Probing the Diffuse Lyα Emission on Cosmological Scales

Lyα Emission Intensity Mapping Using the Complete SDSS-IV eBOSS

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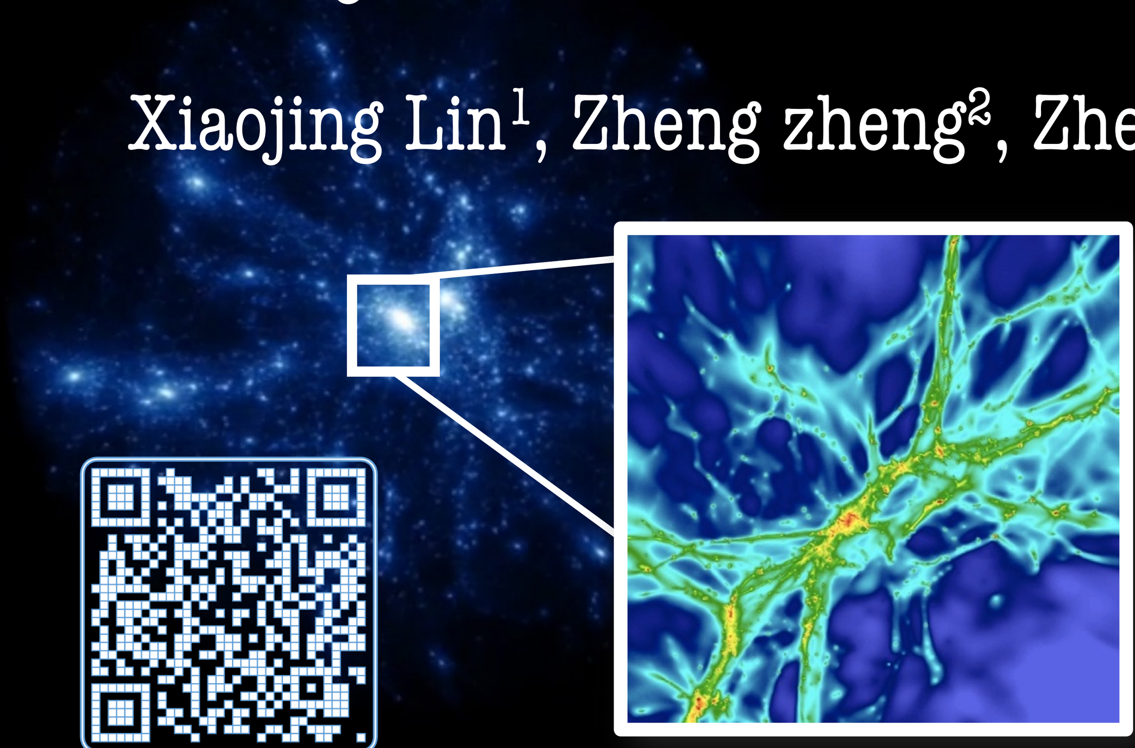
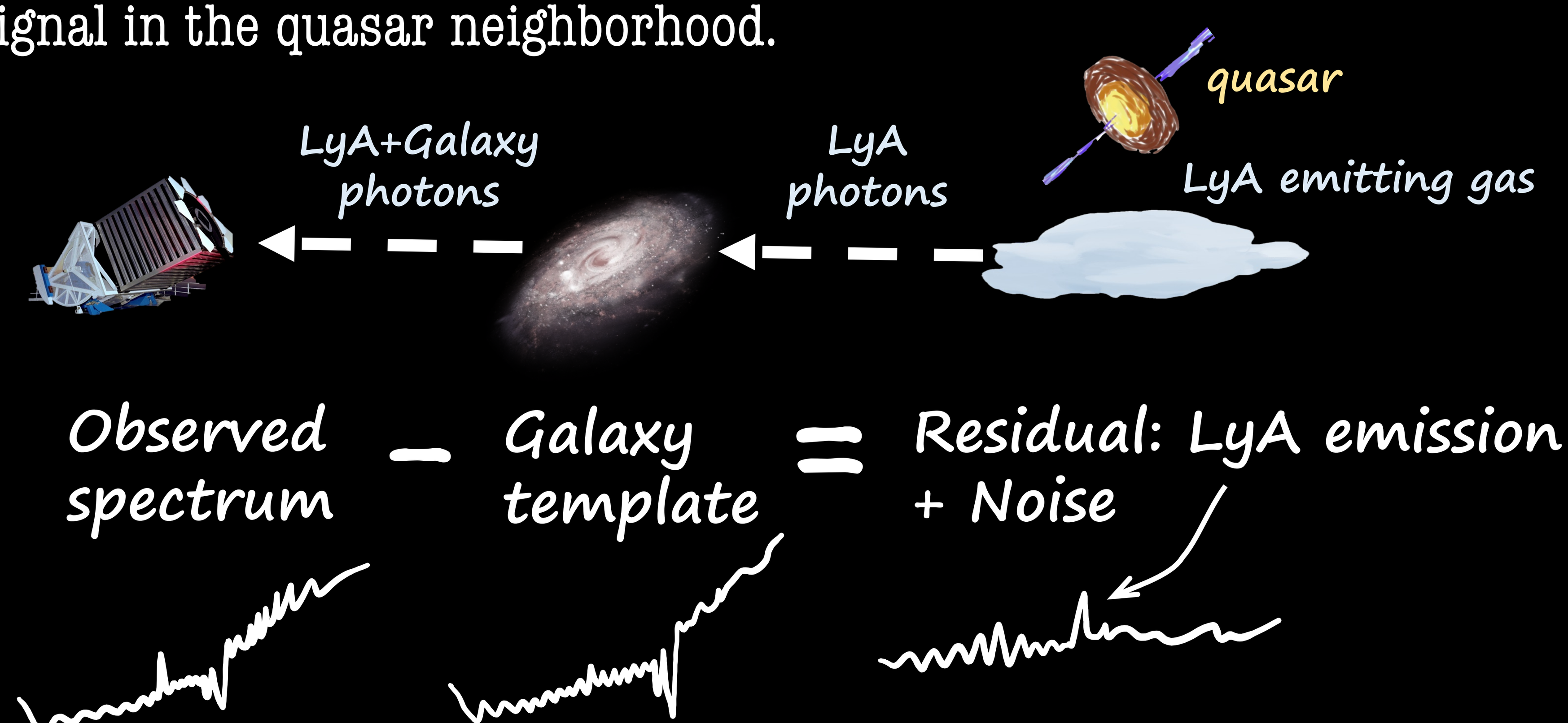


