SOFIA : follow-up opportunities for Herschel

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SOFIA is airborne! Here we see it on its first open door flight

ABSTRACT

SOFIA, the Stratospheric Observatory for Infrared Astronomy, is a Boeing 747-SP airplane with a 2.5 m telescope, designed to operate at altitudes from 12 to 14 km and wavelengths from 0.3 μm to 1.6 mm over a 20 year lifetime. The telescope will be diffraction limited at wavelengths beyond ~15 μm. At 100 μm the resolution is ~10″, which is comparable to the angular resolution of large groundbased telescopes in the mm/sub-mm such as IRAM, JCMT, and CSO.

SOFIA is ideal for follow-up of Herschel observations. Several of our instruments are very complementary, others extend the wavelength range to shorter wavelengths or provide higher spectral resolution. GREAT (German PI instrument) and CASIMIR (US PI Instrument) are both heterodyne instruments similar to HIFI, but with improved mixer technology and some unique wavelength coverage. FIFI-LS, built by MPE, is an integral field spectrometer similar to PACS, but which goes to somewhat shorter wavelengths (42 μm) than PACS. SOFIA now has eight instruments and is expected to add or upgrade instruments every few years during its lifetime.

SOFIA is currently undergoing flight tests and the first light flight is scheduled for May 25 (this month!). The first light observations will be made with FORCAST, a dual channel mid-IR facility camera covering 5 - 38 μm with a 3.2 arcmin field of view. The call for basic science proposals is now open with proposals due on July 30, 2010. Basic science consists of 15 flights with FORCAST and GREAT in 2011. This is the first real opportunity for the astronomical community to use SOFIA. SOFIA will be fully operational in 2014.

SOFIA is now airborne

Limited science observations are expected to start in the fall 2010 and will ramp up to full capability by 2014. Even with the first generation instruments, SOFIA can do unique observations from near- to far-infrared wavelengths, which we summarize briefly below.

