

X15a ALMA Demographics of [CII]158um and Dust Emission in Star-Forming Galaxies at $z \sim 5 - 9$

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We present statistics of [CII]158um-line and dust-continuum emission for star-forming galaxies at $z \sim 5 - 9$. Our samples for the [CII] and dust-continuum emission analysis are composed of 25 and 81 galaxies, respectively, which are made by the combination of our ALMA Band6/7 observations and the archival data. We obtain the $L_{\text{[CII]}} - \text{SFR}$ relation that includes the stacking of no detection data, and find that the stack of $z \sim 5-7$ Lyman alpha emitters places a stringent upper limit in $L_{\text{[CII]}}$ suggesting a very low metallicity ($Z = 0.05Z_{\odot}$). We evaluate the infrared-to-UV luminosity ratio, $\text{IRX} (\equiv L_{\text{IR}}/L_{\text{UV}})$, as a function of UV-continuum slope beta. The IRX-beta plot indicates that the average IRX of $z \sim 5 - 9$ galaxies is smaller than the IRX-beta relation predicted by the SMC extinction law. These results suggest that ALMA [CII] and dust-continuum emission in $z \sim 5 - 9$ galaxies are systematically weaker than star-forming galaxies at low redshifts. We compare these ALMA emission properties with theoretical models, and discuss the physical origins of the weak ALMA emission.