Optical/UV surveys for HI absorbers

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XQ-100: A legacy survey of one hundred $3.5 \lesssim z \lesssim 4.5$ quasars observed with VLT/XSHOOTER *,†

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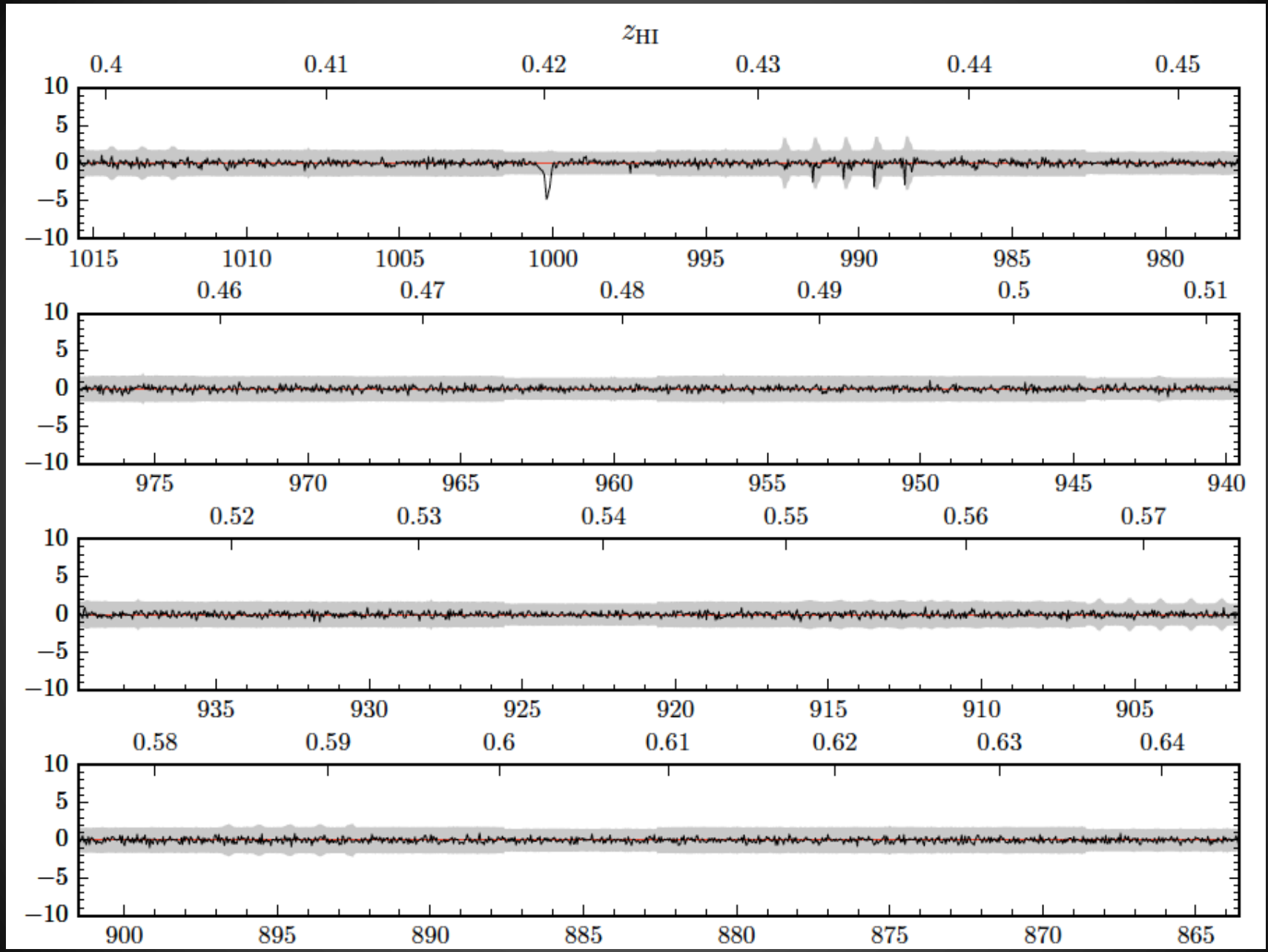
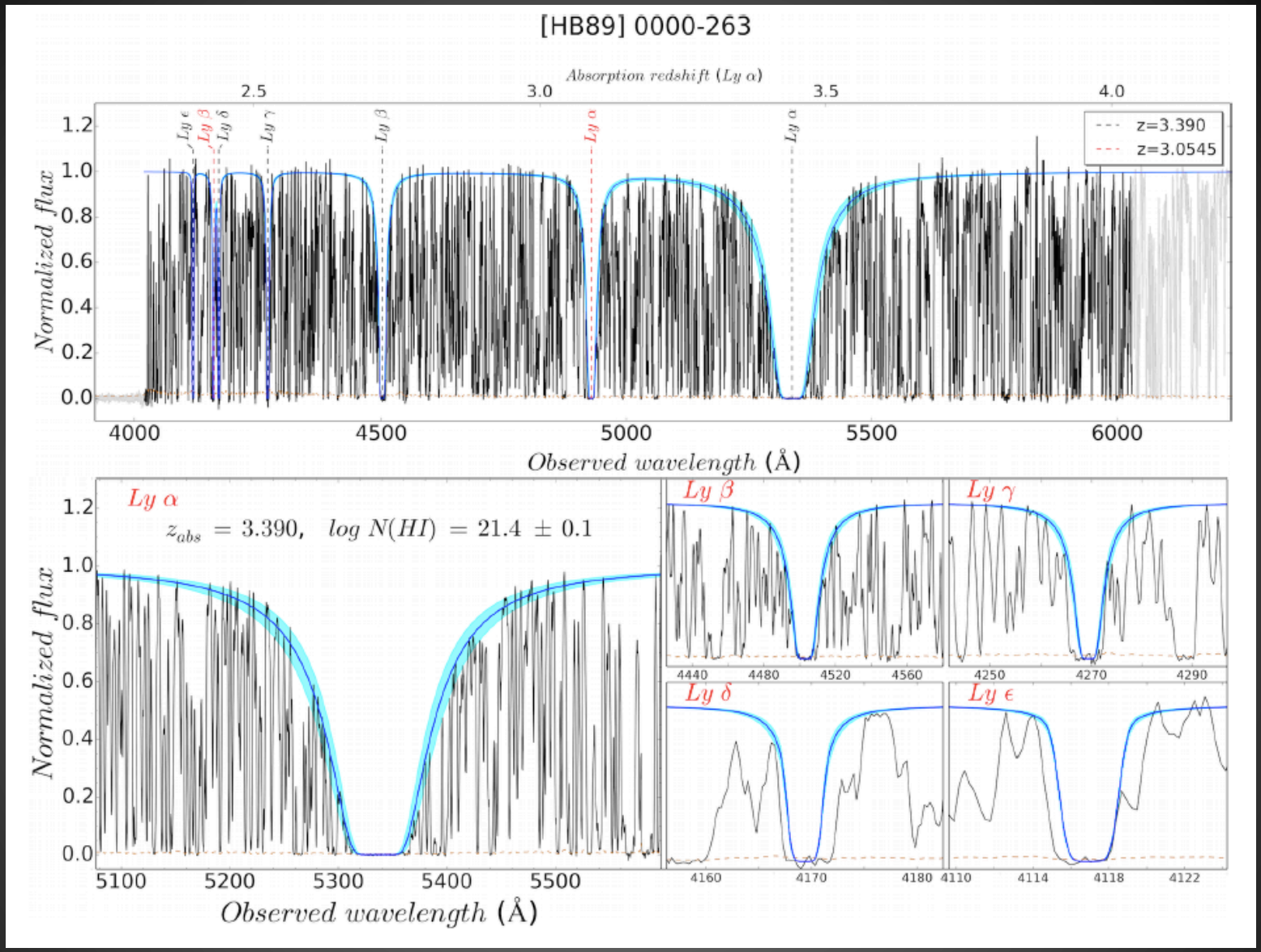
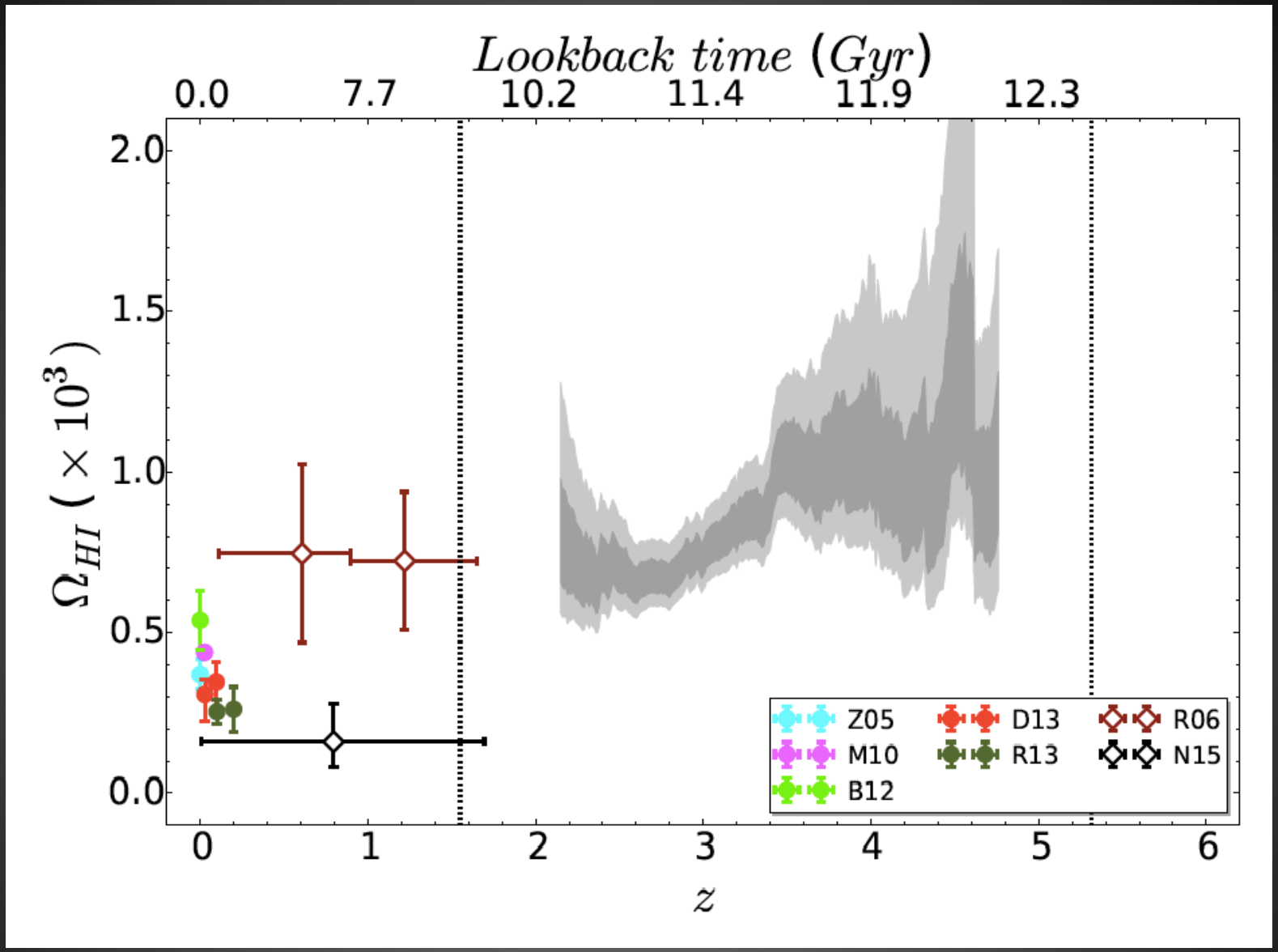
- ESO Large Program, PI: Lopez, D'Odorico, Ellison
- X-Shooter spectra of 100 3.5<z<4.5 QSOs
- Resolution ~6000, S/N~35, 320-2200 nm coverage
- Science goals:
  - cosmology (proximity effect, matter power spectrum)
  - AGN (black holes, outflows, associated absorbers)
  - Intervening absorbers (DLAs, Lya forest)
- Public data release of all reduced data products

