

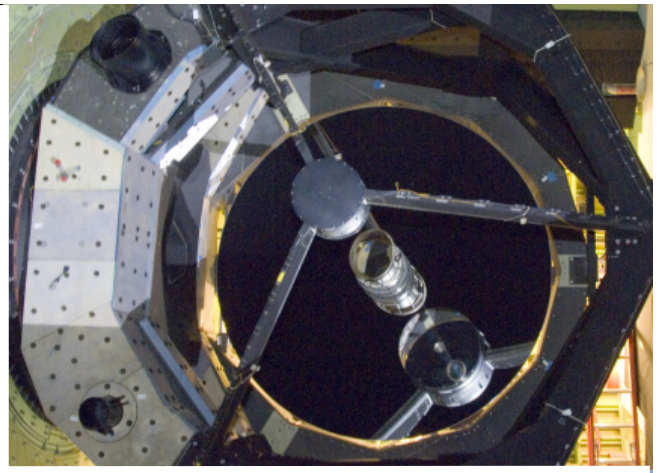


SOFIA
Program Update

Pamela Marcum
SOFIA Project Scientist

January 4, 2010
SOFIA AAS Splinter Session




Outline

- Recent Achievements
- 1-year Look Ahead
- Early Science
- First-generation Instrument Status
- Ramp-up of Science Flights
- Program Status Summary

SOFIA

Stratospheric Observatory for Infrared Astronomy

Boeing 747SP

2.7-meter

International partnership:
80% -- NASA (US)
20% -- DLR (Germany)

Progress Since the Last AAS Splinter

- The program has successfully entered a phase of testing aircraft modifications and flight safety assurance:
  - Functional Check Flight (FCF) on December 9, 2009
  - 10% Open-Door test flight on December 14, 2009
  - **100% Open-Door test flight on December 18, 2009**

- Science preparations for Early Science flights
  - FORCAST science instrument:
    - Line Ops #1 test plans are finalized.
    - Final cool-down prior to shipment to the NASA Dryden Aircraft Operations Facility (DAOF) is underway, instrument is to arrive at the DAOF in early February for observatory installation.
  - Completed an extensive end-to-end Science and Mission Operations simulation.

100% Open Door test flight

December 18, 2009

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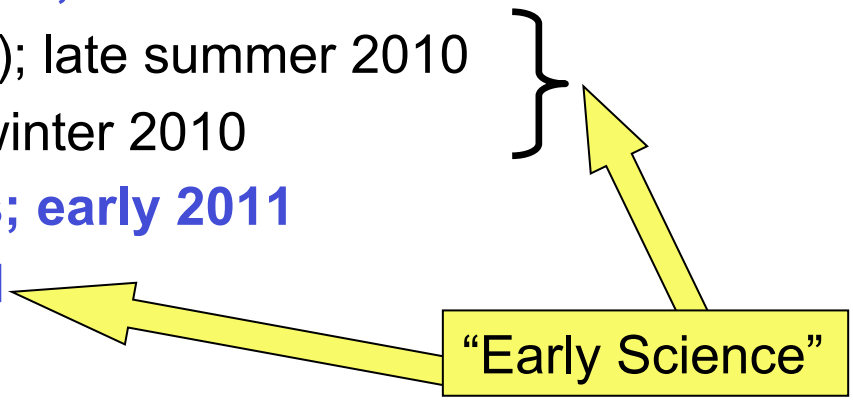
Recent Activities and ~1 Year Look Ahead

- ✓ Functional Check Flight; December 9, 2009
- ✓ 10% Door Open Flight; December 14, 2009
- ✓ 100% Door Open Flight; December 18, 2009
- Telescope activation; early 2010
- Telescope characterization/First light; April 2010
- **Call for Basic Science; April 2010**
- **Instrument workshop, Asilomar, CA; June 2010**
- Short Science #1 flights (FORCAST); late summer 2010
- Short Science #2 flights (GREAT); winter 2010
- **Proposal call for new instruments; early 2011**
- **Basic Science flights; spring 2011**



- **Early Science flights occur before the flight envelop is fully cleared and while some onboard mission systems are still in development.**
  - a shared-risk activity
  - the science community gains earlier access to SOFIA
  - early tests of astronomical observing

<table>
<tr><th></th><th colspan="3">EARLY SCIENCE</th></tr>
<tr><th></th><th>SHORT SCIENCE</th><th colspan="2">BASIC SCIENCE</th></tr>
<tr><td>FORCAST
mid-IR imager (US)</td><td>3 flights
GIs selected</td><td colspan="2" rowspan="2">12 flights -- 80% NASA share
US Guest Investigators
US, international proposals (except from German institutions) accepted.</td></tr>
<tr><td>GREAT
sub-mm heterodyne receiver (German)</td><td>3 flights
GIs selected</td></tr>
<tr><td>FIFI-LS
Integral field FIR spectrometer (German)</td><td>3 flights
Instrument team</td><td>3 flights
20% DLR share
GREAT consortium</td><td></td></tr>
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TWO EARLY SCIENCE INSTRUMENTS

FORCAST

Faint Object infraRed CAmera for the SOFIA Telescope

- **Facility-class instrument**
- **Mid IR, two-channel camera for simultaneous imaging**
- **Selectable ($\Delta\lambda \sim 2\mu m$) filters in 4-8 μm, 16-40 μm regimes**
- **0.75 arcsec/pixel**
- **3.2x3.2 arcmin field-of-view**

