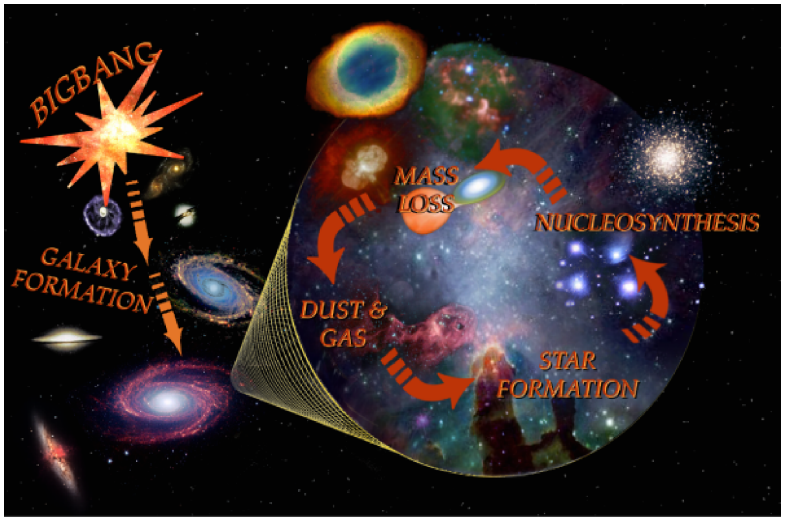
The Stratospheric Observatory for Infrared Astronomy (SOFIA)



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This talk is at: *http://www.sofia.usra.edu/Science/speakers/index.html*

Outline

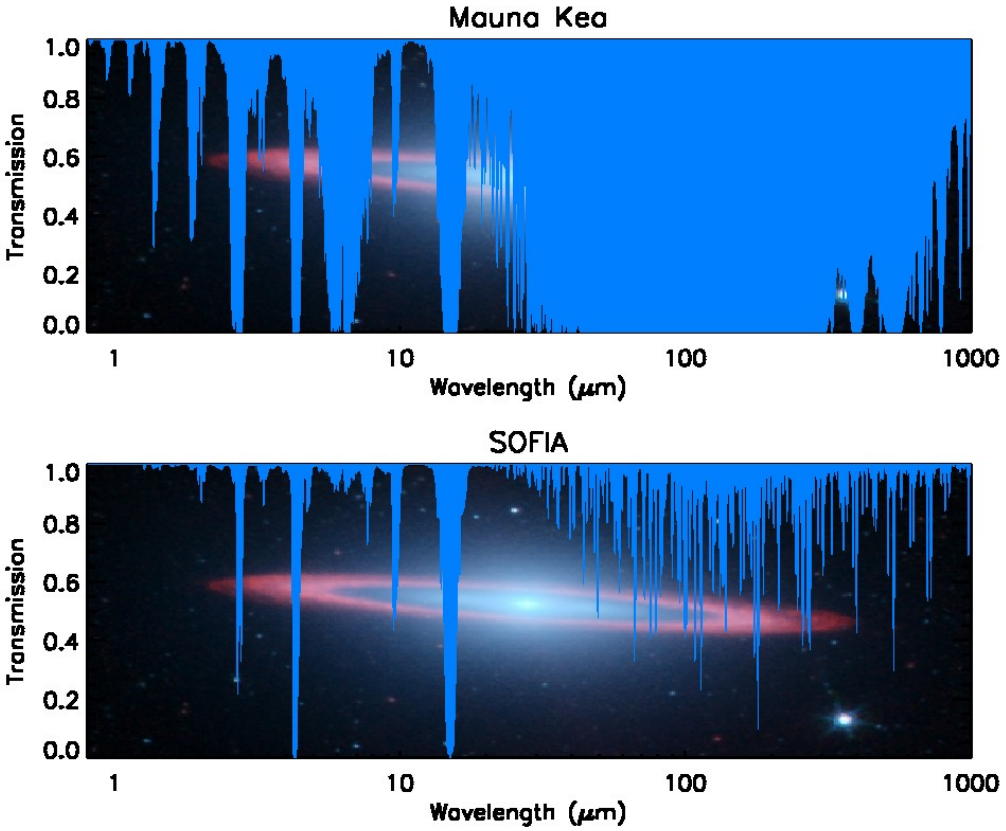
- *SOFIA Description and Status Report*
- *SOFIA First-Light Images*
- *SOFIA Performance Specifications*
- *SOFIA Schedule and General Investigator (GI) Opportunities*
- *Summary*

