

Interdisciplinary Approaches to Astronomy: The Music of the Spheres (Part 2)

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In issue 18 of *Communicating Astronomy with the Public journal*, we explored some of the influences of astronomy on fiction, drama, and poetry. In this second part of our interdisciplinary survey, we examine some musical examples of astronomical inspiration.

Introduction

Many aspects of our modern understanding of the Universe have influenced composers, in the realms of both classical and popular music. Indeed, it may well be in the musical arena that astronomy has had its largest direct cultural influence in our time. In a recent review, I was able to cite 133 different pieces of recorded music influenced by serious astronomical ideas (Fraknoi, 2012), not including casual references to the Moon in lyrics such as “it’s June, there’s the Moon, let’s spoon”. In that review, I restricted myself to pieces that can be found on CD, although the tremendous growth of YouTube, Spotify and other online video and audio repositories is making that distinction less and less important.

Music about astronomers

The life and work of astronomers has served as the inspiration for music from opera to heavy metal and everywhere in between. In part one of this piece we discussed operas about Kepler, Galileo and Einstein, but there are many other musical tributes to noted astronomers. The late-romantic Danish composer Hakon Borresen wrote a 1924 ballet about Tycho Brahe called *At Uranienborg: Tycho Brahe’s Dream*. It takes place on the island of Hven, Sweden, where Brahe had his observatory, and it features dancers who portray stars, comets and the supernova of 1572.

The year 1973, the 500th anniversary of the birth of Copernicus, saw many celebrations, and several musical compositions. Perhaps the best known of these was Polish composer Henrik Gorecki (Goretsky)’s 2nd Symphony *The Copernican*.

Despite not being the most well known, the most interesting piece from this period to my mind is Leo Smit’s *Copernicus: Narrative and Credo*. In 1953, the composer Smit became friends with the astronomer Fred Hoyle. They talked and hiked together, and even wrote an unproduced opera. Their 1973 Copernicus piece is an oratorio of sorts, the last part of which is a moving declaration of modern cosmic belief written by Hoyle. A recording of this has recently become available on CD¹.

On their hikes, one of the many late-night topics that Smit and Hoyle debated was who would be more useful if they were suddenly transported into the far future — a 20th century composer or a 20th century physicist. Hoyle then wrote a science fiction novel based, in part, on this debate called *October the First is Too Late* (which we mentioned in the science fiction discussion in part 1 of this paper). Hoyle and Smit later gave a concert and lecture at Caltech, USA, based on the ideas and music in *October the First Is Too Late*. The Copernicus piece, it seems, grew out of this earlier collaboration.

Moving forward to our time, and picking one example, Stephen Hawking and his work were the subject of great popular interest, even before the release of the award-winning film *The Theory of Everything* in 2014. In 1989 the rock singer and songwriter Todd Rundgren produced a song-called *Hawking*, a first-person meditation on the British scientist’s work and disability. The song’s lyrics are quite poignant — about being trapped in a broken body, questioning why the disease that crippled him happened and asking whether Hawking can see further in space and time because of his illness².



Figure 1. The author with two of the giants of Renaissance astronomy, Tycho Brahe and Johannes Kepler in Prague. Credit: Alex Fraknoi

Astronomer Carl Pennypacker and science writer Judith Goldhaber also wrote a musical piece about Hawking, entitled *Falling through a Hole in the Air: The Incredible Journey of Stephen Hawking*. The Oakland Symphony Chorus serenaded Hawking with a selection from the piece when he visited Berkeley, USA, in 2007³.

Music about constellations

The constellations, which were the only form of wide-screen entertainment available to our ancestors, have provided inspiration for many kinds of music over the years. For example, Philip Glass’s *Orion*, commissioned for the 2004 Olympic Games in Athens, draws inspiration from the myths in different cultures that come



Figure 2. Engraving of Nicolaus Copernicus, from the library of the Wellcome Trust. Credit: Wellcome Trust

from this well-known constellation. The sections were performed using players and native instruments from around the world, including an Indian sitar, an Australian didgeridoo, and a Chinese pipa⁴.

Hayg Boyadjian, a classical composer who is an active amateur astronomer and a member of the Amateur Telescope Makers of Boston, has a number of pieces inspired by constellations, including *Scorpius Rising* and *Cassiopeia*. In both cases, the shape of the constellation in the sky is reflected in the shape the notes make on the staff for the principal motifs in the piece⁵.