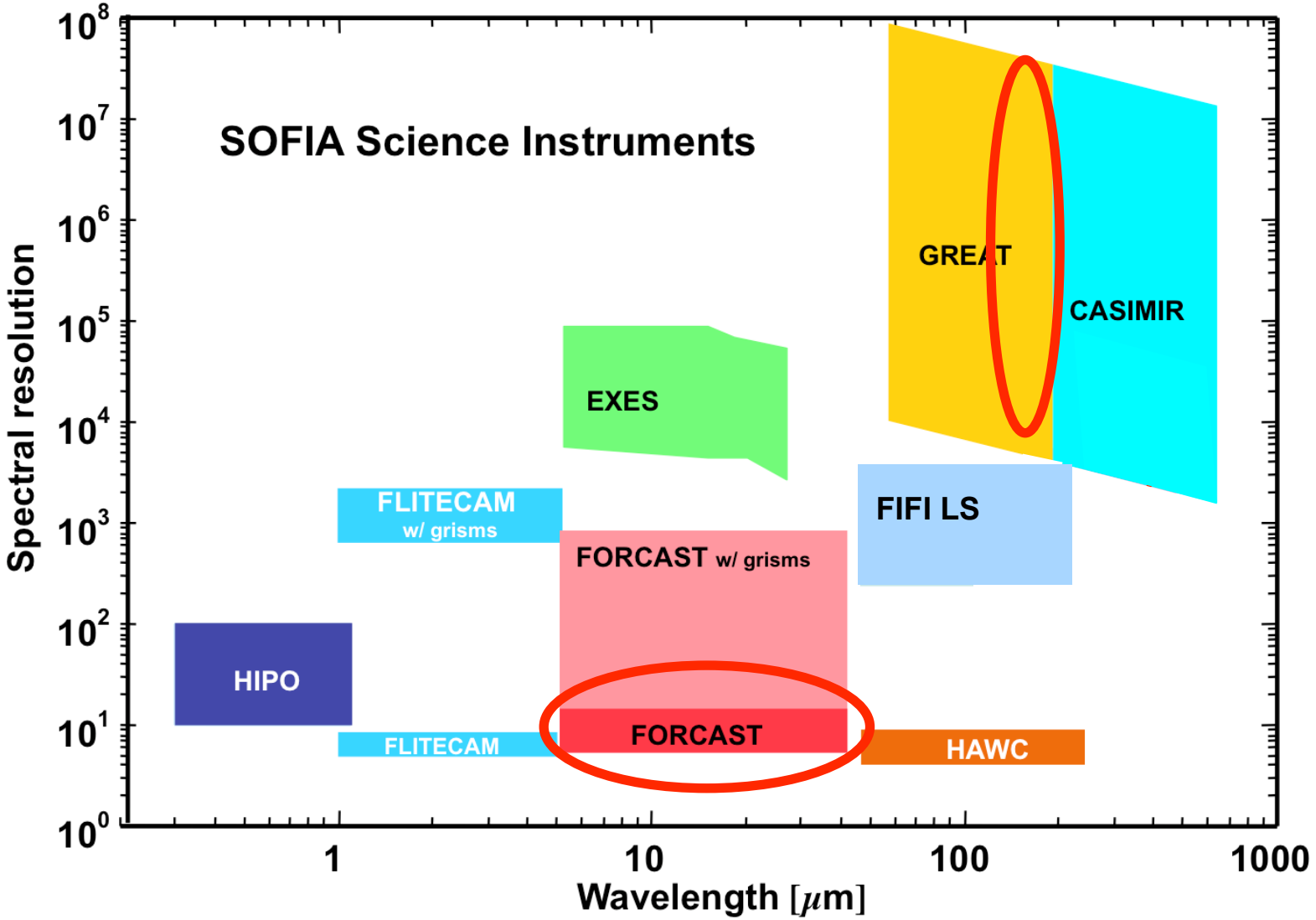
GREAT

German REceiver for Astronomy at Terahertz frequencies

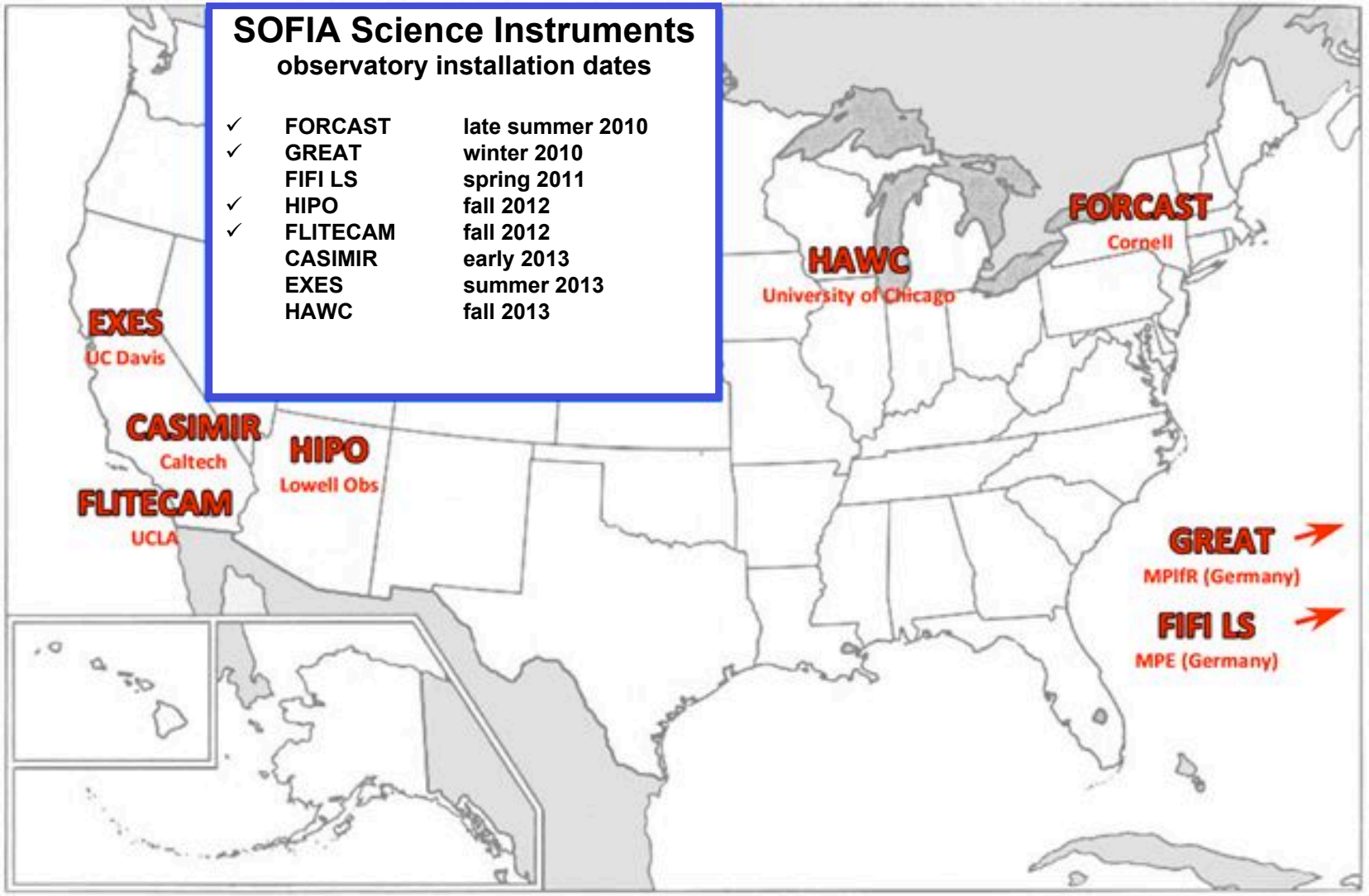
- **Principal Investigator instrument**
- **Heterodyne spectrometer**
- **Dual-channel, 3 frequency windows**
  - **1.6-1.9 THz (158-187 microns)**
  - **2.4-2.7 THz (100-125 microns)**

