The Large Scale Polarization Explorer

Measurements of the Cosmic Microwave Background (CMB) anisotropies offer strong probes of the standard cosmological model. Linear polarization of the CMB is known to emerge from Thomson scattering off electrons at all the scattering last surfaces in the presence of local quadrupole anisotropies in the scattering radiation field. The polarization pattern observed in the sky is commonly decomposed into a curl-free “E-mode” and a divergence-free “B-mode”. E-modes alone emerge in the presence of the velocity fields around peaks in the baryon-photon fluid at last scattering, and thus exhibit a sight correlation with the temperature anisotropies of the CMB. As such, the angular power spectrum and the E-mode power spectrum can be used to extract information about the transition to the matter-radiation decoupling, and to constrain specific parameters (e.g. the reionization optical depth) otherwise intrinsically degenerate with respect to temperature anisotropies. On the other hand, B-modes at small angular scales are observed as a result of B-B leakage due to gravitational lensing, and as such observed in correlation to the line-of-sight integrated lensing potential due to the presence of large scale structure across the light path to last scattering surfaces.

In a large (degree and arc-minute scale) area of the sky, B-mode angular power spectrum is predicted to emerge from a stochastic background of tensor (metric) perturbations, i.e. gravitational waves, generated during the inflationary expansion history of the early universe. The amplitude of the gravitational wave background can be effectively used to constrain inflationary paradigm: the B-mode power yields a direct measurement of the so-called tensor-to-scalar ratio r. As such the power spectrum is a powerful tool to test the predictions of the standard inflationary paradigm, and to constrain the values of specific inflationary parameters.

The limited number of physical detectors and the comparatively small number of wires required for the cryogenic experiment make the approach of Multi-Moded pixels (MM pixels) particularly well suited for CMB polarization measurements. In a MM pixel the Stokes parameters are directly extracted from each pair of diodes at the output. A schematic of the detection chain of STRIP is shown in figure. The benefit of this design is that the Q and U rotation at 60 rpm, corresponding to 4 Hz modulation of the polarized signal.