Cosmological Evolution of Neutral Gas Mass

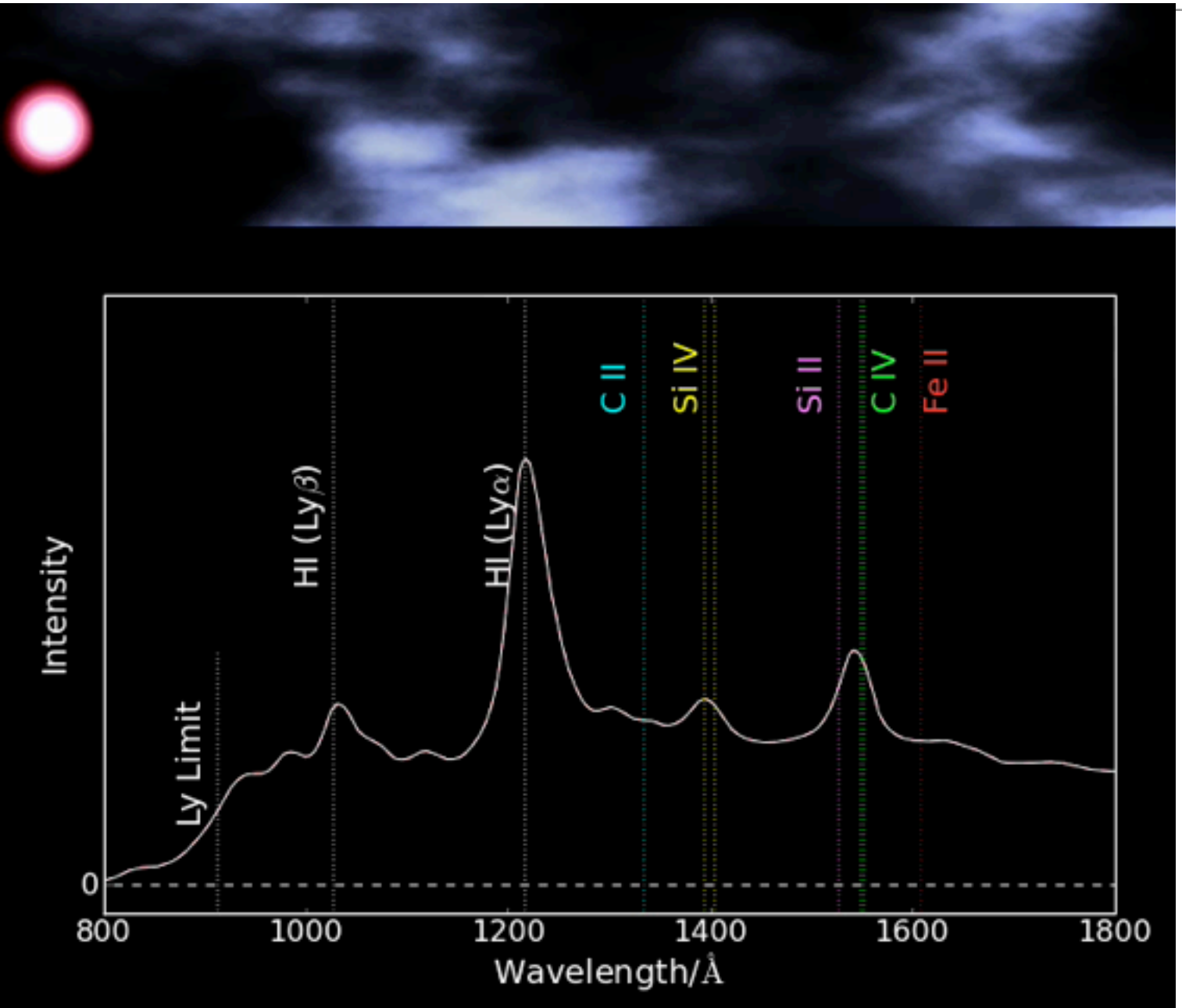
Celine Peroux (Marseille)

