Beyond the Confusion: Enhancing our View at High Redshift with the Herschel Lensing Survey

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Abstract

For the reddest Herschel bands, the fundamental sensitivity limit was set by source confusion. As a result, even the deepest Herschel surveys can only detect the most intensely star-forming galaxies beyond $z \sim 2$, with 'normal' star formation at this epoch left unexplored. We present multi-wavelength results based on the "Herschel Lensing Survey" (HLS). Efficiently exploiting the gravitational lensing effect of massive foreground clusters, HLS removes the veil of confusion and allows us to probe a large sample of intrinsically faint galaxies at $z > 2$. The survey covers many famous clusters, including all those in CLASH and the Hubble Frontier Fields (HFF), ensuring abundant ancillary imaging from UV–to–mm (e.g. GALEX, HST, Subaru, Spitzer, Scuba–2). Thus we can link Herschel-detected dusty star formation to stellar and gas characteristics, yielding a complete picture of galaxies prior to the peak epoch of star formation.

Here, we discuss recent highlights from HLS. A new sample of well-constrained, strongly-lensed galaxies allows us to examine the star-forming main sequence for low luminosity galaxies (e.g. LIRGs) at $z = 2 - 4$. We compare and contrast their dust characteristics with the deep-field detected HyLIRGs. For a subsample with IRAM PdBI CO line measurements we explore the gas component, finding an increasing molecular gas fraction with decreasing stellar mass (at low star formation rates), as well as evidence for a non-universal dust–to–gas ratio. We also investigate several outstanding sources at very high redshift, including a merging system at $z = 5.2$ with spatially distinct (sub-kpc scale) velocity components observed by SMA and JVLA, and a galaxy at $z = 4.7$ which is quintuply lensed at $>130\times$ magnification. Such examples enable a view of the early Universe in a level of detail only recent achievable for local galaxies.