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# DESHIMA on ASTE: First astronomical light captured with an integrated superconducting spectrometer

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A wideband, large field-of-view (sub)millimeter wave imaging spectrometer is the key technology for uncovering dust-enshrouded cosmic star formation and galaxy evolution over cosmic time. Here we report the first astronomical signal captured with an integrated superconducting spectrometer (ISS): a spectrometer that uses a small superconducting integrated circuit for dispersing the signal to achieve a wide instantaneous bandwidth, and to detect the signal in each spectral band. The compact size of the spectrometer and the absence of a local oscillator makes this technology very well suited for constructing spectral imaging arrays.

We present the first on-sky results of DESHIMA (Deep Spectroscopic High-redshift Mapper), obtained from October to December 2017 on the Atacama Submillimeter Telescope Experiment (ASTE), a 10 m diameter antenna in the Atacama Desert of Chile. On the ISS chip of DESHIMA, the signal is captured by a lens-antenna and subsequently travels through a coplanar waveguide made of superconducting NbTiN, from which coplanar NbTiN bandpass filters branch out to divide the signal into separate frequency channels. At the output of each filter is a NbTiN/Al hybrid microwave kinetic inductance detector (MKID). The DESHIMA prototype is a 1-pixel spectrometer that covers the 332-377 GHz band with 49 spectral channels, offering a spectral resolution F/dF ~ 380. We present detection of molecular emission lines from various sources, including a weakly redshifted CO line from the luminous infrared galaxy VV 114. The on-sky performance shows excellent agreement between the design and laboratory measurement in terms of the sensitivity, optical efficiency and beam pattern. In addition, we present wideband spectral maps of extended sources to demonstrate the potential of the ISS technology towards spectroscopic direct imaging.

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

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