

## Creating music from astronomical/planetary data: Herschel/PACS data sonification of Haumea

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### Abstract

Science and technology can be used to create and develop artistic expressions and styles and produce artworks, and also arts can be used to underlying or communicate physical properties, processes or relations. By developing a program code to sonificate scientific data (converting data into sound signals), and using thermal light-curves of a sample of Transneptunian objects (TNOs) observed by the Herschel Space Observatory [1], we generated musical material. We elaborated an audio CD with musical pieces integrating them, the musical pieces were performed in different events (installation and concerts). The project engages the public, promotes astronomy, planetology, and arts, underlies physical characteristics of TNOs, presents data in different aesthetically ways, and uses a new basis for musical composition.

### 1. Introduction

Transneptunian objects (TNOs) are very cold and remote objects beyond Neptune, their physical properties are largely unexplored and their thermal properties are difficult to measure. Their studies can help us to understand the Solar System and its formation [2]. In the framework of the large program “*TNOs are Cool: A survey of the trans-Neptunian region*” [3] Herschel measured the thermal flux of about 140 TNOs and carried out time series observations of few ones.

It is a standard procedure to convert data into visual representations (plots, figures) by which qualitative patterns/relations are evaluated/underlined by simply looking at it. Less common is converting data into sound and listening for patterns. Here we apply sonification to scientific data and incorporate the output audio signals into musical pieces to recognizing and interpreting observed (heard) patterns in a different way and producing artworks.

### 2. Observations and data Sonification

As an example, one of the most remarkable TNOs is the dwarf planet Haumea, Herschel/ Photoconductor Array Camera and Spectrometer (PACS) [4] measured its thermal light-curve [5]. Fig. 1 shows a clear detection of a light-curve at 100  $\mu\text{m}$ . We developed a program in *SuperCollider*<sup>1</sup> to sonificate the light-curve: transposition to aural domain to generate an amplitude envelope, generation of rhythmic impulses, and generation of material for musical notation (Fig. 2), in written notation for instruments, soundfiles for electronic composition, algorithms and data for real time audio and video synthesis.

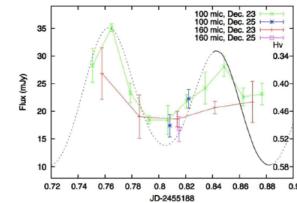


Figure 1: Thermal light-curve of Haumea at 100  $\mu\text{m}$  (green) and 160  $\mu\text{m}$  (red), fluxes vs. a function of fractional date.



Figure 2: Example of Chord instrumentations corresponding to Haumea light intensities

<sup>1</sup> <http://supercollider.sourceforge.net/>

<sup>2</sup> <https://www.bauerstudios.de/de/data/shop/6534/ncd4138.h>

### 3. Deliverables

We incorporated the set of sounds and musical material into nine musical compositions and elaborated the audio CD “signals from the cool”<sup>2</sup> (Fig. 3) by Neuklang Future. The musical piece “Cool Tune (2016)” formed part of the floating light sculpture installation “Rosalie”<sup>3</sup> at SCHAUWERK Sindelfingen, Germany (Fig. 4). The musical ensemble “Polytheistic Ensemble”<sup>4</sup> performed the live music in events like concerts (Fig. 5).



Figure 3: Audio CD “signals from the cool”. Photo credit: Miriam Rengel.



Figure 4: Rosalie exhibited at SCHAUWERK Sindelfingen, Germany, during 13 March 2016–07 January 2018. It was accompanied by the sound installation “Cool Tune” (2016) by M. Ockert. Photo credit: Wolf-Dieter Gericke, ©rosalie.



Figure 5: Tour Concert “signals from the cool” by Polytheistic Ensemble, 10 June 2016, Karlsruhe. Photo credit: Miriam Rengel.

### 4. Summary and Conclusions

Our project explores and offers a way to evaluate qualitative patterns from astronomical/planetary data by converting them into sounds, and integrating it into musical material. The project engages the public, promotes astronomy, planetology, and arts, underlies physical characteristics of TNOs, presents data in different aesthetically ways, and uses a new basis for musical composition.

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<sup>2</sup><https://www.bauerstudios.de/de/data/shop/6534/ncd4138.html>  
<sup>3</sup> [https://www.schauwerk-sindelfingen.de/en/exhibitions/current-exhibitions/detail\\_256.html](https://www.schauwerk-sindelfingen.de/en/exhibitions/current-exhibitions/detail_256.html)  
<sup>4</sup> <http://www.polytheistic-ensemble.net/en/music/>