Lopez et al. (2016)

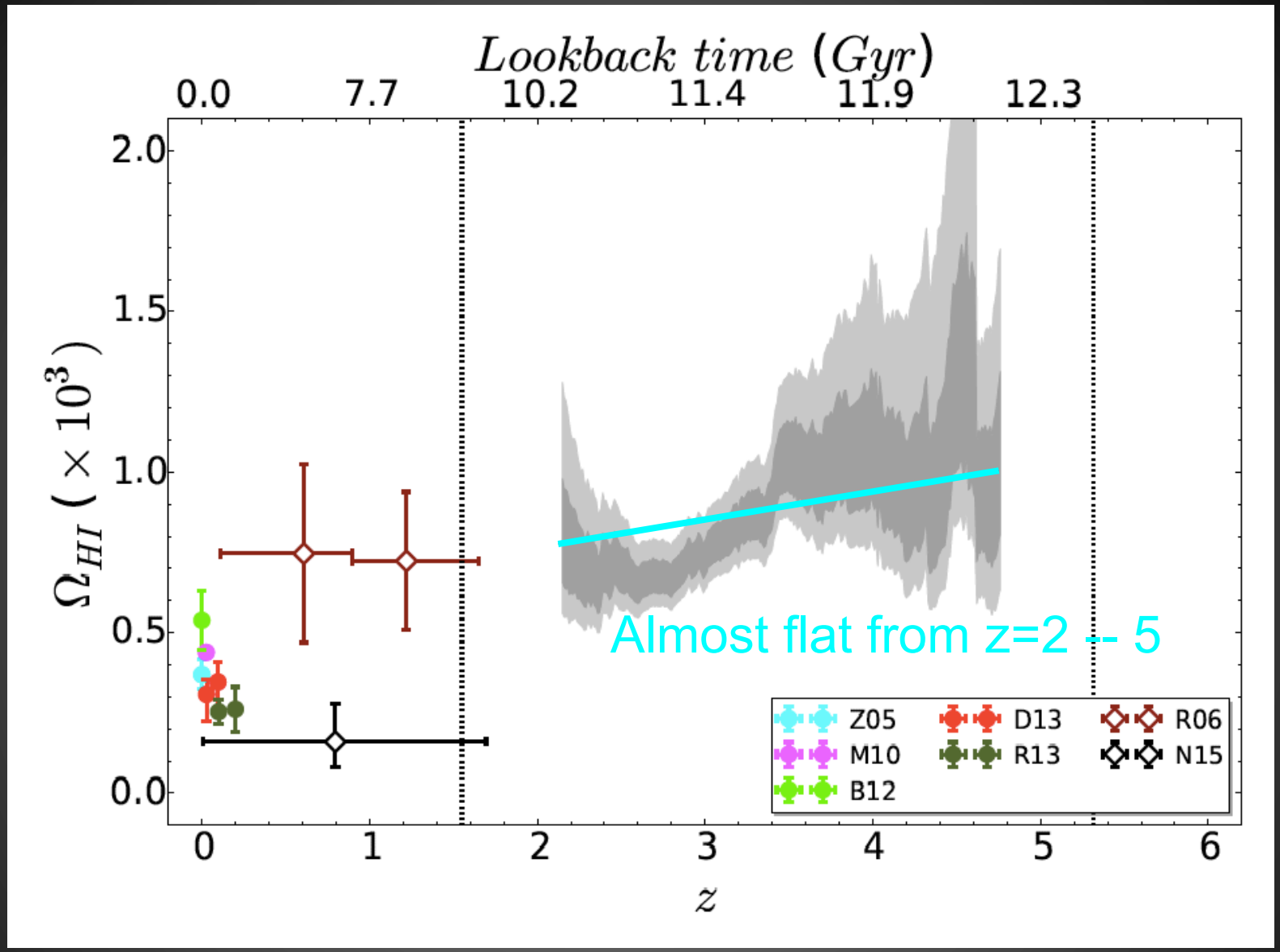

$z_{\rm HI}$
0.4
0.41
0.42
0.43
0.44
0.45
10
5
0
−5
−10
1015
1010
1005
1000
995
990
985
980
0.46
0.47
0.48
0.49
0.5
0.51
975
970
965
960
955
950