this poster

The filamentary structure of the cosmic web is predicted to be a rich reservoir of nearly pristine gas. However, direct imaging of the intergalactic medium (IGM) Lyα emission is challenging because of its low surface brightness (SB). Applying the Intensity Mapping technique to SDSS DR16, we probe the large-scale structure of Lyα emission on scales up to several Mpc from quasars at the cosmic noon, and develop an observation-motivated empirical model which suggests the bulk of LyA photons orignated from star-forming galaxies and their diffuse gas halos.

Method: LyA Intensity Mapping by quasar-LyA emission cross-correlation

When you are observing a galaxy, the LyA photons from the background gas clouds, illuminated by ionizing sources nearby, are also captured. Cross-correlating the residual spectrum pixels (see below) with quasar positions is equivalent to stacking the Lyα signal in the quasar neighborhood.

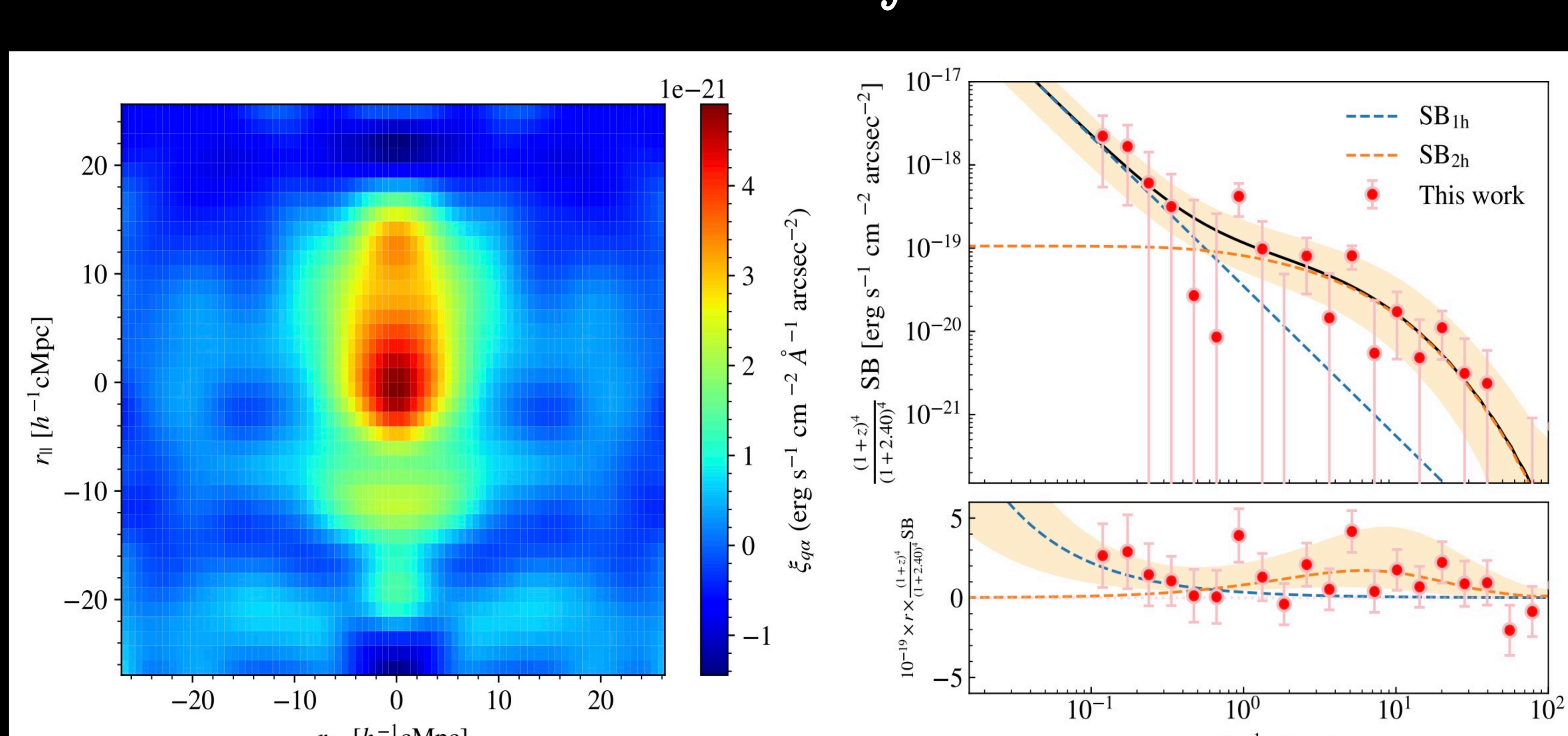


Resulst: Large-scale LyA emission around QSOs at z=2.4

- Apply to SDSS DR16: ≈ 2.55×10^4 quasars at $2.0 \leq z < 3.5$ and ≈ 1.39×10^8 galaxies at $0.15 \leq z < 1.0$
- Surface brightness down to 10^{-21} erg s^{-1} cm^{-2} arcsec^{-2} on scales up to >15 cMpc
- Cosmic LyA luminosity density $\rho_{LyA} = 6.6^{+3.3}_{-3.1}$ erg s^{-1}cMpc^{-3}

