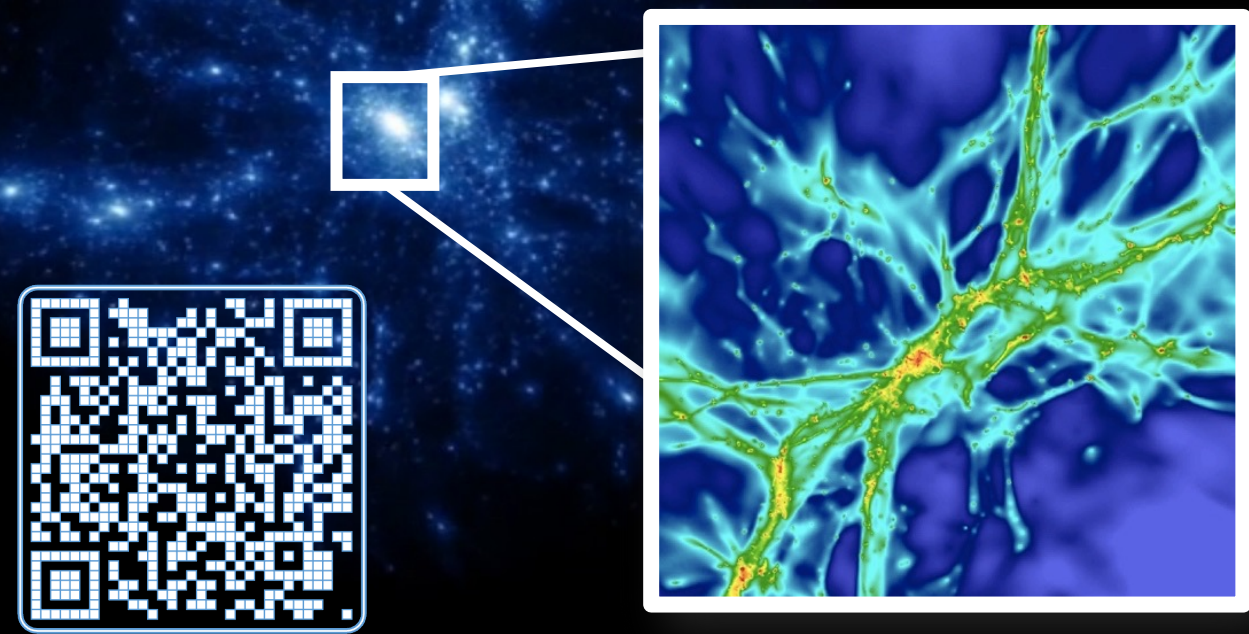


Probing the Diffuse Ly α Emission on Cosmological Scales

Ly α Emission Intensity Mapping Using the Complete SDSS-IV eBOSS

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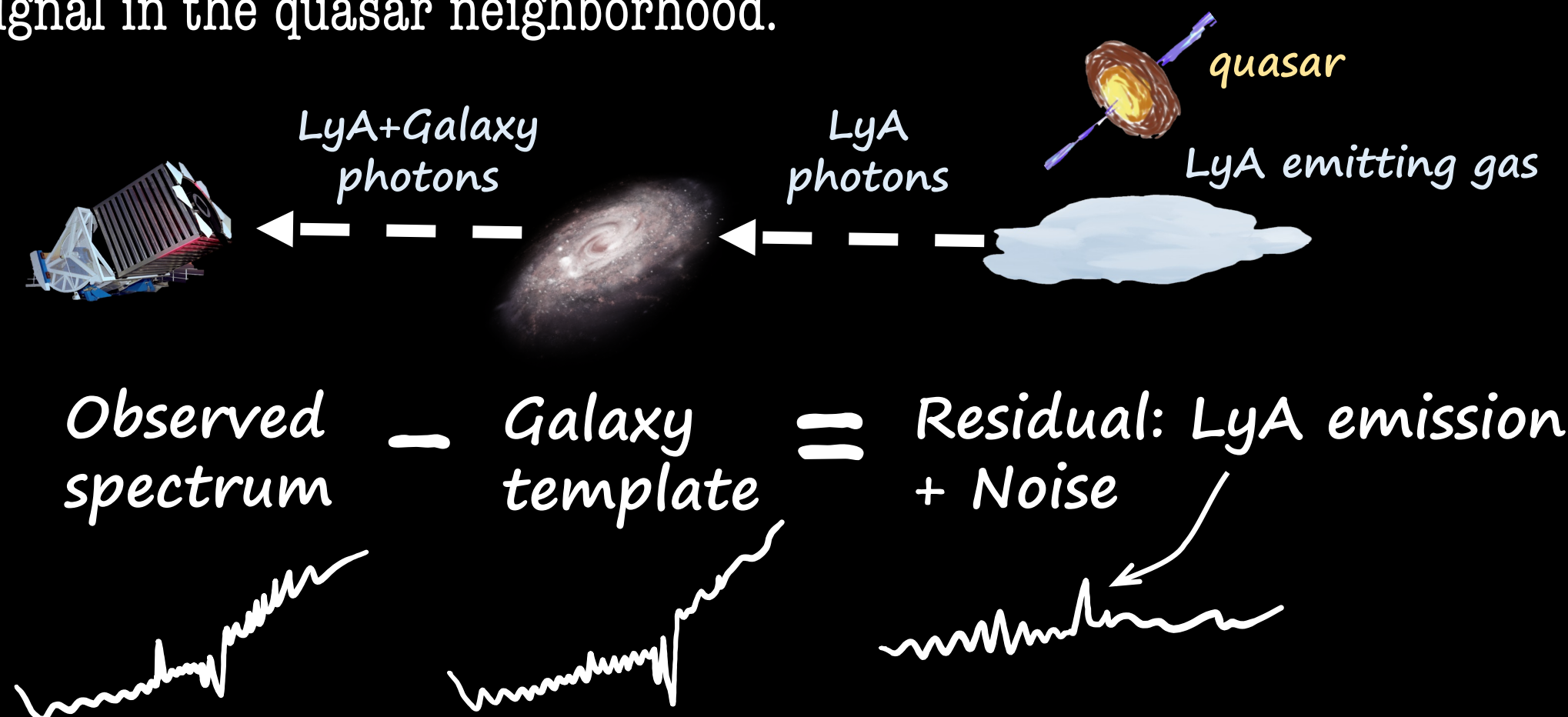


The filamentary structure of the cosmic web is predicted to be a rich reservoir of nearly pristine gas. However, direct imaging of the intergalactic medium (IGM) Ly α emission is challenging because of its low surface brightness (SB). Applying the Intensity Mapping technique to SDSS DR16, we probe the large-scale structure of Ly α 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 Ly α photons originated from star-forming galaxies and their diffuse gas halos.

↑ this poster

Method: Ly α Intensity Mapping by quasar-Ly α emission cross-correlation

When you are observing a galaxy, the Ly α 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 Ly α signal in the quasar neighborhood.

