

Using SIRTf to Study Extragalactic Star Formation

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SIRTf, the Space Infrared Telescope Facility, is a NASA mission to provide a long lifetime, sensitive and flexible infrared observatory in space. SIRTf will be able to study selected objects with a sensitivity over 5,000 times better than the IRAS survey limits, and will provide photometric and low to medium resolution spectroscopic data over almost nine octaves from 1.8 to 700 μm wavelength.

The baseline SIRTf design has an 85 cm telescope with optics and control system designed for diffraction limited operation at 4 μm and longer wavelengths. For wavelengths shorter than 4 μm , the beam size should equal the 4 μm diffraction limit, so 1" (FWHM) imaging will be possible at 2.5 μm . SIRTf will use a 28° inclination 900 km altitude orbit, and a superfluid helium dewar will cool the optics to 3 K and the baffles to about 10 K, allowing natural background limited operations at 5-135 μm at all times, and at 200 μm for 25 percent of the time.

SIRTf will be able to measure important cooling lines from neutral regions, such as the 157 μm [C II] line, and lines from H II regions such as the 88 μm [O III] line. The SIRTf spectrometer will be able to measure the [C II] line in 100 seconds from spiral galaxies 50 times fainter than the IRAS survey limit.

SIRTf will be able to survey small areas of the sky to the confusion limit in the 3-700 μm region. At 60 μm such a survey can reach a density of 10,000 sources per square degree by using a small degree of super-resolution. This count limit should be reached at a flux of 50-100 μJy , while the super starburst galaxy Arp 220 at a redshift $z = 1.4$ in a critical density Universe would have an easily detectable flux of $\sim 300 \mu\text{Jy}$. At 4 μm a SIRTf survey will reach 500,000 sources per square degree at a flux of 0.7 μJy , while Arp 220 at $z = 1.4$ would have a flux $> 14 \mu\text{Jy}$. Because the redshift is moving the peak of the starlight into the 4 μm passband, most sources in this survey will be high redshift, nearly normal galaxies. Spectral synthesis studies by Chokshi (1986) have shown that for $z < 1$ the [2]-[4] μm color of normal galaxies depends mainly on z , but for $z > 1$ the color depends on the star formation history of the galaxy. The 60 μm survey, on the other hand, will be an efficient way to pick out galaxies with very active star formation, because the peak wavelength of the far infrared emission from normal galaxies is longer than 60 μm , and is made even longer by the redshift, while starburst galaxies such as M82 and Arp 220 have substantial emission at shorter rest wavelengths.

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REFERENCES

Chokshi, A. 1986, Ph.D. Thesis, UCLA.