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BISOU: a balloon project to measure the CMB spectral distortions

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With the success of the ESA Planck mission, the concordance cosmological model is established as the reference framework. However, outstanding questions about this model are still unanswered. In particular the simplest inflationary model proposed as the origin of the initial matter perturbations is favoured by Planck measurement of the spectral index and low non-Gaussianity. Nevertheless, it still needs to be confirmed through the measure of its smoking gun signature: the relic background of primordial gravitational waves. The latter can only be observed through the CMB polarisation: namely B-modes. The CMB frequency spectrum is another key observable to probe the cosmological model. Departures of the CMB blackbody spectrum, i.e. spectral distortions, encode information about the full thermal history of the Universe from the early stages (primordial distortions from inflation and cosmological recombination lines) until today (star formation and galaxy clusters). Many of these processes (in particular the late time ones) are part of our standard cosmological model and are expected to leave spectral distortions.

The BISOU (Balloon Interferometer for Spectral Observations of the Universe) project aims to study the viability and prospects of a balloon-borne spectrometer, pathfinder of a future space mission dedicated to the measurements of the CMB spectral distortions, in order to achieve a first measurement. A balloon concept based on a Fourier Transform Spectrometer, covering a spectral range from about 90 GHz to 2 THz, adapted from previous mission proposals such as PIXIE and PRISTINE, is being studied and modelled. Taking into account the specificities of a balloon flight in terms of requirements and conditions (i.e. residual atmosphere, observation strategy for instance), this CNES phase 0 study will evaluate if such a spectrometer is sensitive enough to measure at least the Compton y -distortion while consolidating the instrumental concept and improving the readiness of some of its key sub-systems.

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