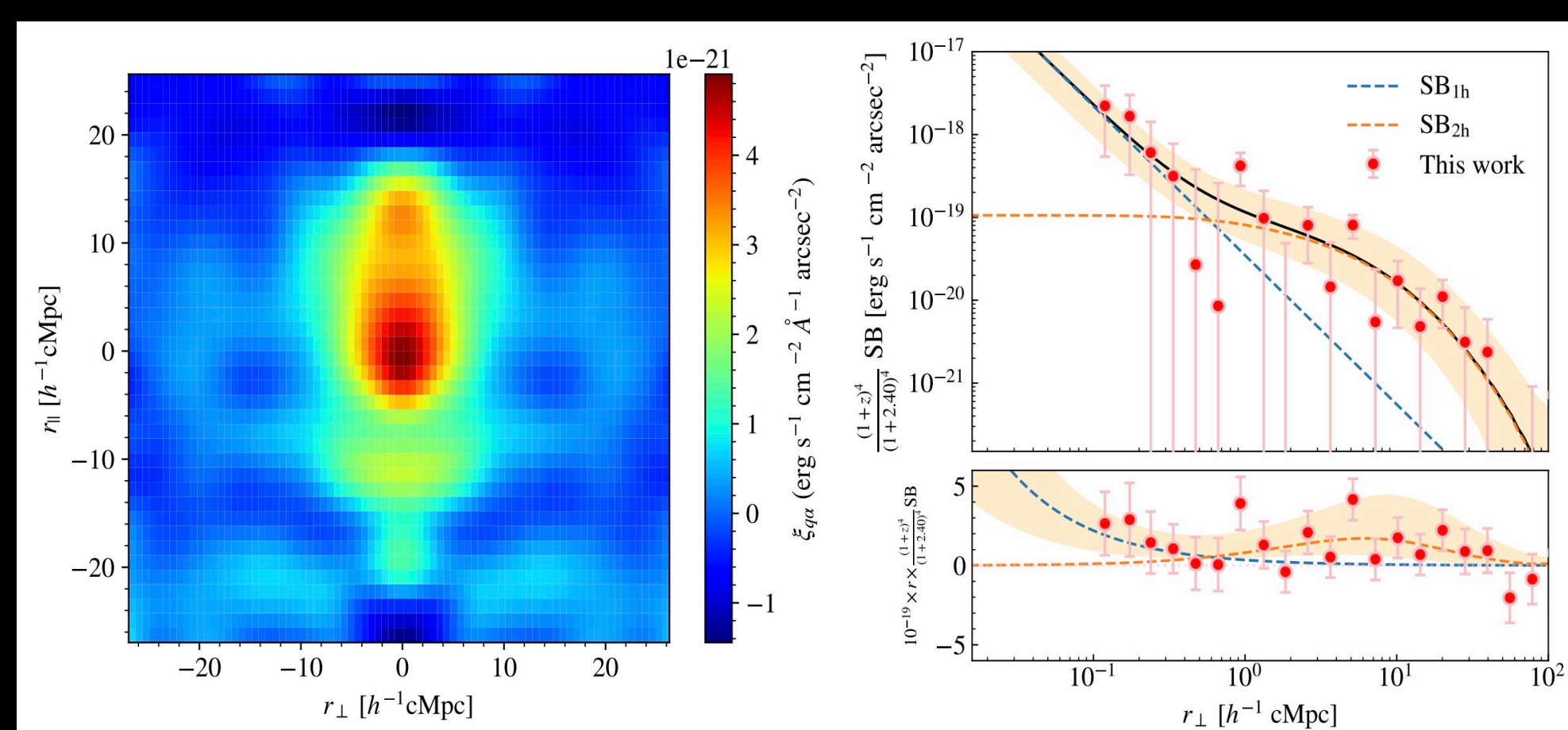


Result: Large-scale Ly α emission around QSOs at $z=2.4$

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

Ly α 2D SB distribution parallel and vertical to the LoS

Radial profile of Ly α SB well described by one- and two-halo term

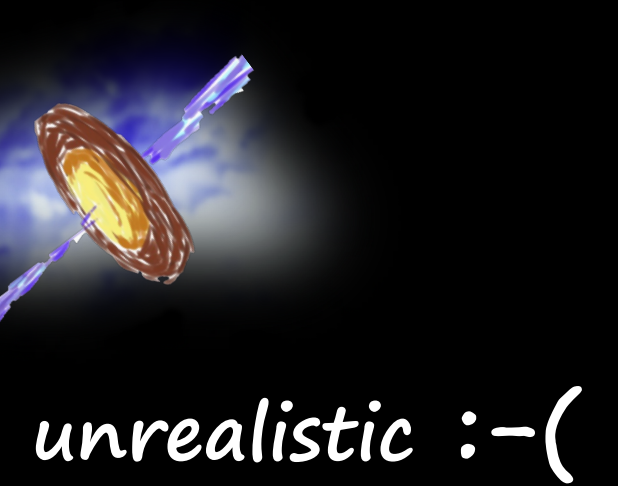


Modelling: The powering sources of the large-scale Ly α

Who is responsible for the large-scale Ly α we observed?