Neutral Gas Mass Ω_{HI}

-

Neutral HI → Molecular H_2 → star formation

Observation in Absorption



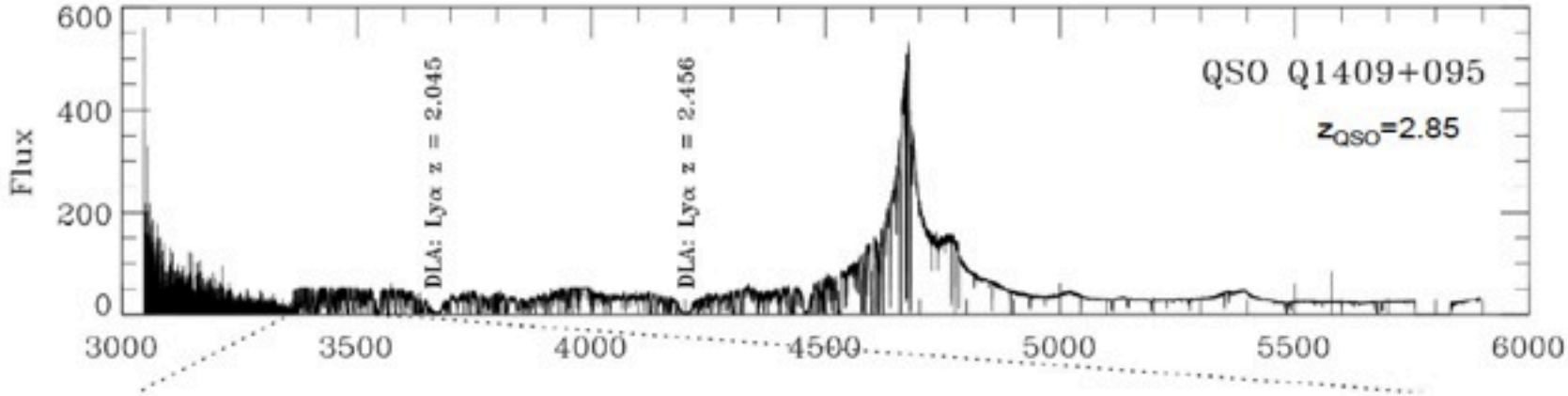
- Quasar Absorbers

(Pontzen et al. 2008)

Quasar Absorbers

- Selected on the basis of the cross-section of the neutral hydrogen gas
- Selected regardless of luminosity, morphology, etc.
- Observed at all redshifts
- Physical properties (like HI, metallicity, etc.) are well constrained
- Connect gas and stars in galaxies

Quasar Absorbers Zoo



QAL Category	log *N*(H I)	Notes
Lyα forest	<17	**IGM low overdensity ionized**
Lyman limit systems (LLS)	17–19	
Sub-damped Lyman-α (sub-DLA)	19–20.3	
Damped Lyman-α (DLA) systems	>20.3	**Galaxies overdense neutral**

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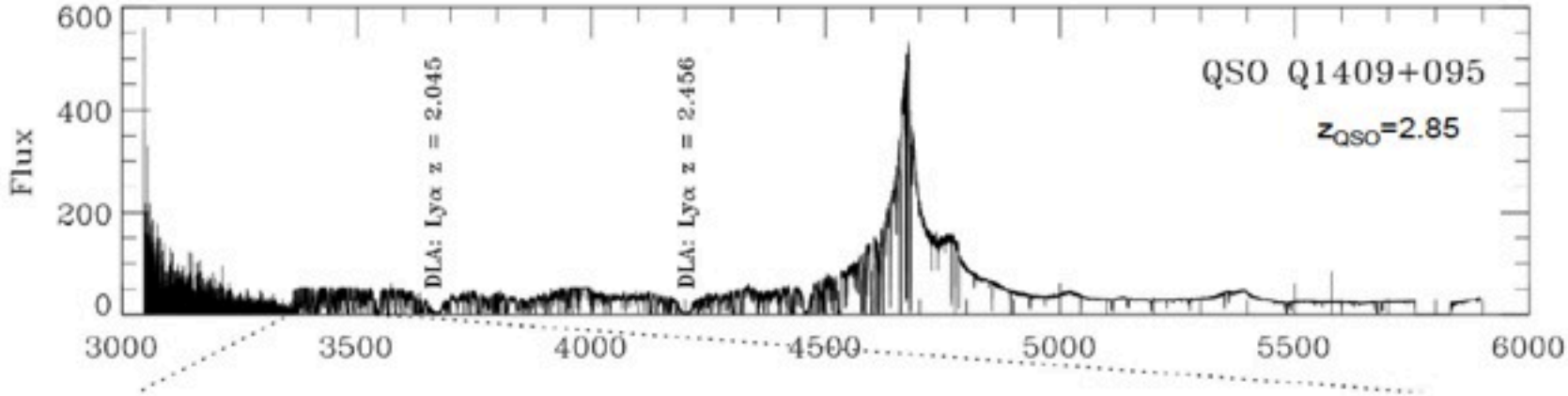

