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Unearthing the Hidden: Number Counts of Dusty Galaxies below Noise

The cosmic infrared background (CIB) originated from reprocessed dust emission after dust in galaxies absorbs the UV light from young massive stars and accreting supermassive blackholes. Resolving the diffuse CIB into individual galaxies provides insights into the cosmic star-forming activities that are obscured at the optical wavelength. Previous studies have constructed number counts of bright sources detected at 450 μm, but these galaxies account for only around 40% of the total CIB at this wavelength. To advance this study, we aim to estimate the CIB contribution from faint 450 μm sources undetected in deep 450 μm images.
We utilized data from the JCMT STUDIES (SCUBA-2 Ultra Deep Imaging EAO Survey) program in the COSMOS field, the deepest ever 450 μm imaging, along with galaxy catalogs at 4.5 μm from Spitzer and JWST to probe faint sources. We used a stacking analysis approach to measure the average 450 μm flux from more than 10000 faint 4.5 μm galaxies and carried out the simulation of sources at random positions to subtract the mean background. We also accomplished simultaneous stacking and deblending to account for biases caused by source clustering at scales similar to the instrumental beam size. After the mean background subtraction, we obtained an average flux of 0.27±0.02 mJy for the 4.5 μm galaxies, closely matching the prediction based on the extrapolation of the number counts of brighter sources. By adding the integrated surface brightness of these faint galaxies to the contribution from brighter sources, we obtain a total surface brightness of 112.4 $\mathrm{Jy/deg^2}$, recovering approximately 84% of the CIB measured by COBE and Planck. Preliminary results from deblended stacking suggest that this method can effectively correct for flux overestimation caused by instrumental confusion and source clustering, so we expect to further refine our measurement on the faint source contribution to CIB.

Section

Galaxy/Extragalactic

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