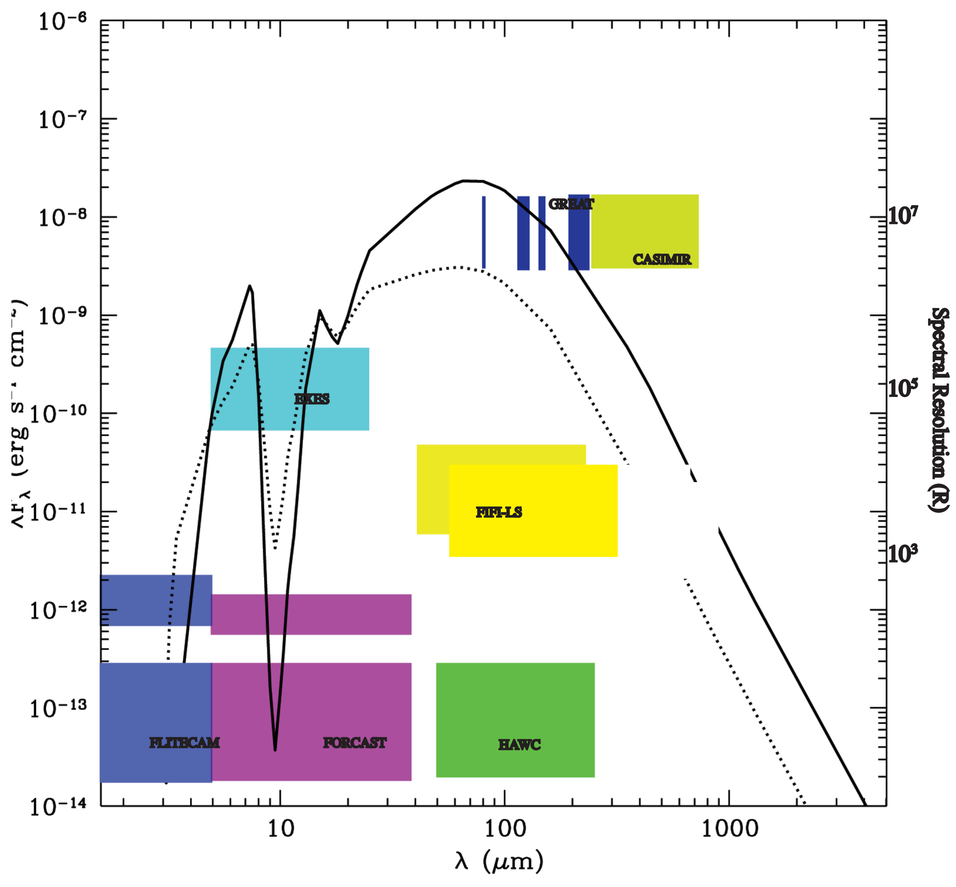
SOFIA FIRST GENERATION INSTRUMENTS

Instrument name	Type	Array & pixel size	Wavelength coverage & resolution
Facility Instruments			
HAWC	Far Infrared Bolometer Camera	12 x 32, 2.3″ - 8″/pixel	40 - 300 μm
FORCAST	Mid IR Camera	256x256 , 0.75″/pixel	5 - 40 μm
FLITECAM	Near IR Test Camera	1024x1024, 0.48″/pixel	1 - 5 μm
PI Instruments			
EXES	Echelon Grating Spectrometer	1024x1024, 1″ - 4″ slit	5 - 28 μm, R=3 10^3 - 10^5
CASIMIR	Heterodyne Spectrometer	Single, diff. limited,	250 - 600 μm, R=10^6-10^8
FIFI-LS	Image Sliced Grating Spectrometer	5x5 (x2), 7″ &14″/pixel	42-110, 110-210 μm R= 2000
GREAT	Heterodyne Spectrometer	Single, diff.limited	63,110-125,156-240 μm R=10^6-10^8

SOFIA is the only FIR mission available to the astronomy community after Herschel !!

Below we list our first generation instruments that can be used for follow-up of Herschel projects (see Table) and give a few examples of what kind of studies could be done with each instrument. We are sure that you will quickly find your own application for one or several of these unique SOFIA instruments.

- FORCAST:
  Follow-up of PACS and SPIRE imaging. At 38 μm FORCAST provides similar spatial resolution as the PACS blue channel. FORCAST will also have spectroscopic capabilities (grisms), but not for the first proposal call.
- HAWC:
  Provides FIR images with narrower filters and better SED sampling than PACS. Ideal for studying star formation in our galaxy and nearby galaxies.
- FLITECAM:
  Can do fast surveys in narrowband filters (e.g. Pα, the 3.1 μm “ice” , and the 3.3 μm PAH band) due to it’s large field of view (8'), allowing us to see the interaction between the hot stars and the surrounding molecular cloud. FLITECAM is also equipped with grisms, which enable medium resolution (R ~ 2000) spectroscopy of lines not observable from the ground.
- EXES:
  Ideal for studying the chemistry and kinematics of protostellar disks. EXES can reach all the pure rotational lines of H_2 from S(0) to S(9) as well as many transitions of H_2O, providing a unique probe of the hot inner parts of protoplanetary disks and the outflows powered by the accretion disks.
- GREAT and CASIMIR:
  Studies of hot dense gas in hot cores, accretions disks and outflows. CASIMIR covers the ground state transition of OH, and can be used to study the chemistry and abundance of the ubiquitous water molecule through $H^{18}O$, which can be expected to be optically thin. GREAT additionally covers deuterated H_2 (HD).
- FIFI-LS:
  Studies of our solar system. Giant gas planets, planetary moons like Titan, and our neighbors, Venus and Mars. Can investigate star formation in nearby galaxies; providing both excitation conditions and accurate SEDs.



The table to the left gives a very short summary of the main characteristics of each intrument. The figure above shows that these instruments essentially cover the whole SED of a young protostar (two separate models). The spectral resolution of each instrument is indicated on the right.

In addition to the first generation instruments, SOFIA will upgrade or add a new instrument every few years, which will enhance or enable new capabilities.

If you have a chance, please come to our instrumentation workshop in June: Scientific Opportunities For new Instrumentation, Asilomar 2010, June 6 - 8, 2010. Even though the registration deadline has passed, we still accept late registrations.