Taking that idea further, we have the work of John Cage, who is notorious in modern classical music for undermining the rules

of how music is made. In one of his projects, entitled *Atlas Eclipticalis*, he put see-through musical notation paper in front of a star atlas, and let the positions of the brighter stars in the atlas determine the positions of the notes on the paper. The notes that emerged were the ones that were played. Such music is, as you might imagine, much more fun to contemplate than it is to listen to.

Music about astronomical objects

Focusing now on more specific topics in astronomy, let us begin with music about the Earth's natural satellite. One of the best known Moon songs is *Walking on the Moon* by the Police, on their album *Reggatta de*

Blanc. In this song the singer compares the feeling of being in love to walking on the Moon — where the lower gravity allows you to take much larger steps and where you hear no outside sounds. There are other songs that also use characteristics of the Moon, especially its phases. The *Whole of the Moon* by the Waterboys plays off the idea of a crescent moon being a small part of a full moon, and how the singer, wrapped up in himself, saw and felt little in a relationship, whilst his lover saw the larger emotional picture. The 2002 song *Earthshine* by the Canadian rock band Rush uses the notion of earthshine as a metaphor for a lover who feels his role in the relationship is merely to be a faint reflector of his beloved's glory. There are of course countless others who have found inspiration in the mystery of our closest neighbour.

Many classical music fans, when they think of astronomical music, think first of Gustav Holst's 20th century romantic suite, *The Planets*. Unfortunately, this suite was inspired by Holst's interest in astrology and not astronomy, and the music reflects astrological aspects of each planet. Holst was introduced to astrology by the brother of fellow British composer Arnold Bax, and actually began casting horoscopes for friends and colleagues. I no longer include the piece in my list of astronomical music, but I understand that the popularity of *The Planets* is undeniable, and NASA, documentary film makers, and several creative astronomers have used the music to illustrate talks, slide shows, or films about the planets.

A number of modern composers have written pieces to accompany Holst's suite and to portray other Solar System bodies, including Pluto and some key asteroids. An example can be found on the version of Holst's piece conducted by Simon Rattle, on the British multinational EMI's recording, which features pieces entitled *Pluto*, *Ceres* and *Asteroid 4179: Toutatis*. The New Zealand Symphony Orchestra recently commissioned a companion piece to *The Planets*, based on native Maori conceptions of the open star cluster Pleiades and its use in determining the new year. That piece, *The Glittering Hosts of Heaven*, by Eve de Castro-Robinson, was recorded on video and is available on Vimeo⁶.

There are a good number of other pieces of music that are inspired by the modern

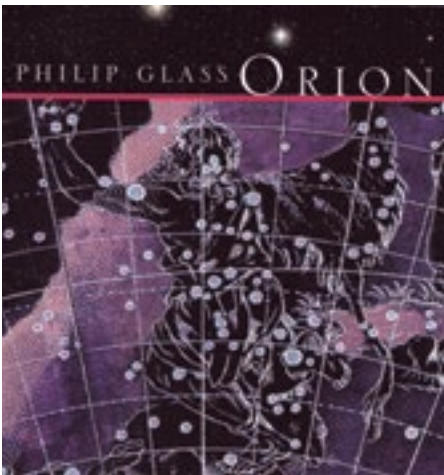


Figure 3. The cover of the CD of Philip Glass's piece *Orion*. Credit: Image courtesy of Orange Mountain Music

exploration of the planets and more are being composed. For example, there is the American composer Judith Lang Zaimont's suite of solo piano pieces from 2000 called *Jupiter's Moons*. These were inspired in part by seeing NASA images coming back from the exploration of Jupiter's system and are available on an Albany Records CD⁷.

The 1970 album by the British rock group Van der Graaf Generator has a title that has endeared it to my students: *H to He, Who Am the Only One*. The three steps of

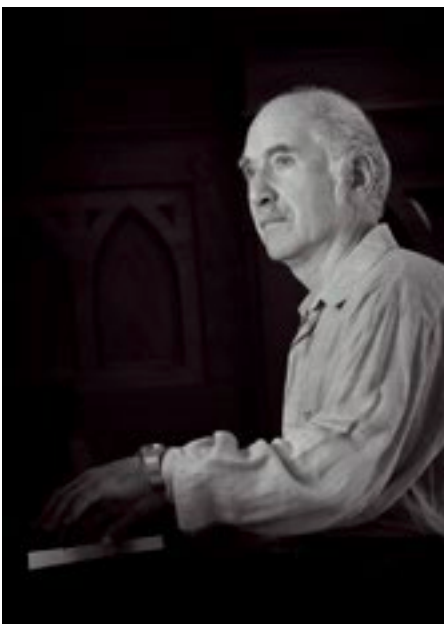


Figure 4. The composer Hayg Boyadjian at the Follen Church in Lexington, Massachusetts. Credit: Andrea Joliat

the proton–proton chain of nuclear fusion are written out at the bottom of the cover. One can only imagine what the typical rock music fan who had not taken an astronomy course thought of the title. However, the songs on the album have little to do with astronomy.

