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ALMA Millimeter Sizes of $z \sim 1-4$ Bright Submillimeter Galaxies

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Early ALMA imaging of submillimeter galaxies (SMGs) with sub-arcsecond resolutions discovered $\gtrsim 2$ compact (sub)millimeter (submm) sizes of SMGs than we believed before ALMA. Two of new questions are whether submm sizes of SMGs evolve along redshift or not, and what makes different submm sizes of SMGs.

In ALMA cycle-2, we obtained ALMA 1100- μm continuum maps with $0''.2-0''.3$ resolution of 143 bright AzTEC SMGs in the Subaru/XMM-Newton Deep Field. We studied submm sizes of SMGs using subsamples of 45 $\geq 10\sigma$ ALMA sources. The obtained submm sizes of 9 SMGs at $z_{\text{photo}} = 2-3$ and 9 ones at $z_{\text{photo}} = 3-4$ are $0.25^{+0.06}_{-0.02}$ and $0.28^{+0.04}_{-0.02}$ arcsec (FWHM; median), corresponding to circularized half light radii of $1.03^{+0.19}_{-0.08}$ and $1.05^{+0.11}_{-0.05}$ kpc, respectively, indicating no size evolution at $z \sim 2-4$.

We also studied a relation between ALMA submm sizes and *Spitzer* IRAC and MIPS AGN colors using 10 ALMA SMGs with $\geq 10\sigma$ detections at $z_{\text{photo}} = 1-3$. Two of the 10 SMGs are categorized as pure AGNs, four as pure star forming and the remaining four as composite. We evaluate extendness of submm emission using an ALMA flux ratio of $F_{\geq 200\text{k}\lambda}/F_{\text{total}}$; here $F_{\geq 200\text{k}\lambda}$ corresponds to a flux from a central ~ 3 kpc region. Only three of them have $F_{\geq 200\text{k}\lambda}/F_{\text{total}} < 0.7$ and all SMGs with *Spitzer* colors of pure AGN have $F_{\geq 200\text{k}\lambda}/F_{\text{total}} < 0.7$. These results imply that extended submm sizes of SMGs at $z \sim 2$ are associated with AGNs.