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# Science Instrument Development Update

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# Science Instrument Development Update

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- ★ Science Instrument Status Summary
- ★ HAWC+ Development Status
- ★ EXES Commissioning Results
- ★ FIFI-LS Commissioning Results (Klein)
- ★ FLITECAM Background Levels (Hamilton)
- ★ Q & A?

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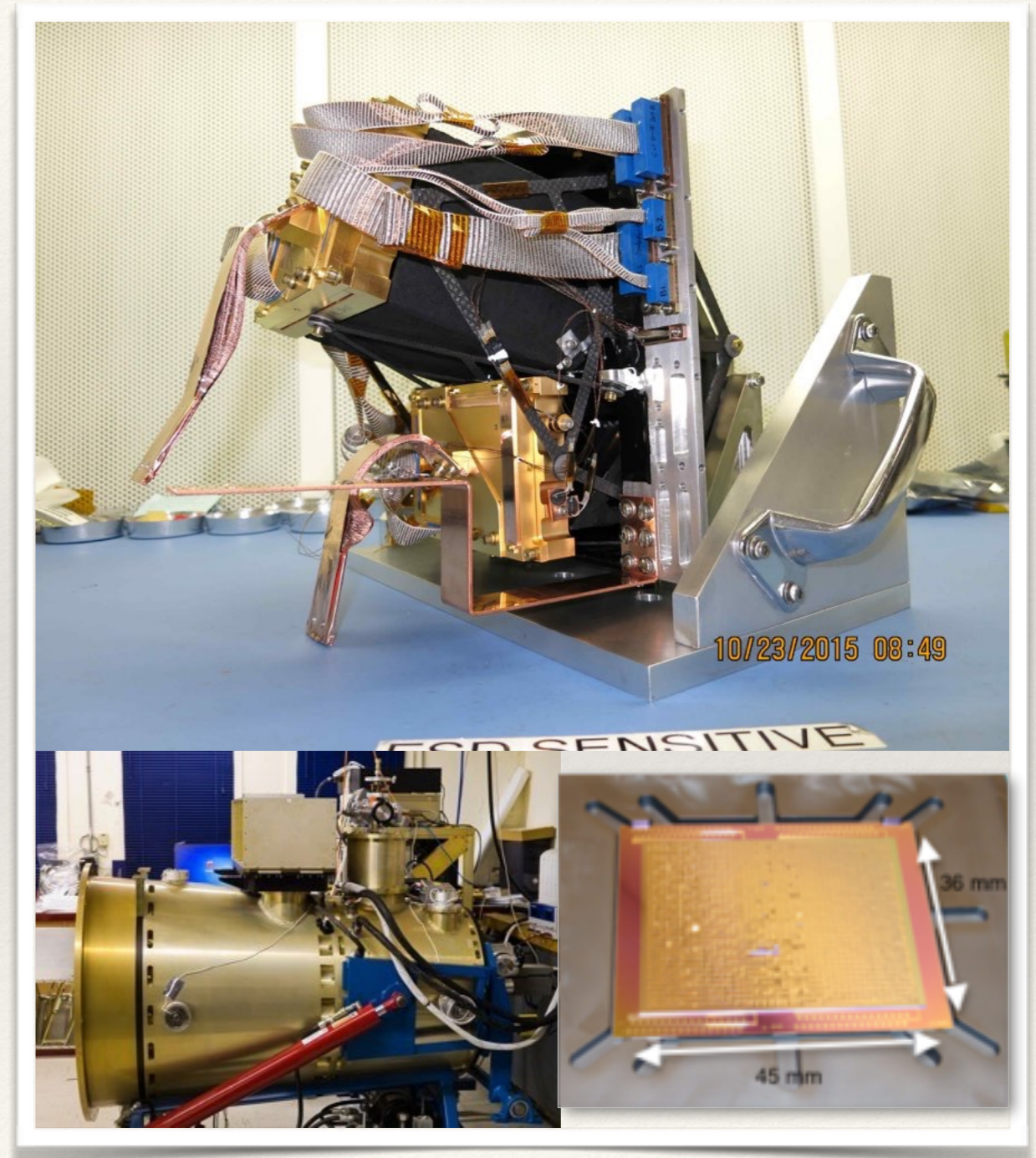
# Science Instrument Status

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- ★ FLITECAM: First solo observing campaign completed, plus successful occultation campaign in NZ. First formally accepted FSI(!)
- ★ FORCAST: Continues as workhorse SI. NZ deployment successfully completed, presently installed for OC-3L. Nearing formal acceptance as FSI.
- ★ GREAT: Continues as workhorse SI. UpGREAT on-deck for OC-3M, using facility cryocooler.
- ★ EXES: Commissioning complete, concluded OC-3H in October. Back at NASA Ames for maintenance / optimization.
- ★ FIFI-LS: Commissioning complete, concluded OC-3I in October. Preparations underway for 'FSI' transition with an acceptance review in December.
- ★ HIPO: Successfully completed occultation campaign during NZ deployment.
- ★ HAWC+: First cold tests to include FPA2 now underway. Pre-ship review scheduled for late January.