LyA 2D SB distribution parallel and vertical to the LoS

Radial profile of LyA SB well described by the one- and two-halo terms



Modelling: The powering sources of the large-scale LyA

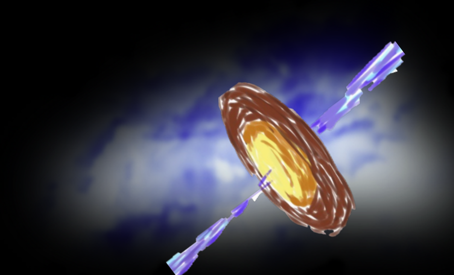
Who is responsible for the large-scale LyA we observed?

Star-forming galaxies around the overdensity ?

likely :-)

If galaxies: all star-forming galaxies and their diffuse gas halos contribute

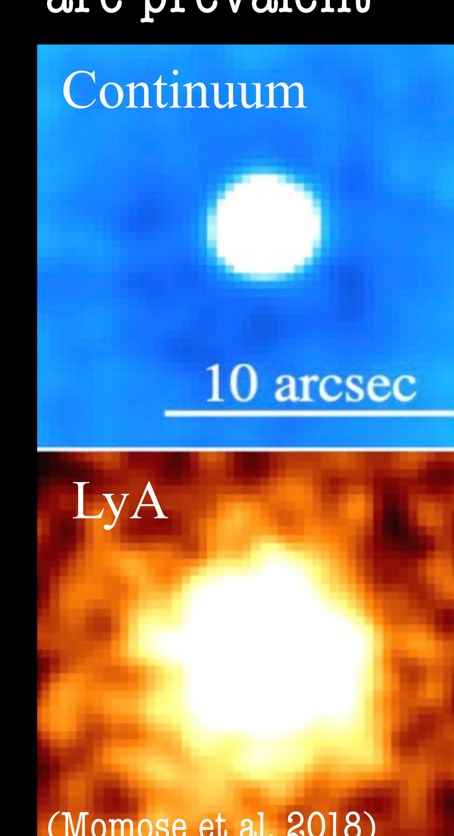
The central quasars in the density peak ?