SOFIA Overview

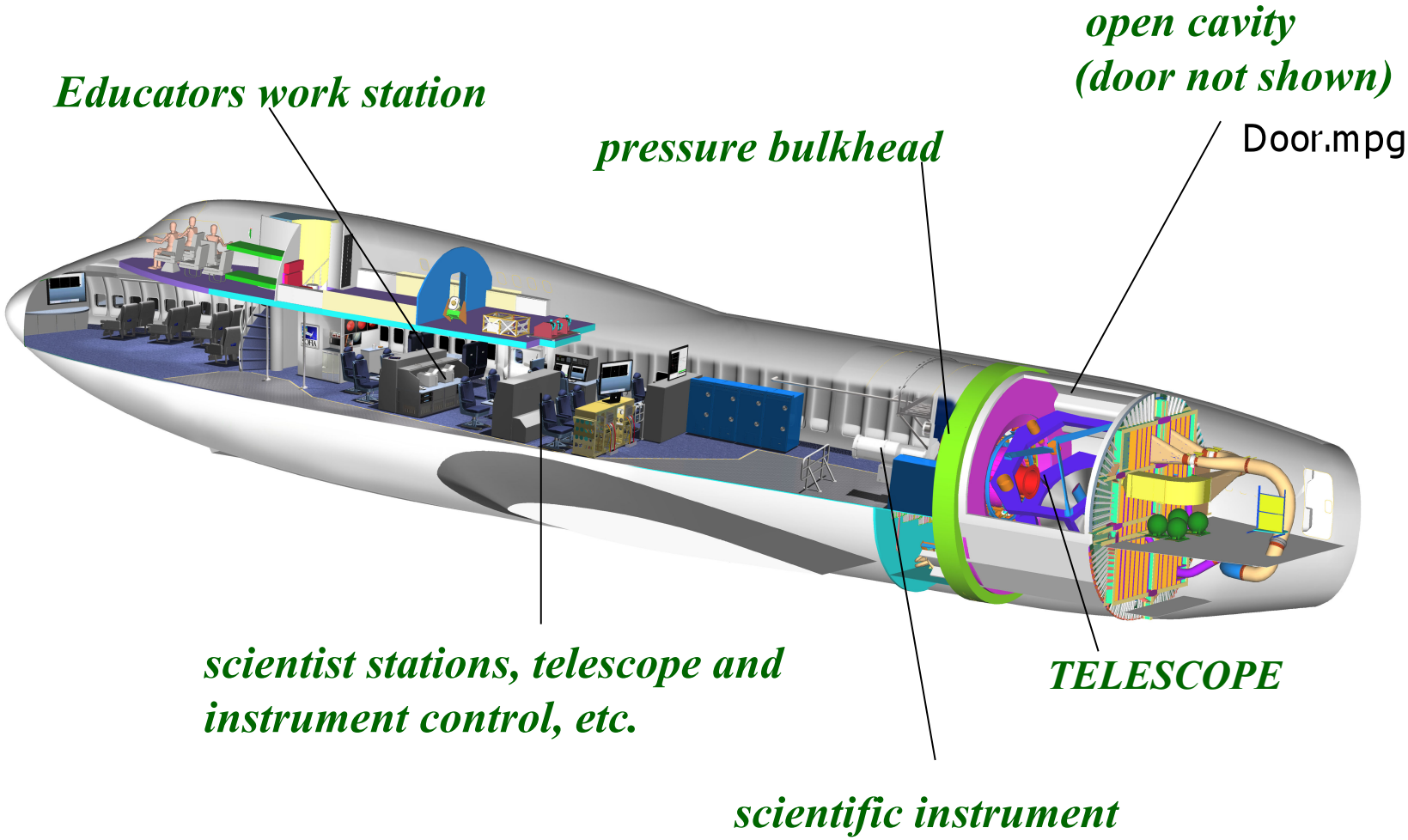
- *2.5 m telescope in a modified Boeing 747SP aircraft*
  - *Imaging and spectroscopy from 0.3 μm to 1.6 mm*
  - *Emphasizes the obscured IR (30-300 μm)*
- *Operational Altitude*
  - *39,000 to 45,000 feet (12 to 14 km)*
  - *Above > 99.8% of obscuring water vapor*
- *Joint Program between the US (80%) and Germany (20%)*
  - *First Light images were obtained on May 26, 2010*
  - *20 year design lifetime –can respond to changing technology*
  - *Ops: Science at NASA-Ames; Flight at Dryden FRC (Palmdale- Site 9)*
  - *Deployments to the Southern Hemisphere and elsewhere*
  - *>120 8-10 hour flights per year*

