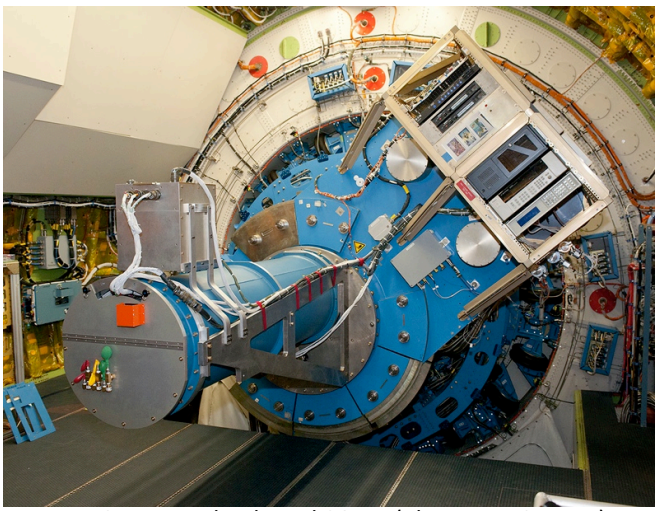
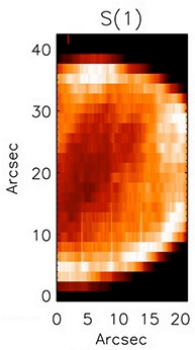
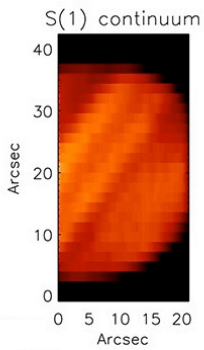
Echelon-Cross-Echelle Spectrograph

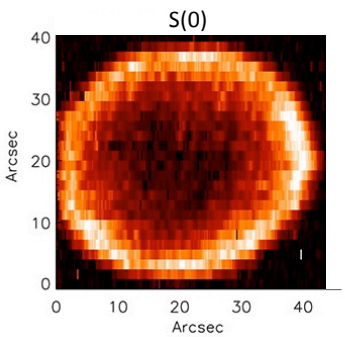
EXES is a Principal Investigator-class, high-resolution mid-infrared (4.5 – 28.3 µm) spectrograph containing an echelon grating cross-dispersed by an echelle grating. EXES on SOFIA is able to observe molecular transitions that are blocked by the Earth's atmosphere for ground-based instruments. In particular, high spectral resolution enables the study of molecular hydrogen, water vapor, and methane from sources such as molecular clouds, protoplanetary disks, interstellar shocks, circumstellar shells, and planetary atmospheres.

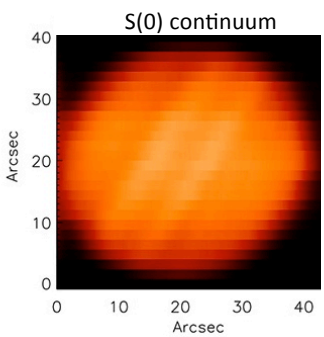


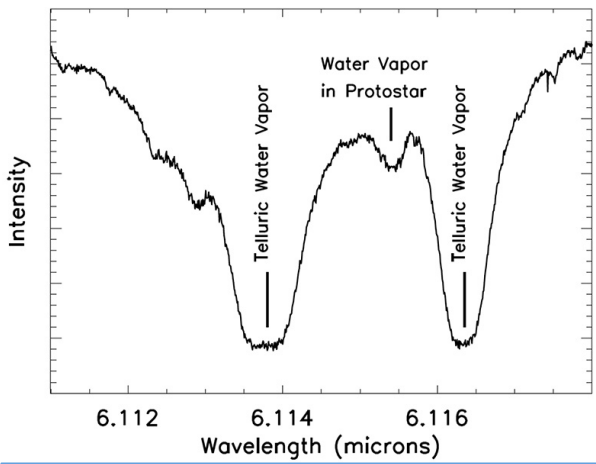
EXES mounted onboard SOFIA (Photo: EXES Team)











Left: EXES spectral maps of Jupiter in two H_2 emission transitions at 17.03 and 28.22 µm showing limb brightening in the stratospheric emission. (C. DeWitt/EXES Team) *Above*: An EXES spectrum of high-mass protostar AFGL 2591 that shows a detection of H_20 vapor from the inner envelope or molecular outflow. (N. Indriolo/EXES Team)

