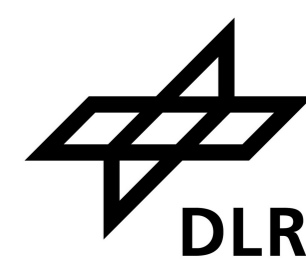


SOFIA-GREAT Post-operation activities and quality measures for heterodyne data

J. L. Verbena, C. Buchbender and R. Higgins

Universität zu Köln



Objectives

SOFIA ended its operations in 2022, nonetheless, there is plenty of scientifically unexploited data in the archive. We want to guarantee and maximize the scientific output coming from SOFIA-GREAT data in the upcoming years with a support project. As part of that effort this project includes:

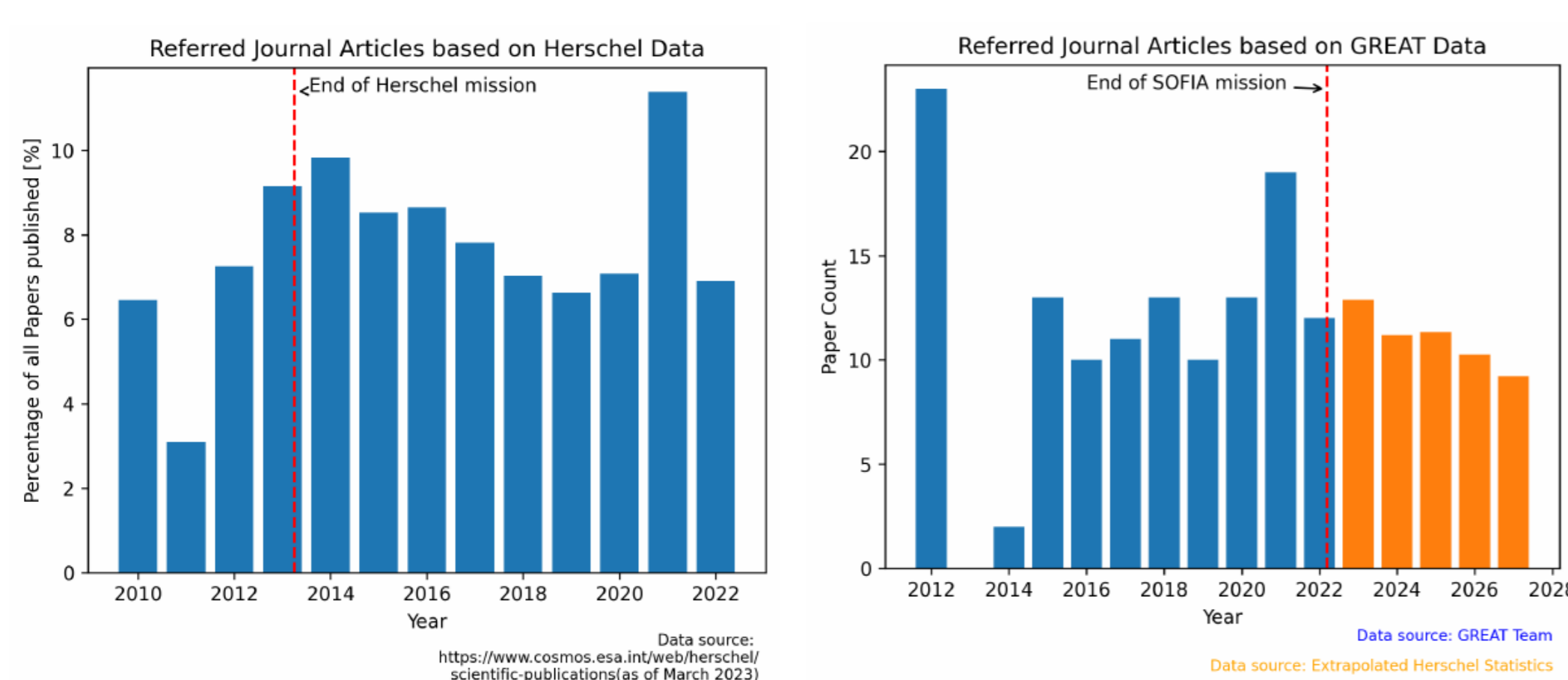
- Continuous and dedicated support to the international astronomical community.
- Development and maintenance of a SOFIA-GREAT data archive.
- Continue the development of an automatic data reduction pipeline, that includes data quality measurements.
- Analysis of special yet unexploited GREAT datasets.