When it comes to stellar evolution, there is no topic like a black hole to inspire dramatic songs. The Canadian rock group Rush, in their 1977 album, *Farewell to Kings*, had perhaps the most astronomically accurate set of lyrics for a black hole song in *Cygnus X-1* (see Table 1)⁸.

Over the years, with the help of my students, I have found five other songs inspired by black holes. The group Aqualung has a song entitled *Black Hole* on their 2007 Album *Memory Man*. A song with the same title appears on Amanda Lear's 1979 album *Never Trust a Pretty Face*, in which the destructive power of a relationship is compared to the destructive power of black holes.

The other three black hole songs that we found are: *Places Named After Numbers* by Frank Black — lead singer of the Pixies, whose real name is Charles Thompson — on his 1993 album *Frank Black; Beyond the Black Hole* on the 1997 album *Somewhere Out in Space* by the German metal band



Figure 5. Judith Lang Zaimont.

Gamma-Ray; and *Black Holes in the Sky* on the 1975 album *Phoenix* by the group Labelle, whose lead singer is Patti LaBelle.

Quasars have not broken into the public sphere in quite the same way as black holes, but in the 1960s there was a brief flurry of public attention paid to quasar CTA 102 because its radio signals were claimed to include coded information from an advanced civilisation. There was nothing like a message there, it turned out, but the American singing group The Byrds was intrigued by the original story and wrote a song entitled *CTA 102* on their *Younger than Yesterday* album. Radio astronomer Eugene Epstein then thought it would be a lark to include the names of the Byrds' members in a reference in a paper on CTA 102 he was writing for the *Astrophysical Journal*. He got it past the editors in proof stage⁹, referring to the song as a private communication and using the names of the band members as authors. He sent a note with the paper to Columbia Records and Roger McGuinn, the leader of the group, came to visit him and even attended a colloquium with him on the search for life elsewhere.

In the constellation of Cygnus
There lurks a mysterious, invisible force
The black hole
Of Cygnus X-1...

All who dare
To cross her course
Are swallowed by
A fearsome force...

Through the void
To be destroyed
Or is there something more?
Atomized at the core
Or through the astral door
To soar

I set a course just east of Lyra
And northwest of Pegasus
Flew into the light of Deneb
Sailed across the milky way...

Headed for the heart of Cygnus
Headlong into mystery

The X-ray is her siren song
My ship cannot resist her long
Nearer to my deadly goal
Until the black hole
Gains control

Table 1. Lyrics from the Canadian rock group Rush's song *Cygnus X-1*.

Converting astronomical data to music

The idea of using actual data from cosmic objects to drive music in some way has captured the imagination of a number of composers and technicians. Data that people used to make music several decades ago include the instantaneous velocity of each planet in its orbit, as a way playing Kepler's *Music of the Spheres* (Rodgers & Ruff, 1979), and the index that measures how solar activity affects the Earth's magnetic field (the Kp index of geomagnetic activity)¹⁰.

More recently, the alternative Reggae band Echo Movement used transit data for two Kepler planets in the introduction to their 2012 album, *Love and the Human Outreach*. The album also features songs inspired by the uncertainty principle and quantum entanglement, and by the *Voyager* mission and Carl Sagan.

The notes for the music *Supernova Sonata* are supplied by the distance and characteristics of 241 Type Ia supernovae, seen on the Canada–France–Hawaii telescope Legacy Survey. Created by Alex H. Parker from the Southwest Research Institute, Texas, and Melissa L. Graham from the University of California, Berkeley, USA, the piece can be seen and heard on the internet¹¹. The volume in the piece is deter-

mined by distance, the pitch by the light curve, and the instrument playing the note by the mass of the host galaxy.

The European Space Agency also realised the potential of creating song from the sounds of space and released an audio track called *The Singing Comet*, a sonification of magnetic field data created by the *Rosetta* RPC–MAG instrument team. This piece has had almost six million listens on SoundCloud and has since been widely used by musicians (Baldwin et al., 2016).

