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ALMA Observation of 158 μm [CII] Line and Dust Continuum of a $z \simeq 7$ Normally Star-forming Galaxy in the Epoch of Reionization

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High redshift star-forming galaxies in the epoch of cosmic reionization (EoR) have been usually detected via either their Lyα emission or UV continua. However, UV lights from such galaxies trace only the lights from ionized gas or stars, and we have seen merely a portion of star formation activities in galaxies. Another aspect yet unexplored is dust-obscured star formation in EoR galaxies, and rest frame far-infrared (FIR) molecular/atomic lines and continuum can probe it because they reflect fuel for star formation and UV light from stars once absorbed and re-emitted by dust, respectively. FIR lights from galaxies in EoR are redshifted to mm wavelengths and observable from the ground with ALMA. Among many FIR lines, 158 μm [CII] is the strongest cooling line of an interstellar medium and suited for probing faint distant galaxies such as ones in EoR. Here we report the first ALMA observation of [CII] line and underlying FIR (redshifted $\sim$ 1.3 mm) continuum of a normally star-forming galaxy in EoR, a $z = 6.96$ Lyα emitter, IOK-1. Probing unprecedentedly deep limits of $\sigma_{[\mathrm{CII}]} = 89$ μJy beam^{-1} (over a channel width of 200 km s^{-1}) and $\sigma_{\mathrm{FIR}} = 18$ μJy beam^{-1}, we found it undetected in both [CII] and FIR continuum. We will present the constraints on FIR spectral energy distribution of IOK-1, its dust mass, total IR luminosity, dust-obscured star formation rate and [CII] luminosity and discuss their implications for early galaxy formation in the context of gas and dust.