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## Abstract

We describe the results of a new, wide-field survey for  $z=3.1$  Ly-alpha emission-line galaxies (LAEs) in the Extended Chandra Deep Field South (ECDF-S). By using a nearly top-hat 5010 Angstrom filter and complementary broadband photometry from the MUSYC survey, we identify a complete sample of 141 objects with monochromatic fluxes brighter than  $2.4E-17$  ergs/cm<sup>2</sup>/s and observers-frame equivalent widths greater than  $\sim 80$  Angstroms (i.e., 20 Angstroms in the rest-frame of Ly-alpha). The bright-end of this dataset is dominated by x-ray sources and foreground objects with GALEX detections, but when these interlopers are removed, we are still left with a sample of 130 LAE candidates, 39 of which have spectroscopic confirmations. This sample overlaps the set of objects found in an earlier ECDF-S survey, but due to our filter's redder bandpass, it also includes 68 previously uncataloged sources. We confirm earlier measurements of the  $z=3.1$  LAE emission-line luminosity function, and show that an apparent anti-correlation between equivalent width and continuum brightness is likely due to the effect of correlated errors in our heteroskedastic dataset. Finally, we compare the properties of  $z=3.1$  LAEs to LAEs found at  $z=2.1$ . We show that in the  $\sim 1$  Gyr after  $z\sim 3$ , the LAE luminosity function evolved significantly, with  $L^*$  fading by  $\sim 0.4$  mag, the number density of sources with  $L > 1.5E42$  ergs/s declining by  $\sim 50\%$ , and the equivalent width scale-length contracting from  $70^{+7}_{-5}$  Angstroms to  $50^{+9}_{-6}$  Angstroms. When combined with literature results, our observations demonstrate that over the redshift range  $z\sim 0$  to  $z\sim 4$ , LAEs contain less than  $\sim 10\%$  of the star-formation rate density of the universe.

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