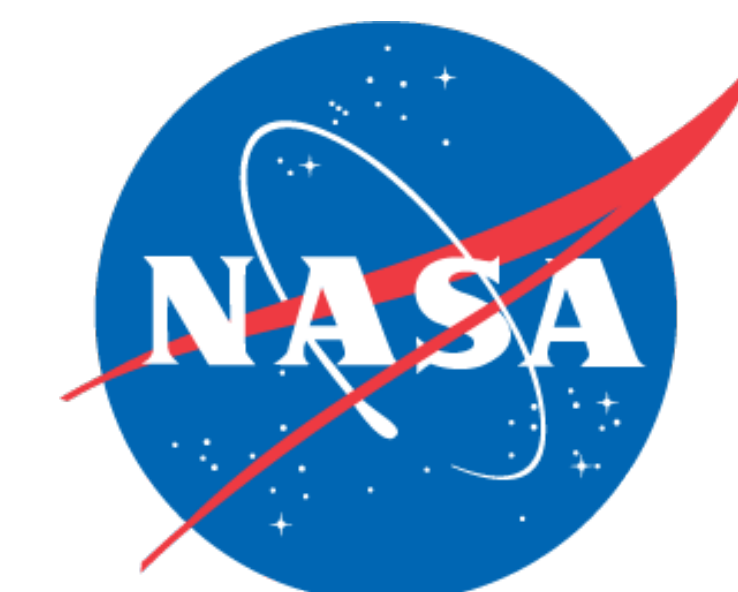




# EXES: The Echelon-Cross-Echelle Spectrograph for SOFIA



## Spectrograph for SOFIA

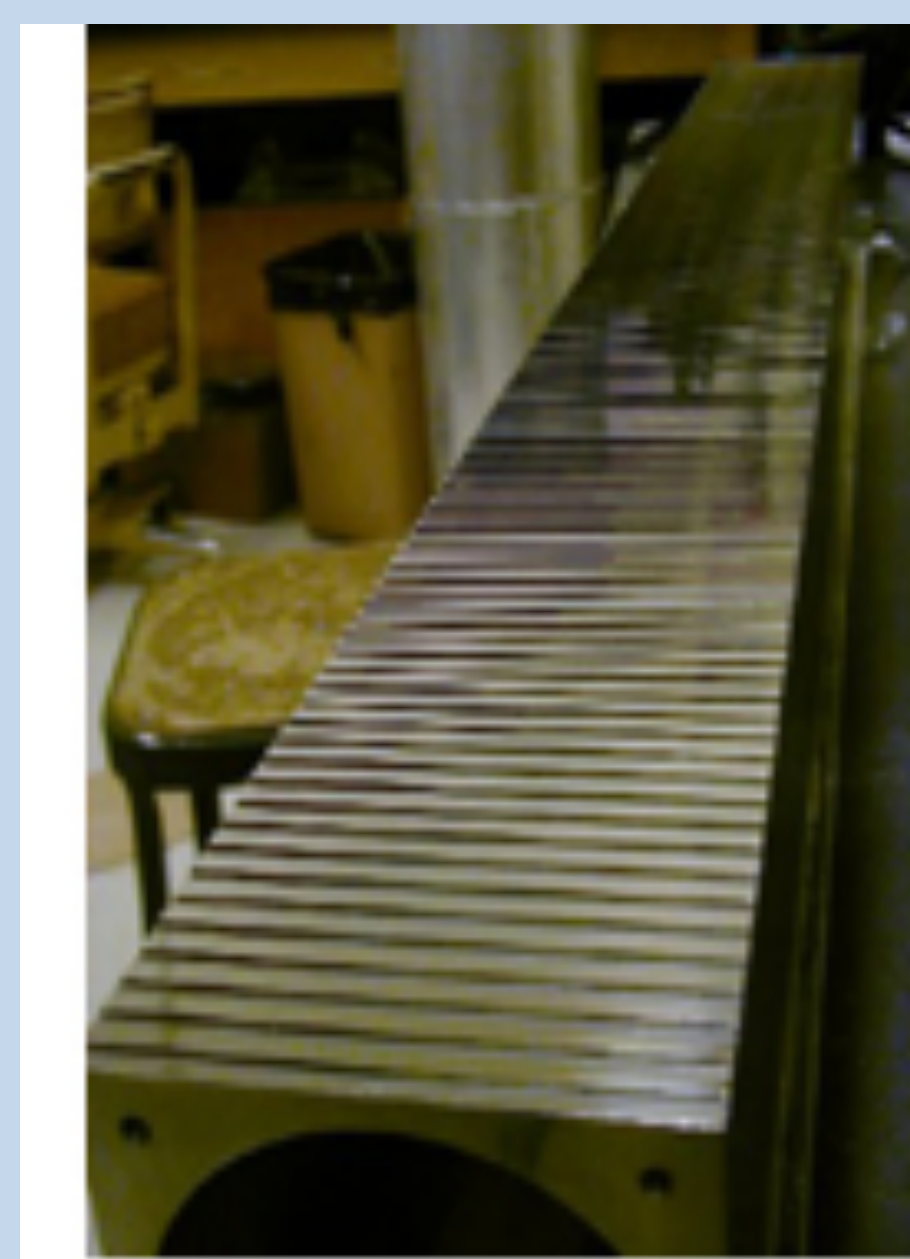


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### What is EXES?

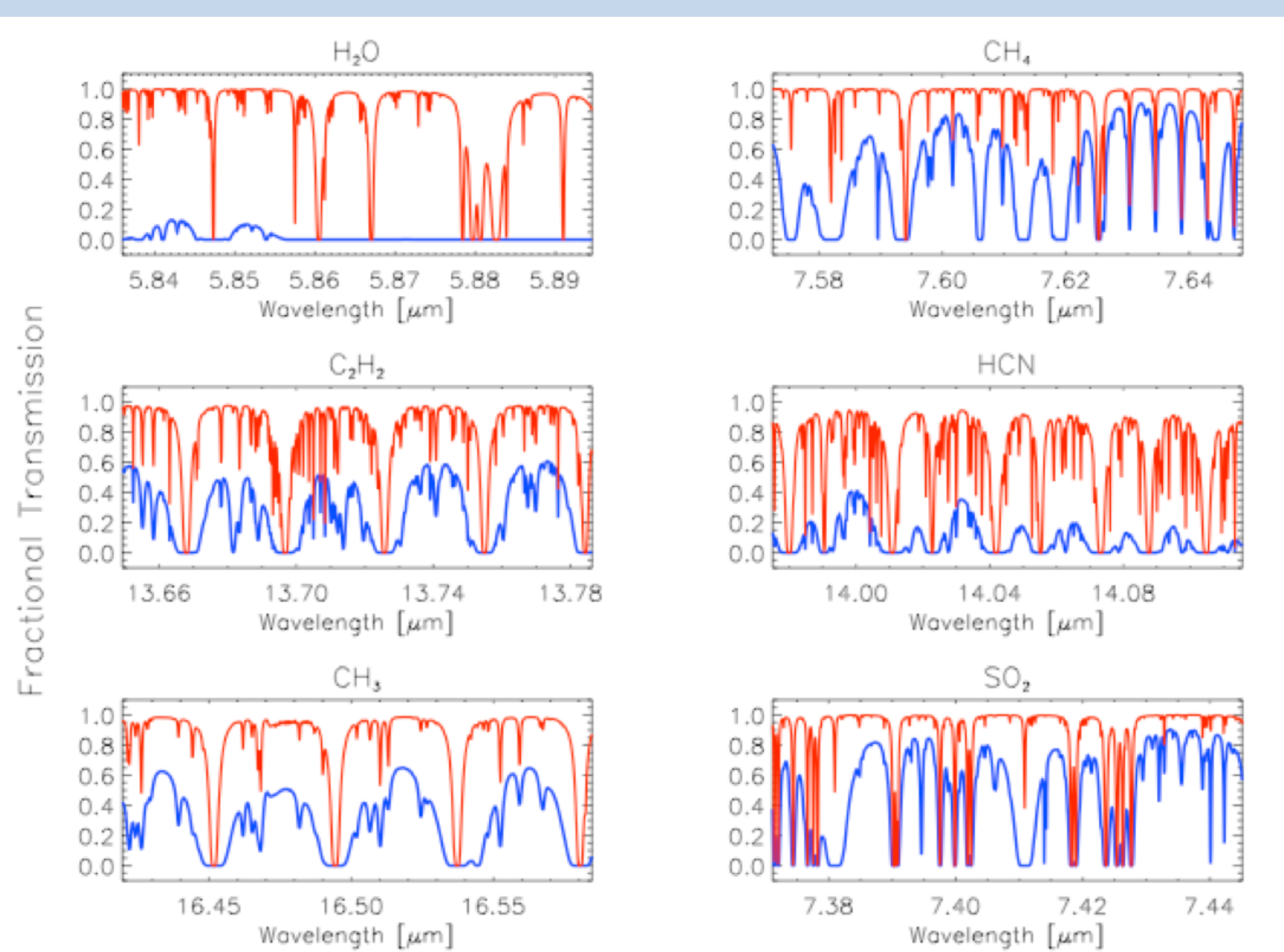
- First generation spectrograph for SOFIA
- Operates between 4.5 and 28.3  $\mu\text{m}$
- Three spectral modes and a camera mode for slit positioning
  - high ( $R \sim 100,000$ )
  - medium ( $R \sim 15,000$ )
  - low ( $R \sim 3,000$ )
- Uses a 1024x1024 Si:As detector optimized for low background
- Features an echelon, a coarsely-ruled, steeply-blazed Al reflection grating for high resolution



