# X17a ALMA twenty-Six Arcmin$^2$ survey of GOODS-S At One-millimeter (ASAGAO): X-ray AGN Properties of Millimeter-Selected Galaxies

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We investigate the X-ray active galactic nucleus (AGN) properties of millimeter galaxies in the GOODS-S field detected with ALMA, by utilizing the Chandra 7-Ms data, the deepest X-ray survey to date. Our millimeter galaxy sample comes from the ASAGAO survey (12 sources at a 1.2-mm flux-density limit of $\approx$0.6 mJy), supplemented by the deeper but narrower 1.3-mm survey of a part of the ASAGAO field by Dunlop et al. (2017). Fourteen out of the total 25 millimeter galaxies have Chandra counterparts. The observed AGN fractions at $z = 1.5 - 3$ is found to be $90^{+8}_{-19}$% and $57^{+23}_{-25}$% for the ultra/luminous infrared galaxies with log $L_{\rm IR}/L_\odot$ = 12–12.8 and log log $L_{\rm IR}/L_\odot$ = 11.5–12, respectively. The majority ($\sim$2/3) of the ALMA-Chandra objects appear to be star-formation dominant populations, having $L_{\rm X}/\ L_{\rm IR}$ ratios smaller than the "simultaneous evolution" value expected from the local black-hole mass to stellar mass ($M_{\rm BH}$-$M_*$) relation. On the basis of the $L_{\rm X}$ and stellar mass relation, we infer that a large fraction of star-forming galaxies at $z = 1.5-3$ have black hole masses smaller than those expected from the local $M_{\rm BH}$-$M_*$ relation. Our results are consistent with an evolutionary scenario that star formation occurs first, and an AGN-dominant phase follows later, in objects finally evolving into galaxies with classical bulges.