The Nature of [CII] emission in Lensed Dusty Star-forming Galaxies from the SPT survey

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Abstract

ALMA spectroscopy (cycle 0 and 1) of point sources from the South Pole Telescope survey has uncovered a population of high-redshift ($z = 2 - 5.7$), strongly lensed dusty star-forming galaxies (DSFGs). This has resulted in an unbiased redshift distribution for DSFGs peaking for $z \sim 3.5$, i.e. higher than previously believed of $z \sim 2.5$, and doubled the number of sources at $z > 4$. In this talk I will present the latest result from our fine-structure line survey of 20 DSFGs. Comparing [CII] velocity profiles (APEX and *Herschel)* with CO velocity profiles from ALMA reveals consistent velocity profiles, suggesting little differential lensing between these species. Combining the [CII] detections with low-J CO detections (ATCA), we find [CII]/CO(1–0) luminosity ratios of 5200 ± 1800, and argue that this line ratio is best described by [CII] and CO emitting gas with higher [CII] than CO excitation temperature, high CO optical depth $\tau_{\rm CO(1–0)} \gg 1$, and low to moderate [CII] optical depth $\tau_{\rm [CII]} \lesssim 1$. The geometric structure of photodissociation regions (PDRs) allows for such conditions.