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WSPEC: A waveguide filter-bank focal plane array spectrometer for millimeter wave astronomy and cosmology

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Imaging and spectroscopy at millimeter and sub-millimeter wavelengths are key frontiers in astronomy and cosmology. Large area spectral surveys with moderate spectral resolution (R=50-200) will be used to characterize large scale structure and star formation through intensity mapping surveys in emission lines such as the CO rotational transitions. Such surveys could also be used to study the SZ effect, and could detect the emission lines and continuum spectrum of individual objects. WSPEC is an instrument proposed to target these science goals. It is a channelizing spectrometer realized in rectangular waveguide, fabricated using conventional high-precision metal machining. Each spectrometer is coupled to free space with a machined feed horn, and the devices are tiled into a 2D array to fill the focal plane of the telescope, enabling the high instantaneous sensitivity needed for a large area survey. The detectors will be aluminum Lumped-Element Kinetic Inductance Detectors (LEKIDs), which are straightforward to fabricate and read out. In lab measurements they have already demonstrated the required coupling efficiency and sensitivity for photon-noise limited sensitivity in a ground-based instrument. To target the CO lines and SZ effect, we will have bands at 135-175 GHz and 190-250 GHz, each Nyquist-sampled at R=200 resolution and avoiding a strong atmospheric line at 185 GHz. Here we will discuss the

instrument concept and design, successful initial testing of the prototype spectrometer, and progress towards the goal of integrating a spectrometer with a LEKID array and deploying a prototype device to a telescope for first light.