PLANCK — UNLOCKING THE SECRETS OF THE UNIVERSE

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The Planck satellite is a European Space Agency ESA's mission capable of mapping the whole sky at several radio wavelengths. The ultimate purpose of the satellite is to measure, with a high resolution, the cosmic microwave background (CMB) anisotropy pattern, and thus define the geometry and content of our Universe. At the same time all foreground radio sources in the sky, including extragalactic radio sources, will be measured, too. The by-products of the CMB map cleaning process, the foreground source maps, will become useful scientific results in themselves. Hence the task is two-fold. First, to provide the cosmologists with tools for cleaning the CMB maps, and second, to extract scientific information out of the high radio frequency all-sky foreground source catalogs.

One of the most important goals of our Planck project is the acquisition of complete sky surveys at several high radio frequencies —an unprecedented event that should solve at least some of the open questions regarding active galactic nuclei (AGNs). Even though we do have a general idea of the basic structure and nature of AGNs, the detailed structure and precise physical processes at work are not yet well understood. AGNs emit at all electromagnetic frequencies from the radio to the gamma-ray region, and all these frequencies are connected, each frequency adding to the complete picture. The future of the AGN research is in multi-frequency studies performed with sophisticated ground-based and space-borne instruments or instrument networks, and Planck will be a significant contributor to this work.

The Metsähovi and Tuorla Planck team has developed a special software called the Quick Detection System (QDS), that will be used for detecting strong, possibly flaring, radio sources in the time-ordered data stream of the Planck satellite within one week from the time of observation. This is essential for follow-up observations since the actual data product of the satellite will not be available until after two years after the mission has started, and even the Early Release Compact Source Catalog (ERCSC) will be available only approximately nine months after the first full sky observation cycle has been completed. The QDS will give us a unique opportunity to get our hands on the Planck foreground data months before anybody else, to trigger virtually simultaneous follow-up observations of interesting events, and also help monitor the quality of the satellite data at an early stage. QDS will be operated in the Planck Low Frequency Instrument (LFI) Data Processing Centre (DPC) in Trieste, Italy, by our team. The launch date of the Planck satellite is currently set for early 2008, and the operation of the QDS will start as soon as the test period of the satellite has been completed.

In this paper we describe the Planck mission; the instruments and the science it has been designed to study. A special emphasis will be made on the Finnish participation in the project. This includes, for example, the 70 GHz receivers that were designed and build in Finland, and many aspects of the science we are currently involved in.