The Submillimetre Spectral Energy Distributions of Herschel/SPIRE-Detected Galaxies


We present colours of sources detected with the Herschel/SPIRE instrument in deep extragalactic surveys of the Lockman Hole, Spitzer-FLS, and GOODS-N fields in three photometric bands at 250, 350, and 500 μm. We compare these with expectations from the literature and discuss associated uncertainties and biases in the SPIRE data. We identify a 500 μm flux limited sample of sources from the Herschel–SPIRE point source catalogue that appears free from neighbouring/blended sources in all three SPIRE bands. We compare the colours with redshift data of various contemporary models. Based on these spectral templates we show that regions corresponding to specific population types and redshifts can be identified better in colour-flux space. The redshift tracks as well as the colour-flux plots imply a major density of objects with redshifts at 1–3.5, somewhat depending on the group of model SEEDs used. We also note that a population of 520/530 < 0.8 at fluxes above 50 mJy as observed by SPIRE is not well represented by contemporary models and could consist of a mix of cold and lensed galaxies.

Input Data and Processing

The redshifts of the background galaxies were calculated by fitting a complete bolometric census of star formation in the Universe. It consists of 6 tiers of survey fields with increasing depth over smaller areas, covering most of the sky observed in the extragalactic plane by the Herschel Space Observatory plus individual selected clusters. A total of 416 Herschel fields were surveyed during Herschel’s Science Demonstration Phase (SDP) and we have used the deep observations in GOODS-N, Lockman-North, Spitzer-FLS, and Lockman-SWIRE catalogues. These fields are 250, 350, and 500 μm deep surveys with relative depths of 0.5, 0.23, 0.03. These were calculated as the fraction of the number of repest scans and scan speed, normalised to the deepest field GOODS-N. More details of the observations are given by Oliver et al. (2010).

Data processing was based on the standard SPIRE Scan Map pipeline (Griffiths et al. 2010) applied in the three SPIRE bands, and source catalogues for each individual band were generated using the SUSSEXtractor software (Savage & Oliver 2007) within HIPE 3.0 (2009). The three shallow maps were smoothed with a point-source smoothed slice while the deepest field map was filtered with a detection and exclusion of spurious sources, mostly due to high energy particle hits.

Catalogue Selection

A total of 7500 candidate sources were detected in the three SPIRE bands. For this work we have constructed a 500 μm band flux limited sample. It is justified in three ways. The stongest redshift indication in the wavebands higher than redshift galaxies (the redshfit range spanned by the much shallower B LASS surveys). The second 500 μm flux limit is chosen as more than 2 strong-band flux detections indicate a source at z = 1–2.

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Colour Diagrams

In Figure 5 we present the degeneracy in the SPIRE colours (Figure 2), we plot colour-flux distributions. In Figure 6 we show the 250/350/500 μm bands. The sources in GOODS-N appear in red, GOODS-N-SWIRE respectively. The selection leaves 48, 61, 608, and 824 sources at 500 μm parameter space. The same even thinner surface is seen in similar plots of mock catalogues. The observed data are compared to mock catalogues of 1 deg 2 on the sky by Pearson et al. (2007) (left) and Xu et al. (2001) (right) that were cut below three times the mock noise limit at 500 μm. The mock noise catalogue is a 10% of the spread of the data in Xu et al. (2001) (right) and the noise catalogue given by the symbols in the Pearson et al. (2007) SED catalogue. The high-redshift sources are lensed ones. Inclusion of other wavelengths as shown by Rowan-Robinson et al. (2010) will be needed for further interpretation.

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References

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