945
940
0.52
0.53
0.54
0.55
0.56
0.57
935
930
925
920
915
910
905
0.58
0.59
0.6
0.61
0.62
0.63
0.64
900
895
890
885
880
875
870
865



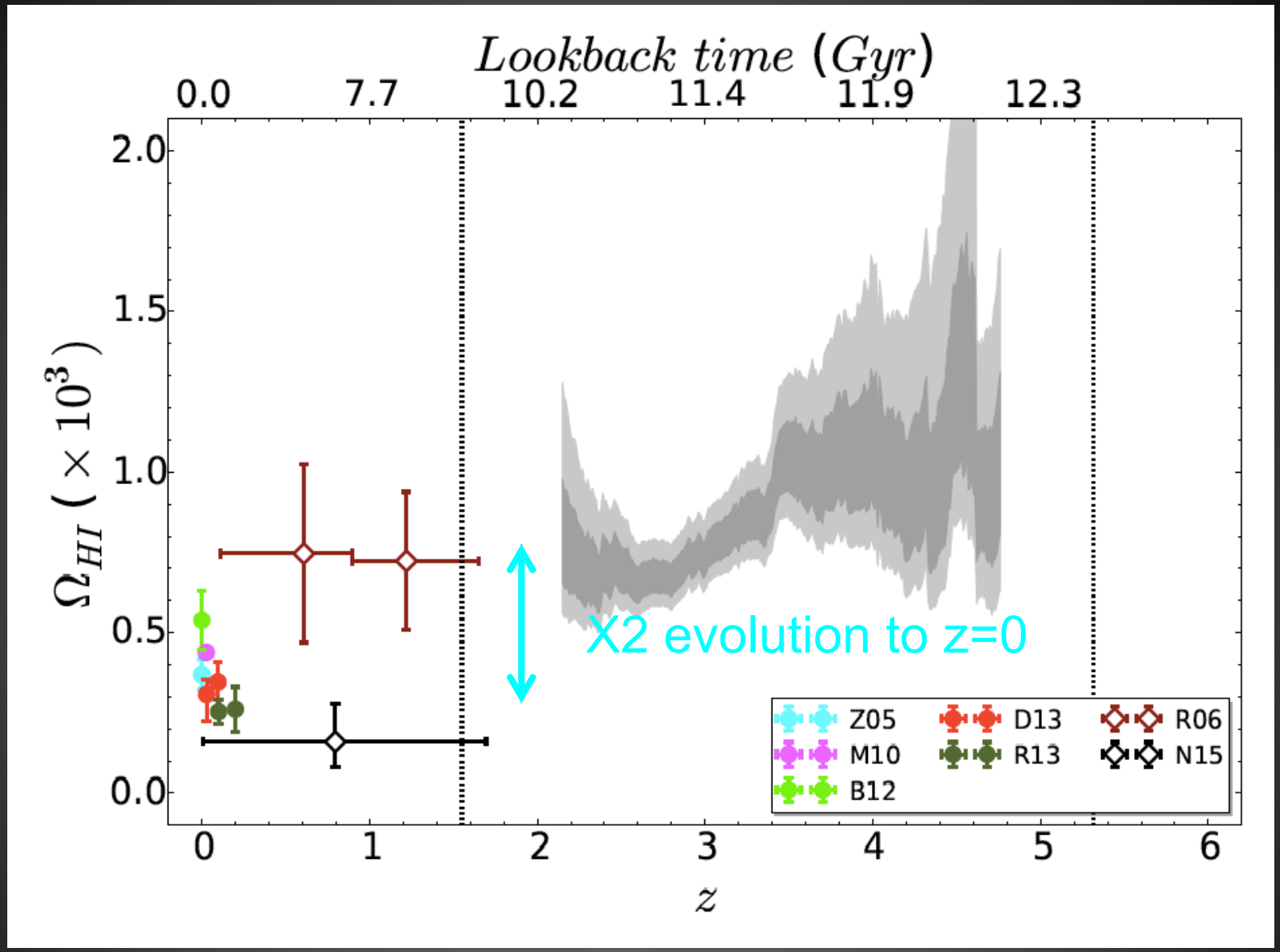
Sanchez-Ramirez et al. (2016)



