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MIPS 70μm Observations of the Spitzer Extragalactic First Look Survey

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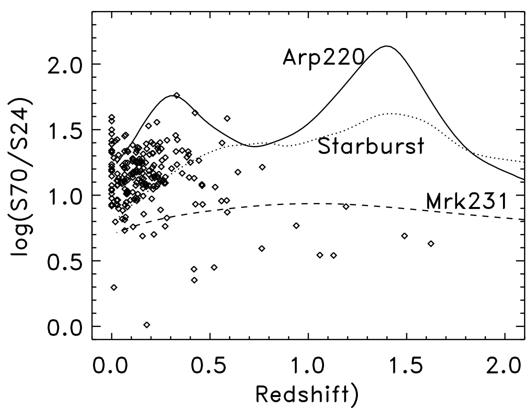
Abstract.
Early results from the 70μm observations of the Spitzer Extragalactic First Look Survey are presented. As a whole, about 90% of the population show infrared colors that are consistent with the spectral energy distributions of the local IRAS population of luminous infrared starbursts, while approximately 10% of the sample show warm infrared colors consistent with AGN activity. The mean redshift for the population is $z = 0.2$, and the mean total infrared luminosity is about $L(\mathrm{ir}) = 2 \times 10^{11} L_{\odot}$.

1. Observations and Data Reduction

One of the first science observations carried out with the Spitzer Space Telescope was the extragalactic First Look Survey (FLS) which was designed to characterize the infrared sky at previously unexplored sensitivities. The extragalactic FLS covers a 4.4 sq-degree region near the ecliptic pole (RA[J2000]=17:18, Dec[J2000]=+59:30), within the northern continuous viewing zone of Spitzer. Inside the FLS main survey a smaller verification strip of 0.25 sq-degree was observed with an integration time of 4 times that of the main survey to characterize the completeness and source reliability of the main survey. In total, 27.7 hours of observations were taken in 2003 December with the Multiband Imaging Photometer for Spitzer (MIPS, Rieke et al. 2004).

The basic calibrated data products (BCDs) used were downloaded from the SSC data archive, software version S10. The general steps for processing MIPS data are described in Gordon et al. (2005). The two main artifacts impacting the FLS-70μm data are the stim flash latents and the variations of the slow response as a function of time. The combination of a high-pass time median filter and a column median filter removes the bulk of the data artifacts. To preserve photometric results, the data were filtered in two passes. In the first filtering pass, we applied the filtering corrections and coadded the data to determine the positions of sources. The source positions within the original BCDs were flagged and new filtering corrections were calculated in the second pass, ignoring the pixels containing sources. The two pass reduction minimized the data artifacts while preserving point-source calibration. The data were coadded and corrected for array distortions with the SSC MOPEX software. Source detection and photometry were done using the SSC APEX software package. The achieved 5σ point source sensitivities are 20 mJy for the main survey (42 s of integration) and about 10 mJy for the verification strip (210 s of integration).

2. Results and Conclusions



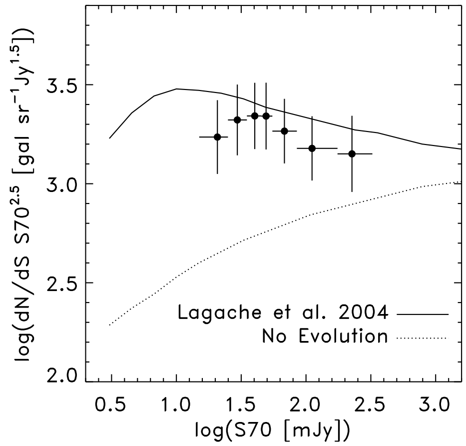


Figure 1 (left) shows the observed infrared colors (flux ratios) for the 70μm-selected FLS sources with known redshifts compared to the predicted colors as a function of redshift. The local ULIRGs Arp220 (starburst) and Mrk231 (AGN+starburst) are shown by the solid and dashed lines, respectively. A starburst model from Dale & Helou (2002) is represented by the dotted line. Only sources with one-to-one band-merged matches are shown to avoid potential issues with false matches. The S70/S24 flux density ratios can be used to help distinguish between infrared-warm AGN and infrared-cool starbursts (S70/S24$\gtrsim$ 10). The majority of galaxies detected at these depths are $z < 1$ starbursts. Sources below the dashed line of Mrk 231 are likely AGN.

Figure 2 (right) shows the FLS 70μm differential number counts (Frayer et al. 2005, in preparation) compared to the models of Lagache et al. (2004). The FLS 70μm counts are consistent with the counts measured in other fields from Dole et al. (2004).

About 90% of the sources with redshifts have infrared-cool starburst colors, while about 10% have warm colors consistent with AGN activity. For the 70μm selected-sources with known redshifts, the mean redshift for the population is $z \simeq 0.2$. The average S70/S24 ratio is consistent with the ratio expected based on S60/S25 colors observed for the IRAS population if redshifted to $z = 0.2$. Using the models of Dale & Helou (2002), we estimate a mean total infrared luminosity of $L(\mathrm{ir}) \simeq 2 \times 10^{11} L_\odot$ for these sources. Much deeper 70μm observations are needed to constrain the evolutionary models at high-redshift and to estimate the relative contribution of LIRGs and high-redshift ULIRGs to the total cosmic infrared background.

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References

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