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*

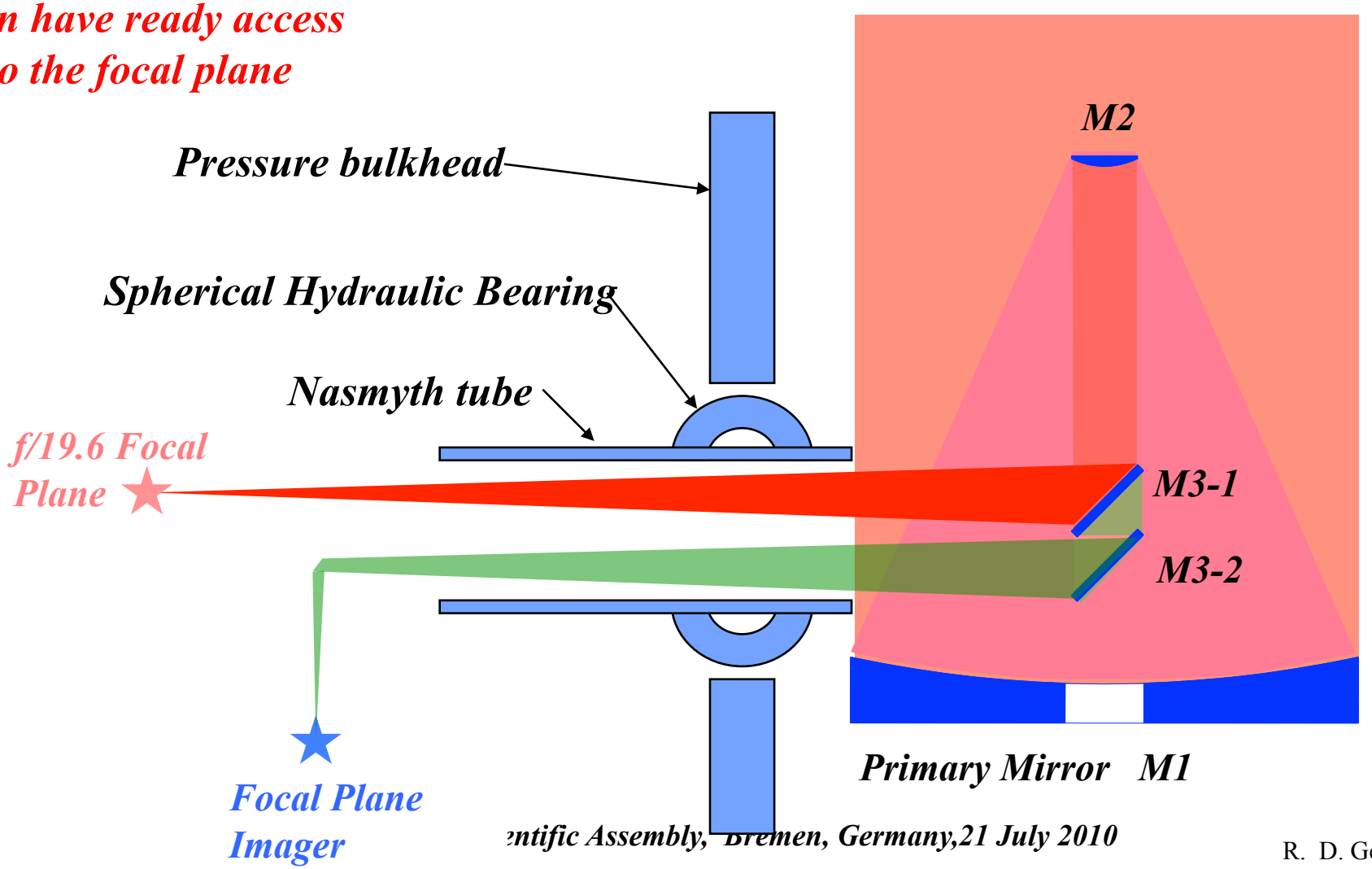


The SOFIA Observatory

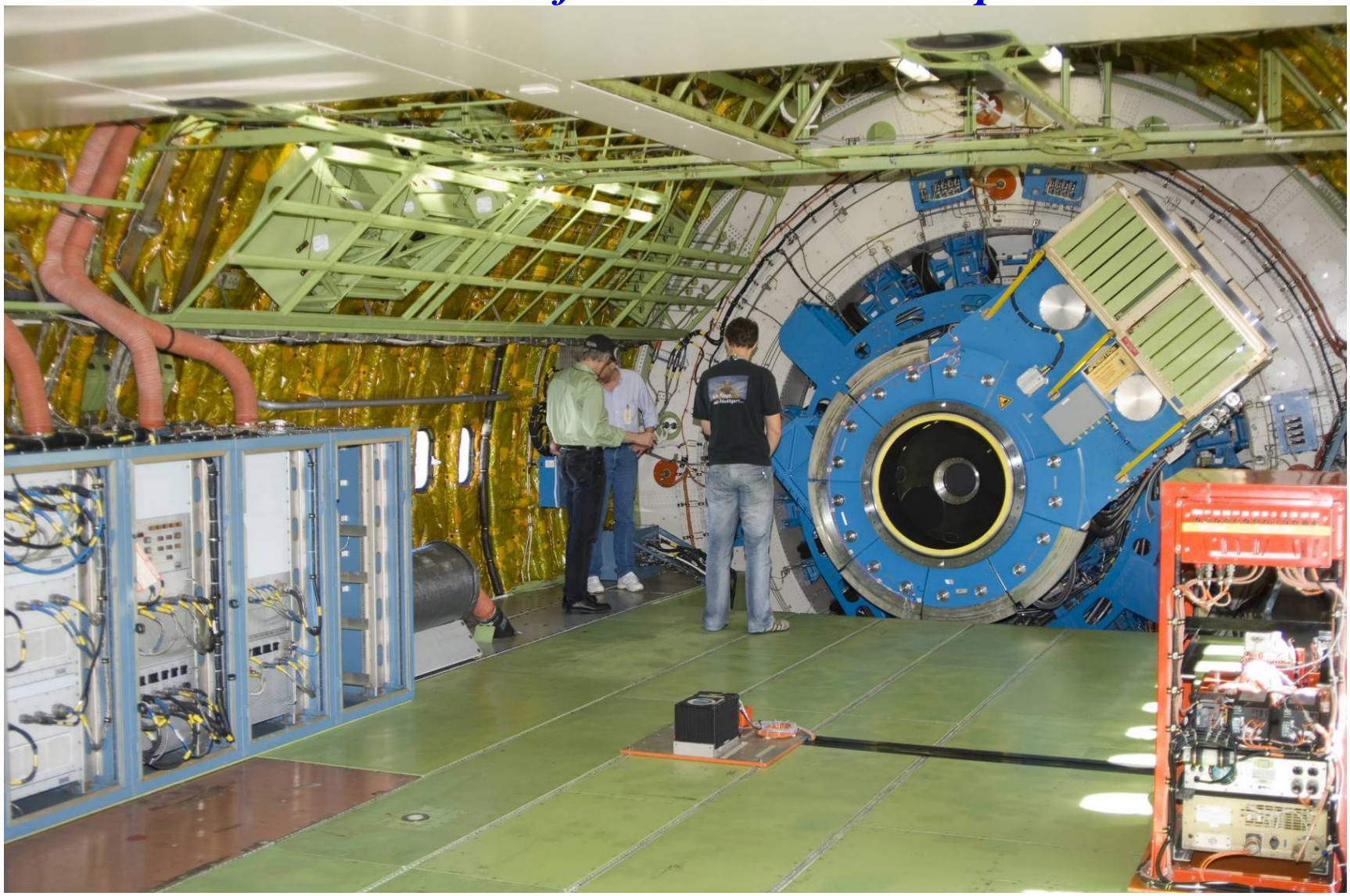