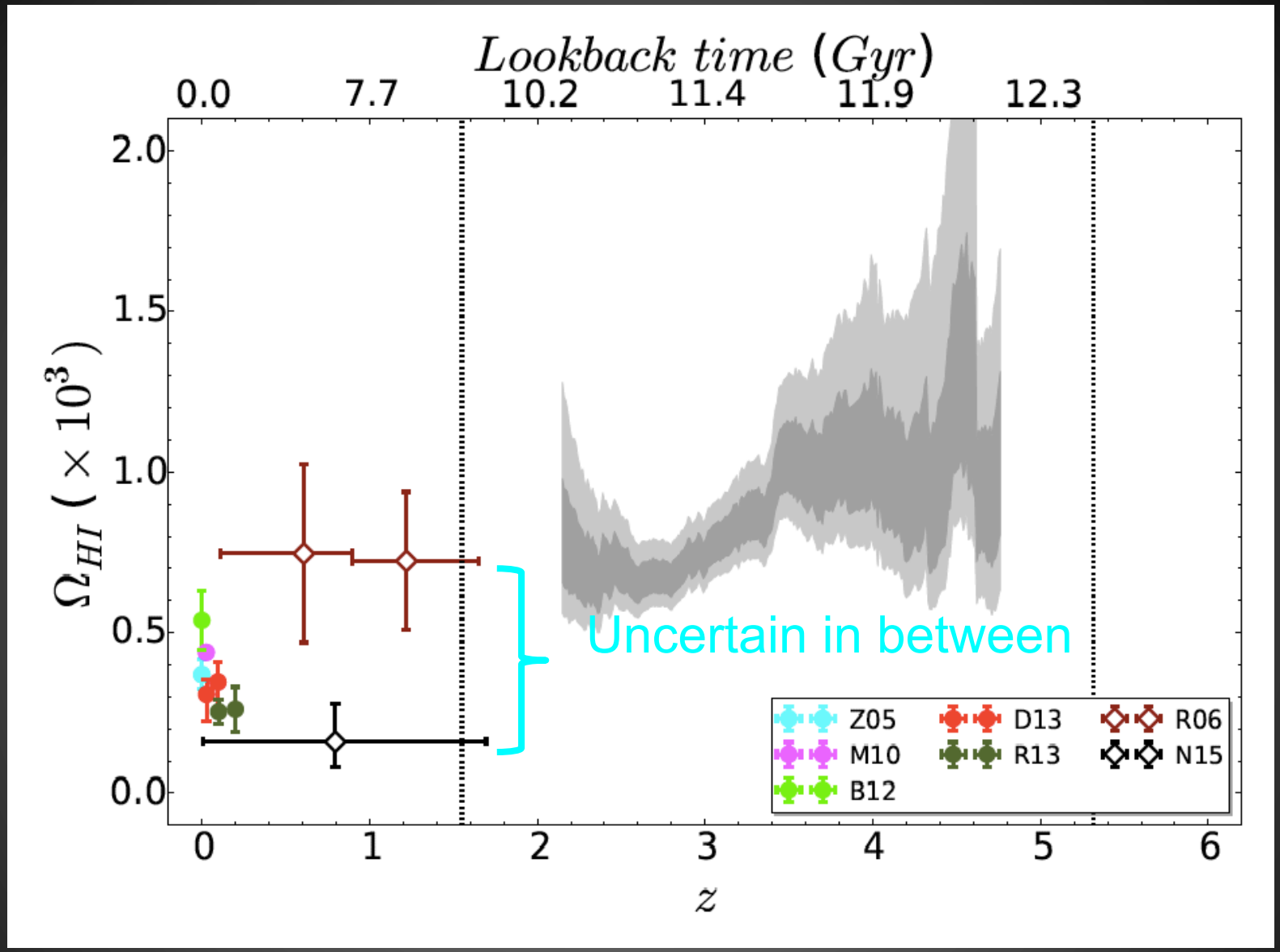
Sanchez-Ramirez et al. (2016)



Sanchez-Ramirez et al. (2016)