EXES Specifications

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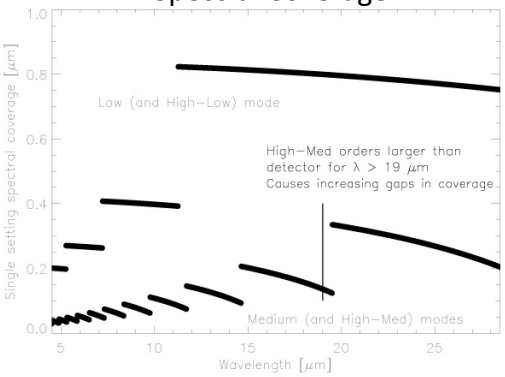
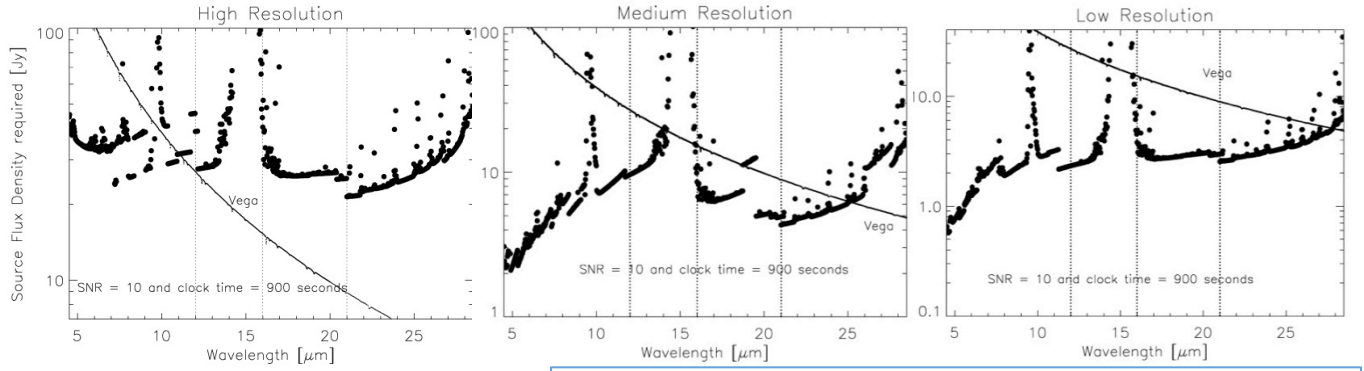
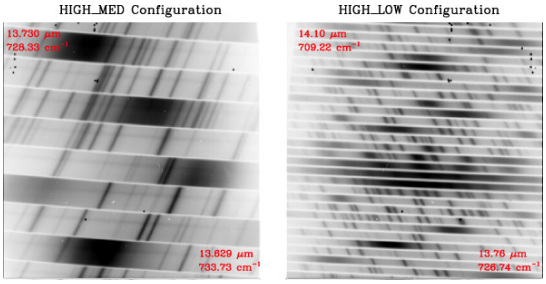
SOFIA Instrument pages - http://www.sofia.usra.edu/Science/instruments
EXES Team page – http://irastro.physics.ucdavis.edu/exes

The Echelon-cross-Echelle Spectrograph (EXES) operates in the 4.5 – 28.3 μm wavelength region, at high (R ≈ 50,000 – 100,000), medium (R ≈ 5000 – 20,000) and low (R ≈ 1000 – 3000) spectral resolution. The instrument uses a 1024x1024 Si:As detector array. High resolution is provided by an echelon – a coarsely-ruled, steeply-blazed aluminum reflection grating – along with an echelle grating to cross-disperse the spectrum. The echelon can be bypassed so that the echelle acts as the sole dispersive element. This results in single order spectra at medium- or low-resolution depending on the incident angle.

Spectral Coverage







EXES completed commissioning on SOFIA in early 2015, and the data analysis is ongoing. Pre-commissioning sensitivity estimates for point and extended sources are plotted above and below, assuming an altitude of 41k feet, 40° elevation, and 7 μm PWV. The vertical lines show the boundaries between the slit widths used (1.4", 1.9", 2.4", 3.2") for the estimates. Images to the left show raw 2D spectra. The spectra are not nod-subtracted, highlighting the sky emission lines (dark). While they have the same same spectral resolution, High_Low has a larger spectral coverage at the expense of a shorter slit.