Available to Basic Science Guest Investigators

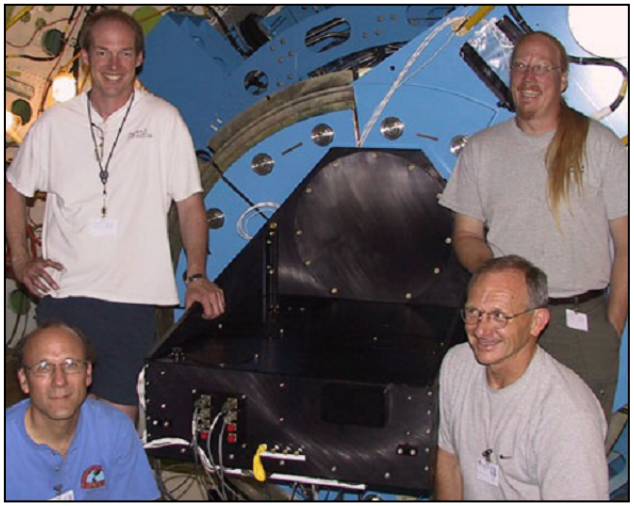
Instrument R/λ graph



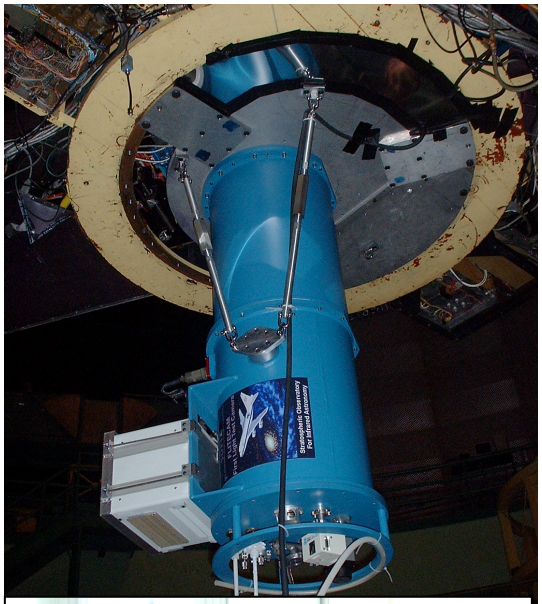
Science Instruments – Key Activities



FOUR OF THE 1st GENERATION INSTRUMENTS

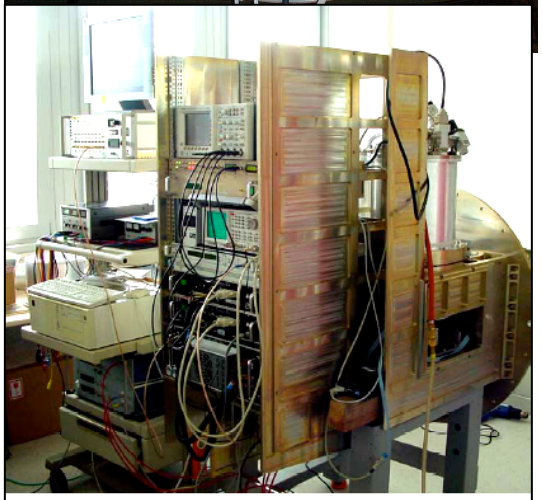


Working/complete
HIPO instrument
(on SOFIA)



Working/complete
FLITECAM
(Lick observatory)

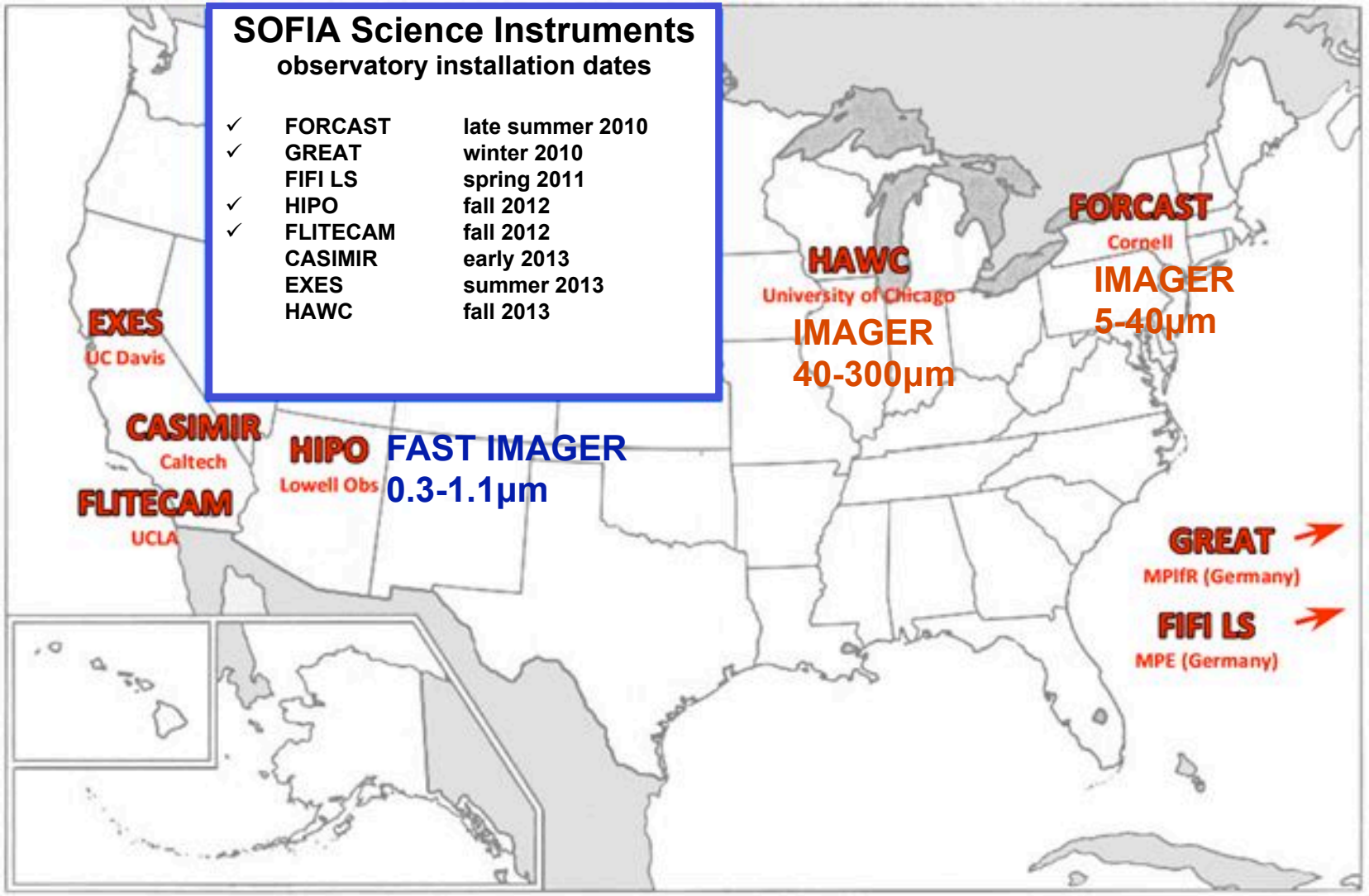
Working/complete
FORCAST
instrument
(Palomar)



