

X34a ALMA Deep Field in SSA22: The survey description and source catalogue

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We present the results of a $2' \times 3'$ deep survey at 1.1 mm taken with the Atacama Large Millimeter/submillimeter Array (ALMA) in the SSA22 field (ALMA deep field in SSA22 or ADF22). Using a mosaic of 103 ALMA pointings, we observed 7 arcmin² area at the center of a $z = 3.09$ proto-cluster, achieving an typical rms sensitivity of $60 \mu\text{Jy beam}^{-1}$ at a resolution of 0.7 arcsec and $75 \mu\text{Jy beam}^{-1}$ at a 1.0 arcsec resolution, respectively. We obtained 18 robustly detected ALMA sources with a signal-to-noise ratio (SNR) > 5 . At least 10 ALMA sources have spectroscopic redshifts, $z = 3.09$. Not only are these galaxies members of the protocluster but they in fact reside within the node at the junction of the 50 Mpc-scale filamentary three-dimensional structure traced by Lyman- α emitters (LAEs) in this field. We find that six of the 10 ALMA sources host a X-ray luminous active galactic nuclei (AGN). Our results suggest that the vigorous star formation activity and the growth of super massive black holes (SMBHs) occurred simultaneously in the densest regions at $z \sim 3$, which may correspond to the most active historical phase of the massive galaxy population found in the core of the clusters in the present universe.