtwistle’s *Monodrama* (1967), Maxwell Davies’s *Eight Songs for a Mad King* (1969), Berio’s *The Modification and Instrumentation of a Famous Hornpipe as a Merry and Altogether Sincere Homage to Uncle Gloag*, Kenneth., Jones, Nicholas, eds. *Peter Maxwell Davies Studies*. Cambridge: Cambridge University Press, 2009, p200

My experience of forming my ensemble Ephemera, to develop my compositions, has taught me a number of aspects of writing for small ensembles: to think carefully about the timbre and volume of each instrument, to write a sufficiently interesting part for each instrument, to carefully notate phrasing, and to not make the score too busy and make sure the important phrases can sing out and be heard clearly. The other advantage of writing for smaller ensemble is that the costs are limited and it is easier to manage and organise.

The rewarding experience of writing for small ensembles forced me to examine my initial desire to write a “great work”. Musicologist David Horn\(^\text{18}\) discusses the formal long-established perceptions of the work as requiring certain features such as being large-scale, elaborate, innovative, impressive and milestones of achievement in some sense and that these features help musicologists to identify, regulate, evaluate and ultimately control and judge the composer as great or otherwise. In our contemporary multi-faceted post-modern world, this attitude is outdated and ever dependent on specific musical, cultural and social models or

expectations. For these reasons coupled with very real financial practical reasons of it simply being easier to manage and fund, I decided I did not need to write an opera.

**Scene by Scene Analysis**

**Scene 1. Fragmentation**

Scene 1 opens with total darkness and two sleeping characters Nysa and Aten (named after asteroid groups in our solar system) on the floor. The spaceship hum fades in, then the nebulae and star sounds (from Dr Francis’ collection) fade in and out on the soundtrack. On stage there are vignettes in spotlights of Nysa and Aten’s body parts shaking on stage, e.g. a foot, a hand, a breathing stomach, synchronised in brightness with the space sounds’ crescendos and diminuendos. After approximately one minute, Aten begins to wriggle, toss and turn while his eyes are closed. His aria is to be performed as if sleep-talking, to the accompaniment of double bass, cello and nebulae soundscape. Pitches present in the nebulae sound are Middle C, the C above Middle and the F above Middle C. From this material I have expanded it to include many notes from the F Lydian mode.

It was during the rehearsal process that I gained many valuable insights into the most practical way of notating sections. The first section was initially notated with rhythmic precision. However, following advice of professional cellist Rachel Pogson and professional bassist Annabel Cameron, who recorded the section in my home studio after workshopping it was decided that it would be easier to play and sound more free. I notated it without bar lines and rhythmic values, but approximately 1 cm = 1 second. In order for it to be effective with all
musicians playing, including the tenor, must be able to see the whole score at all times for this to work, to be able to see when their part enters. The section opens on tremolo A on double bass and the tenor comes in shortly afterwards. The strings’ and tenor lines involve a degree of glissandi to interplay with the blending harmonics of the nebulae soundtrack. Also while workshopping the piece, professional tenor Spencer Darby, suggested that it would be easier if his part comes in between the other lines rather than at any point at the same time, so that is how I structured it, with certain fragments fully notated including Sprechstimme and interplay between spoken and sung lyrics. The effect in performance works very well and allows performers to use their interpretative skills in phrasing and details of note lengths, as shown in Example 7. In this way the performer can engage more fully with the piece and give it their own personal stamp.

Example 7: *Dark Genesis*, Line 1

Aten sings and speaks his aria: “What’s that? I can’t hear you…What do you mean, you have the plague? There’s no cure, no cure?! You’re saying I should leave Earth and save myself?!! But I love you! My love is strong, is strong. My love is strong. Ahh..You are fading. Ah. I will miss you. Hmm.” This aria is an introduction to the dream-like fragmented mood of the
entire work. It also introduces the audience to the idea that Aten and Nysa have left Earth as the human population is dying. The characters are on the ship begrudgingly, and out of desperation rather than sense of adventure. The double bass and cello continue their duet followed by more nebulae sounds fading in, as if confirming the distance of Earth and the stories left behind. Punctuating the end of the scene, a fortissimo cluster chord from all instruments using tremolo and flutter tongue makes a sudden entry as astonished characters wake up and spotlight is on their face.