Astronomers as musicians

A different perspective on the relationship between astronomy and music can be seen in the work of astronomers who write and perform music, starting in the 18th century with William Herschel, who was a professional musician and a self-taught astronomer¹². We have mentioned Fred Hoyle providing text for a piece of music, but he is by no means alone in doing this. Physicist Lisa Randall recently provided text for an opera based on the idea in her cosmology book *Warped Passages* and astronomer Fred Watson provided text for composer Ross Edwards' *Fourth Symphony*.

A group from NASA's Goddard Space Flight Center called The Chromatics have put together a number of straightforward



Figure 7. Eugene Epstein at the Aerospace Corporation. Credit: Image courtesy of E. Epstein

songs exploring ideas from modern astrophysics¹³. If music by scientists in general is your cup of tea, don't miss Walter Smith's expansive website on physics songs¹⁴.

Conclusion

There are many other pieces of classical and popular music with deep astronomical influences. If you want to see more, you can take a look at the catalogue of pieces in my resource guide (Fraknoi, 2012).

The sampling of connections between astronomy and the humanities considered in these two articles was meant merely to whet your appetite and makes no claim to be comprehensive. Please see the sources in the footnotes for many other examples and ideas about the cross-fertilisation of the fields. I continue to collect such examples, and would welcome additional suggestions from any readers. My hope is that you might be inspired by some of the above to explore such connections on your own and to share them with students and audiences as I have. I wish you many hours of enjoyable reading, watching and listening.

Notes

- ¹ Leo Smit's *Copernicus: Narrative and Credo* is available on a CD from the American record label Composers Recordings, Inc. (CRI)'s American Masters series.
- ² A performance of Todd Rundgren's *Hawking* is available on YouTube: <http://www.youtube.com/watch?v=jk7uZO1IED8>



