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Memorie della

Planck/LFI: the Data Processing Centre

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Abstract. The success of the Planck mission heavily relies on careful planning, design and implementation of its ground segment facilities. Some aspects related to the control of the LFI instrument, to the data flow and to the data processing for Planck are described in this poster, which provides an overview of the activities being carried out for the LFI Data Processing Centre.

Key words. techniques: miscellaneous – astronomical data bases: miscellaneous – space vehicles: instruments

1. Planck and its Scientific Ground Segment

Planck is the M3 mission of the ESA Horizon 2000+ programme and it is in its phase B/C both for the spacecraft and the payload components. It is due to be launched in February 2007 together with Herschel (previously known as FIRST); the two missions will be jointly operated by ESA. The major elements of the Planck ground segment are the ESA Mission Operations Centre (MOC) and Planck Science Office (PSO), together with two Data Processing Centres (DPCs), operated by the teams responsible for building the two instruments (LFI and HFI) which form the scientific payload of Planck. The Consortium in charge of the LFI is formed by 33 institutes located in 12 different countries and is led by N. Mandolesi of IASF/CNR, Sezione di Bologna.

The tasks in the Planck Scientific Ground Segment are distributed as follows. The responsibility of the MOC is to uplink commands to Planck and receive from the Ground Station telemetry from spacecraft and instruments, check it to guarantee safety, and make it available to DPCs. The PSO is in charge of controlling the scanning strategy and coordinating merged DPC inputs to the MOC during operations. The Planck DPCs are responsible for operating the respective instruments and for the delivery of the scientific data products. At the end of the mission, after processing and a proprietary period of one year, the DPCs will provide to ESA the final results to be stored in the Planck Long Term Archive.

2. The LFI Data Processing Centre

The deliverables of the mission to be provided by the DPCs are: calibrated time series data, after removal of systematic fea-

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tures and attitude reconstruction; photometrically and astrometrically calibrated maps of the sky in the observed bands; sky maps of the main astrophysical components; catalogs of sources detected in the sky maps of the main astrophysical components. A key to the production of an integrated set of Planck products is the exchange of data between DPCs, essential for the understanding and removal of the systematic effects in the data, and to properly build a merged set of homogeneous results.

Other information is crucial for processing flight data and updating the knowledge and the performances of the instrument, e.g. the estimated characteristics of each detector and the telescope or the ground calibration information produced during the instrument development and testing. A high level of coordination with the LFI Instrument Development Team is therefore needed, to harmonize properly instrument knowledge and data processing tasks. *Inter alia*, the DPC Team is implementing the telemetry-handling software to be used for the LFI ground tests (Fogliani et al. 2003).

It is furthermore clear that all above activities will need a phase of detailed simulations. An important point for the development philosophy is that successively more and more realistic simulations of the data flow need to be built, which will be used as inputs to the pipeline for tests before launch. Tests on simulated data are important for the development of data processing algorithms, e.g. the in-flight calibration but also to define the instrumental setup, or the impact on science of specific technical choices; e.g. the analysis of the impact of the quantization factor on the CMB power spectrum (Maris et al. 2003). Complete coordination of the LFI Simulations, Modelling and Prototyping Teams with the DPC is absolutely essential.

The DPC structure has been divided in five logical levels:
– Level 1: telemetry processing and interface with the MOC (no scientific processing of the data);
– Level 2: data reduction and calibration (requires detailed instrument knowledge);
– Level 3: component separation and optimization (requires HFI and LFI data to be analyzed jointly);
– Level 4: joint HFI and LFI generation of final products (reception, archiving, preparation of public release material);
– Level S: during the pre-launch phase, simulation of data acquired from the Planck mission.

Although contributions to the LFI DPC, in terms of info on instrument characteristics and prototype software come from many Institutions throughout the Consortium, the operations are centralized in Trieste, where they are run by the OAT and SISSA. Only Level 4 is operated by MPA, Garching.

By the end of July 2002, a Breadboard Model (BBM) of the whole LFI DPC is going to be ready. It will then be operated on a year's worth of simulated telemetry generated by Level S to produce results, which will be used to evaluate the data flow, the processing load, and the processing algorithms used.

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