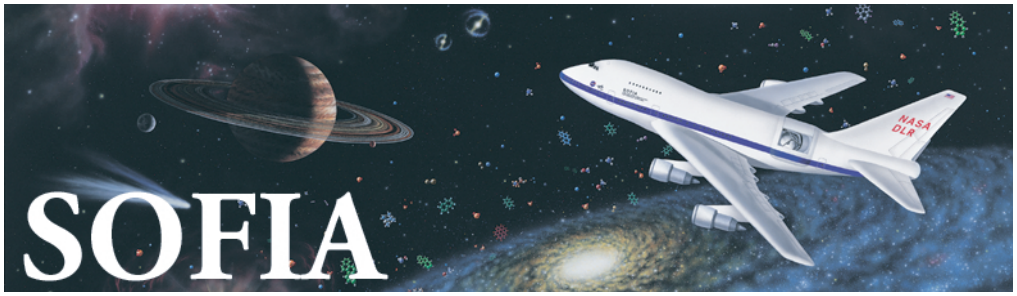
SAFIRE:

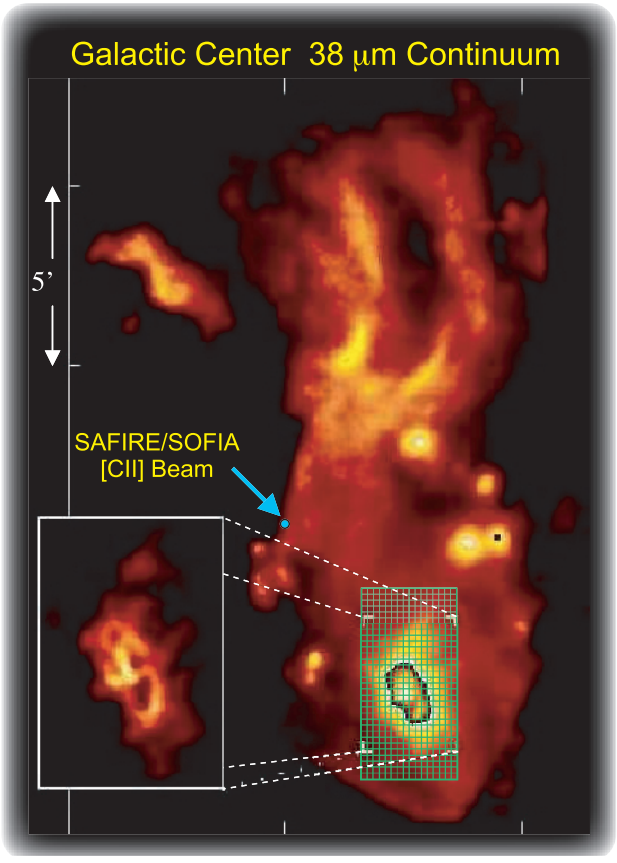
Submillimeter and Far-InfraRed Experiment



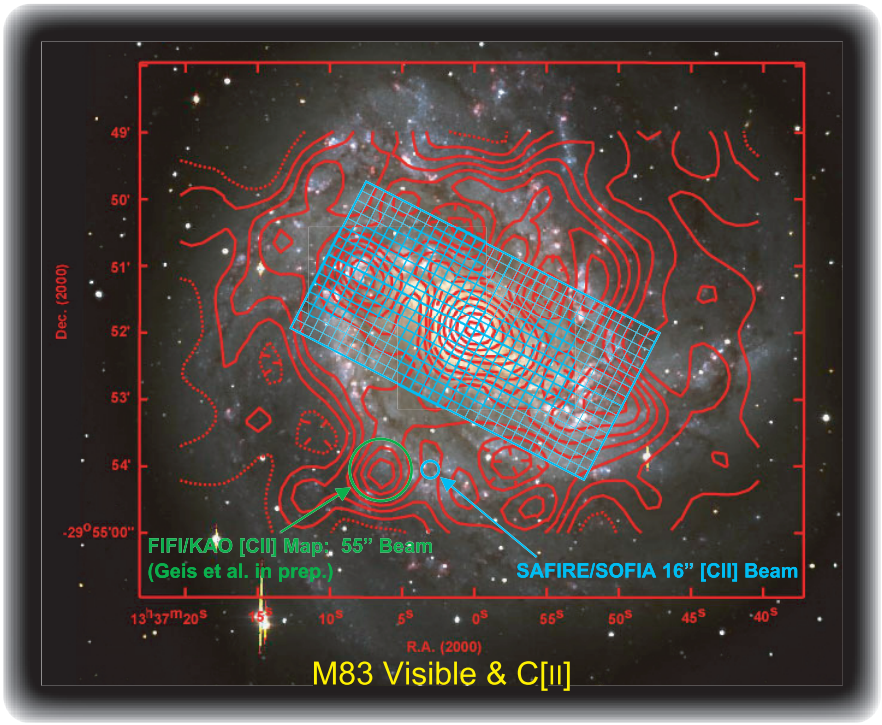
SAFIRE is a versatile imaging Fabry-Perot spectrograph covering 100<λ<655μm, with a spectral resolving power of ~2,000. SAFIRE will make high sensitivity maps of molecular, atomic, and ionized line emission from objects. These observations are critical to achieving a clear understanding of the processes which result in the formation of stars and which control star formation on a galactic scale in starburst galaxies. SAFIRE will determine the energy balance and physical conditions in many important phases of the interstellar and circumstellar environment in our own galaxy, and will measure the large scale physical conditions in other galaxies. SAFIRE will examine active galactic nuclei, cooling flows in galaxy clusters, and star formation in the most distant galaxies in the Universe.