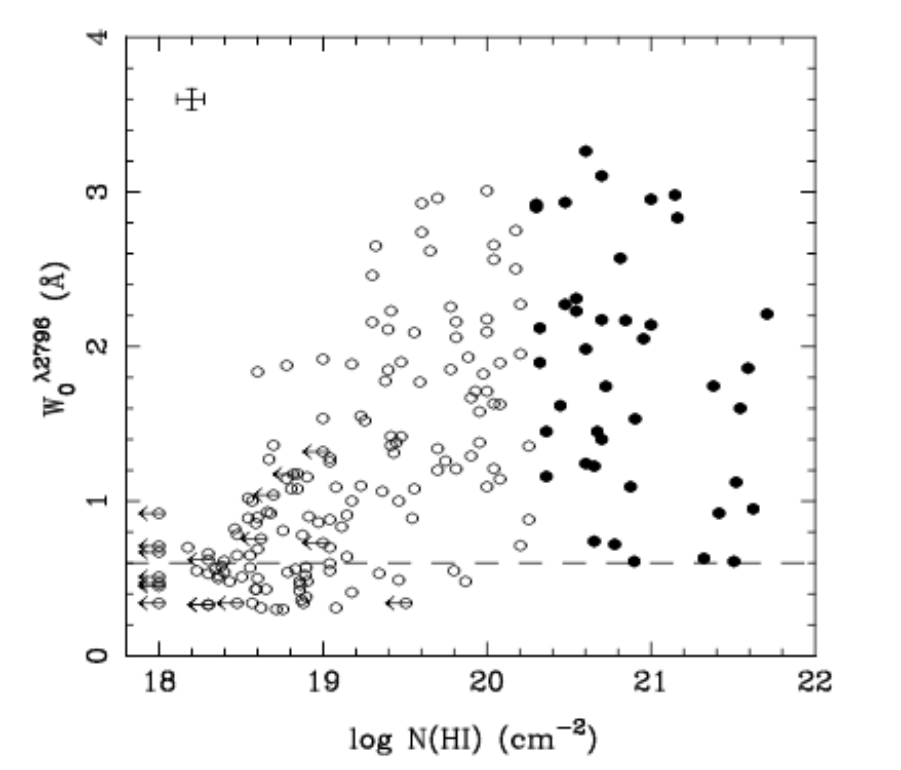
Sanchez-Ramirez et al. (2016)



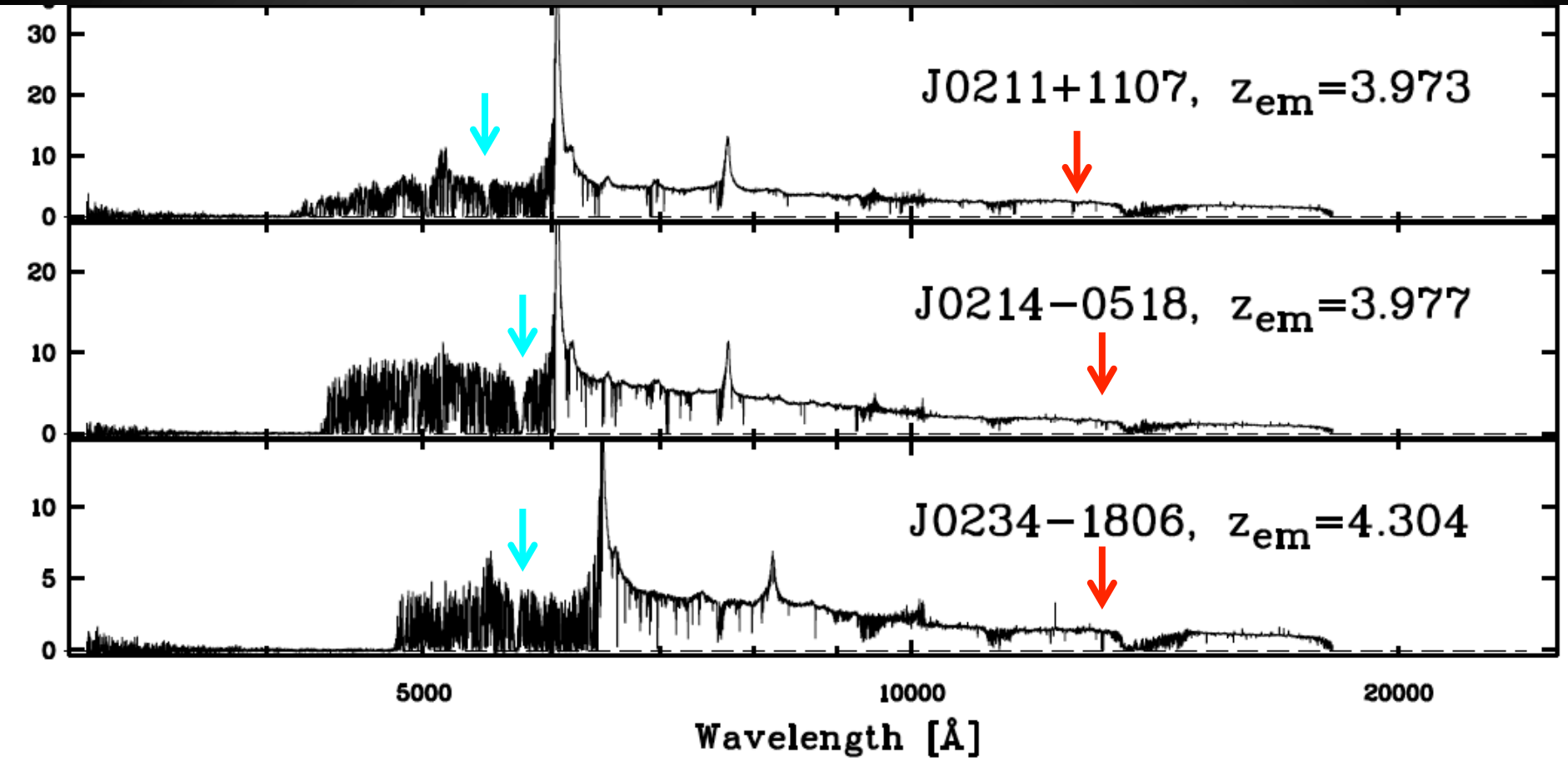
Sanchez-Ramirez et al. (2016)