# HAWC+ Development Status

- ★ Instrument undergoing cold testing in preparation for pre-ship review (Jan. 2016).
- ★ Development issues with detector subsystem have pushed back delivery by approx six months.
- ★ So far one 32x40 BUG array has been demonstrated to meet sensitivity requirements and is considered to be science grade. Two additional BUG arrays have been integrated with HAWC+ and have yet to be fully evaluated.
- ★ Detector development decoupled from overall SI development schedule with consent of SMD / APD, establishing flexibility for an 'interim' commissioning configuration.
- ★ Initial commissioning will be conducted with the detectors we have now, while efforts continue at GSFC to produce full complement of science-grade BUG arrays.
- ★ First commissioning series may not demonstrate differential polarimetry.
- ★ All types of science observations will be possible in the 'interim' configuration, but brighter targets may be required without full set of arrays.
- ★ First flight series scheduled for April 2016.



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# EXES Commissioning Results

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- ★ EXES successfully completed six commissioning flights and five science flights. Peer-reviewed science results have been published, with more in work.
- ★ A commissioning review held at Ames on May 24, 2015 ended in unanimous approval of the EXES Commissioning Data Package, formally concluding the commissioning process. All tests and demonstrations were successfully completed per the Commissioning Plan.
- ★ EXES is performing as anticipated, demonstrating R ~100k on sky. Next flight series expected in Q1 2016.
- ★ Selected commissioning results are presented on the following slides.