Nasmyth: Optical Layout

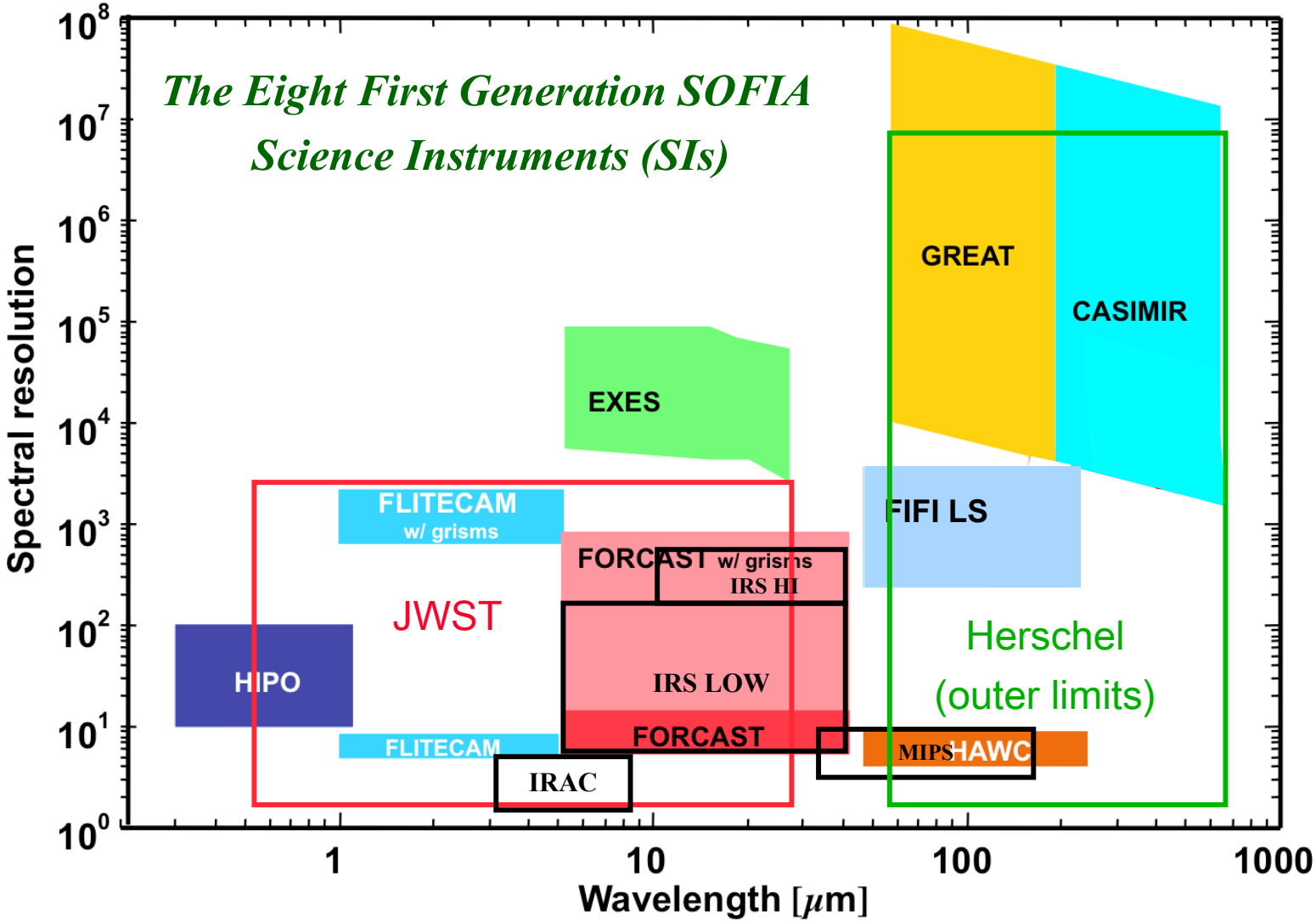
Observers in pressurized cabin have ready access to the focal plane



