X58a Lyα Intensity Mapping with SFGs at $z = 5.7$ and 6.6: Lyα Emission Extended at > 150 ckpc Beyond the Virial-Radius Scale of Galaxy DMHs

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We present results of the cross-correlation Lyα intensity mapping with Subaru/HSC ultra-deep narrowband images and LAEs at $z = 5.7$ and 6.6 in a total area of 4 deg^2. We conduct extensive analysis evaluating systematics of large-scale point spread function wings, sky subtractions, and unknown errors on the basis of physically uncorrelated signals and sources found in real HSC images and object catalogs, respectively. Removing the systematics, we carefully calculate cross-correlations between Lyα intensity of the narrowband images and the LAEs. We identify very diffuse Lyα emission with the 3σ (2σ) significance at > 150 ckpc far from the LAEs at $z = 5.7$ (6.6), beyond a virial radius of star-forming galaxies with $M_{\rm h} \sim 10^{11} M_\odot$. The diffuse Ly$\alpha$ emission possibly extends up to $1,000$ ckpc with the surface brightness of $10^{-20} - 10^{-19}$ erg s^{-1} cm^{-2} arcsec^{-2}. We confirm that the small-scale (< 150 ckpc) Lyα radial profiles of LAEs in our Lyα intensity maps are consistent with those obtained by recent MUSE observations. Comparisons with numerical simulations suggest that the large-scale ($\sim 150 - 1,000$ ckpc) Lyα emission are not explained by unresolved faint sources of neighboring galaxies including satellites, but by a combination of Lyα photons emitted from the central LAE and other unknown sources, such as a cold-gas stream and galactic outflow. We find no evolution in the Lyα radial profiles of our LAEs from $z = 5.7$ to 6.6, where theoretical models predict a flattening of the profile slope made by cosmic reionization, albeit with our moderately large observational errors.