**Scene 2. Spaceship**

As Scene 2 begins, the light comes up properly on stage to show Nysa and Aten on a small spaceship standing in front of large window (a projector screen with spacescapes, as if travelling slowly through space). There are two single beds and a toilet present on stage. The space sounds are no longer heard in this scene, only the spaceship hum on the soundtrack. Linking Scene 1 and Scene 2 is a low E two octaves before Middle C played by double bass. This E is a note from Scene 1’s harmonies, a note from the cluster chord and also signifies the tonal centre of the next section, while at the same time signifying an ominous mood through its low pitch, suggesting the tone of the next section. After five seconds of the low E, there is a fourteen bar trio of flute, double bass and cello in E Phrygian mode. The flute’s solo line is written in an improvisatory style, with flurries of activity alongside sustained notes, as shown in Example 7.1.
This scene introduces the first and second of three motifs that bear significance on the whole piece, returning in many guises throughout. As seen in Example 7.2, Motif 1 is the ascending demi-semiquaver flourish seen in Bar 60 double bass part of the following pattern: minor second, minor third, major third, major second, again based on Phrygian mode with a sharpened third. As shown in Table 2, this motif is repeated with a longer held last note in Bar 63 double bass part, the cello part in Bar 65, as shown in Example 7.3. It recurs in the double bass part Bar 70, this time starting on low F, then again in Bar 72 of the cello part starting on the original note and will return numerous times in Scene 3. The destabilising effect of the
flourish flowed by sustained note, coupled with the mix of irregular intervals contributes to the mood of tension and uncertainty.

Example 7.2: *Dark Genesis*, Bar 60, double bass part

An argument between Nysa and Aten ensues, discussing their predicament, some of which is shown in Example 7.3. Nysa speaks, with some sung notes: “How long have we been here? How long is it now? How long have we suffered? How long, how long, how long?!” Aten replies “Shut up! You’re not the only one suffering!” She retorts: “Don’t speak to me like that! All my savings to be trapped like this, trapped like this, on the last ship out from Earth!”

Example 7.3: *Dark Genesis*, Bars 63-67
Motif 2 is the ascending quaver pattern (semitone, tone, semitone) ending with a held note, seen in Example 7.4 Bar 63 of the double bass line.

![Example 7.4: Dark Genesis, Bar 66, double bass part](image)

The strain of this close collection of pitches as it ascends and then stops suggests striving and not achieving, taking one difficult step forward and then stopping, as if walking through honey, reflecting their onerous predicament.

<table>
<thead>
<tr>
<th>Motif</th>
<th>Bar Introduced</th>
<th>Bar Recurs</th>
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<tbody>
<tr>
<td>1.</td>
<td>60, Double Bass</td>
<td>63 in Double Bass</td>
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<td></td>
<td></td>
<td>65 in ‘Cello</td>
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<td></td>
<td></td>
<td>70 in Double Bass (starting on F)</td>
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<td></td>
<td></td>
<td>72 in ‘Cello</td>
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<tr>
<td></td>
<td></td>
<td>230 in Flute (starting on F)</td>
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<td></td>
<td></td>
<td>236 in Flute (starting on C)</td>
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<tr>
<td></td>
<td></td>
<td>235 in Double Bass (starting on F)</td>
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<tr>
<td>2.</td>
<td>66, Double Bass</td>
<td>67 in Double Bass (starting on A♭)</td>
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<td></td>
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<td>68 in Double Bass (starting on A♭)</td>
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<td></td>
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<td>68 in ‘Cello (starting on A♭)</td>
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<tr>
<td></td>
<td></td>
<td>73 in Double Bass</td>
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<td></td>
<td></td>
<td>74 Double Bass (starting on A♭)</td>
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<td></td>
<td></td>
<td>76-78 canonic interplay of the motif</td>
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<td></td>
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<td>between Double Bass and ‘Cello with</td>
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<td>starting pitches G, A♭ and B♭</td>
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<td></td>
<td></td>
<td>233 on Flute (starting on G)</td>
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<td></td>
<td></td>
<td>234 on Flute (starting on A♭)</td>
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<tr>
<td></td>
<td></td>
<td>237 in ‘Cello (starting on G)</td>
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<tr>
<td></td>
<td></td>
<td>238 in ‘Cello (starting on A♭)</td>
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<thead>
<tr>
<th>3.</th>
<th>171, Trumpet</th>
<th>178 Trumpet (starting on E)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>186 Trumpet (starting on E)</td>
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<tr>
<td></td>
<td></td>
<td>194 Trumpet (starting on G♭)</td>
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<tr>
<td></td>
<td></td>
<td>207 Trumpet (starting on E)</td>
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<tr>
<td></td>
<td></td>
<td>219 Cello (starting on B)</td>
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<td></td>
<td></td>
<td>227 Cello (starting on B)</td>
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<td></td>
<td></td>
<td>237 Flute (starting on B)</td>
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<td></td>
<td></td>
<td>228 Tenor (starting on C)</td>
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</tbody>
</table>

