X28a [C II] Halo in the early Universe

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Recent ALMA studies find the existence of ∼10–15 kpc scale [C II] 158um line halo surrounding early galaxies in deep stacking measurements. Individual experiments are further required to understand the physical mechanisms of the [C II] halo. Here we present the physical extent of [C II] line-emitting gas from 46 star-forming galaxies at z=4–6 from the ALMA Large Program to INvestigate CII at Early Times (ALPINE). Using exponential profile fits, we measure the effective radius of the [C II] line ($r_{\rm e,[CII]}$) for individual galaxies and compare them with the rest-frame ultraviolet (UV) continuum ($r_{\rm e,UV}$) from *Hubble Space Telescope* images. The effective radius $r_{\rm e,[CII]}$ exceeds $r_{\rm e,UV}$ by factors of ∼2–3. We identify ∼30% of isolated ALPINE sources as having the $>$ 10-kpc scale [C II] halo detected at 4.1–10.9σ beyond the size of rest-frame UV and FIR continuum. One object has tentative rotating features up to ∼10 kpc, where the 3D model fit shows the rotating [C II]-gas disk spread over 4 times larger than the rest-frame UV-emitting region. Galaxies with the extended [C II] line structure have high star formation rate, high stellar mass ($M_{\rm star}$), low Lyα equivalent width, and more blueshifted (redshifted) rest-frame UV metal absorption (Lyα line), as compared to galaxies without such extended [C II] structures. Including the latest theoretical predictions, we will discuss possible physical origins of the [C II] halo.