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Second-generation Micro-Spec: spectrometer design for the Experiment for Cryogenic Large-Aperture Intensity Mapping

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Micro-Spec (μ -Spec) is a direct-detection spectrometer that integrates all the components of a diffraction-grating spectrometer onto a $\sim 10\text{-cm}^2$ chip using superconducting microstrip transmission lines on a single-crystal silicon substrate. The second-generation μ -Spec has been designed to operate with a spectral resolution of ~ 512 in the far-infrared and submillimeter (420–540 GHz, 714–555 μm) wavelength range, a band of interest for NASA's EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM). EXCLAIM will be a high-altitude balloon mission that is being designed to map the emission of redshifted carbon monoxide and singly-ionized carbon lines over a redshift range $0 < z < 3.5$. EXCLAIM will be the first demonstration of the μ -Spec technology in a space-like environment.

This work reviews the status of the μ -Spec design for the EXCLAIM instrument, with emphasis on the spectrometer's two-dimensional diffractive region, through which light of different wavelengths is focused on microwave kinetic inductance detectors (MKIDs) along the spectrometer focal plane. An optimization process generates a geometrical configuration of the diffractive region that satisfies specific requirements on size, operating spectral range and performance. An initial optical design optimized for EXCLAIM is presented in terms of geometric layout, spectral purity and efficiency.

Less than 5 years of experience since completion of Ph.D

Y

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