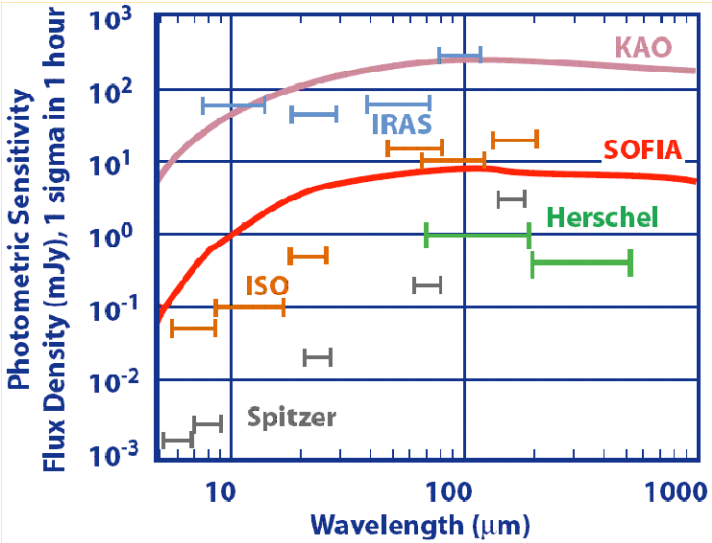
Back End of the SOFIA Telescope

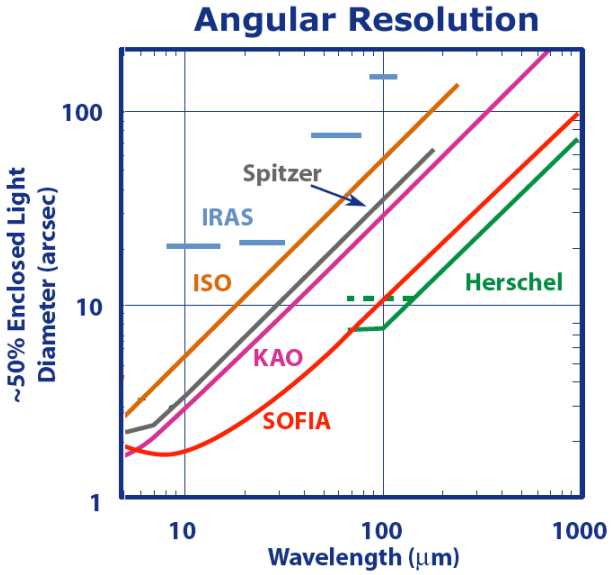


SOFIA First Generation Instruments



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

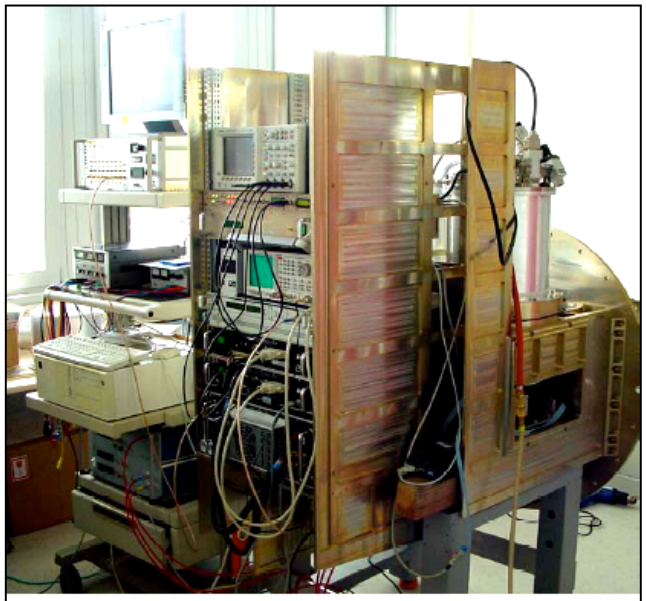
Early Science with FORCAST and GREAT

Faint Object infraRed Camera for the SOFIA Telescope (FORCAST)

- *Mid IR, two-channel camera*
- *0.75”/pixel 4-8 μm,16-40 μm*
- *R = 200 grisms beyond early science*

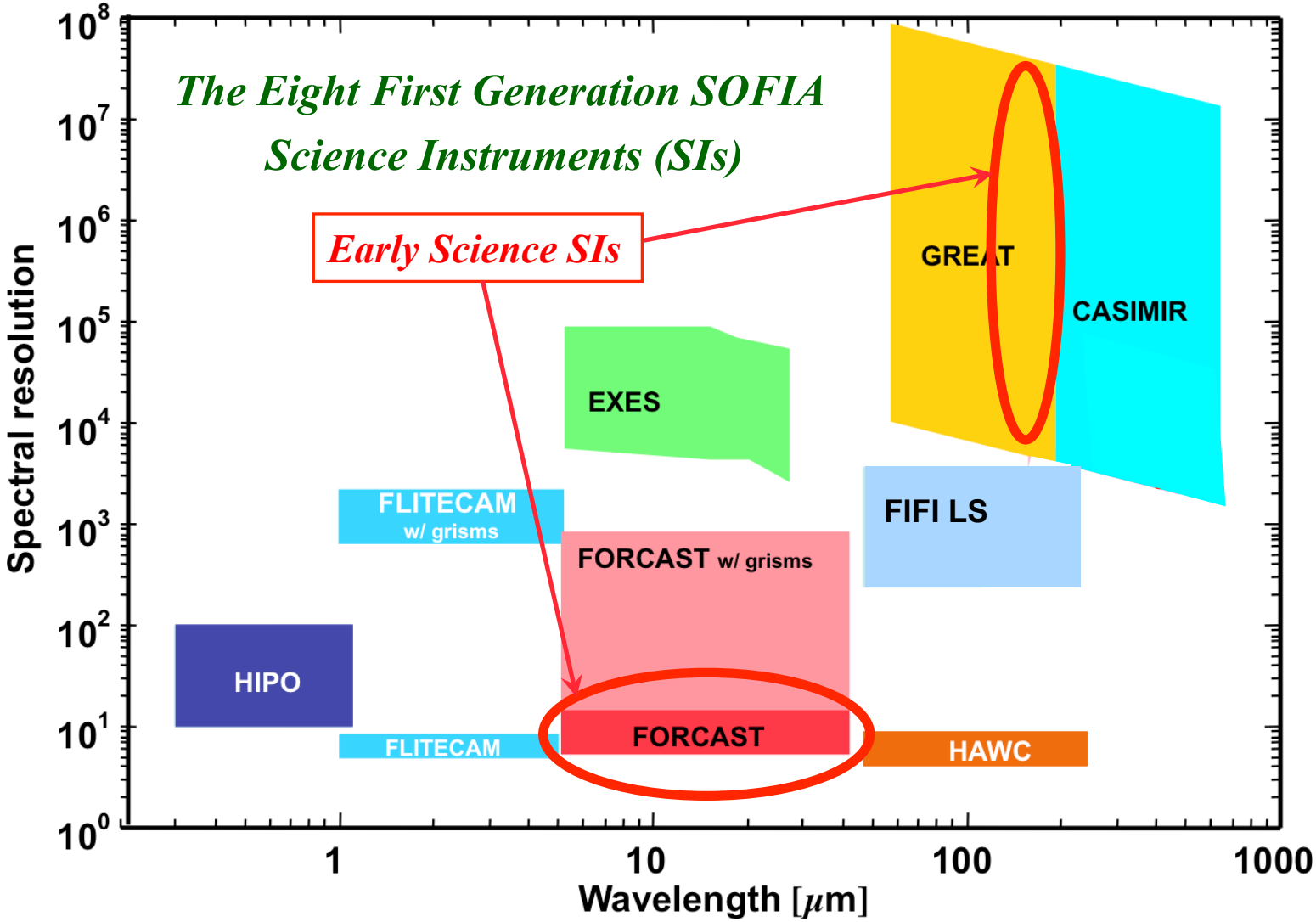
German REceiver for Astronomy at Terahertz frequencies (GREAT)