Star-forming galaxies around the overdensity?

The central quasars in the density peak?

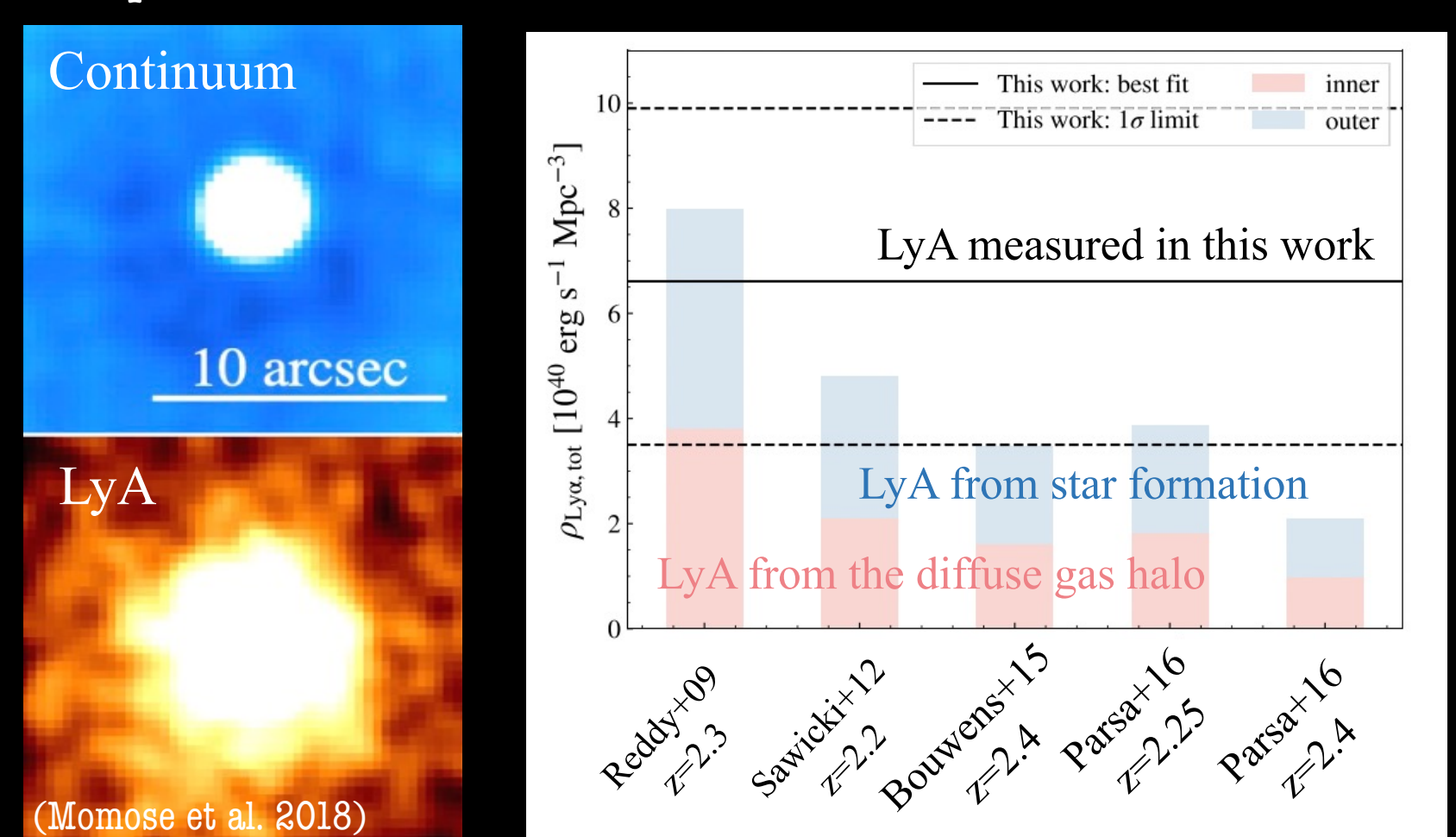


If galaxies: all star-forming galaxies and their diffuse gas halos contribute

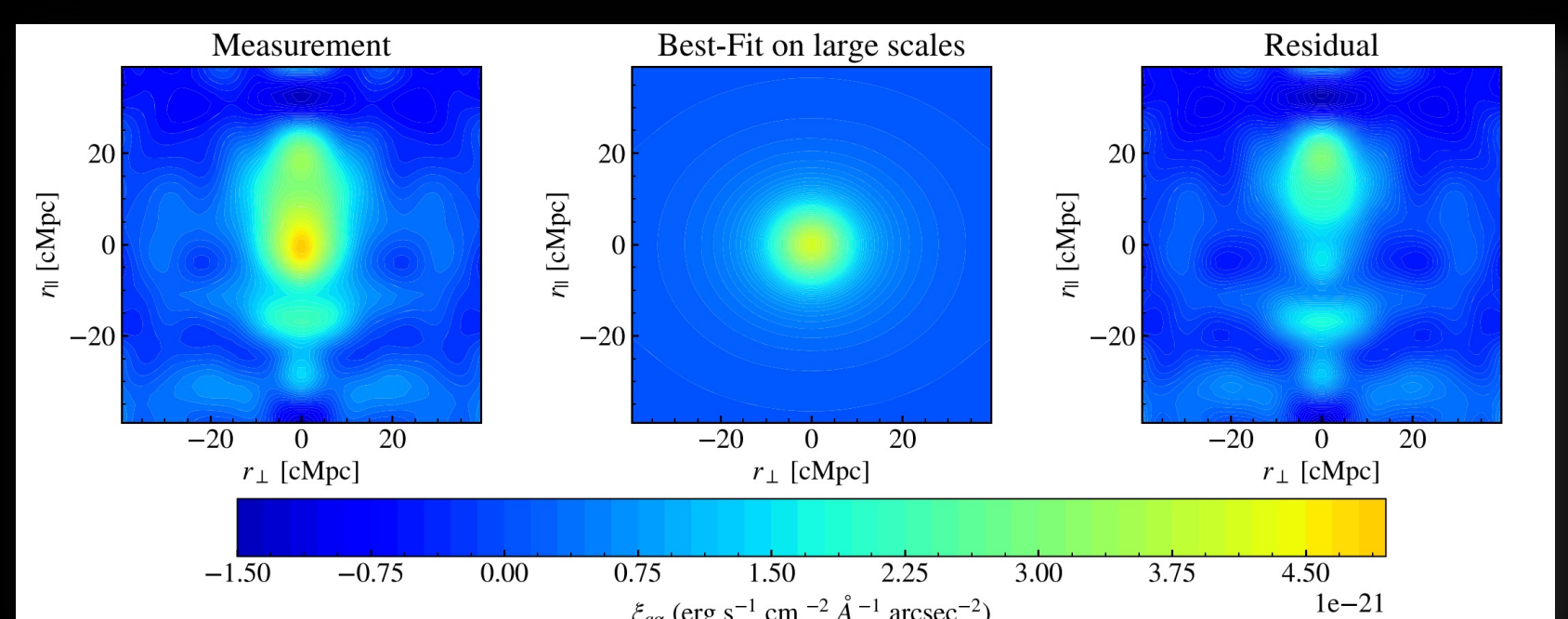
If quasar: require quasar Ly α luminosity $> 10^{45} \text{ erg s}^{-1}$, 10-100 times brighter than typical quasars!!!

Diffuse gas halos are prevalent

Ly α luminosity density predicted by our model with different observed UV LFs



The reconstructed large-scale Ly α 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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