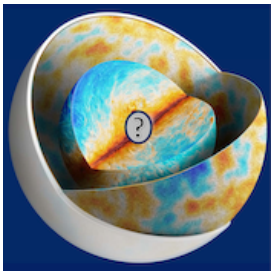

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Optimisation and Forecasting Studies for CMB Spectral Distortion Experiments

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In the 1990s, the COBE/FIRAS mission measured the Cosmic Microwave Background (CMB) spectrum and demonstrated that its spectral energy distribution is extremely close to a perfect blackbody. However, theory shows that tiny departures from a black body are expected at the level of $\Delta I/I \simeq 10^{-5}$, known as spectral distortions. The two main types of CMB spectral distortions are the y-distortion, arising from energy release in the optically thin regime at redshifts $z < 5 \times 10^4$, and the chemical potential or μ-distortion, imprinted in the optically thick regime at $z > 5 \times 10^4$. Measuring these faint signals is challenging, but it will provides unique access to the thermal history of the Universe, from the very early Universe to now, which cannot be extracted in any other way.

High-precision spectroscopy of the CMB is one of the three themes selected by the ESA Voyage 2050 programme. Since 2011, several dedicated space missions have been proposed, including PIXIE, PRISTINE, and FOSSIL. In addition, balloon-borne experiments such as BISOU are being considered as pathfinders for a future space mission targeting CMB spectral distortions.

I will present the latest optimisation of the instrument and forecasting studies of the BISOU (CNES Phase A) and FOSSIL (ESA M8 proposal) instruments, both dedicated to measuring CMB spectral distortions. Fisher forecasts and optimisation of instrument design and mission parameters (frequency range, scanning strategy, mission duration, etc.) are performed by combining the outputs of two complementary models: a versatile photometric model based on key instrument subsystem choices and parameters, and a sky emission model that accounts for spatially varying foregrounds across the frequency range relevant to CMB spectral distortions.

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