- *Heterodyne spectrometer*
- *Dual-channel 1.6-1.9 THz, 2.4-2.7 THZ (111-125 μm, 158-188 μm)*



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

SOFIA First Generation Instruments



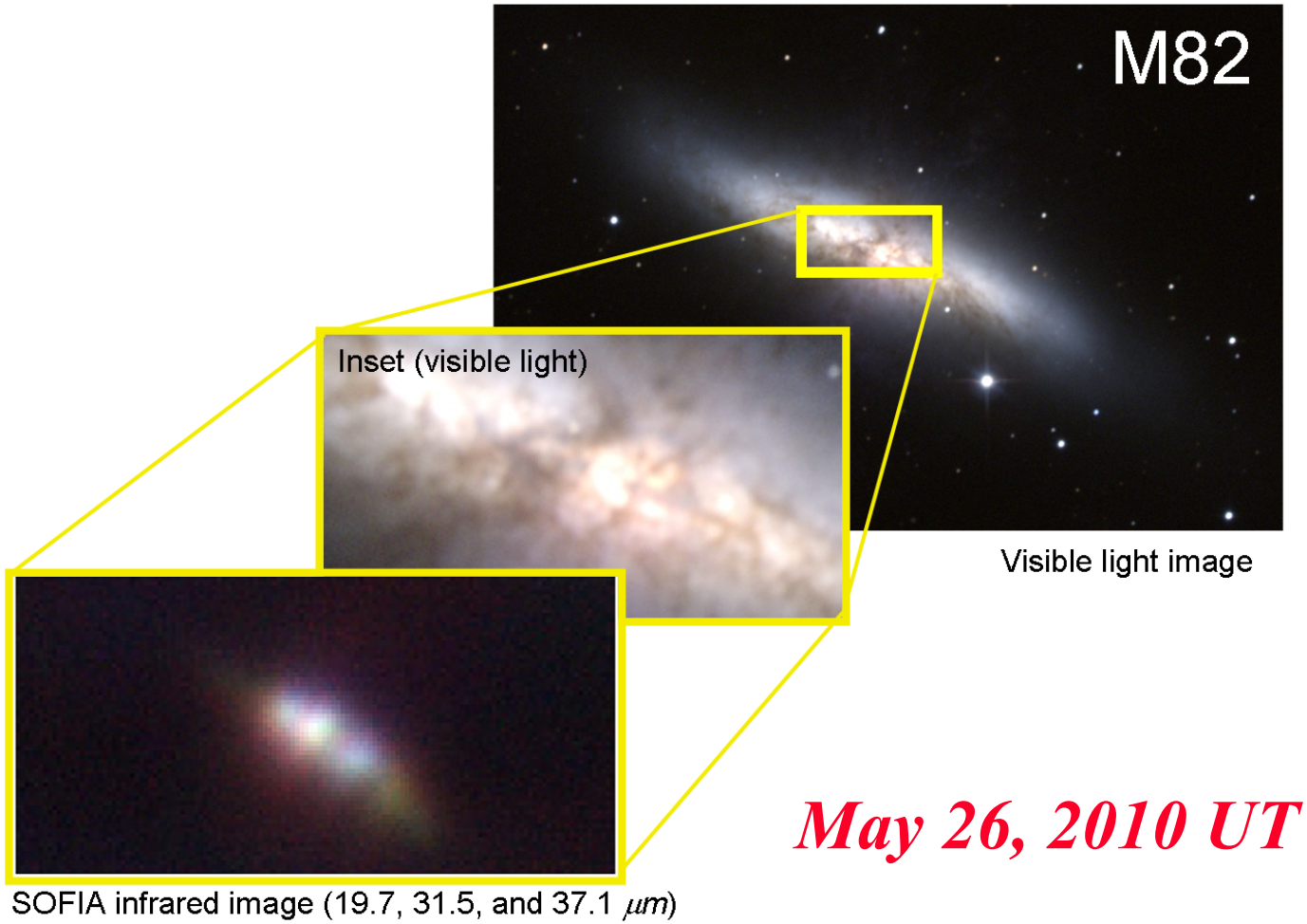
SOFIA Airborne with Door Open!

NASA's Stratospheric Observatory for Infrared Astronomy 747SP on Dec. 18, 2009. (NASA Photo / Carla Thomas)

