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Development of DESHIMA: Superconducting on-chip spectrometer for submillimeter wave cosmology

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Ultra-wideband millimeter-submillimeter wave spectrometry can become a very efficient method for rapidly determining the redshift of dusty starbutst galaxies in the early Universe. We are developing a new instrument, DESHIMA (Deep Spectroscopic High-redshift Mapper), which takes advantage of the multiplexibility of KIDs to realize a spectrometer that covers the entire submillimeter band (326-905 GHz), with a frequency resolution of f/df = 500, and up to 7 spatial pixels. DESHIMA is remarkably compact, thanks to the on-chip filterbank spectrometer design, and also the adoption of an adiabatic demagnetization refrigerator (ADR) to operate the KIDs at 150 mK. The filterbank spectrometer chip consists of the following components: (1) a leaky-lens antenna to couple a linearly polarized beam to a coplanar waveguide (CPW) over the wide DESHIMA band, (2) an array of superconducting narrow band filters, each being a quarter-wavelength CPW resonator made of superconducting NbTiN, and (3) NbTiN/Al hybrid CPW KIDs. In the conference we will give an overview on the recent progress of DESHIMA, focusing especially on the development of the on-chip filterbank.

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