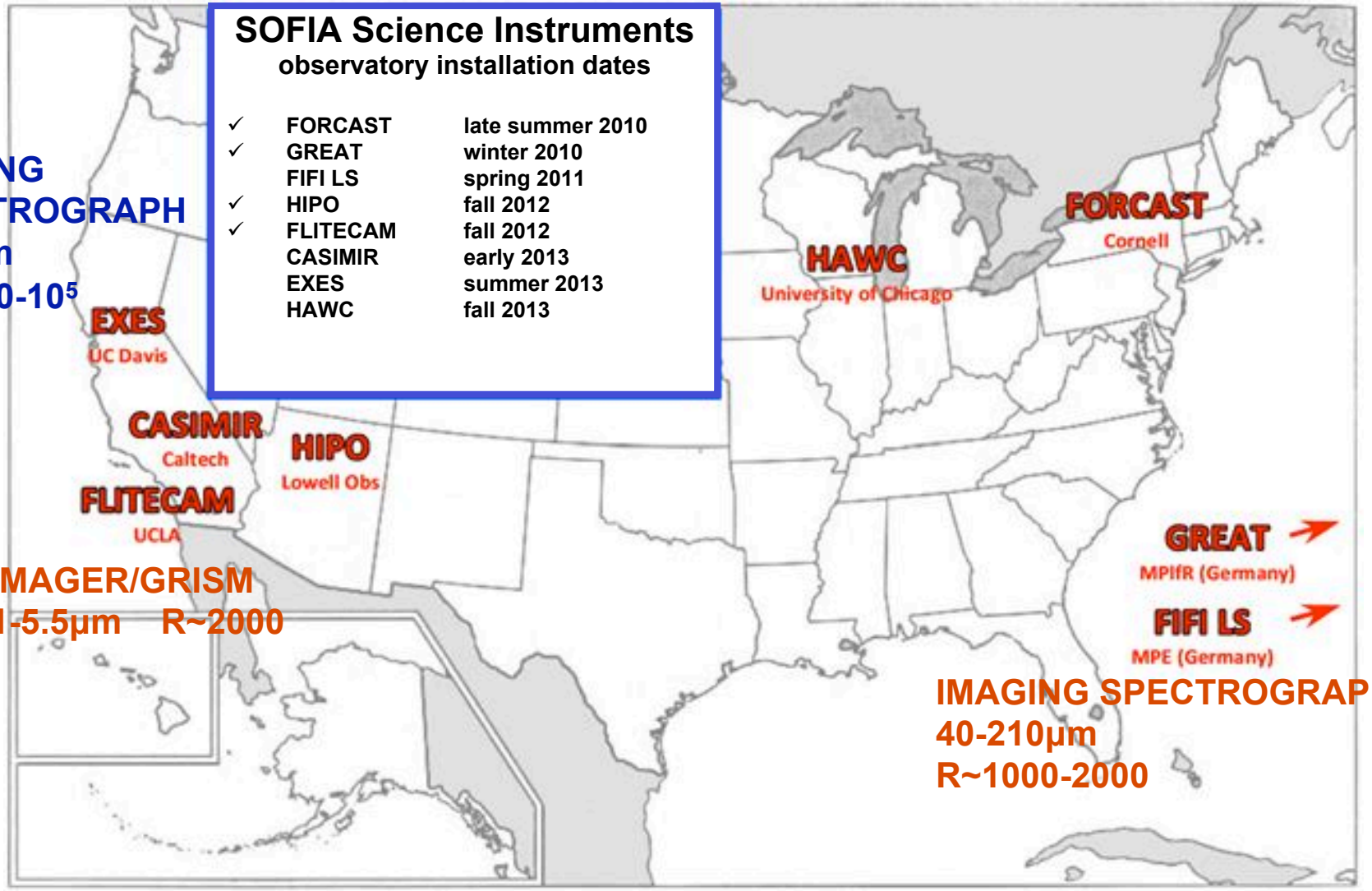
Lab-picture of GREAT equipped with the KOSMA 1.9THz channel