Aluminum R10 echelon grating for EXES (40" x 4")

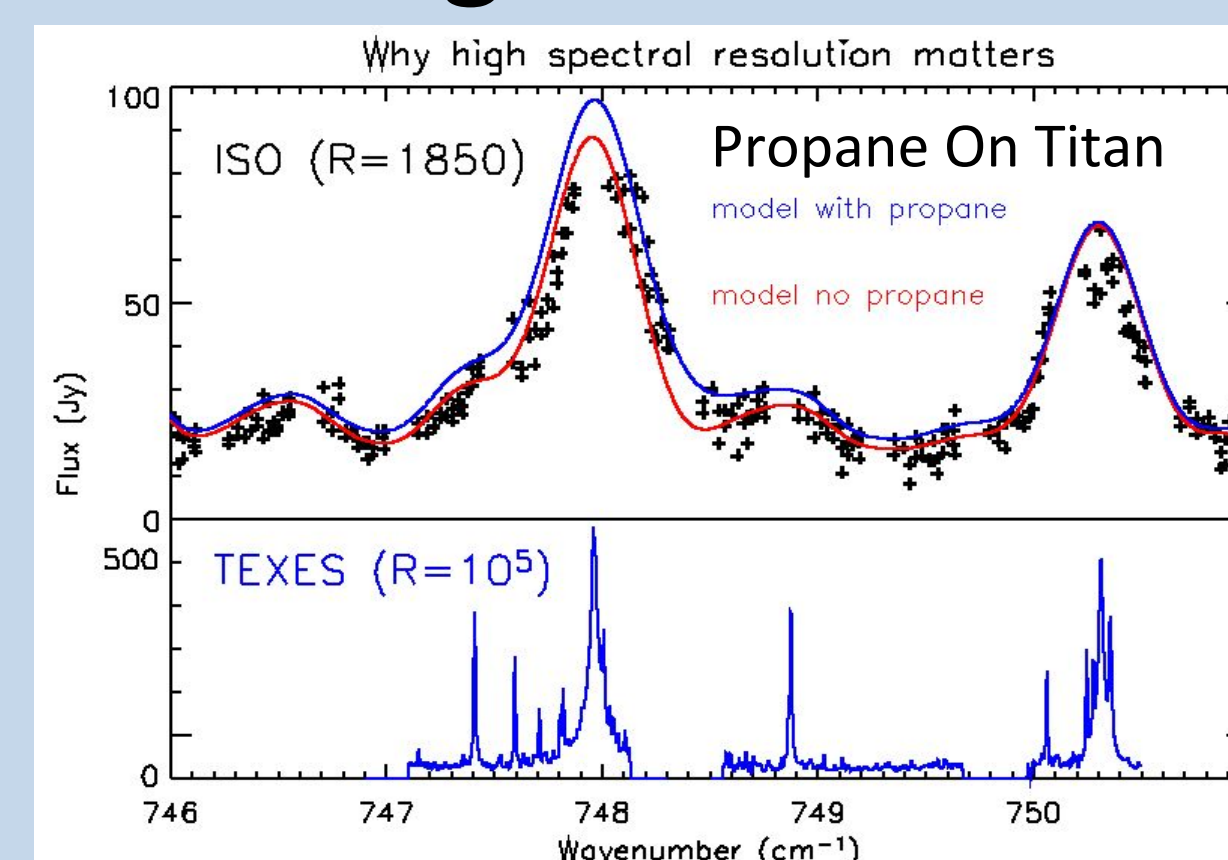
### The Advantage of SOFIA

A comparison of atmospheric transmission at Mauna Kea (blue) and from SOFIA (red) for selected molecular species.



