Cosmological-Scale HI Distribution Around Galaxies and AGN Probed with the HETDEX and SDSS Spectroscopic Data

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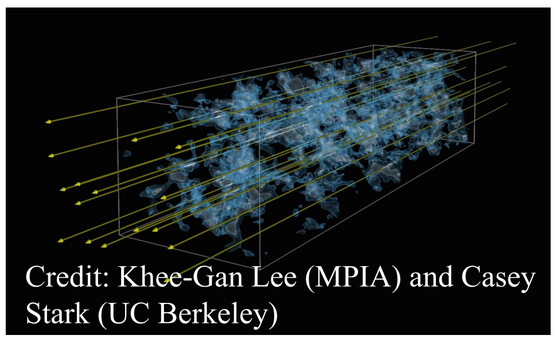
Observational cosmology group

1. Introduction

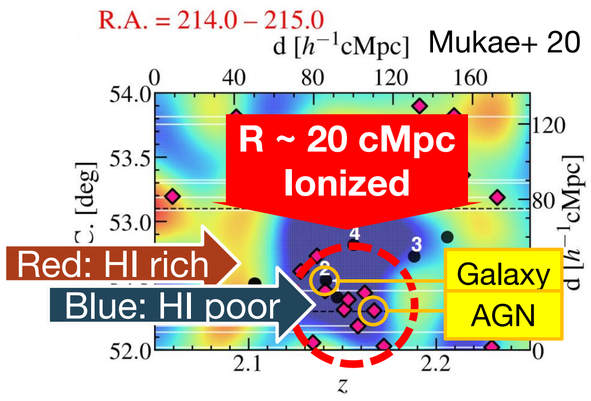
- **Intergalactic Medium (IGM)** is the clue to understand galaxy formation and evolution.
- **HI** gas traces IGM
- **Lyα forest absorptions** trace HI in IGM



HI tomography map

- multiple sightlines → Lyα forest absorptions distribution

Question: Large-scale (R > 10cMpc) Ionized structure around **AGN and galaxies** at z~2-3 **generally existed?**

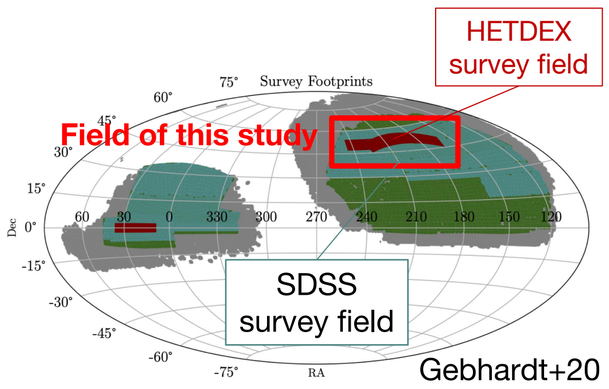


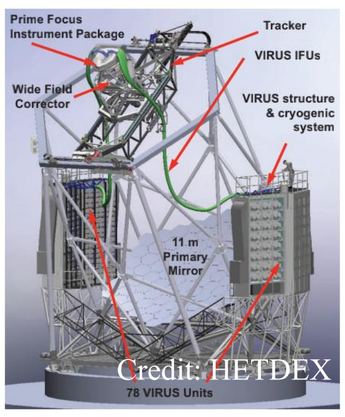
- We investigate **statistical Lyα forest absorption** around AGN and galaxies.

2. Data

Field of this study:

- RA [deg] : 6.3 - 36.3, Dec [deg] : 44.5 ~ 54.5, z = 2.0 - 3.0
- Covering area ~ 738 deg²

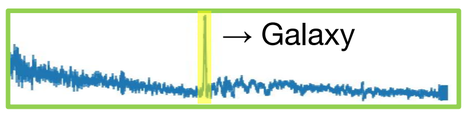




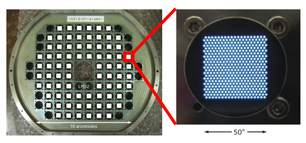
10-m HET telescope

Hobby-Eberly Telescope Dark Energy Experiment (HETDEX)

- Blind integral field spectroscopic (IFS) survey (PI: Gebhardt)
- **Galaxy**: 11436 HETDEX Galaxies ($FWHM_{lya}$ < 1000 km s^{-1}, M_{uv} > -22 mag)