Successful lab
demonstration
of GREAT

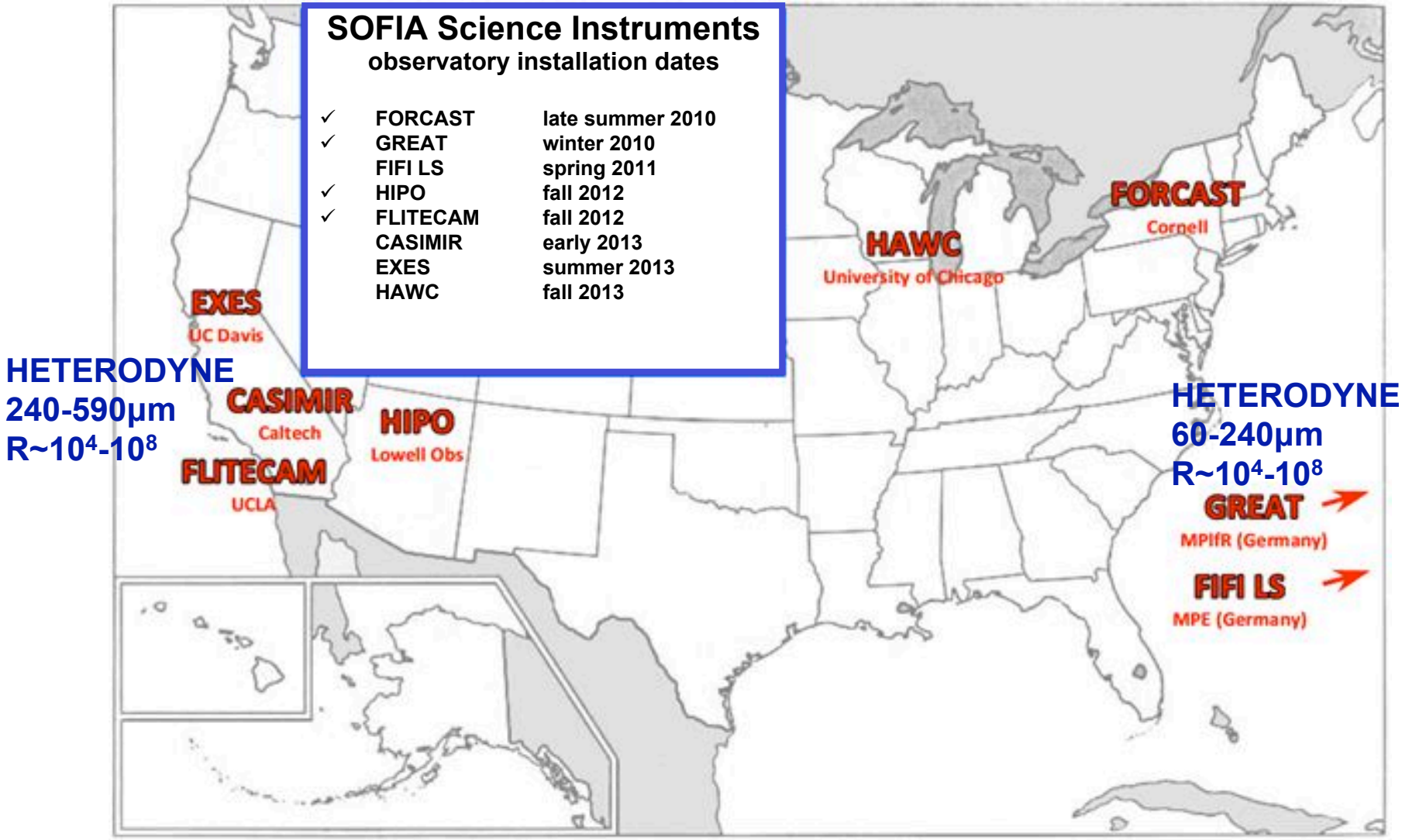
Science Instruments – Key Activities



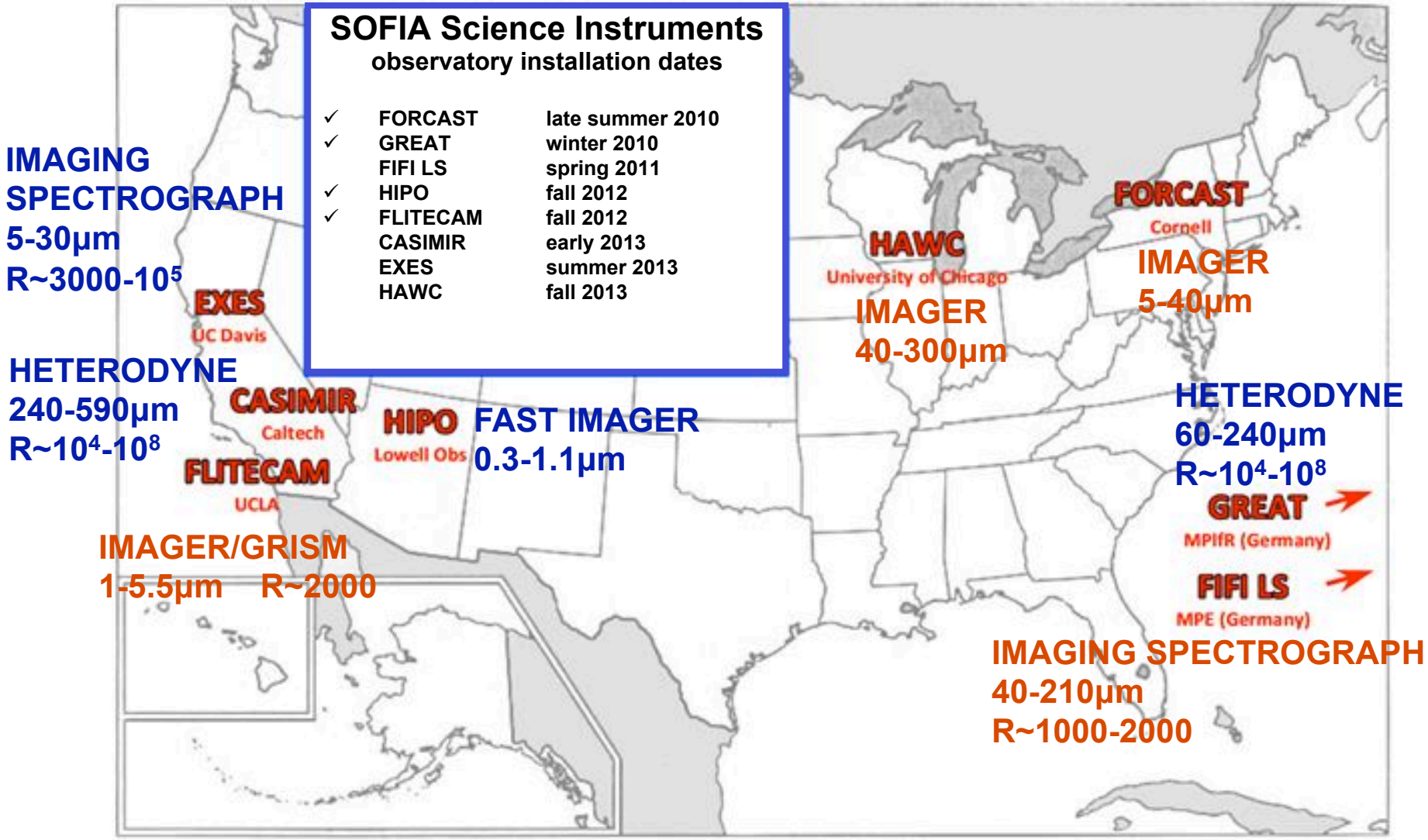
Science Instruments – Key Activities



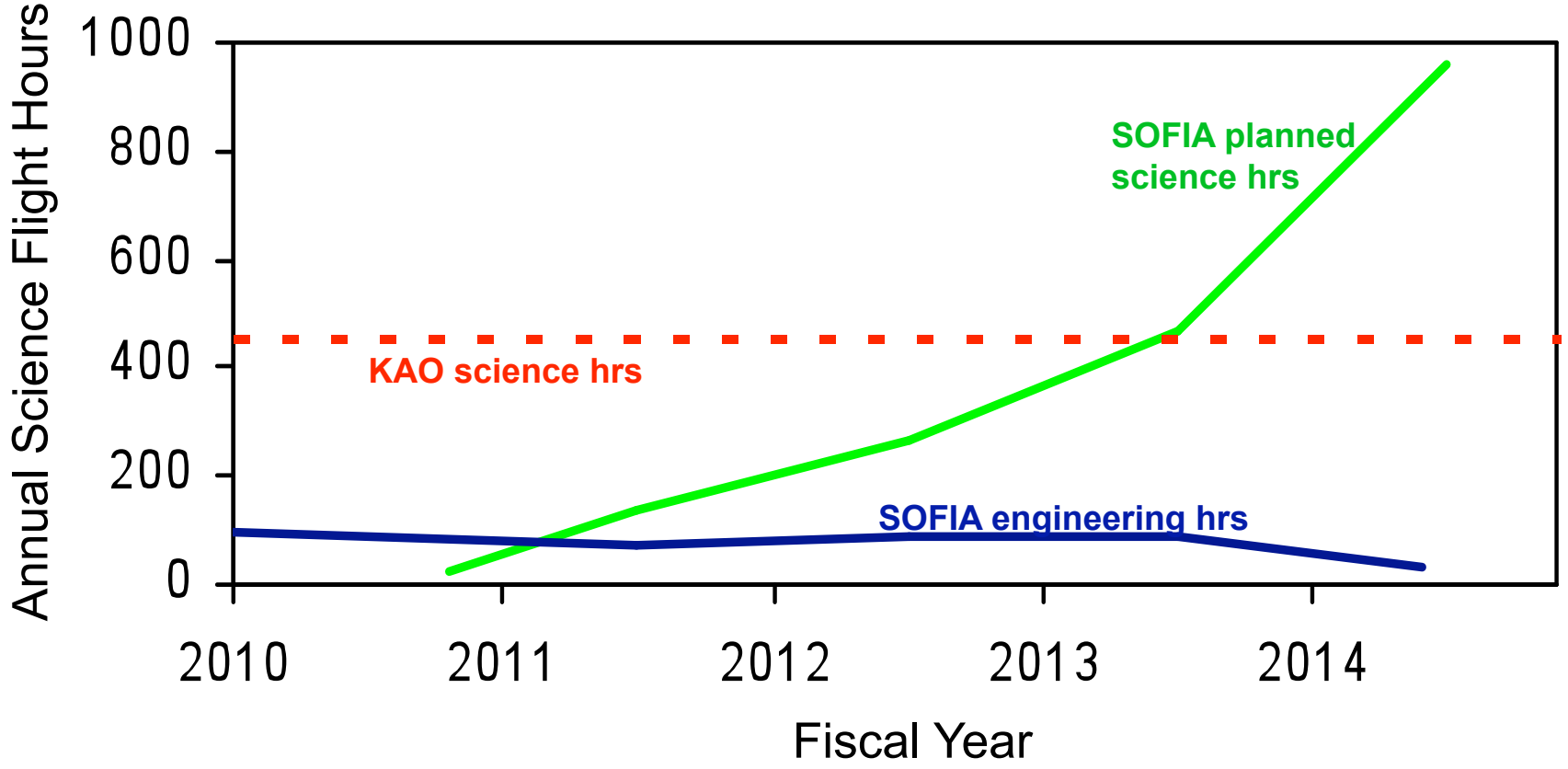
Science Instruments – Key Activities



Science Instruments – Key Activities



Science Flight Hours Ramp Up



With the onset of science flights in 2010, science hours available using SOFIA will steadily increase as all of the 8 first-generation instruments are commissioned, envelop expansion flights conclude, and aircraft system development is completed.

Program Summary

The SOFIA Program has made significant progress:

- The Functional Check Flight and the 100% door open flight milestones have been achieved, significantly reducing overall technical risk associated with the cavity door open during flight. **(Video of flight at the SOFIA booth)**