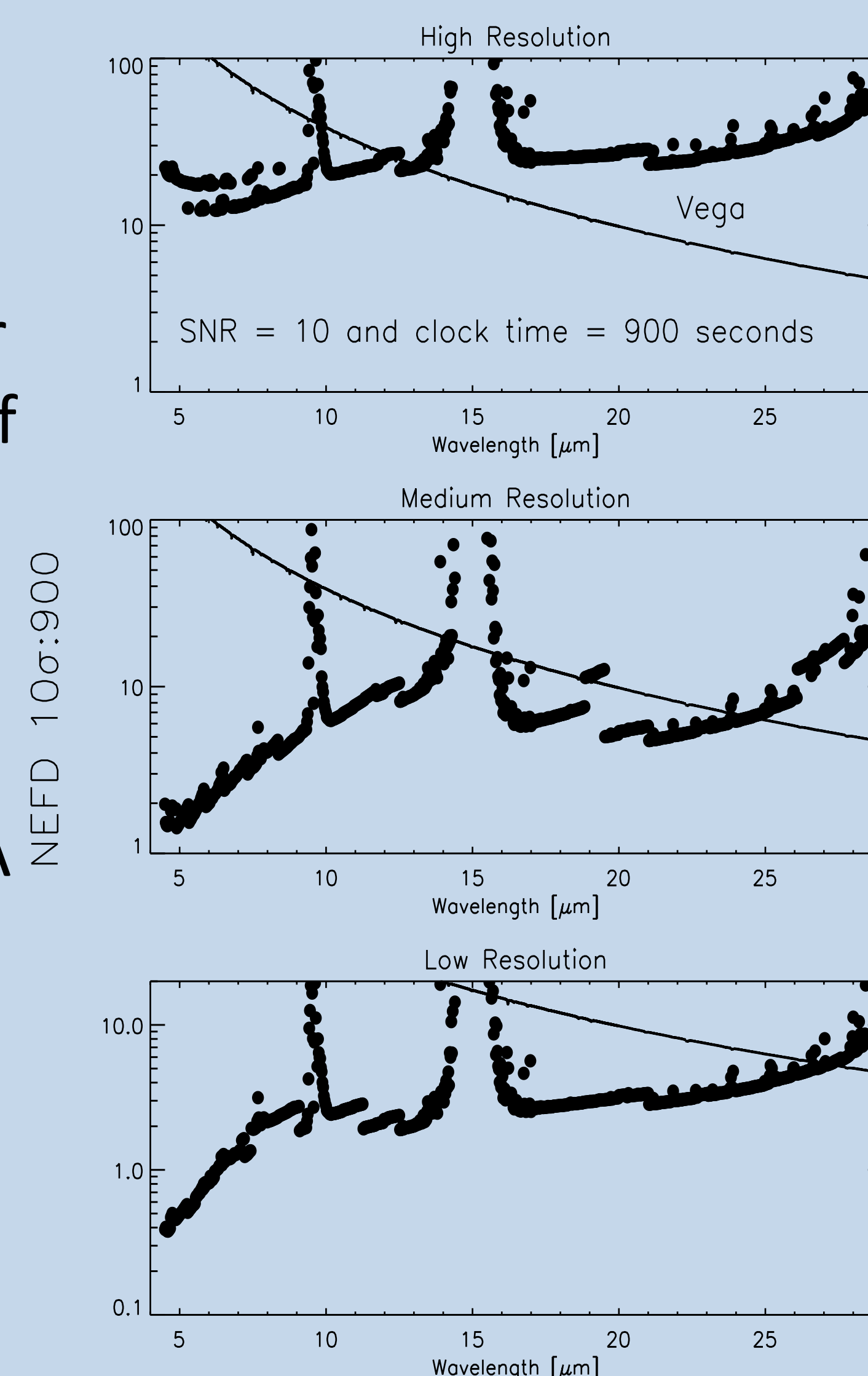
### Science Goals

- Chemistry and dynamics of molecules (H<sub>2</sub>O, CH<sub>4</sub>, and others) around HII regions, YSOs, disks.
- Atmospheres of mass-losing AGB stars
- Abundances in comets, solar system planets and moons' atmospheres



