

An Experimental Investigation of the First Stages of the Formation of Cosmic Structures

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Paolo de Bernardis is Professor of Astrophysics and Observational Cosmology at the Università di Roma “La Sapienza”. Andrew Lange was Marvin L. Goldberger Professor of Physics at the California Institute of Technology.

This project, carried out under Professor Paolo de Bernardis, aimed to measure the effect of the first structures on the background CMB light, using an original approach, performing *spectroscopic* measurements of CMB anisotropy. From the experimental point of view, this strategy required building a *differential spectrometer* matched to a large aperture telescope to achieve the necessary angular resolution. Several publications resulted from the preparatory phases. The idea was tested experimentally with the flight of the OLIMPO balloon-borne telescope, which had been upgraded with an ambient-temperature differential spectrometer, inserted as a plug-in in the optical path between the telescope and the multi-band photometer, transforming the 4-band photometer in a low-resolution spectrometer.

A full phase-A study of an innovative satellite mission, called SAGACE, was carried out by the group at “La Sapienza” in the framework of the second project above, and is described in a long document (ref. KISAG- RP-010), which has been submitted to the Italian Space Agency for evaluation and possible implementation as a national small mission.

Balzan funds were used to acquire hardware to design and complete the instruments, to support the dedicated work of postdoctoral students already trained on the BOOMERanG project, to support the collaboration with the Cardiff (Ade, Mauskopf) and Pasadena (Lange) groups for the development of subsystems, and the diffusion of cosmology results through the preparation of a book on observational cosmology. Three Balzan postdoctoral fellowships at “La Sapienza” focusing on the data analysis of the BOOMERanG and Planck experiments and on the SAGACE study were assigned. This work resulted in a large number of papers. Balzan funds also provided support for: the hardware of the large throughput Martin-Puplett interferometer built in the group (a prototype for the missions described above, and the subject of Alessandro Schillaci’s PhD thesis); the development of innovative mm-wave detectors, the microwave kinetic inductance detectors (paper submitted for publication) and the cold electron bolometers; cooperation with the Caltech group on CMB polarization measurements, with the development of a parallel study carried out in Europe for a space mission devoted to CMB polarization.

Two proposals have been submitted to European Space Agency (ESA), with Paolo de Bernardis serving as the PI and with the collaboration of the US teams in addition to the European ones. His group is also actively studying the impact of systematic effects on the scientific exploitation of these measurements. An even more ambitious mission, PRISM, was studied and proposed to the ESA in 2013 in the framework of the call for science with large missions.

Publications

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