Table 2
As shown in Table 2, it recurs in Bar 67 of the double bass part, this time starting on Ab, then again in Bar 68 again on Ab. It returns in Bar 68 in the cello part this time starting on Ab, then again in Bar 73 in the double bass part this time starting on the original G, then again in Bar 74 on the Ab. Then from Bar 76-78 there is a hint of what is to follow with this motif being used in canonic interplay between the cello and double bass part. As tension increases towards the end of this section, the motif is played backwards starting sometimes from G, sometimes Ab and sometimes Bb, in more canonic interplay between the cello and double bass part with increasingly brief hold notes in between, as shown in Example 7.5.

Aten continues the dialogue: “Small price to pay for your freedom, Small price to pay for your freedom, small price to pay when Earth is dying, everyone is dying.” During this Nysa mutters to herself: “Trapped like this! Earth’s surface is dead, and the underground cities near dead too”. During this section tension is increased with a poco accelerando and with the addition of syncopated piano chords, ending on a cluster chord Bar 93 with G in the bass, as shown in Example 7.5.
Example 7.5 Dark Genesis, Bars 88-101
The second section of Scene 2 begins in Bar 94, shown in Example 7.5, with a shift to five crotchet beats per bar. This section represents a change in tone from dread to optimism and mainly concerns Nysa’s gradually more hopeful state of mind as she allows herself to dream about finding a new place to live. Optimism is reflected through the shift in tonality to C Major and a heavy use of primary triads. This section also uses many extended jazz chords which are subtly apparent: for instance, Bar 94’s piano line features an arpeggiated FM13#4 chord and Bar 95 is an arpeggiated G13 chord, as shown in Example 7.5. Imielski has a healthy sense of humour and I found it highly entertaining when he suggested that Nysa sing an aria while sitting on the toilet. Her toilet aria lasts 12 bars and in addition to adding lightness and fun to the performance, it implies the cramped living conditions they are in, contributing to the sense of urgency and uncertainty.

As she sits on the toilet and gazes out the window Nysa sings, and occasionally speaks:

“Maybe there’s a chance to be free. Perhaps there’s a possibility, a possibility, a possibility to live free!” accompanied only by piano. She then flushes the toilet and daydreams: “ Hm..a new beginning. No more underground cities, no more wastelands. A new home! Hm..” accompanied only by flute. Pregnancy is suggested as she places her hand on her stomach. The aria is then developed using fragments of these melodies with the addition of piano, cello and double bass. The scene ends with a passage in rhythmic unison in C Major as shown in Example 7.6. Nysa sings a soaring A two octaves above Middle C, with the phrase concluding on a triumphant C Major seventh chord.
Scene 3 Black Hole Vortex Birth

Scene 3 commences with a large crash on the soundtrack just before the last chord of Scene 2 finishes. It represents a transformation of the mood on stage to shock, surprise and gives a sense being in the middle of a natural disaster. The stage directions are to simulate a crash. Nysa and Aten shake and look around wondering what’s happening. On the projector screen there is a swirling vortex, a montage of images past and present and future of Earth and planets, galaxies. On the soundtrack there is approximately one minute of a jumble of radio signals from Russian announcements to Chinese broadcasts to a dog barking, a hint of didgeridoo, Gregorian chant choirs, to distortion of unknown origin, Morse code signals and people talking in a crowded room. A trumpet solo begins over the cracking of the radio interference, introducing a new motif, Motif 3, which recurs starting on different pitches in different instruments throughout the scene. As shown in Example 7.7 Bar 174, the pattern of
three quavers followed by chromatically ascending quintuplet demi-semiquavers creates a mood of de-stabilisation, as if one is swaying as if one is losing footing or about to tumble over, which is very apt for this scene of turbulence and chaos.