### Sensitivity

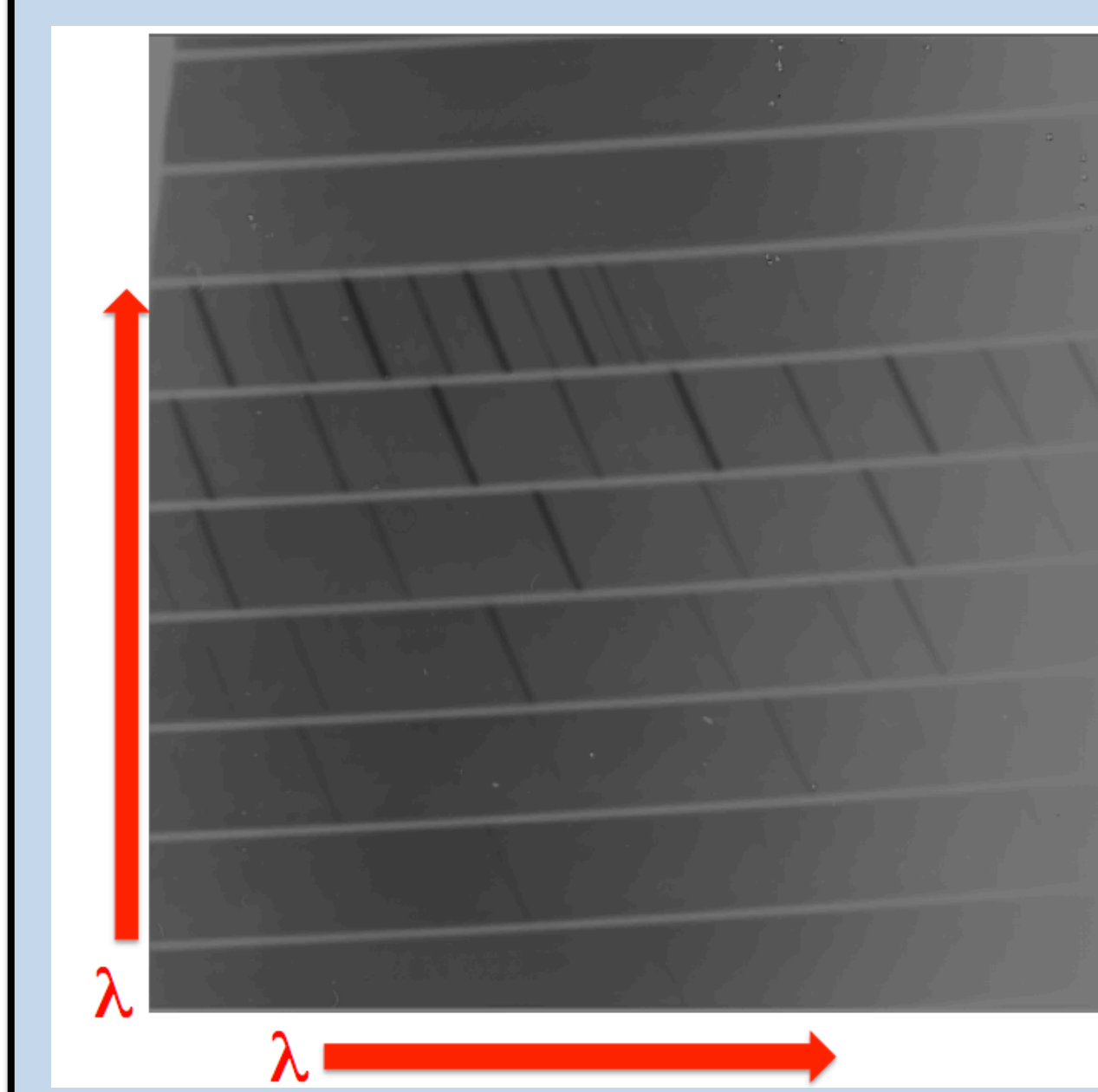
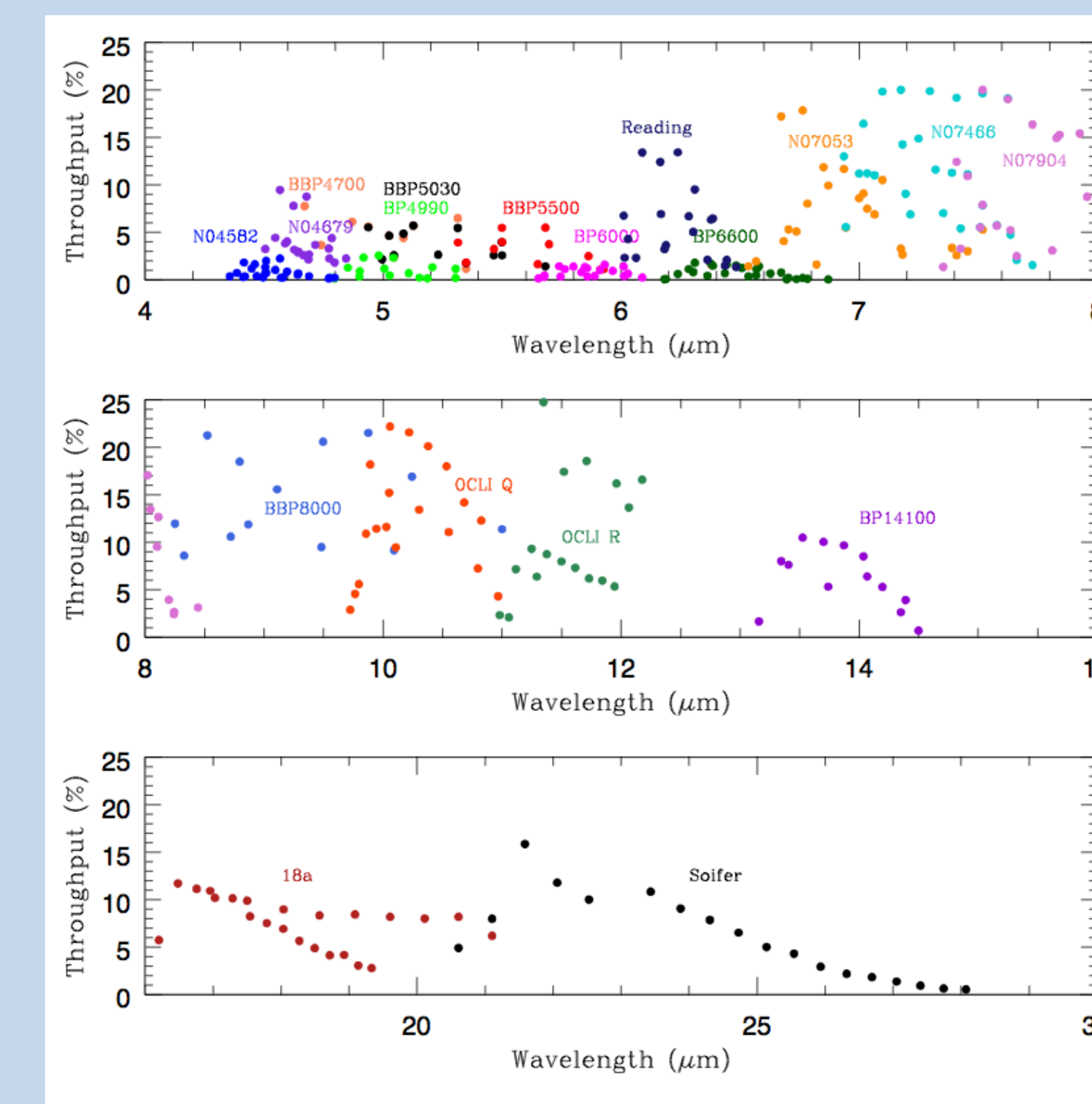
We plot the estimated Noise Equivalent Flux Density (NEFD) for S/N = 10 in 900s of integration on a point source. For comparison, Vega is included on all three plots. SOFIA is able to observe single targets for up to ~4hrs continuously.