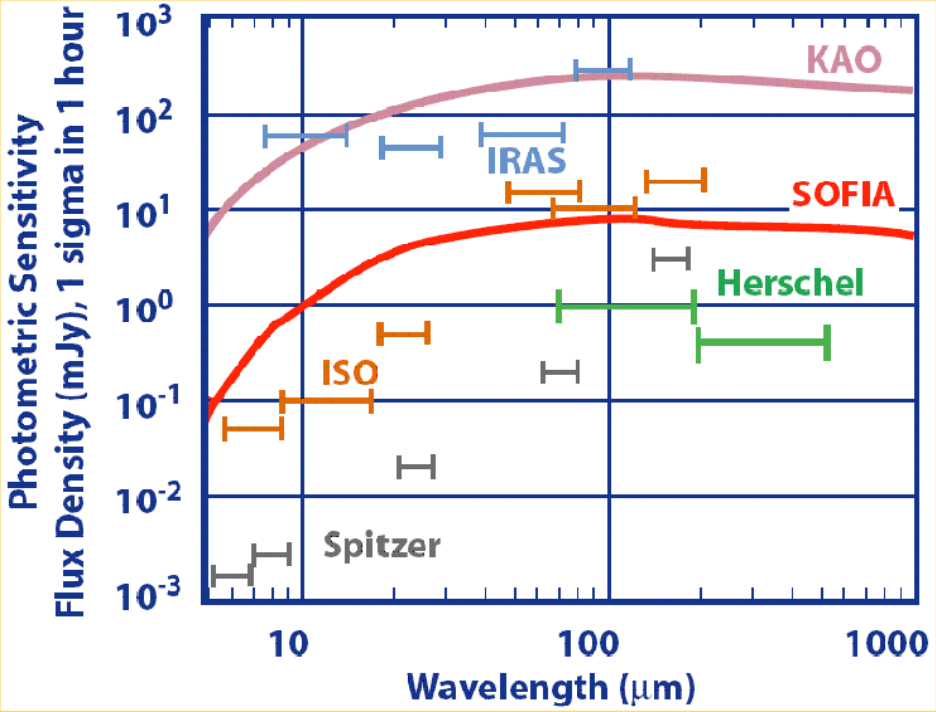
- Instrument development remains on schedule; half of the 8 first-generation instruments are ready for installation.

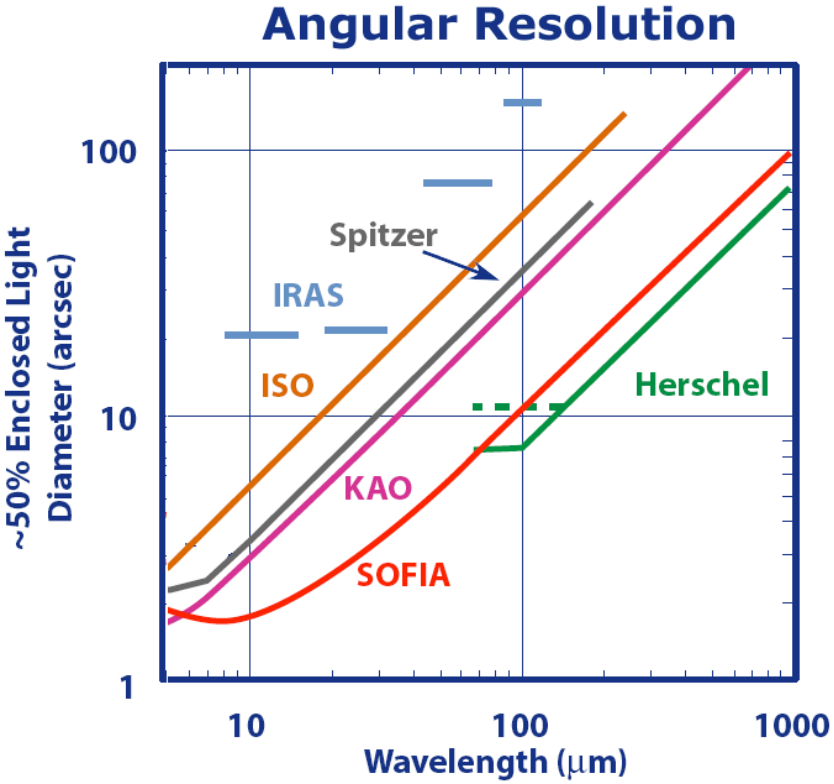
Upcoming events/activities to watch for:

- Call for Basic Science; **April 2010**
  - Basic Science flights; **spring 2011**
- Instrument workshop, Asilomar, CA; **June 6-8, 2010**
  (see SOFIA booth for more info)
- Proposal call for new instruments; **early 2011**

