Bivariate UV/TIR luminosity function at z~1.5

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Motivations

The evolution of the Cosmic Star Formation Rate is one the main observables to constrain galaxy formation. The ultraviolet range of the spectrum is a widely used proxy for star formation estimation. This range is however particularly sensitive to the extinction by interstellar dust. **It is hence important to characterize the selection effects due to the use of a UV selection, and the impact on the estimation of the SFR**. An approach to this problem is to study the FIR properties of a UV selected sample.
Here we combine a UV selected sample at z~1.5 with infrared data from HerMES/Herschel observations.

Data sample

We use the CFHT u imaging of the COSMOS field from Capak et al. (2008). We build an UV selected sample from galaxies with 18<u<25 and $1.2<z_{phot}<1.7$, using photometric redshifts from Ilbert et al. (2009). This yields ~15 000 galaxies within the HerMES footprint of the COSMOS field. Direct cross-identification of this UV selected catalog with the HerMES 250 microns blind catalog yields a very low detection rate of 4%. Stacking is hence required for a statistical analysis.

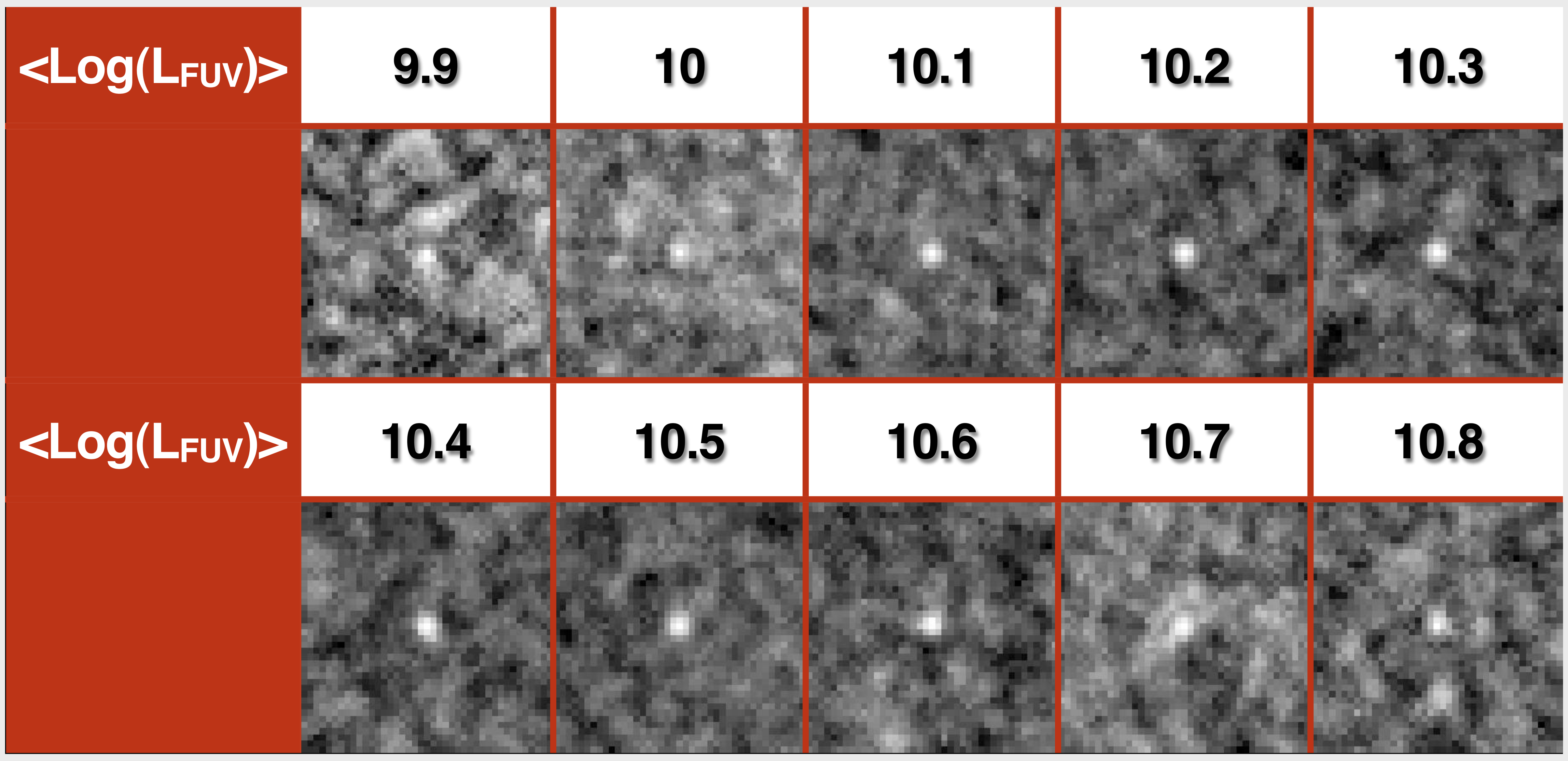
Stacking analysis

We stack UV selected galaxies at 250 and 350 microns as a function of UV luminosity using the IAS library (Bavouzet 2008; Béthermin et al. 2010). We correct the stacking for the incompleteness of the input catalog and clustering of input sources.

Incompleteness of input catalog

We quantify the impact of the incompleteness of the input catalog on the stacking measurements, by adding point sources in the U band image. We measure the stacking at 250 and 350 microns of sources recovered after source extraction as a function of U apparent magnitude. The results show that faint objects are not well recovered if they are close to bright ones, hence the actual background is lower at the center of the stacks for these objects. The radial profiles of these stacks are subtracted from the profiles of the real stacks to correct for the incompleteness.

