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THE AUSTRIAN HERSCHEL/PACS ON-BOARD REDUCTION WORK PACKAGE

R. Ottensamer[1], F. Kerschbaum[1], C. Reimers[1],
A. N. Belbachir[2], H. Bischof[2],

[1]*Institut für Astronomie der Universität Wien,*
[2]*Institute for Computer Graphics and Vision, Graz*

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Abstract. ESA's cornerstone mission HERSCHEL is an ambitious infrared and sub-mm satellite to be launched in 2007. It will have a radiatively cooled 3.5m telescope and a science payload complement of three instruments (HIFI, PACS, SPIRE) housed inside a superfluid helium cryostat.

The Photodetector Array Camera and Spectrometer (PACS) instrument employs in total four novel photoconductor and bolometer arrays covering the 57 to 210 micron range.

The Austrian participation covers on-board reduction and compression software to cope with the high readout rate and the low telemetry bandwidth limited by the spacecraft's distant orbit around L2. The high raw data rates force us not only to use highly specialized lossless compression algorithms, but also to carry out irreversible reduction steps that are normally done on ground. So special attention must be given to the fact that future astronomers may no longer have access to raw data but only to at least partly reduced data products.

Key words: HERSCHEL, PACS, reduction, compression, processing, on-board

1. Introduction

The Herschel Space Observatory (HSO), an infrared and sub-mm satellite named after Sir William Herschel, will carry a science payload complement of three instruments (HIFI, PACS and SPIRE) inside its

superfluid Helium cryostat (Pilbratt et al. 2001) when launched in 2007.

Lead by the Max Planck Institute for Extraterrestric Physics in Garching, Austrian scientists participate in the development of PACS, the Photodetector Array Camera and Spectrometer (Poglitsch et al. 2000). With two Ge:Ga photoconductor arrays and two bolometer arrays, the instrument allows imaging line spectroscopy and imaging photometry. Our responsibility is to develop and implement the PACS on-board software (OBSW), that takes a pioneering step towards on-board reduction of science data.

2. Problem Statement

As a consequence of the high readout rates of the detector arrays, the instrument generates a raw data flow of up to 3600 kbit/s in spectroscopy and up to 1600 kbit/s in photometry. These data rates are by far above the telemetry rate, which is normally restricted to 100 kbit/s.

Since compression only will not fulfill the telemetry requirements, the consequence is the need to process the science data already on board.

3. On-Board Processing Concept

The goal of our software is not to reduce/compress the data to as little as possible, but to retain as much science within the allowed data rate of 100 kbit/s. The following processing steps have evolved during the past three years of development:

- *data selection and rejection* All detector arrays can be masked arbitrarily to only transmit selected channels. It allows to blind out defunct pixels and on the other hand a compromise in the quantity (more pixels) and the quality (less reduction) of the data can be found. Data rejection is also a major feature of our software, allowing to detect and reject glitch affected samples automatically.

- *data processing* Once the validity of the readouts is ensured by the previous module, the averages/ramps are calculated conventionally using mean/least squares. In case a much higher reduction rate is demanded, integration can be selected as well. That is the lossy part of the reduction scheme, where special attention has to be given to, because after the integration step the access to the raw data is lost.
- *data compression* The data processed so far have still some statistical properties we can use to compress more using lossless coding. This is done by temporal and spatial redundancy reduction, finally followed by a standard lossless compression algorithm.

4. Conclusion

In this paper we described the PACS on-board software processing concept which combines compression algorithms with real reduction steps. The flexibility of the software ensures that it is still possible to retrieve raw data by trading detector channels, but normally it will be more feasible to run the full scheme including data reduction.

5. Acknowledgments

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