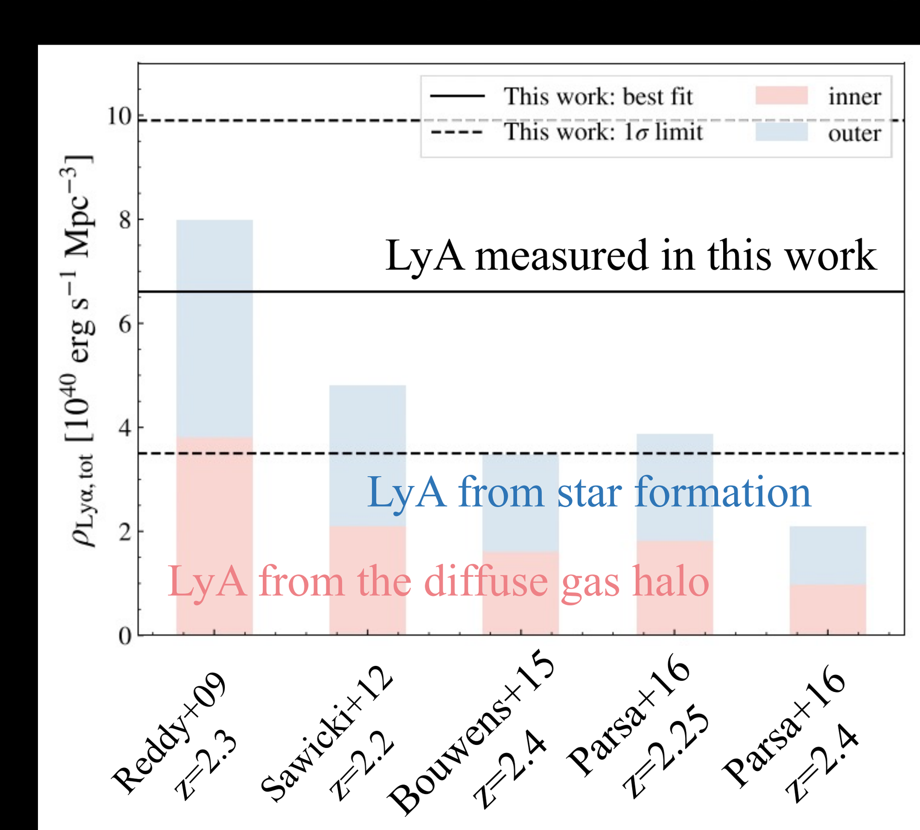
unrealistic :-(

If quasar: require quasar LyA luminosity > 10^{45} erg s^{-1}, 10-100 times brighter than typical quasars!!!

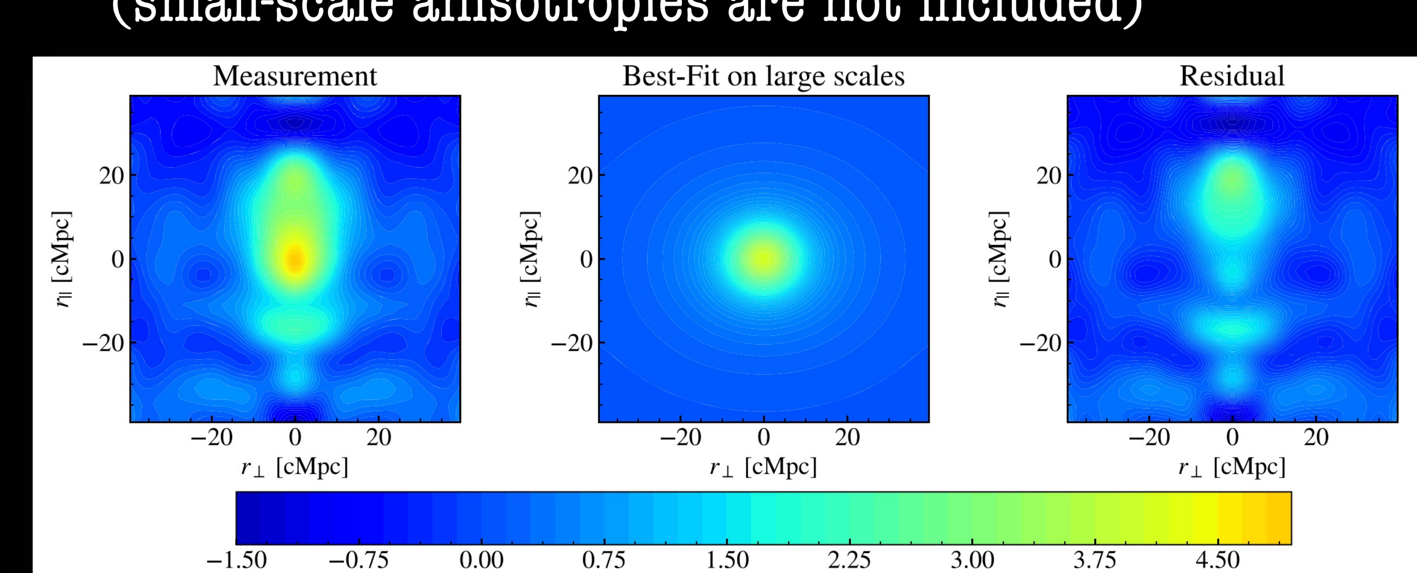
Diffuse gas halos are prevalent



LyA luminosity density predicted by our model with different observed UV LFs



The reconstructed large-scale LyA SB by our model (small-scale anisotropies are not included)



Our Paper

Lin et al. 2022, The ApJS, 262, 38

10.3847/1538-4365/ac82e8

10.48550/arXiv.2207.10682

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Learn more about Xiaojing (林小靖)