MgII pre-selection pioneered by Rao et. al (2000, 2006):

- Select strong z<1.5 λ2796 MgII systems from optical spectra
- Follow-up with HST UV spectroscopy to confirm Lyα

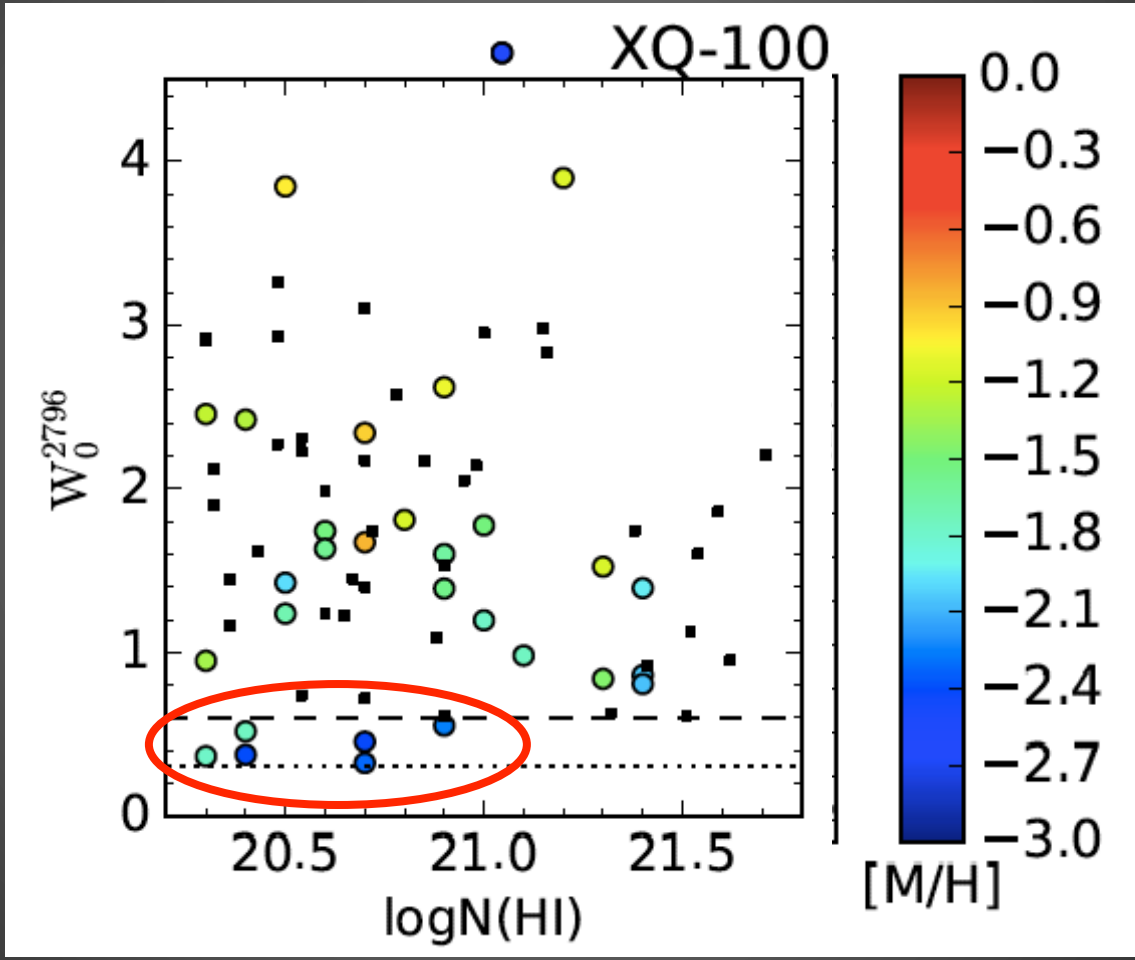


Rao et al. conclude “There is little chance of encountering a DLA unless MgII EW> 0.6 A.”



XQ-100 spectra cover simultaneously MgII and Lya.