# EXES PERFORMANCE TEST SUMMARY TABLE

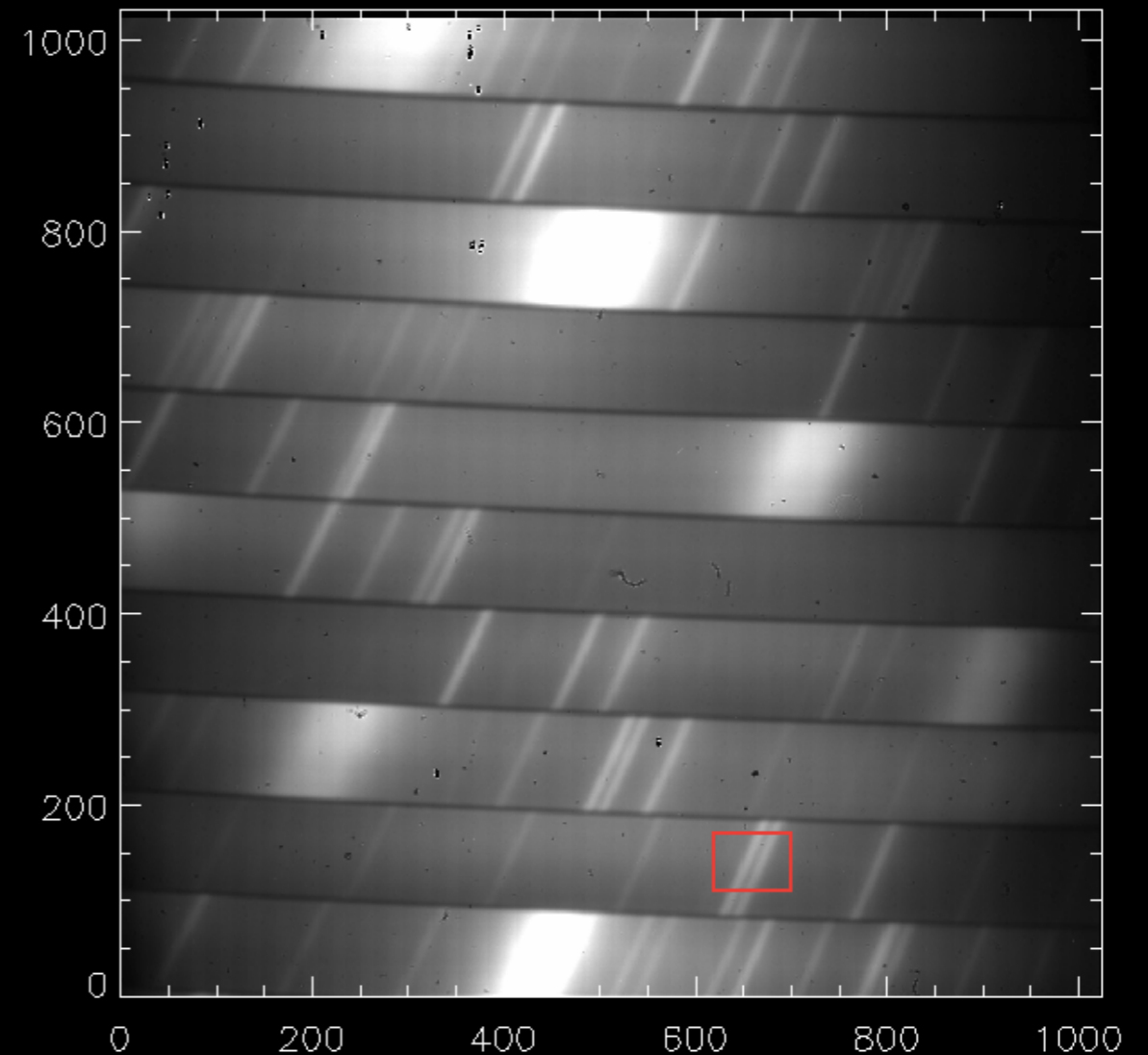
## COMMISSIONING FLIGHT TESTS

Property/Test	Goal	Measured	Comments
Frame rates, flux	match est.	unsaturated	<i>Verify sky flux estimates are roughly correct.</i>
Point source sensitivity	measure	49Jy @ 19 $\mu$ m	<i>Measure sensitivity of SOFIA/EXES, standard stars.</i>
PS flux calibration	establish	1 - 1.1	<i>Comparison to blackbody source, flux slit.</i>
Focus	~280mm	280mm	<i>Knife-edge test using flux slit.</i>
Extended object	measure	3.7Jy/asec <sup>2</sup> @ 7.2 $\mu$ m	<i>Measure sensitivity on extended sources.</i>
Ext. Obj. flux cal.	establish	1 - 1.5	<i>Use source with known, spatially resolved flux maps.</i>
Maximum SNR	measure	>200	<i>Bright targets, vary mode and wavelength.</i>
Faint object limit	establish	<10Jy	<i>Visible source that is IR-faint, check tracking, pointing.</i>
Non-sideral tracking	demonstrate	yes	<i>Characterise tracking, overhead for observations.</i>
LOS rewind stab.	stable	stable	<i>Verify source remains at SIBS through rewind.</i>

# FLIGHT TEST

## RESOLVING POWER W/ON-SKY DATA

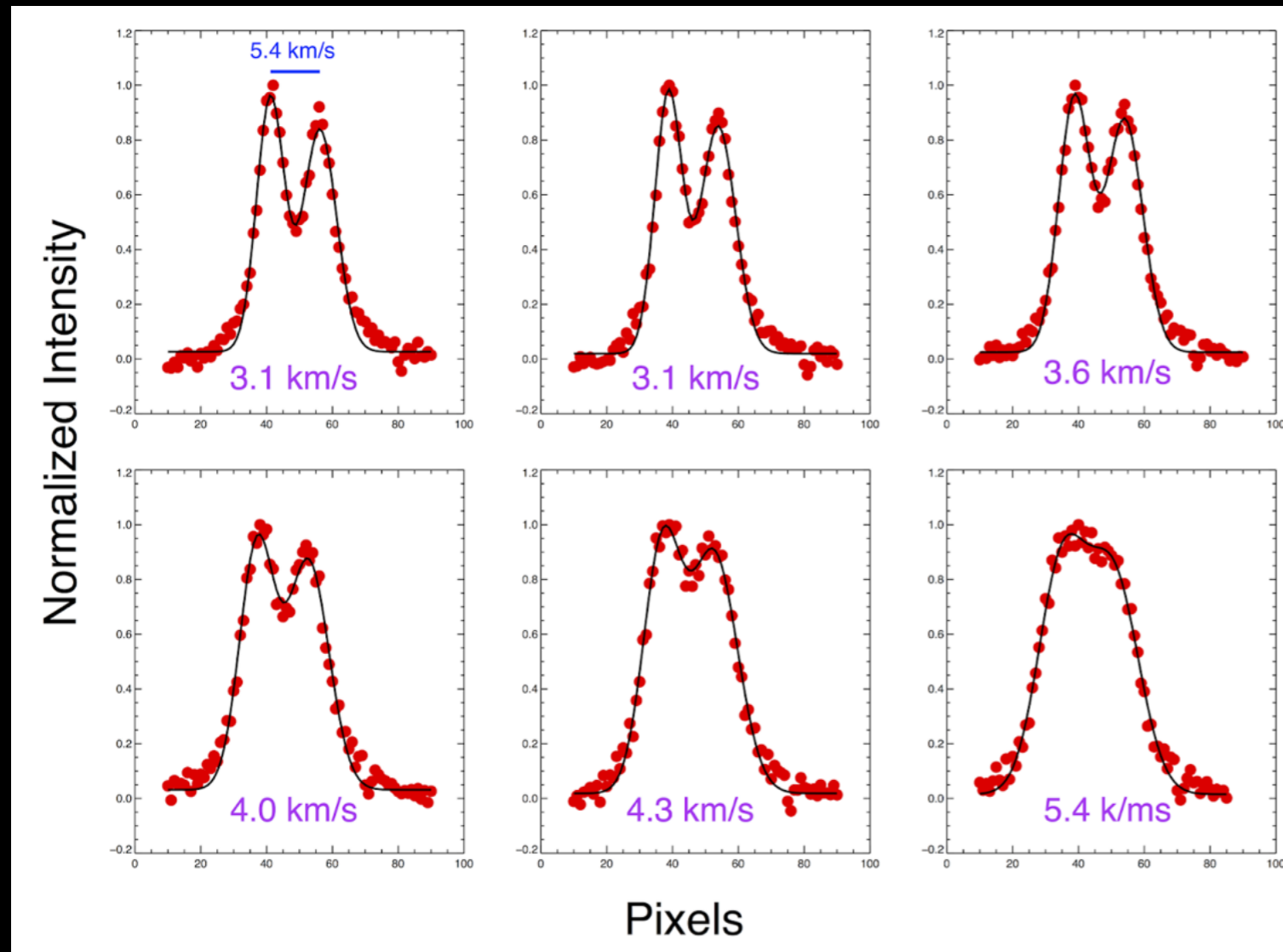
- Comparable spectra can also be obtained on telluric lines ( $O_3$  here) to boot-strap laboratory spectra to observations.
- This hi-med spectrum obtained on commissioning flight 5.
- Orange box identifies two ozone lines @ $13.5\mu\text{m}$  separated by  $5.4\text{km/s}$  in redshift-space, or  $R=55,555$  if just resolved.



