

The ALMA Frontier Fields Survey: V. ALMA Stacking of Lyman-Break Galaxies in Abell 2744, Abell 370, Abell S1063, MACSJ0416.1-2403 and MACSJ1149.5+2223

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Abstract

Context. The Hubble Frontier Fields offer an exceptionally deep window into the high-redshift universe, covering a substantially larger area than the Hubble Ultra-Deep field at low magnification and probing 1-2 mag deeper in exceptional high-magnification regions. This unique parameter space, coupled with the exceptional multi-wavelength ancillary data, can facilitate for useful insights into distant galaxy populations. **Aims.** We aim to leverage Atacama Large Millimetre Array (ALMA) band 6 (≈ 263 GHz) mosaics in the central portions of five Frontier Fields to characterize the infrared (IR) properties of 1582 ultraviolet (UV)-selected Lyman-Break Galaxies (LBGs) at redshifts of $z \sim 2-8$. We investigated individual and stacked fluxes and IR excess (IRX) values of the LBG sample as functions of stellar mass (M_\star), redshift, UV luminosity and slope β , and lensing magnification. **Methods.** LBG samples were derived from color-selection and photometric redshift estimation with Hubble Space Telescope photometry. Spectral energy distributions -templates were fit to obtain luminosities, stellar masses, and star formation rates for the LBG candidates. We obtained individual IR flux and IRX estimates, as well as stacked averages, using both ALMA images and u-v visibilities. **Results.** Two (2) LBG candidates were individually detected above a significance of $4.1-\sigma$, while stacked samples of the remaining LBG candidates yielded no significant detections. We investigated our detections and upper limits in the context of the IRX- M_\star and IRX- β relations, probing at least one dex lower in stellar mass than past studies have done. Our upper limits exclude substantial portions of

parameter space and they are sufficiently deep in a handful of cases to create mild tension with the typically assumed attenuation and consensus relations. We observe a clear and smooth trend between M_{\star} and β , which extends to low masses and blue (low) β values, consistent with expectations from previous works.

Author keywords

Galaxies: clusters: general

Galaxies: high-redshift

Gravitational lensing: strong

Submillimetre: galaxies