Stratospheric Observatory For Infrared Astronomy
TECHNICAL INFORMATION

The SOFIA observatory consists of a Boeing 747SP aircraft carrying a telescope with an effective diameter of 2.5 meters to altitudes between 12 and 14 km (39,000 to 45,000 ft). At those altitudes, SOFIA is above more than 99 percent of Earth's atmospheric water vapor. SOFIA is a joint project of NASA and the DLR (German Aerospace Center), designed to provide a world-class infrared and submillimeter-wavelength observatory for the next two decades.

SOFIA System Characteristics

Nominal Operational Wavelength Range	0.3 to 1600 μm
Primary Mirror Diameter	2.7 meters
Effective Aperture Diameter	2.5 meters
Optical Configuration	Bent Cassegrain with chopping secondary mirror and flat folding tertiary
System f-ratio	19.6
Primary Mirror f-ratio	1.28
Telescope Elevation Range**	23 to 57 degrees (approx.)
Field-of-View Diameter**	8 arcmin
Maximum Chop Throw on Sky**	± 4 arcmin

Image Quality of Observatory System*	Diffraction-limited at $\lambda \geq 20$ μm (corresponds to 2.1 arcsec FWHM at 20 μm)
Chopper Frequencies	1 to 20 Hz for 2-point square-wave chop
Pointing Stability*	≤0.4 arcsec (radial rms) for sidereal targets ≤1.0 arcsec (radial rms) for non-sideral targets
Pointing Accuracy*	0.3 arcsec (radial rms) with on-axis focal plane tracking
Total Telescope Emissivity*	≤14.5% over 8.45–8.75 μm bandpass with dichroic tertiary
Observatory System Polarization*	≤4% across 40–300 μm
Recovery Air Temperature in Cavity (Optics Temperature)	240 K

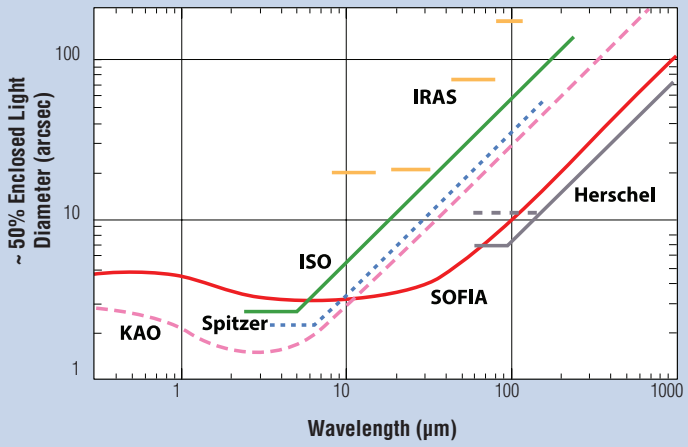
** Requirement, to be met at FOC + 4 years. ** Unvignetted*

Science Instruments

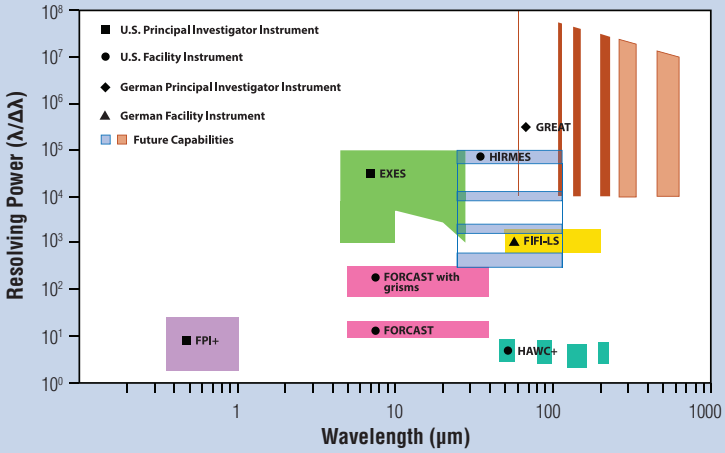
Name	Principal Investigator	Description	Wavelength Range Resolving Power $R = \lambda/\Delta\lambda$	Field of View Features
INFRARED INSTRUMENTS				
EXES	Matthew Richter, UC Davis	Mid-IR Echelle Spectrometer PI Instrument	4.5 – 28.3 μm R = 1,000 – 10^5	1" – 180" slit lengths 1024x1024 Si:As
FIFI-LS	Alfred Krabbe, DSI	Far-IR Imaging Grating Spectrometer Facility Instrument	51 – 200 μm R = 600 – 2,000	30" x 30" (Blue) 60" x 60" (Red) 2x(16x25) Ge:Ga
FORCAST	Terry Herter, Cornell University	Mid-IR Camera & Grism Spectrometer Facility Instrument	5 – 40 μm R = 100 – 300	3.2' x 3.2' 2x(256x256) Si:As, Si:Sb
GREAT	Rolf Güsten, MPIfR	Far-IR Heterodyne Spectrometer PI Instrument	63 – 612 μm R = 10^6 – 10^8	diffraction limited heterodyne receiver
HAWC+	Charles Dowell, JPL	Far-IR Bolometer Camera & Polarimeter Facility Instrument	50 – 240 μm R = 2.3 – 8.8	from 1.4' x 1.7' (53 μm) to 4.8' x 6.1' (215 μm) 3x(32x40) bolometer
HIRMES	Harvey Mosely, NASA Goddard	Mid-IR Bolometer Spectrometer Facility Instrument	25 – 122 μm R = 325 – 100,000	8.8" x 143" slit 119" x 103" imaging
OPTICAL INSTRUMENTS				
FPI+	Jürgen Wolf, DSI	Focal Plane Imager Facility Instrument	0.36 – 1.10 μm R = 0.9 – 29.0	8.7' x 8.7' 1024x1024 CCD