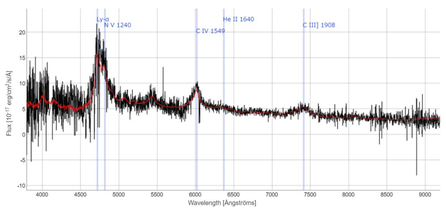
HETDEX spetrum



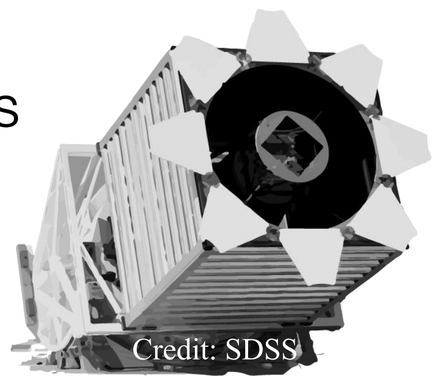
76 IFUs 448 Fibers

Sloan Digital Sky Survey (SDSS):

- **AGN**: 13933 SDSS QSOs
- **Background sightlines**: 12555 SDSS QSOs spectrum



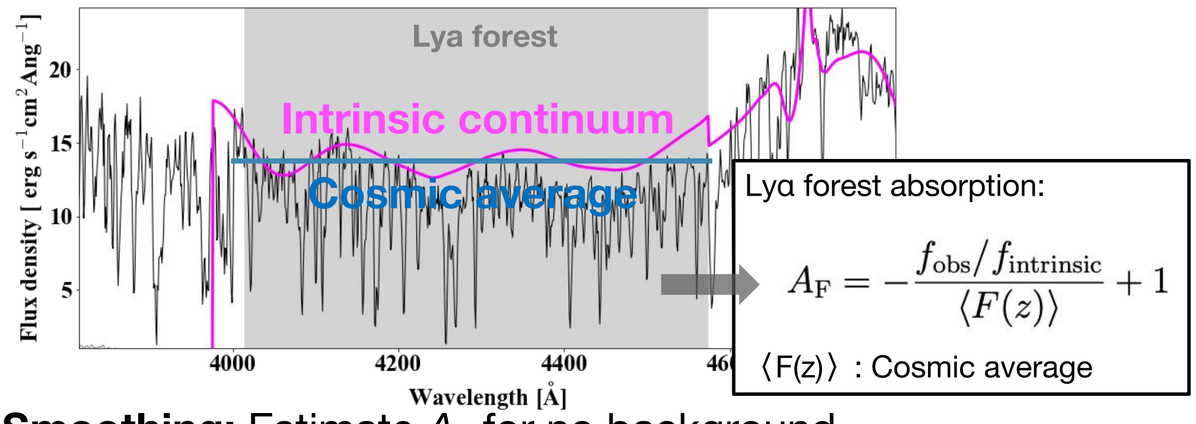
SDSS QSO spetrum



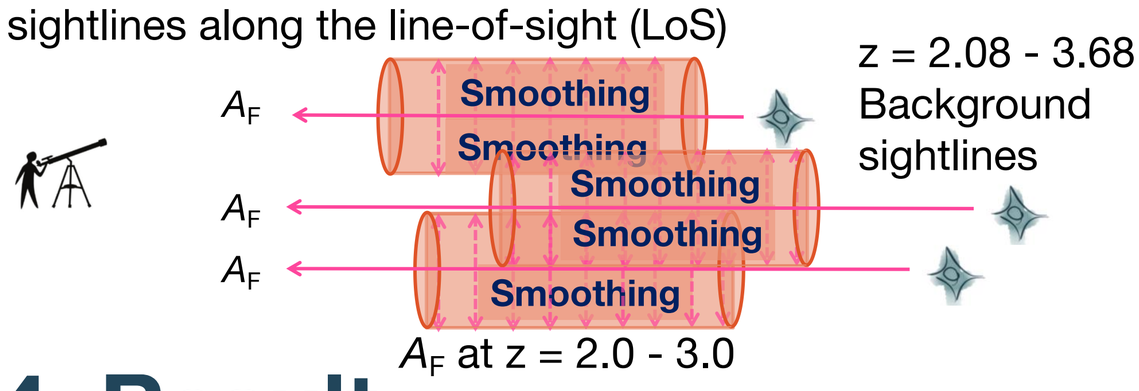
Sloan foundation 2.5m telescope

3. Method

Lyα forest absorption estimation (A_F) for spectrum of background sightlines:

