X32a ALMA Lensing Cluster Survey: Deep 1.2 mm Number Counts and Infrared Luminosity Function at $z \simeq 1-8$

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We present a large statistics of 180 dust continuum sources blindly identified in ALMA Lensing Cluster Survey (ALCS). ALCS is a homogeneous 1.2-mm survey over a total of 133 arcmin^2 area from 33 lensing cluster fields, which enables us to identify rare objects including a faint dust emission from strongly ($\mu = 160$) and multiply lensed galaxy at $z = 6.07$. We derive 1.2-mm number counts down to $\simeq 7$ μJy with the assistance of gravitational lensing, and find that the total integrated 1.2mm flux of the securely identified sources is $21.2^{+0.7}_{-1.5}$ Jy deg^{-2} which corresponds to $\sim$80% of the cosmic infrared background light. However, we also find that the resolved fraction of the CIB can be changed by factors of $\sim \pm 2$, because the faint-end slope of the number counts depends on the intrinsic size distribution of the dust emission. In conjunction with recent identifications of serendipitous mm sources even at $z > 7$ in the literature, we also derive infrared (IR) luminosity functions (LFs) at $z = 0.6$–7.5 with the direct ($1/V_{\rm max}$) method. We confirm recent reports of the redshift evolution of IR LFs characterized by the positive luminosity evolution coupled with negative density evolution. The total (=UV+IR) cosmic star-formation rate density (SFRD) at $z > 4$ is estimated to be 180^{+50}_{-80}% of the previous results obtained with the optical-NIR galaxies, suggesting that our general understanding of the cosmic SFRD is unchanged by more than $\sim$2x even with the faint mm sources.