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The BISOU optical concept design

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The last and only measurement of the CMB spectrum was performed by COBE-FIRAS in 1991, showing that it is close to a perfect blackbody emission. However, deviations referred to as CMB spectral distortions are expected. Due to its limited sensitivity, FIRAS could only give upper limits, leading to new space missions being proposed to perform this measurement. The balloon-borne mission BISOU (Balloon Interferometer for Spectral Observations of the primordial Universe) will serve as a pathfinder, performing the first detection of the y -parameter distortion, while also establishing the measurement concept. During BISOU CNES Phase A, a laboratory breadboard of the instrument is being developed at the Institut d'Astrophysique Spatiale (IAS). It will enable us to study the various subsystems and to characterize systematic effects of this new concept, particularly of the optical system.

This presentation outlines the optical modeling process of the BISOU instrument. I will begin with an overview of the optical concept of its Fourier Transform Spectrometer (FTS), followed by the first overall configuration based on geometric optics. The design was refined and optimized through iterations using Gaussian beam propagation, enabling more realistic modeling of the instrument's optical performance. The outcome is an optical configuration that incorporates key constraints such as size and thermo-mechanical limitations. I will present the current concept and the simulation results concerning the co and cross polarisation beam performance, including the ellipticity, together with the remaining steps required to finalize the design and prepare for the associated breadboard implementation.

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