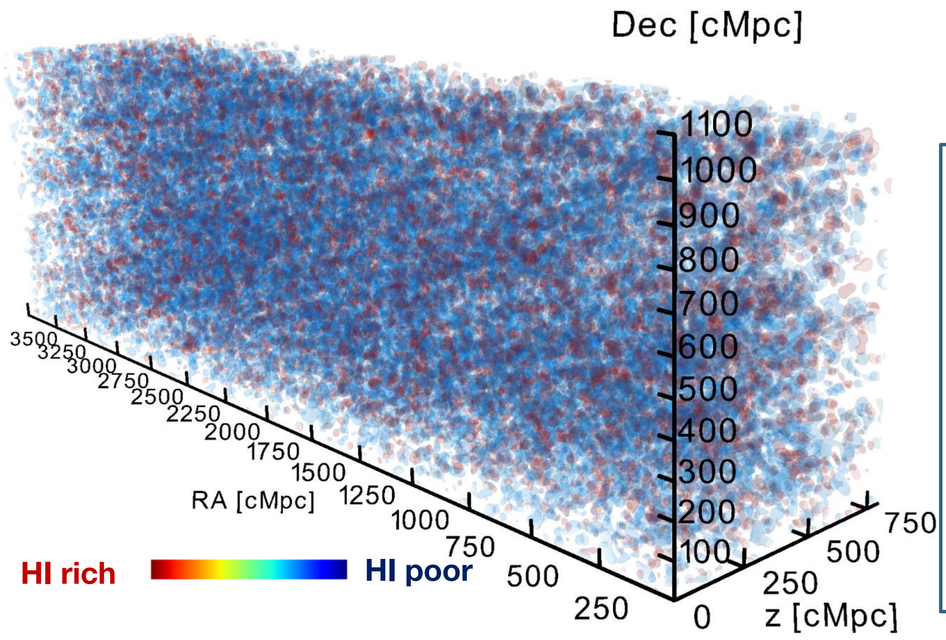


Smoothing: Estimate A_F for no background sightlines along the line-of-sight (LoS)

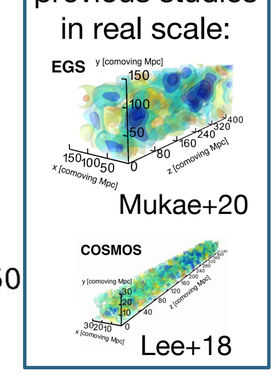


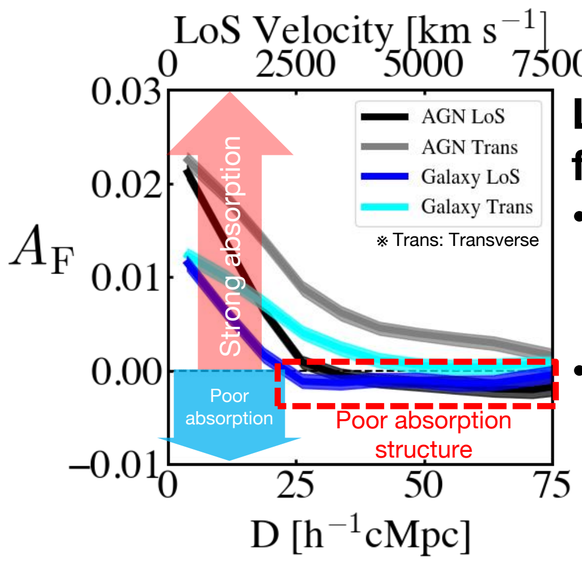
4. Result

HI tomography map for field of this study:



HI tomography maps of previous studies in real scale:





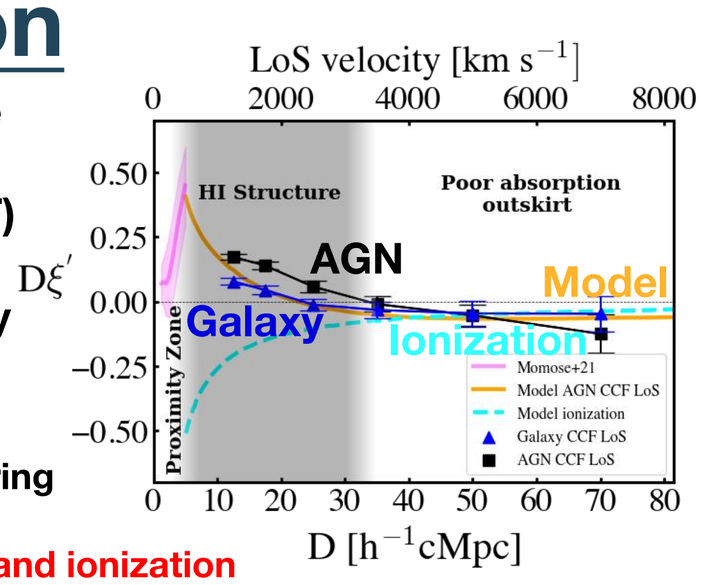
LoS and Transverse (Trans) Lyα forest absorption (A_F) profiles:

- Cross-correlation between A_F and AGN/Galaxy in LoS and Transverse
- Both AGN and Galaxy LoS A_F profiles show **poor absorption structure** at D > 20 cMpc.

5. Discussion

Comparison between the model AGN LoS cross-correlation function (CCF) and the observed results of this study (AGN/Galaxy CCF LoS):

- Model AGN CCF LoS: Linear theory model, **Clustering**
- Poor absorption outskirt: **Combination of clustering and ionization**



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