Example 7.7 Dark Genesis, Bar 174 trumpet part

As shown in Table 2, motif 3 recurs throughout Scene 3; On trumpet: Bar 181 starting on E, 189 on E, 197 on Gb, 204 on Eb, 210 on E. It also recurs in the cello line Bar 222 and 230 starting on B as well as the flute part in Bar 240 starting on middle B as well as the tenor part in Bar 231 starting on C.

During the scene Nysa and Aten become weightless and confused – an impression that could be created through aerial ropes. Aten says “What the hell is happening? Where are we? Am I dreaming? I’m scared. I’m very scared” (Bar 196-202). Nysa whispers “Me too” (Bar 103). They try to speak but they can't finish words or sentences: Aten continues: “I am numb. Ahh. I don’t know if I exist at all, exist at all. Saa Ah ee ya ya” (Bar 204-210). Aten then pushes words out as he realises what’s happening: “Is it a, is it a…?” The pianist, flautist, cellist, bassist from the ensemble shout erratically while clapping “Black hole, black hole, black hole” as if echoing his thoughts (Bar 217-219). Aten continues to talk over the shouting: “A region of space-time with such strong gravitational pull that light, space and time deform.”
Astronomer Kip Thorne writes (2014, p46)“Black holes are made from warped space and warped time...Black holes can spin, just as Earth spins. A spinning black hole drags space around it into a vortex-type whirling motion” Scene 3 is my sound representation of what might happen when entering a black hole. The slow speech represents time slowing down, the random mix of radio signals represents time not progressing in the same way.

Following the realisation that the characters have entered a black hole, the double bass has sliding notes with double stops while Nysa looks at her stomach and notices her pregnancy is progressing abnormally fast. She says “Wha..Uh oh. Uh oh”.

Example 7.8 Dark Genesis, Bar 222 cello part

After the solo double bass sliding double stops, from Bar 222, Motif 1 and 2, discussed in Scene 2, return in a number of guises, as shown in Table 2. Motif 1 recurs in the flute part starting on F in Bar 230 and on C in bar 236 as well as the double bass part starting on F in Bar 235. Motif 2 recurs in the cello part in Bar 237 starting on G, 238 starting on Ab, then again the trumpet line in Bar 239 starting on G then again in bar 240 starting on Ab. Finally,

---

the flute line plays Motif 2 in bar 233 starting on G, then 234 starting on Ab. This is shown in Example 7.9.

\[ \text{Example 7.9 Dark Genesis, Bars 235-240} \]

Aten continues: “Wha…Ah.. Ooo..ah-k” Nysa watches her stomach grow before her eyes:

“Uh oh, Uh oh” as shown in Example 7.9. To build up to the climax of the scene, the ensemble play in rhythmic unison for ten bars. The effect is somewhat like Morse code, with instruments added every few bars and a prominent crescendo as shown in Example 7.10.
A dramatic “whooshing” sound is heard on the soundtrack, symbolising travelling across the event horizon of the black hole. Thorne writes (p47) “What happens at the event horizon of a black hole? Time is so extremely warped there that it flows in a direction you would have thought was spatial; it flows downward towards the singularity.” The singularity is the centre of a black hole, “a one-dimensional point which contains a huge mass in an infinitely small space, where density and gravity become infinite and space-time curves infinitely, and where the laws of physics as we know them cease to operate” according to astronomer Luke Mastin (2009)\textsuperscript{20}. Following the “whoosh” there are seven seconds of eerie silence. Then comes a primal scream on the soundtrack while Nysa has her legs parted.