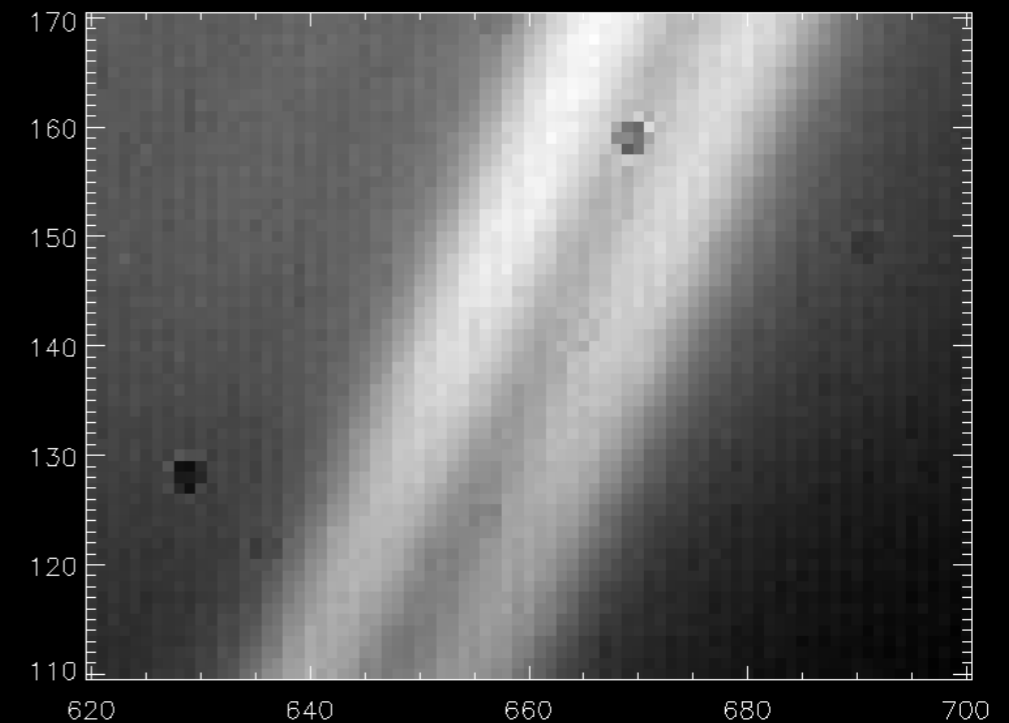
★ Telluric lines resolved  
@ $R > 55,000$  on-sky.

# FLIGHT TEST

## RESOLVING POWER W/ON-SKY DATA



- Series of line cuts made on images obtained with slits of different widths.
- Gauss fits made to each of the resolved lines show a minimum width of 3.1 km/s, equivalent to a resolving power of  $\sim 98k$ .



★ R  $\sim 98,000$  demonstrated on-sky, possibly limited by pressure broadening. Goal met.