

IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS
(A7)

Technology Needs for Future Missions, Systems, and Instruments (3)

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SECOND-GENERATION MICRO-SPEC: A COMPACT SPECTROMETER FOR FAR-INFRARED
AND SUBMILLIMETER SPACE MISSIONS**Abstract**

Micro-Spec (μ -Spec) is a direct-detection spectrometer which integrates all the components of a diffraction-grating spectrometer onto a $\sim 10\text{-cm}^2$ chip through the use of superconducting microstrip transmission lines on a single-crystal silicon substrate. The second generation of μ -Spec is being designed to operate with a spectral resolution of at least 512 in the far-infrared and submillimeter (500-1000 μm , 300-600 GHz) wavelength range, a band of interest for several spectroscopic applications in astrophysics. Due to its compact size, μ -Spec can enable a wide range of flight missions that are still difficult to realize due to the large size of current spectrometers and the required spectral resolution and sensitivity. High-altitude balloon missions are being targeted as the first testbed to demonstrate the μ -Spec technology in a space-like environment and, in addition, they represent an economically viable venue for multiple observation campaigns. This work reports on the current status of the instrument design, while providing an overview of each instrument subsystem. Particular emphasis will be given to the design of the spectrometer's two-dimensional diffractive region, through which the light of different wavelengths is focused on the kinetic inductance detectors along the focal plane. An optimization process is used to generate geometrical configurations of the diffractive region that satisfy specific requirements on spectrometer

size, operating spectral range and performance. An optical design optimized for balloon missions will be presented in terms of geometric layout, spectral purity and efficiency.