PROCEEDINGS OF SCIENCE

Foreword

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"More than ever before, astronomical discoveries are driving the frontiers of elementary particle physics, and more than ever before our knowledge of elementary particles is driving progress in understanding the universe and its contents" (Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century", Committee on the Physics of the Universe, National Research Council, USA, 2003).

The Cosmic Microwave Background (CMB) is by far the most powerful cosmological probe. Its discovery in 1965 established the paradigm of the Hot Big Bang cosmology and also provided the first link between cosmology and particle physics, namely the production of light elements in the first three minutes after the beginning of the expansion. An impressive series of experiments aimed at mapping CMB anisotropies, culminating in the presently flying NASA's Wilkinson Anisotropy Probe (WMAP), have led to determine that the universe is close to spatially flat, is dominated by dark energy, accounting for about 70% of the present cosmic energy density, and by dark matter comprising about 85% of the matter density, and that primordial fluctuations had a nearly scale-invariant spectrum, consistent with having emerged from a primordial inflationary phase. The tremendous inflationary expansion bridges the gap between the subatomic length scales and astrophysical scales, relating the seeds of the structure we observe in the universe to quantum fluctuations originated some 10-35 seconds after the big bang. In other words, from CMB anisotropies, that are directly related to the primordial density fluctuations, we can learn about physical processes occurring at extreme energies, unattainable in any conceivable accelerator on earth. Thus studies of the CMB bring us to the deepest questions about the origin of the universe.

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A synergic approach, involving cosmologists and particle physicists, is thus essential to identify an efficient strategy to understand the birth and the early evolution of the universe. This conference aimed at providing a context helping to foster exchanges between particle physicists and cosmologists, and to break communication barriers among the two disciplines.

Recent technological advances and the widespread recognition of the key role of information encoded in CMB maps are promoting design studies of a new generation of experiments, with at least an order of magnitude better sensitivity than ESA's Planck satellite. The new experiments will target CMB polarization, and in particular the very weak B-mode, imprinted by the gravity-wave background produced during the very earliest epochs of the universe evolution. Another key aim of this conference was to provide a forum where different projects are compared and discussed, vis-a-vis with scientific priorities and taking into account the status of relevant technologies.

In a few months ESA will release the first call for new missions in the framework of the Cosmic Vision long-term (2015-2025) programme, which includes an All Sky Cosmic Background Polarization Mapper as a potential mission. A mission with essentially identical goals is being considered in the framework of NASA's *Beyond Einstein* programme. In France, the CNES has supported an assessment study of SAMPAN (SAtellite to Measure the Polarized ANisotropies), and in Italy a study commissioned by ASI has identified a mission (B-Pol) targeting the B-mode of CMB polarization as the top priority in the Cosmology sector. This commonality of interests strongly suggests that the future missions to search for the B-modes induced by primordial gravitational waves should naturally be developed in the framework of wide international collaborations. This conference aimed at being, and indeed was, an opportunity to start the dialogue.

Thanks are due to the speakers for the lively and stimulating presentations, to the chair-persons of the Sessions and to all the participants, who all contributed to make the Conference scientifically fruitful.

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