Introduction

In this poster we present the plans for future and continuous support to the astronomical community regarding the data obtained with the GREAT instrument, which flew on board of SOFIA (2011-2022). GREAT offered 3 different receiver arrays:

- **Low Frequency Array (LFA):** 14 pixels targeting the emission of ionized carbon [CII] at 1.9 THz.
- **High Frequency Array (HFA):** 7 pixels observing at 4.7 THz targeting the emission of neutral atomic oxygen [OI].
- **4GREAT:** a 4-channel receiver, usable in parallel to HFA, targeting the frequencies around 500, 900 GHz, and 1.3, 2.5 THz.

The figure below shows the article output histogram from the Herschel mission, and a projection onto SOFIA-GREAT. The orange bars represent the theoretical output of expected GREAT publications, based off of the outcome from Herschel after the end of the mission.



Data Archive

Currently a SOFIA data archive is hosted at the NASA/IPAC Infrared Science Archive (IRSA). The site hosts only calibrated GREAT data. Hosting a data archive at the University of Cologne will provide the advantage that the raw data can be hosted there and be recalibrated if necessary, for example, once new developments and improvements are developed and applied in the data reduction pipeline.

The project will identify data, from the entire archive, that has not yet resulted in publications, to inform the PI's of the projects, and the scientific community accordingly. The goal will be to raise awareness of the science potential of the SOFIA-GREAT data archive and to encourage and offer support to produce scientific publications.

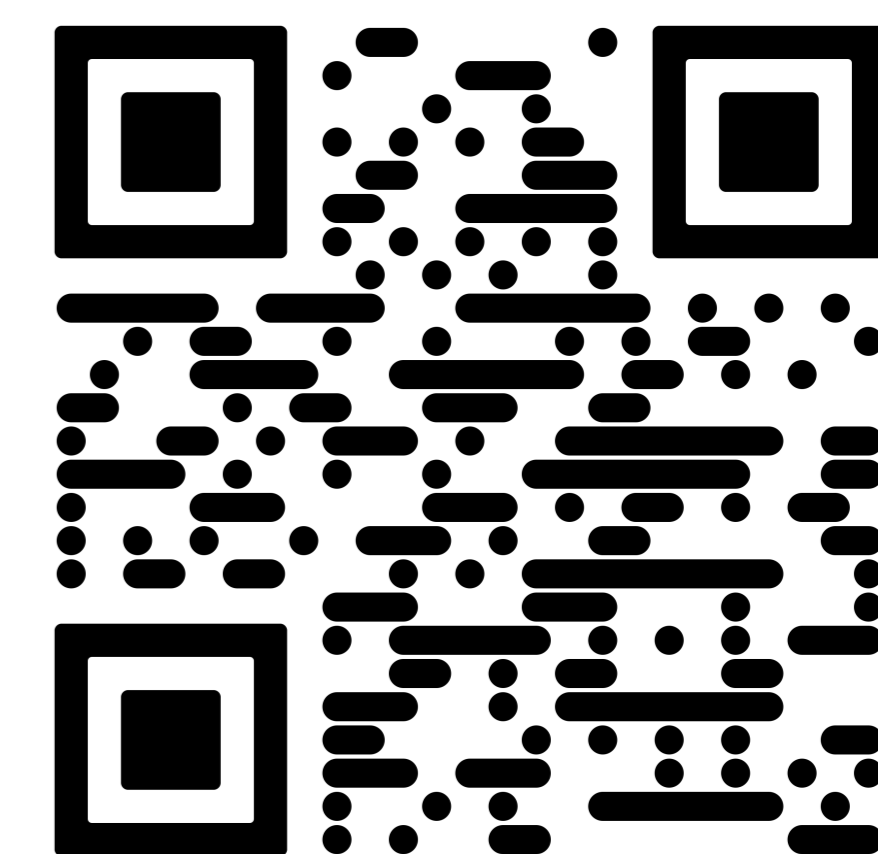
Quality Measures

As part of the development of the data reduction pipeline, quality measures have been, or are in the process of being, implemented in the preprocessing steps, that is, during the gain and atmospheric calibration of the data. These measures are listed below:

