X06a ALMA uncovers the [CII] emission and warm dust continuum in a z = 8.31 LBG

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Forming a complete picture of star-formation through cosmic time is one of the main challenges of galaxy evolution studies. Our current understanding of star-formation at high redshifts ($z > 7$) is mostly formed through rest-frame ultraviolet (UV) observations of Lyman-Break Galaxies (LBGs), which directly probe their stellar light and ionized hydrogen. Complementary to this, the Atacama Large Millimeter/submillimeter Array (ALMA) has detected UV-selected high-redshift galaxies in sub-mm colours, tracing dust-obscured regions and far-infrared spectral lines (e.g. [OIII] at 88 μm) out to redshifts around 8 to 9. One such galaxy is the Y-dropout galaxy, MACS0416_Y1, where a previous ALMA detection of [OIII] (and dust continuum) confirmed its spectroscopic redshift to be $z = 8.312$. Modeling of its UV-to-FIR spectrum suggests both a young (age ~ 4 Myr) and old stellar component ($z \sim 14$) in a moderately high metallicity ($Z \sim 0.2\ Z_{\odot}$) LBG.

We present the highest-redshift detection of the [CII] 158 μm line in MACS0416_Y1 using ALMA. Its high [OIII]-to-[CII] luminosity ratio ($\sim$9) implies a strong inter-stellar radiation field, and the [CII] velocity profile suggests a rotation-dominated system. Surprisingly, we fail to detect the dust continuum emission at 160 μm rest-frame, suggesting an extremely high dust temperature ($T_{\rm dust} > 80$K), which could imply that recent ALMA studies might have significantly over-estimated dust-masses in the Early Universe.