BACKUP

Photometric Sensitivity and Angular resolution



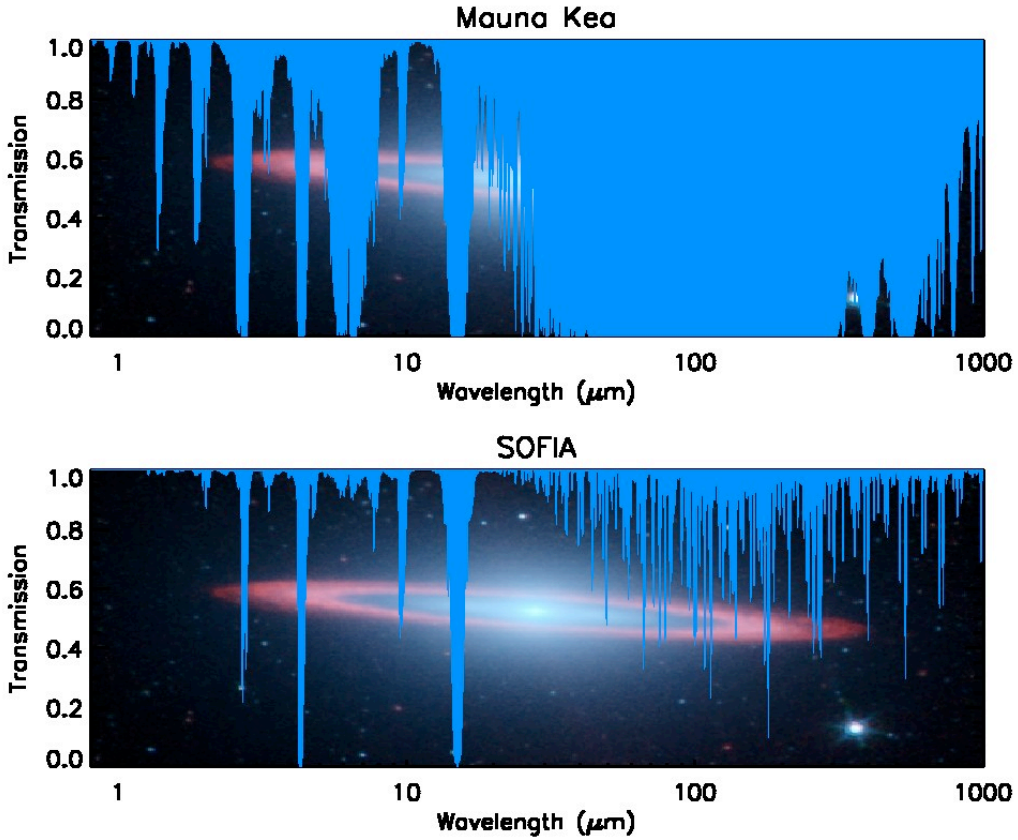


SOFIA is as sensitive as ISO

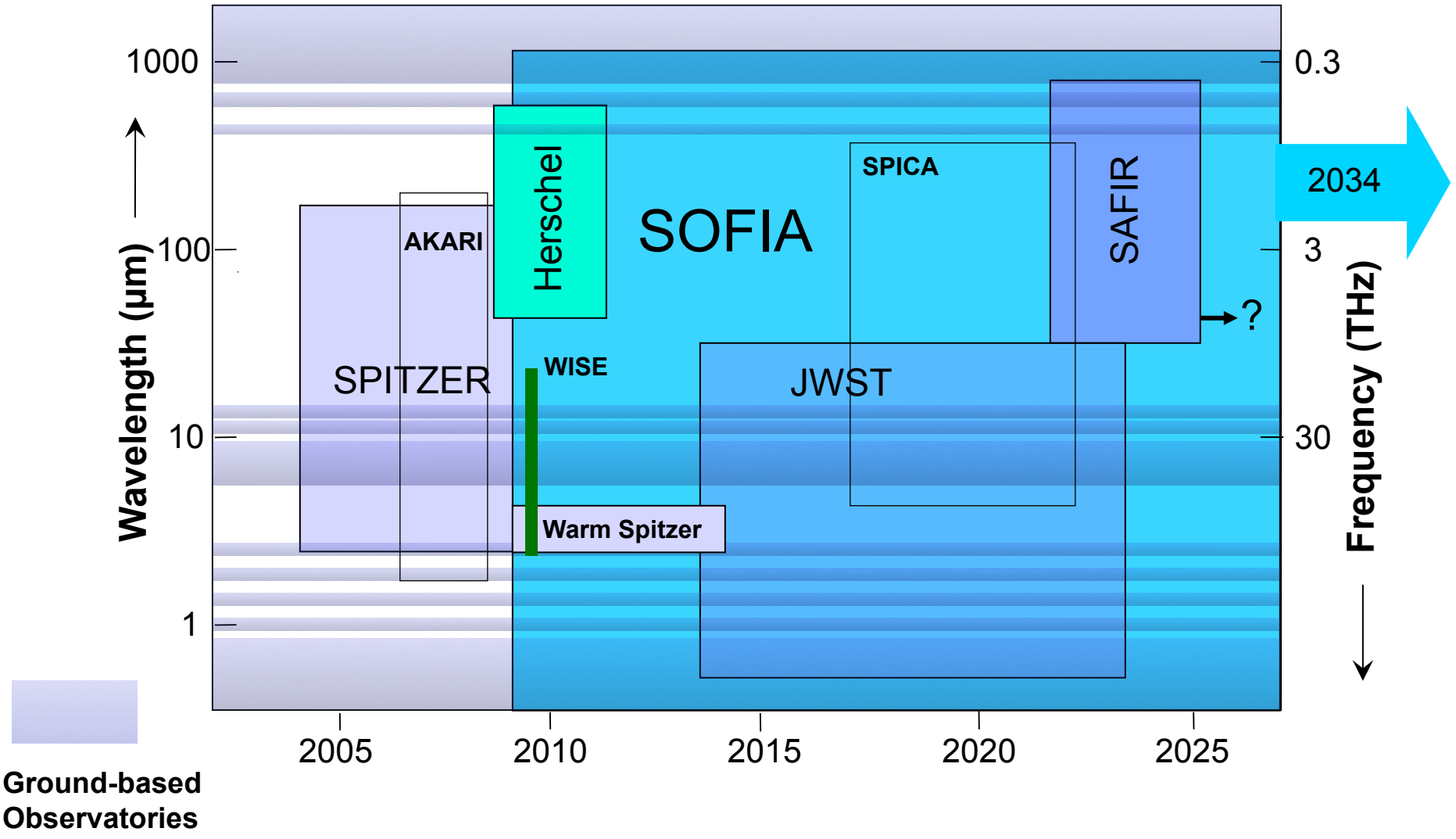
SOFIA is diffraction limited beyond 25 μm (θmin ~ λ/10 in arcseconds) and can produce images three times sharper than those made by Spitzer

The Advantages of SOFIA

- ***Above 99.8% of the water vapor***
- ***Transmission at 14 km >80% from 1 to 800 μm; emphasis on the obscured IR regions from 30 to 300 μm***
- ***Instrumentation: wide variety, rapidly interchangeable, state-of-the art – SOFIA is a new observatory every few years!***
- ***Mobility: anywhere, anytime***
- ***Twenty year design lifetime***
- ***A near-space observatory that comes home after every flight***



SOFIA and Major IR Imaging/Spectroscopic Space Observatories



SOFIA's First-Generation Instruments

Instrument	Type	λλ (μm)	Resolution	PI	Institution
HIPO (Available 2010)	fast imager	0.3 - 1.1	filters	E. Dunham	Lowell Obs.
FLITECAM * (Available 2010)	imager/grism	1.0 - 5.5	filters/R~2000	I. McLean	UCLA
FORCAST * (Available 2009)	imager/(grism?)	5.6 - 38	filters/(R~2000)	T. Herter	Cornell U.
GREAT (Available 2009)	heterodyne receiver	62 - 65 111 - 12 158 - 187 200 - 240	R ~ 10^4 - 10^8	R. Güsten	MPIfR
CASIMIR (Available 2011)	heterodyne receiver	250 -264, 508 -588	R ~ 10^4 -10^8	J. Zmuidzinas	Caltech
FIFI LS ** (Available 2009)	imaging grating spectrograph	42 - 110, 110 - 210	R ~1000 - 2000	A. Poglitsch	MPE
HAWC * (Available 2011)	imager	40 - 300	filters	D. A. Harper	Yerkes Obs.
EXES (Available 2011)	imaging echelle spectrograph	5 - 28.5	R ~ 3000 - 10^5	J. Lacy	U. Texas Austin

** Facility-class instrument*

*** Developed as a PI-class instrument, but will be converted to Facility-class during operations*