SOFIA Performance Characteristics

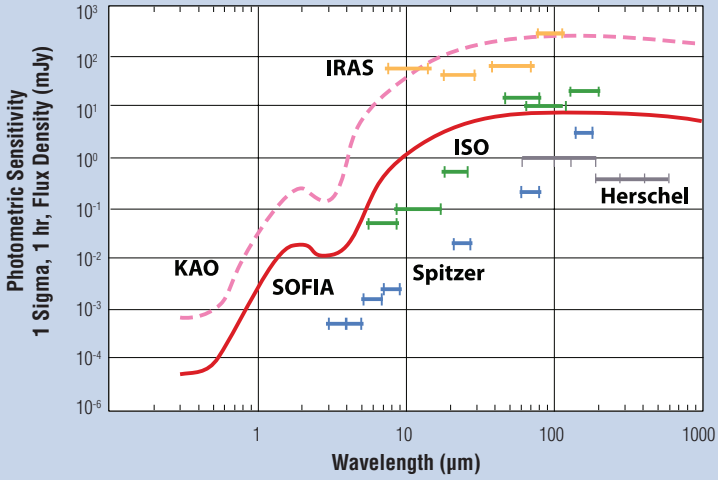
Angular Resolution



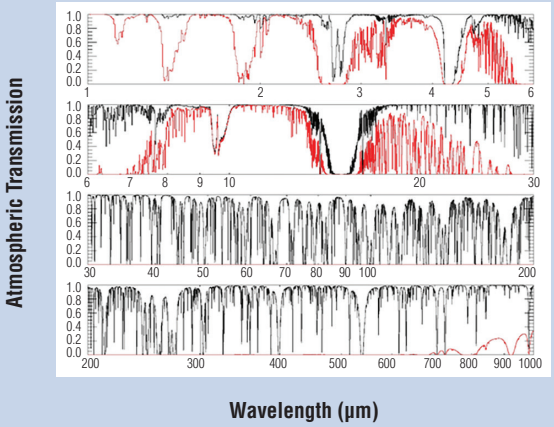
The SOFIA Instruments



Point Source Photometric Sensitivity



Atmospheric Transmission



The atmospheric transmission for SOFIA *(black)* at an altitude of 41K feet and 7.3 μm of precipitable water vapor compared to Mauna Kea *(red)* at an altitude of 13.8K feet and 3.4 mm water vapor over the range of 1–1000 μm.

Science Instruments — Recent and Upcoming Developments

The High Resolution Mid-InfrarEd Spectrometer (HIRMES) is the new, third-generation facility science instrument being developed by a team from NASA's Goddard Space Flight Center led by principal investigator Samuel Harvey Moseley. HIRMES employs background limited bolometers and a combination of Fabry-Perot interferometers and gratings. HIRMES has more than 90 percent quantum efficiency over reasonably broad bands, increased sensitivity as compared to photoconductors, and has no inherent quantum noise limit. HIRMES is optimized to detect neutral atomic oxygen, water, as well as normal and deuterated (or heavy) hydrogen molecules at wavelengths between 25 and 122 μm. Initial flights with HIRMES are planned for the spring of 2019.

GREAT has been upgraded to run in upGREAT or 4GREAT configurations. The upGREAT Low Frequency Array (LFA) is a dual polarization, 2x7 pixel array operating at ~1.9 THz, and the upGREAT High Frequency Array (HFA) is a 1x7 pixel array operating at 4.745 THz. 4GREAT has four single-pixel channels that observe the same position on the sky simultaneously. Their central frequencies are 0.43, 1.00, 1.37, and 2.54 THz.

Information for Researchers
www.sofia.usra.edu/Science