### EXES Lab Tests

EXES has tested as much as possible in the lab to alleviate need for time on the plane

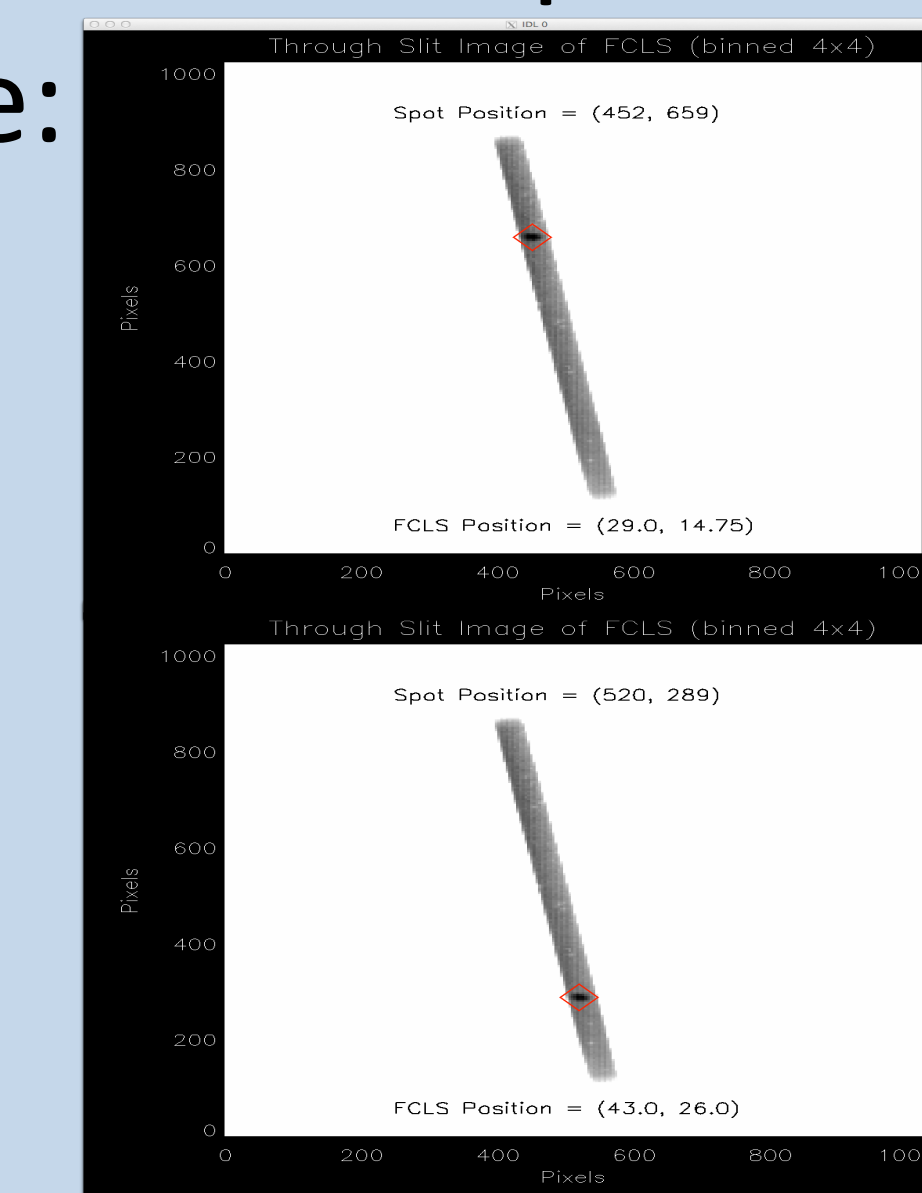
- Sensitivity testing at all wavelengths using the room or temperature controlled blackbody



- High-resolution mode, C<sub>2</sub>H<sub>2</sub> gas cell spectrum
- 726.2-731.9 cm<sup>-1</sup>
- R=100500 with 1.5" slit

- Use of Ames TAAS (SOFIA telescope simulator) to determine:

- Platescale
- Boresight
- Focus
- pupil size
- pupil alignment
- test observations



### Status of EXES

EXES is currently at DAOF completing final tests before beginning its first commissioning flights on SOFIA on April 7<sup>th</sup> and 9<sup>th</sup>. Exes will have its second round of commissioning flights later this year. In addition, EXES will be part of the Cycle 2 science flights during the latter part of 2014. All of EXES's modes will be available during the SOFIA Cycle 3 call for proposals for the general community.

### References

Richter et al., "Status of the Echelon-cross-Echelle Spectrograph for SOFIA," Ground-based and Airborne Instrumentation for Astronomy III, Ian S. McLean, Suzanne K. Ramsay, & Hideki Takami, Editors, Proc. SPIE 7735, 77356Q (2010)

Richter et al., "Development and future use of the echelon-cross-echelle spectrograph on SOFIA," Ground-based and Airborne Instrumentation for Astronomy, Ian S. McLean & Masanori Iye, Editors, Proc. SPIE 6269, 62691H (2006)