EM-0095-27.mov

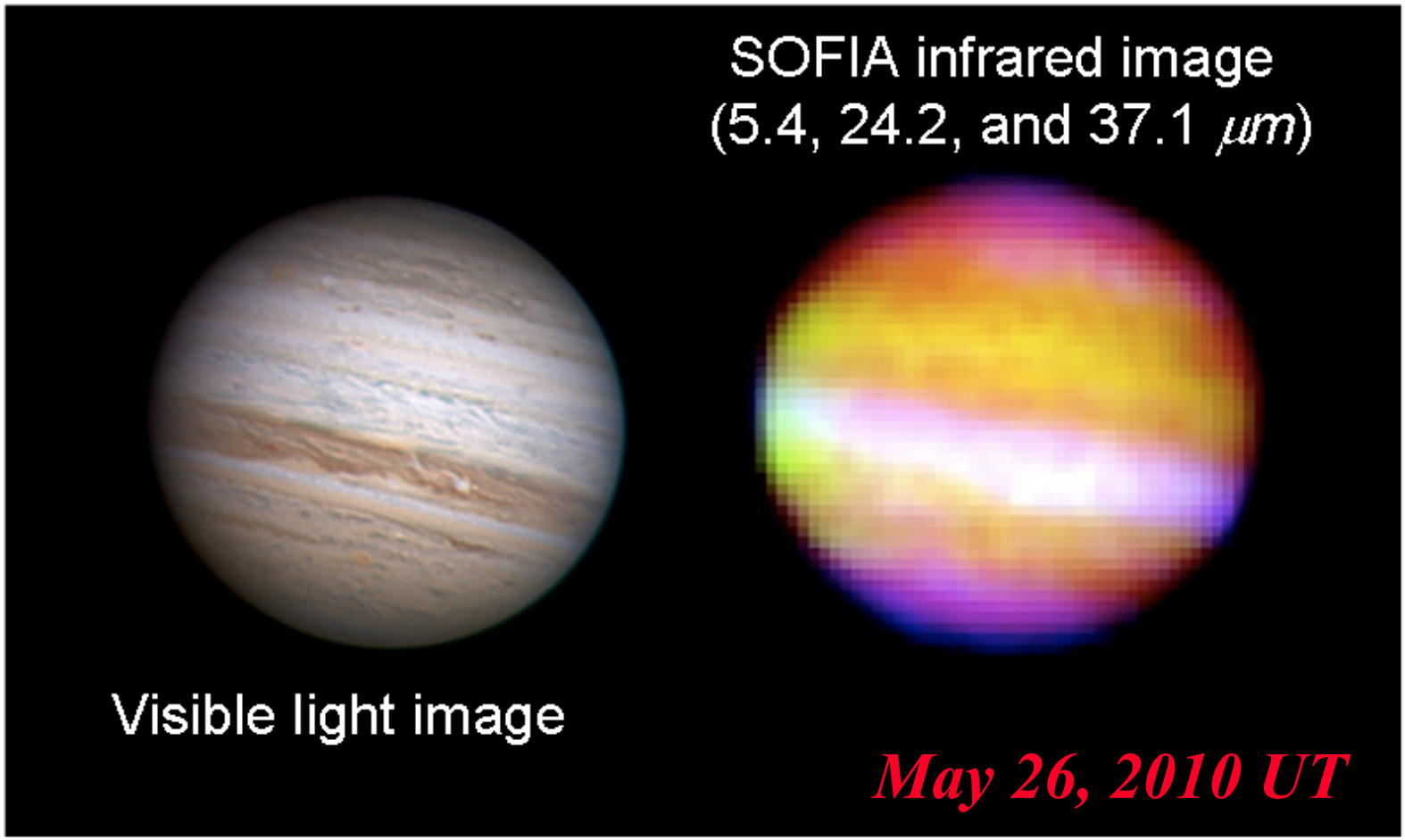
SOFIA_OpenDoor_100.wmv

SOFIA's FORCAST First-Light Images: M82



May 26, 2010 UT

SOFIA's FORCAST First-Light Images: Jupiter



Early General Observer Opportunities

- First light images were obtained with FORCAST on May 25, 2010
- Early Short Science begins during 2010 with FORCAST and GREAT
  - Teams have been selected
  - Very limited number of flights (~3 per instrument)
  - GO's will not fly
- Early Basic Science for General Investigators (GIs) with FORCAST and GREAT
  - Longer period (~15 Flights) during early 2011
  - The SOFIA Basic Science Call will be released on April 19, 2010; Due date is July 30, 2010
  - http://www.sofia.usra.edu/Science/proposals/basic_science/index.html
- General Investigator (GI) Science
  - Next call for proposals will be in 2011
  - Flights rate ramps up to over 100 per year by 2014

SOFIA Instrumentation Development Program

- *The second call for instruments expected in 2011*
- *The instrumentation development program will include:*
  - *New Facility and PI Class science instruments*
  - *Upgrades to present instruments*
  - *New technology investigations*
- *There will be additional calls every 3 years*
- *There will be one new instrument or upgrade per year*
- *Funding for new instruments and technology is ~$10 M/yr*

Summary

- *The Program is making progress!*
  - *Open door flights began in December 2009*
  - *First light was achieved on May 26, 2010*
  - *Science flights will begin in late 2010*
- *SOFIA will be a premier facility for far-IR and submm astronomy for many years*