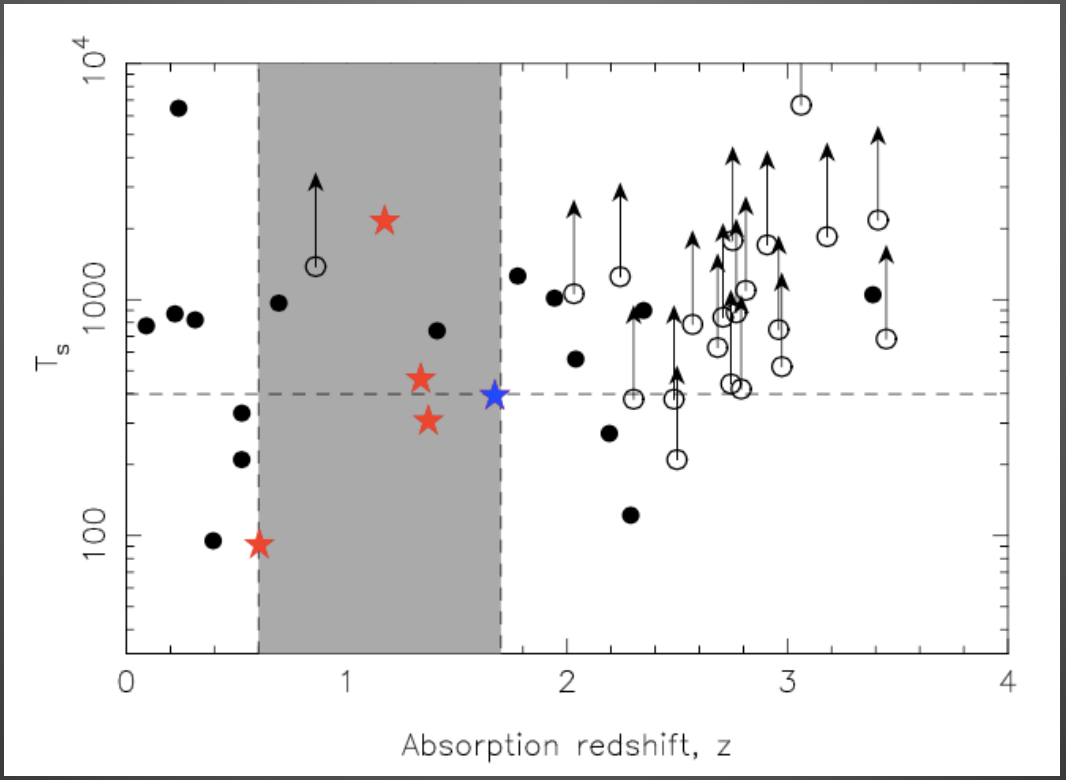
Identify DLAs and then look at MgII properties. 17% of DLAs would not have been selected from a MgII EW cut.



Berg et al. (in prep)

The role of blind 21cm searches: Some closing thoughts

- Finding (intervening) 21cm has previously been challenging, e.g. 1 absorber in 89 sightlines (Grasha et al.), no absorbers in ~2500 sightlines (Darling et al. 2011).



Ellison et al. (2012)

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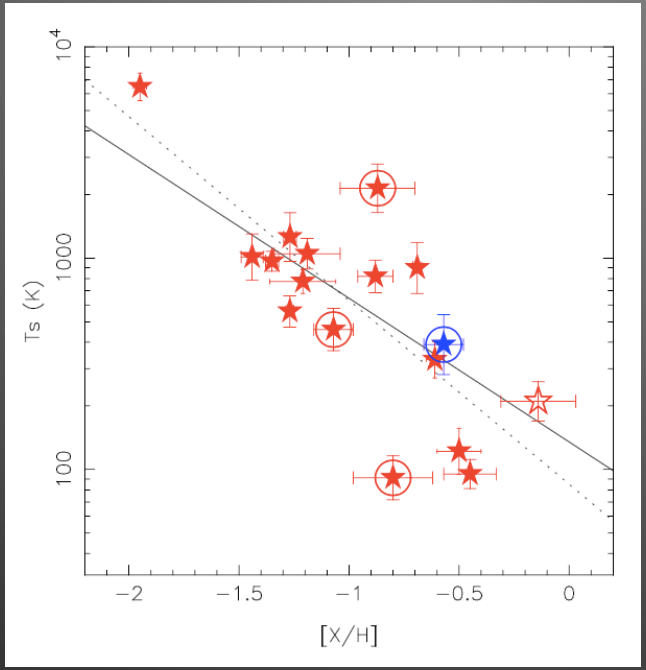
- Spin temperature inversely proportional to metallicity? 21cm surveys may still be biased towards high metallicities.



Ellison et al. (2012)

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- Spin temperature inversely proportional to metallicity? 21cm surveys may still be biased towards high metallicities.
- Most useful science still requires UV follow-up to observe Lyα, but most quasars are not UV bright.

Summary

- XQ-100 survey of 100 3.5<z<4.5 QSOs with public data: Lopez et al. (2016).
- Largest compilation of z>2 DLAs shows little evolution in Ω_{HI} from 2<z<5: Sanchez-Ramirez et al. (2016).
- A cautionary tale for MgII pre-selection of low z DLAs. 17% may be missed this way (with caveats): Berg et al. (in prep).
- FLASH will present significant advance over previous surveys, but biases and follow-up still present challenges.