The Field-Imaging Far-Infrared Line Spectrometer

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FIFI LS (the Field-Imaging Far-Infrared Line Spectrometer) will utilize the unprecedented high angular resolution and sensitivity of SOFIA (the Stratospheric Observatory for Infrared Astronomy) to address many key questions in modern astronomy. As a state-of-the-art astronomical instrument, FIFI LS will enable simultaneous observations in two separate bands (42-110 and 110-210 μm) and simultaneous 3D imaging--- 2D spatially and 1D spectrally.

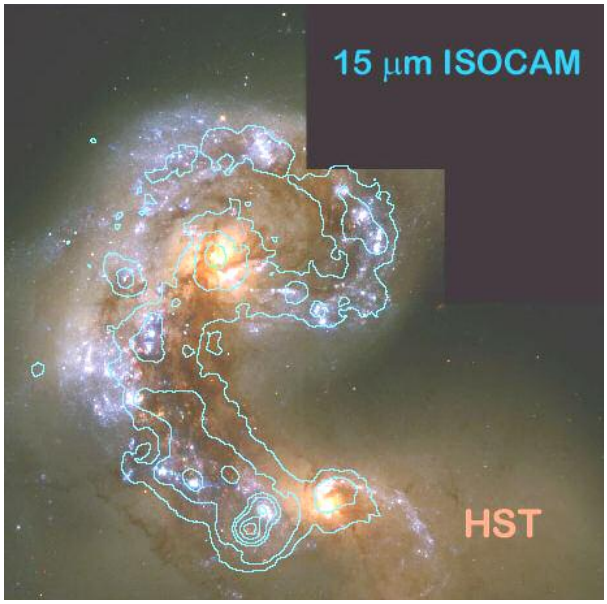
Goals and Capabilities

FIFI LS will provide a unique tool for astronomical 3D spectral imaging of line emission in the far-infrared. Observing in the far-infared, which is largely unaffected by dust extinction and contains a large number of important emission lines, will allow FIFI LS to make significant contributions to a number of astrophysical problems. The scientific goals and topics include:

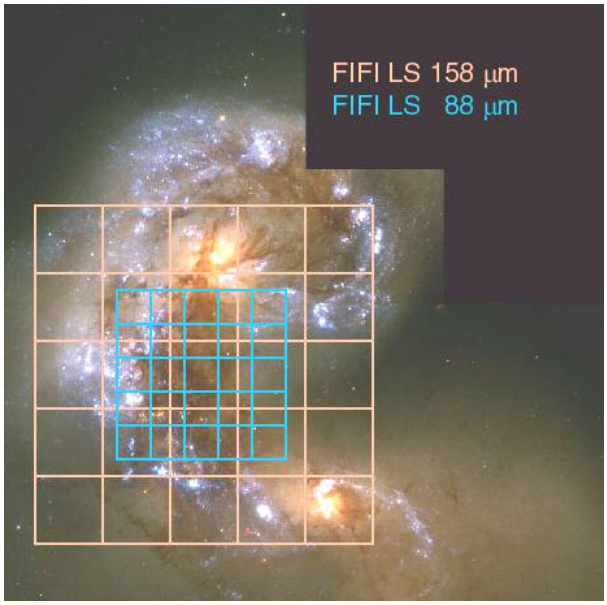
- Triggered star formation and the interstellar medium in merging/interacting galaxies.
- The relationship between active galactic nuclei and starbursts galaxies.
- The morphology of heating and cooling in galaxies.
- Local and extragalactic star formation.
- The powering mechanisms of ultra-luminous infrared galaxies (ULIRGs).
- The interstellar medium in low-metallicity environments (such as dwarf galaxies).

For these topics, our scientific understanding is at a critical juncture; the injection of new far-infrared data will play an essential role. Below is an example of the scientific impact that FIFI LS will have on our knowledge of merging/interacting galaxies.

A Scientific Example: NGC 4038/4039 "The Antennae"



An ISOCAM image of "The Antennae" (Vigroux et al.), a collision of two nearby galaxies, overlaid on the HST image (Whitmore & Schweizer). The two galaxy nuclei are slightly off the vertical axis of this image. The ISO data illustrate that the interaction region is the primary site of activity in the system (the emission is peaked between the galaxy nuclei). However, the interaction region is almost completely obscured in the HST image (note the dark dust lanes).