Figure 6. Canadian rock band Rush. Credit: Photo courtesy of Rush.com

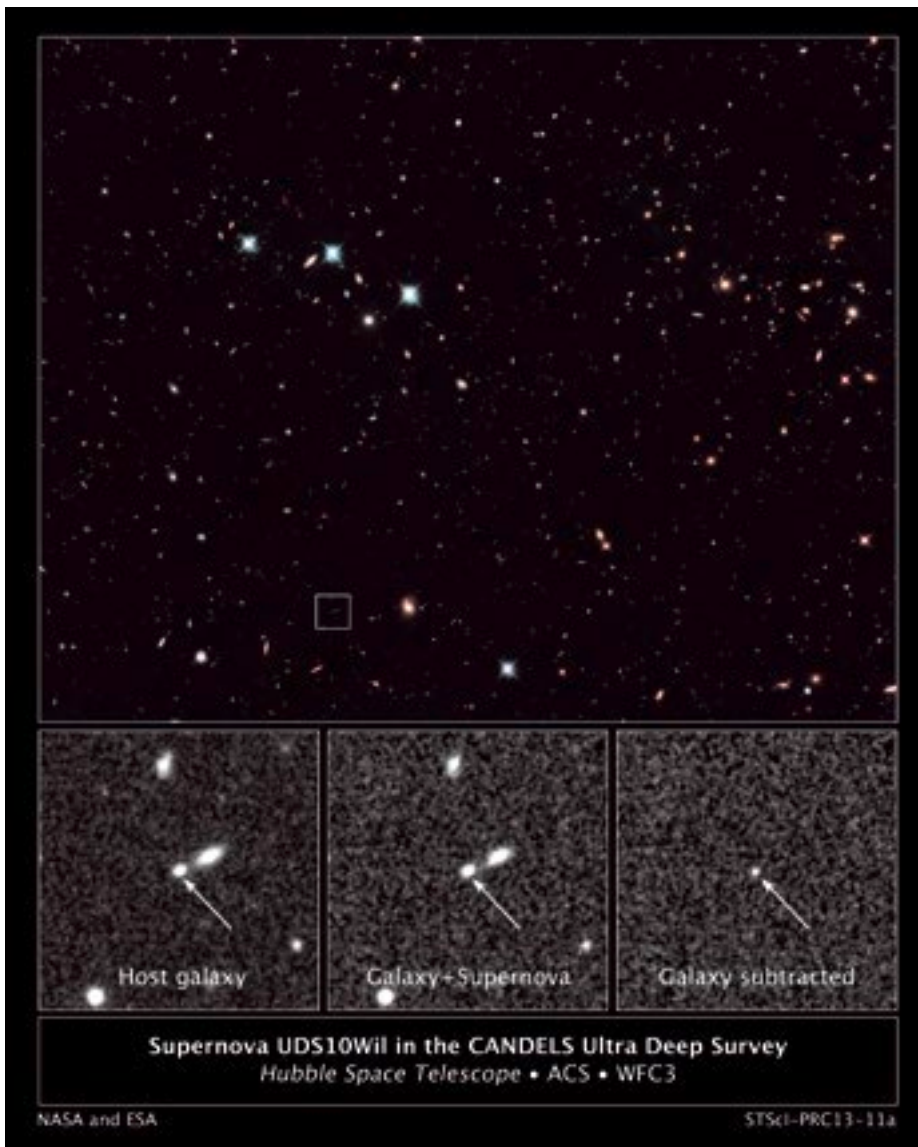


Figure 8. This Type Ia supernova, seen with the Hubble Space Telescope, is designated SN UDS10Wil, and was one of the 241 Type Ia supernovae used in Alex H. Parker and Melissa L. Graham's piece *Supernova Sonata*. Credit: NASA, ESA, A. Riess (STScI and JHU), and D. Jones and S. Rodney (JHU)

- ³ A clip from the performance at Berkeley of Carl Pennypacker and Judith Goldhaber's *Falling through a Hole in the Air: The Incredible Journey of Stephen Hawking* is available here: http://www.berkeley.edu/news/media/releases/2007/06/22_hawking.shtml
- ⁴ A pipa is a four-stringed instrument that is plucked and is something like a lute; a didgeridoo is a wooden drone pipe wind instrument; a sitar is an Indian string instrument. Philip Glass's *Orion* is available on a CD from Orange Mountain Music.
- ⁵ For more on Boyadjian's works, see: <http://www.haygboyadjian.com/>
- ⁶ *The Glittering Hosts of Heaven* by Eve de Castro-Robinson is available at: <https://vimeo.com/68986729> (For an interview with

the composer, see: <https://www.nzso.co.nz/enotestheplanets/>)

- ⁷ Judith Lang Zaimont's *Callisto* piece can be heard at: <https://www.youtube.com/watch?v=V1M7Rp6tKgW>. Her website is available at: <http://www.jzaimont.com/>
- ⁸ A British comic book version of the song *Cygnus X-1*, produced in 1979, can be found at: <http://www.cygnus-x1.net/links/rush/comicbook-cygnus-x1-b1.php>
- ⁹ The reference to the Byrds in Eugene Epstein's paper on CTA 102 can be found in *Astrophysical Journal* volume 151 in the second paragraph of page 31.
- ¹⁰ The index that measures how solar activity affects the Earth's magnetic field is known as the Kp index of geomagnetic activity.

The music inspired by this is by composer Charles Dodge; it can be heard at: <https://www.youtube.com/watch?v=j5M-Hsnc67yw> and is explained at: http://music.columbia.edu/cmcmusicandcomputers/popups/chapter1/xbit_1_1.php

- ¹¹ A recording and explanation of *Supernova Sonata* by Alex H. Parker and Melissa L. Graham can be found here: http://www.astro.uvic.ca/~alexhp/new/supernova_sonata.html
- ¹² A CD with a selection of William Herschel's music is available on Newport Classics under the title *Sir William Herschel: Music by the Father of Modern Astronomy*.
- ¹³ More information about the Chromatics: <http://www.thechromatics.com/>
- ¹⁴ A listing of physics songs: <http://www.haverford.edu/physics-astro/songs/>

References

- Baldwin, E. et al. 2016, CAPJournal, 19, 30
- Duckles, V. 1962, Publications of the Astronomical Society of the Pacific, 74, 436, 55 (<http://adsabs.harvard.edu/full/1962PASP...74...55D>)
- Fraknoi, A. 2006, Astronomy Education Review, 5, 1, 139 (<http://dx.doi.org/10.3847/AER2006009>)
- Fraknoi, A. 2012, Astronomy Education Review, 11, 1 (<http://dx.doi.org/10.3847/AER2012043>)
- Hoyle, F. 1966, *October the First is Too Late*, (London: William Heinemann)
- Rodgers, J. & Ruff, W. 1979, American Scientist, May/June, 286

Biography

Andrew Fraknoi is Chair of the Astronomy Department at Foothill College near San Francisco, and serves on the Board of Trustees of the SETI Institute and on the Lick Observatory Council. His book of teaching activities on the Sun, Moon and eclipses (*Solar Science*) is published by the National Science Teachers Association. He does not play a musical instrument (although he loves to listen to music); a few years ago he got to write and perform astronomical narration to Holst's *The Planets* with the California Symphony Orchestra.