250 micron stacked images as a function of UV luminosity



Clustering of input sources

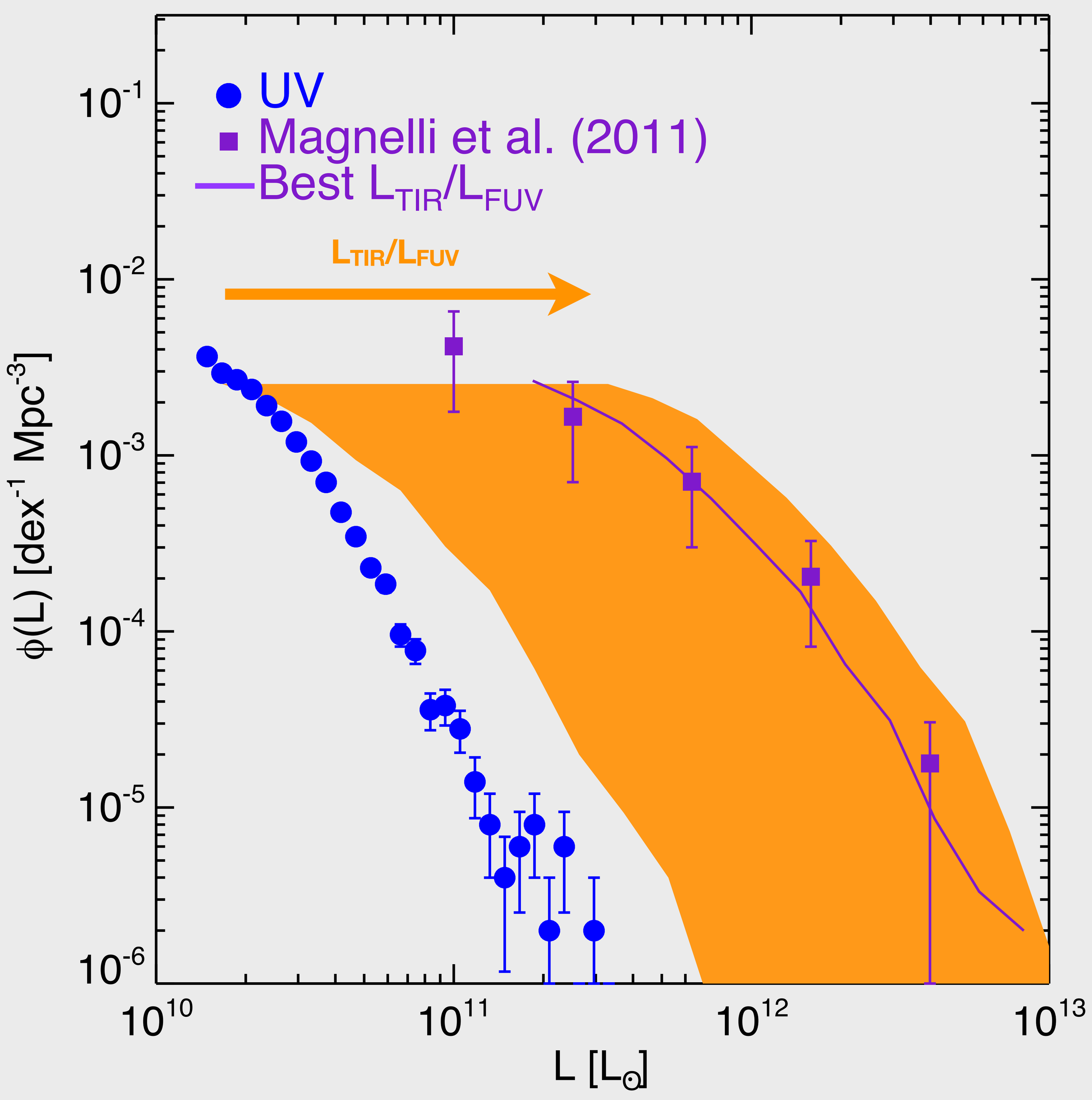
In the case of randomly distributed sources, they contribute to an homogeneous background. However, as galaxies are not distributed randomly, the actual background is not homogeneous. It can be described by including the angular correlation function of the input sources in the measure of the stacked fluxes (Béthermin et al. 2010). We fit the radial profile of a given stack by assuming that it is the sum of a PSF term and a clustering term, the latter including the angular correlation function of the input sources.

Discussion

We attempt here to put some constraints on the level of dust extinction correction needed to be applied to UV selected galaxies in order to recover the TIR luminosity function.

Total infrared to ultraviolet luminosity ratio

The total infrared to ultraviolet luminosity ratio is a proxy for dust extinction within galaxies. We assume that $1.<L_{TIR}/L_{FUV}<20.$, which covers the range of measured values at z<1.3 (Buat et al. 2009). We also assume that L_{TIR}/L_{FUV} is independent of UV luminosity and that the distribution of the ratio around the mean is gaussian with a standard deviation $\sigma(\log(L_{TIR}/L_{FUV})) = 0.35$.



Recovering the TIR Luminosity Function

Using these assumptions, we assign a TIR luminosity to each galaxy. We compute then the TIR luminosity function of the UV selected sample for several values of L_{TIR}/L_{FUV}. We compare these results to the TIR luminosity function of Magnelli et al. (2011) measured in the same redshift range. Our results suggest that high values of L_{TIR}/L_{FUV} are needed in order to recover the TIR luminosity function. We find that an average $L_{TIR}/L_{FUV} = 11.8\pm3.$ yields a good match to the result of Magnelli et al. We note that this value is higher than the average values measured at z<1.3 for UV-selected galaxies (Buat et al. 2009) and also than those derived at z~2 for Lyman Break Galaxies (Reddy et al. 2010). The stacking analysis underway using Herschel data will enable us to measure directly for the first time the average L_{TIR}/L_{FUV} at z~1.5. We will hence be able to discuss the amount of Star Formation Rate Density a UV selected sample is able to recover after dust extinction correction.

References
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