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Central Structure of the Brightest Unlensed Submillimeter Galaxies

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The central structure in three of the brightest unlensed submillimeter galaxies at $z = 3 - 4$ are investigated through $0.02''$ (~ 160 pc) 860 micron continuum images obtained using ALMA. The distribution of dust in the central kpc in two of the sources are extremely complex, and they are composed of multiple clumps with size scale of $\sim 200 - 300$ pc. One source consists of two components that are separated by ~ 1.5 kpc, indicating a mid-stage merger. The high average SFR densities in the central kpc suggests that the central region of these SMGs are forming stars near the Eddington Limit. We further find that $80 - 90\%$ of the emission is extended beyond the central kpc, and we identify at least five additional ~ 200 pc clumps in the extended 3-4 kpc region. These compact massive star forming clumps could migrate inward to merge with the central galaxy which can be the ancestor of the compact quiescent galaxies found at $z \sim 2$, or evolve into the central galaxy in a proto-cluster if there is sufficient overdensity of galaxies. Overall, the data presented here suggest that the sizes and surface densities of the central kpc of the brightest SMGs are comparable to the central region of the brightest ULIRGs in the local universe, but the large amount of > 1 kpc scale extended and clumpy star formation as well as the available gas are what make them different from the local counterparts.