**Scene 4 New Galaxy**

This scene is the “calm after the storm” and uses much of the same musical material as Scene 1, but without the vocal line. On the film are calm scenes of a new galaxy forming. The implication is that Nysa is giving birth to a new universe. This is my interpretation of the multi-verse big bang theory. In 2014 the Harvard-Smithsonian Centre for Astrophysics unveiled results from experiments with gravitational wave energy. Essentially, they concluded (paraphrased by Dan Vergano, National Geographic journalist, 2014)\(^2\) “that the process that inflates a universe looks just too potent to happen only once; rather, once a Big Bang starts, the process would happen repeatedly and in multiple ways.”. The end of Scene 3 and Scene 4 is my visual musical and artistic embodiment of the recurring “big bang” notion.

**Soundtrack**

For Scene 1 and Scene 4 the space sound collection of Dr Francis is quite prominent. I used ten of his samples. I wove them into the soundtrack for the vignette section, principally using the nebulae sound for the rest of the scene and for the whole of Scene 4. The following are a list of space sounds used from [http://www.mso.anu.edu.au/pfrancis/Music/](http://www.mso.anu.edu.au/pfrancis/Music/):

- carbonstar.mp3
- crab.mp3
- helix_a.mp3
- nebulae.mp3
- vela.mp3

---

Acoustic instruments are associated strongly with the Western classical tradition. For a more futuristic effect that is redolent of science fiction films, I realised I would need to use other sounds, including electronically generated and industrial sounds. I came across the website freesound.org which is a collection of a wide assortment of sound samples uploaded from individuals around the world. The sounds are licensed under Creative Commons. I have also listed them on the score. I discovered a number of sounds on site that I wove into the soundtrack that add another dimension to the performance by using real sounds. These include a primal scream, radio signals as discussed above, crackling interference, and an industrial crash. These sounds help shape and bookend the scenes and will heighten the dramatic effect when performed live.

The following is a list of sample sounds from freesound.org and their user, or individual that uploaded the sample, that have been included in Dark Genesis:

- user: thanvannispen, sound: industrial_crash02.aif
- user: ok1has, sound: telephone battery charger.mp3
- user: qubodup, sound: Plane Crash.flac
- user: FreqMan, sound: psycho scream 1.wav
- user: tcrocker68, sound: Girl_Scream.wav and Girl_Scream_Short.wav
- user: queen_westeros, sound: WOMAN SCREAM
- user: tec_studios, sound: a black hole st.mp3
- user: Greego, sound: Ghost Opera
- user: hykenfreak, sound: Deep Space Ship Effect
- user: kwahmah_02, sound: opera on shortwave.wav
- user: kh7clx, sound: Russian ham or pirate with music & cw qrm 7050.0kHz LSB.wav and Russian ham or pirate out of tune with music with others talking 7050.0kHz LSB.wav
- user: makosan, sound: Crowded Opera Lobby.wav
- user: GowlerMusic, sound: Radio Static
- user: juicet, sound: dub techno synt.wav
- user: zagi2, sound: pop rock loop 2.wav and rock shelter.wav
- user: pechenyshki, sound: Children playing outdoors
- user: RutgerMuller, sound: Wind Low Short.aif
- user: Equality_X12, sound: Wind SoundEffect
- user: kangarooindaloo, sound: Medium Wind
IV. CONCLUDING COMMENTS

Astronomical phenomena have long been an inspiration for composers around the world. However, it is only recently that authentic space sounds deriving from astronomical phenomena have been available for use in electroacoustic composition, due to increasing advances in space technology and the accessibility of the information collected. A small number of contemporary composers have begun using these sounds in acoustic music, reflecting on the beauty of the sounds and recognizing connections with the harmonic series. Astrophysics incorporates many concepts that can be used in effective ways in music composition.

Developing my portfolio has allowed me to evolve my compositional style by defining its origins and influences, refining my musical language, workshopping pieces with musicians and linking my music more deeply to my personal vision. My background as a performer-composer with valuable experiences in flamenco fusion, experimental theatre and jazz, as well as my classical training, has had a strong influence on my compositional style, and created a portfolio that is a unique personal synthesis of my sonic experiences.

The future of my performances and publications will continue to focus on space, outside of society and culture; seeking to shift the locus of experience to positions nearer the observed astral objects (e.g. sounds and imagery from exploratory probes and drones). This collection's contribution to Australian contemporary music emphasizes place and landscape, linking the tradition to the emerging influence of space exploration.
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