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Measuring spectral distortions of the CMB: the COSMO experiment

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The COsmic Monopole Observer (COSMO) is a pathfinder, ground-based experiment, designed for the detection of the isotropic y -distortion of the Cosmic Microwave Background (CMB). Deviations from a pure blackbody are expected as an evidence of all the interactions that CMB photons undergo along the thermal history of the Universe. Their observation provides an insight into processes involving CMB photons that took place both before and after recombination. The upper limit on the y -distortion is still the one from the COBE-FIRAS mission ($y < 10^{-5}$) due to the extreme accuracy required for spectral distortions measurements. COSMO exploits a cryogenic Martin-Puplett Fourier Transform Spectrometer, comparing the radiation collected from the sky to the one from an internal, cryogenic blackbody reference with high emissivity. All the optical elements of the FTS are maintained at a temperature of 2.7 K to minimize instrument emission. The interferogram is obtained modulating the optical path difference (OPD) with cryogenic, frictionless linear motion of one of the two roof-mirrors. The maximum mirror displacement is ± 25 mm, and it is measured with a resolution of $10\mu\text{m}$. This provides a spectral resolution around 5 GHz. A flat spinning wedge mirror, at room temperature, allows to perform fast sky dips along 20° diameter circle in the sky while scanning the interferogram. This strategy enables to measure and remove most of the atmospheric emission and its slow fluctuations. Fast detectors are required, so small multi-mode Kinetic Inductance Detectors (KIDs) arrays ($\tau \sim 50\mu\text{s}$), operating in the 120-280 GHz range, will equip the two focal planes.

COSMO will operate from the Concordia station, at Dome-C, in Antarctica, arguably the best site on Earth for this kind of measurements.

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