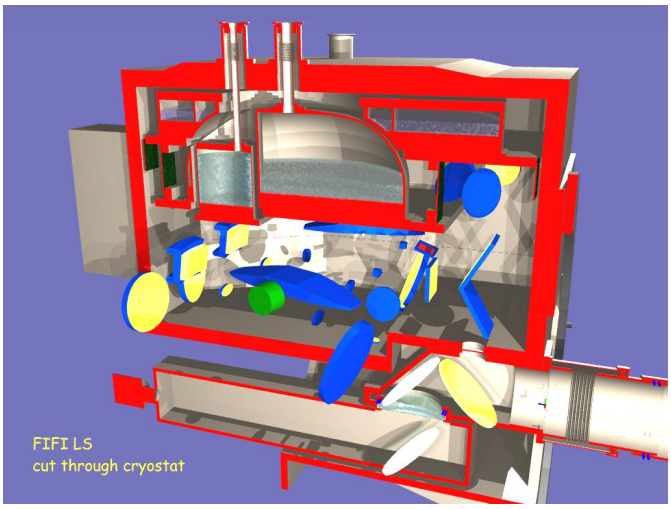


Overlaid on the HST image is the spatial footprint of FIFI LS on the sky-- the long- (red square) and short- (blue square) wavelength channels. With SOFIA, FIFI LS will have the resolution necessary to penetrate the optically obscured region between the two galaxy nuclei. At lower resolution, observations on the KAO have shown that C II emission, a star formation tracer, is peaked between the two galaxy nuclei (Nikola et al.). FIFI LS will open a new chapter of study for this source and more distant mergers.

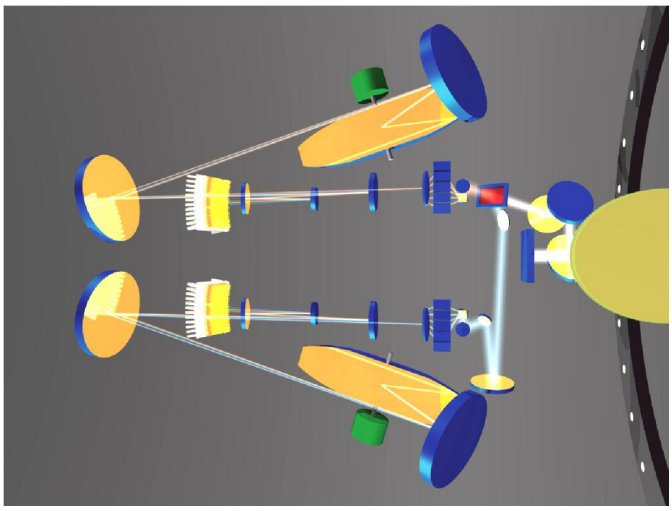
FIFI LS Specifications

FIFI LS is a 3D integral field far-infrared spectrometer with simultaneous observing in two channels—short wavelength (42-110 μm) and long wavelength (110-210 μm). The expected system characteristics are given in the following table.

Wavelength	42-110 μm	110-210 μm
Detector Type (photoconductor)	Ge:Ga	Stressed Ge:Ga
Spatial Pixels	5x5	5x5
Spectral Pixels	16	16
Pixel Size	7″	14″
Field of View	35″x35″	70″x70″
Velocity Resolution	150-300 km/s	150-300 km/s
Instantaneous Velocity Coverage	1500-3000 km/s	1500-3000 km/s
Line Sensitivity (5σ in 1hr)		
50 μm	5.5×10^{-17} W/m^2	----
100 μm	3.5×10^{-17} W/m^2	----
150 μm	----	2.2×10^{-17} W/m^2
200 μm	----	1.4×10^{-17} W/m^2



A simulated image of the FIFI LS cryostat. To the right is the SOFIA telescope. The infrared light from the telescope enters through the boresight (the tube on the bottom right) to the dichroic filter (yellow) and up into the cryostat. In this cryostat, most of the optical components in FIFI LS are cooled to 4-degrees Kelvin and the detector arrays are cooled to ~2-degrees Kelvin.



A close-up image of the two light paths in FIFI LS. The top and bottom halves are the long and short wavelength light paths, respectively. Again, the SOFIA telescope is to the right.

The FIFI LS Team

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