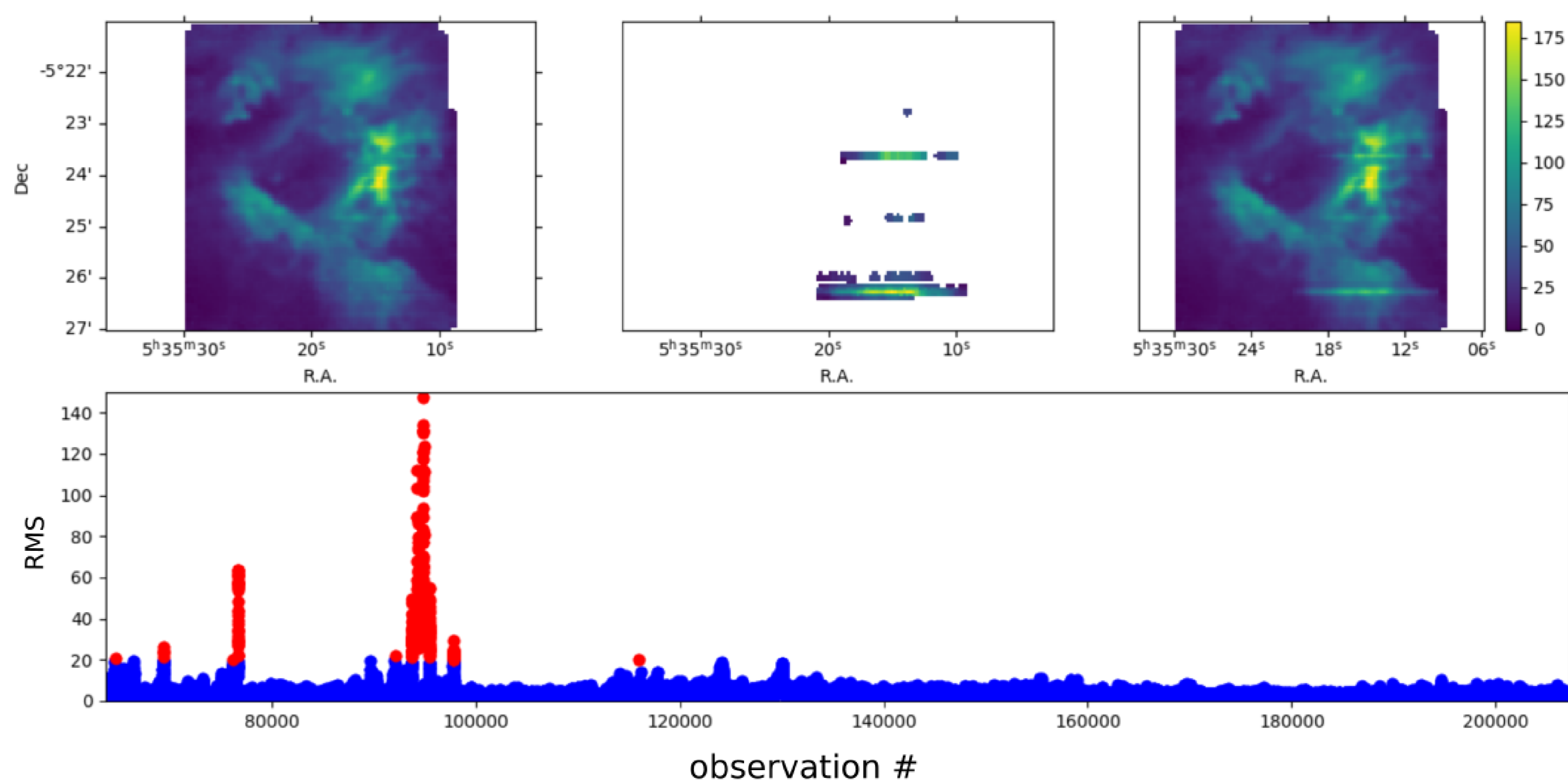
- Comparison of the measured RMS to that expected from the radiometer equation.
- Detection and treatment of radio frequency interference (RFI).
- Treatment of the baseline: detection of standing waves, and identification of datasets which require more advanced treatment, i.e., the Cologne-developed principal component analysis method (PCA).
- Determination of the quality of the atmospheric fit: determine if a new fit is needed, or if the low quality of the spectra requires that it be discarded.

Contact & Resources

- **Contact:** Juan Luis Verbena (verbena@ph1.uni-koeln.de).
- **Webpage:** upgreat.uni-koeln.de



The figure below shows an example of basic quality check on the spectra and the result after removing low quality data.



Special Datasets

Two datasets of great potential have been identified to be further analyzed:

OI Data

There is plenty of unexploited neutral atomic oxygen data [OI] that resulted as byproduct of observation projects whose scientific main goal was the detection and analysis of ionized atomic carbon [CII]. This data is publicly available. The processing and reduction of [OI] data is in general more challenging and presents more problematic baselines and complicated atmospheric fits. Recent improvements in the data reduction pipeline will be able to make the data scientifically exploitable.

Atmospheric Data

The observation modes, as well as the high spectral resolution of the GREAT instrument make it possible to extract detailed atmospheric spectra from the observations. Through subsequent analysis these data can be built into a dataset of atmospheric spectra, which, can be organized according to the geographical location, flight altitude, and tuned frequency of the receiver. The support project will be responsible for building and exploiting this dataset and will communicate the results to the scientific community via a scientific publication.