Our Web site: ***http://www.sofia.usra.edu//***

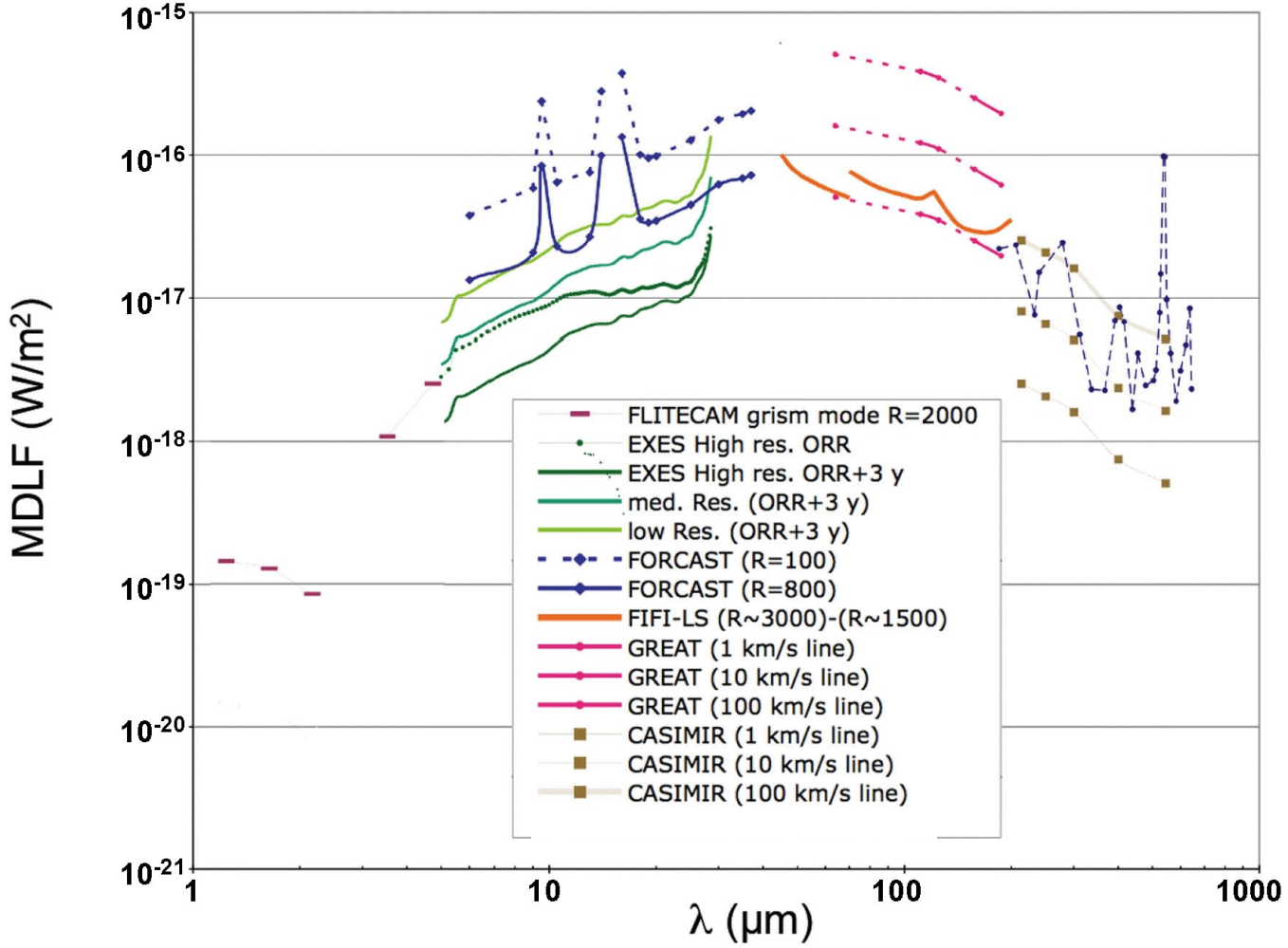
This talk: ***http://www.sofia.usra.edu/Science/speakers/index.html***

BACKUP

SOFIA's First-Generation Instruments

Instrument	*Description*	*Institution and PI*	*λ range (μm) Resolution (λ/Δλ)*	*Field of View Array Size Array Type*	*Date Available*
FORCAST (Facility SI)	**F**aint **O**bject Infra**R**ed **CA**mera for the **S**OFIA **T**elescope: *Facility Instrument - mid-IR camera and grism spectrometer*	Cornell University T. Herter	5 - 40 R ~ 200	3.2' x 3.2' 256 x 256 @ 0.75" Si:As, Si:Sb	2010
GREAT	**G**erman **RE**ceiver for **A**stronomy at **T**erahertz Frequenceies: *PI Instrument – heterodyne spectrometer*	MPIfR, KOSMA, DLR-WS R. Güsten	60-200 R = 10^6 - 10^8	Diffraction Limited Single pixel heterodyne	2010
FIFI-LS (Facility SI - like modes)	**F**ield **I**maging **F**ar-**I**nfrared **L**ine **S**pectrometer: *PI Instrument with facility-like capabilities – imaging grating spectrometer*	MPE, Garching A. Poglitsch	42 - 210 R = 1000 - 3750	30" x 30" (Blue) 60" x 60" (Red) 2 -16 x 5 x 5 Ga:Ge	2011
HIPO	**H**igh-speed Imaging **P**hotometer for **O**cculation: *Special PI Instrument – high speed imaging photometer*	Lowell Observatory E. Dunham	0.3 – 1.1 R = UBVRI; custom NB filters	5.6' x 5.6' 1024 x 1024 @ 0.05" or 0.33" CCD	2012
FLITECAM (Facility SI)	**F**irst **L**ight **I**nfrared **T**est **E**xperiment **CAM**era: *Facility Instrument – near-IR test camera and grism spectrometer*	UCLA I. McLean	1 – 5 R ~ 2000	8.2' x 8.2' 1024 x 1024 @ 0.48" InSb	2012
CASIMIR	**CA**ltech **S**ub-millimeter **I**nterstellar **M**edium **I**nvestigations **R**eciever: *PI Instrument – Heterodyne Spectrometer*	Caltech J. Zmuidzinas	200 – 600 R = 3×10^4 – 4×10^5	Diffraction Limited Single pixel heterodyne	2012
HAWC (Facility SI)	**H**igh-resolution **A**irborne **W**ideband **C**amera: *Facility Instrument – far-IR bolometer camera*	University of Chicago D. Harper	50-240 R = 5 - 10	Diffraction Limited 12 x 32 Bolometer	2013
EXES	Echelon-Cross-Echelle (**EXE**) **S**pectrograph: *PI Instrument – echelon spectrometer*	University of California Davis M. Richter	5 – 28 R = 10^4, 10^5, or 3000	5" to 90" slit 1024 x 1024 As:Si 1" – 4" slit width	2013

Line Sensitivities with Spectrometers
(4σ in 900 sec on source time)



Primary Mirror Installed Oct. 8, 2008

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