SAFIRE will study objects through the use of many diagnostic lines:

[CII] 158μm lines - one of the brightest lines - traces PDRs, atomic clouds,warm neutral medium
[OI] 145μm - probes physical conditions inWNM
[NII] 122μm and 205μm lines - trace the WIM
High-*J* CO lines - trace shocked gas around PDRs
OH lines - trace shocks in cool, dense regions
[CI] 370 & 609μm lines - dense gas in clouds
Molecular lines - constrain cloud chemistry



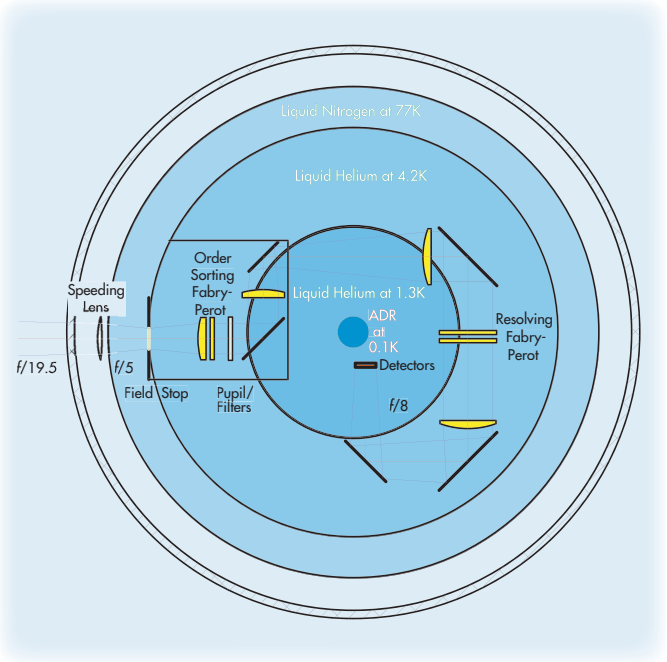
SAFIRE's large field of view enables it to take snapshot pictures of line emission. Shown here is the footprint of SAFIRE's array superimposed on a map of thermal emission from the center of our Galaxy. In a single frame, the bright circumnuclear disk (inset to lower left) can be imaged.

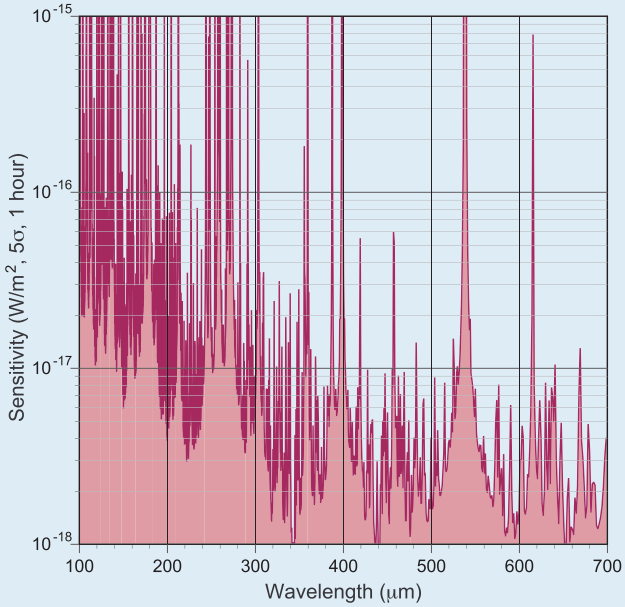


SAFIRE's sensitivity is enabled by a combination of SOFIA's 2.5m aperture, the low atmospheric opacity, and advanced ultrasensitive superconducting detector arrays built at NASA/GSFC. Nearby galaxies such as the starburst galaxy M83 (above) are well-matched to SAFIRE's field of view and spatial resolution. The sensitivity of SAFIRE to the [CII] emission from M83 will permit a map 3 times more sensitive and at 3.5 times the angular resolution of the previous (KAO) maps to be made in one hour.

SAFIRE Specifications:

Wavelength Range:	100μm-655μm; covers major cooling lines such as C[II] at 158μm
Detector Format:	16x32 array of superconducting transition edge sensor bolometers (8x32 minimum); SQUID multiplexed amplifiers for readouts Detector NEP ~10^{-17} W/$\sqrt{Hz}$; time constant τ~5ms.
Spectral Resolution	Variable; R~2,000 (150km/s) standard, up to R~10,000 possible
Angular Resolution	Diffraction-limited at λ>200μm; ≈22″ at 200μm; ≈14″ at 100μm
Field of View	Fixed at 160″x320″; orientation fixed in Alt-Az coordinates
Imaging readout rate:	Readout of entire array at ~10kHz





The optical system has three principal elements:an R~2,000 Fabry-Perot (high-resolution); an R~100 Fabry-Perot (order sorting); and an R~10 filter wheel (resonant metal mesh bandpasses). By selecting narrowband filters, higher spectral resolution is possible for chosen emission lines, although with a reduced field of view.

SOFIA's high altitude permits most of the infrared light, normally blocked by water vapor in the Earth's atmosphere, to reach the sensitive SAFIRE detectors. A nearby starburst galaxy has far-infrared line fluxes of ~10^{-12} W/m^2; hyperluminous galaxies at cosmological distances are predicted to have fluxes of ~10^{-17} W/m^2.

SAFIRE, built by NASA's Goddard Space Flight Center, is a PI instrument for the SOFIA observatory.

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For more information, visit http://pioneer.gsfc.nasa.gov/public/safire or http://www.sofia.usra.edu/Science/instruments/instruments_safire.html

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