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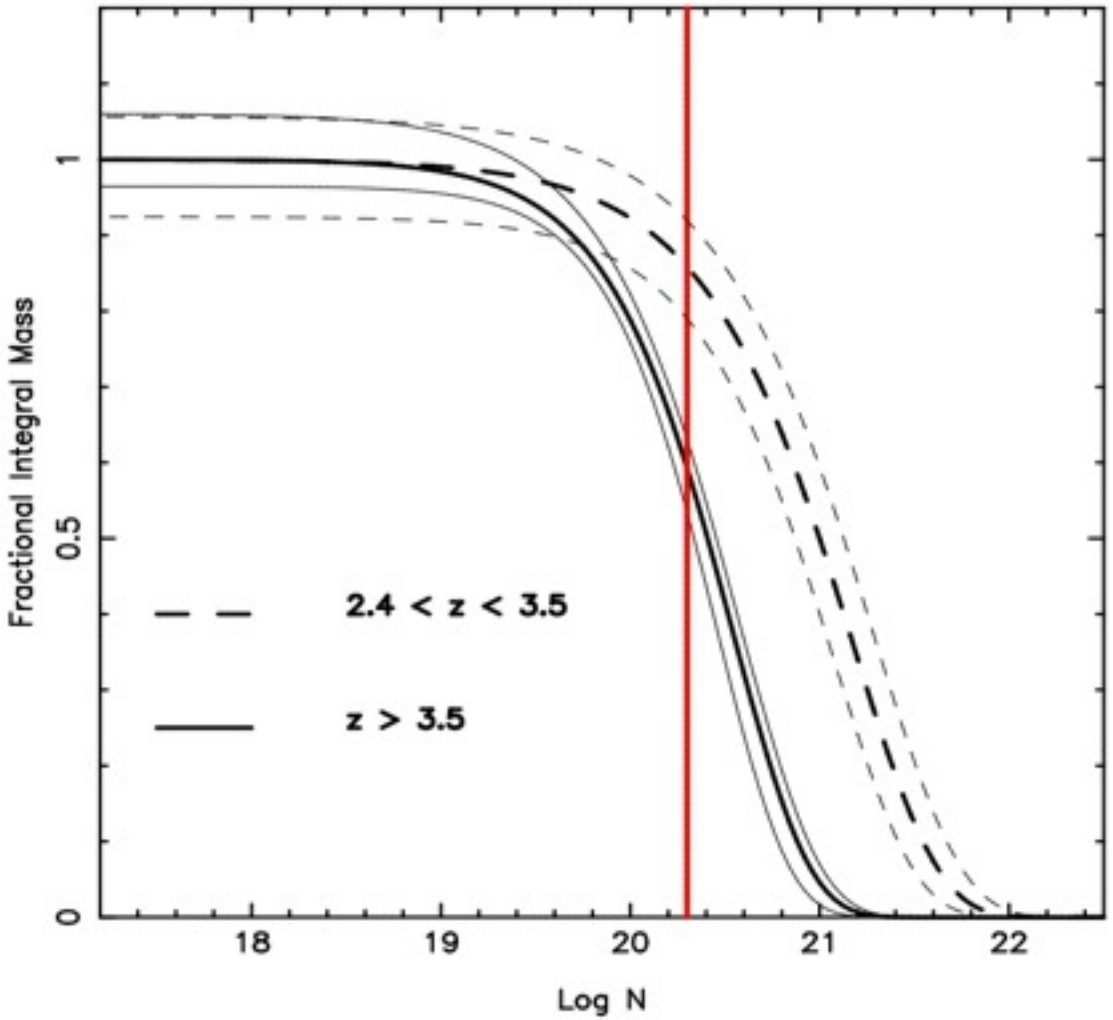
Sub-DLAs Contribution



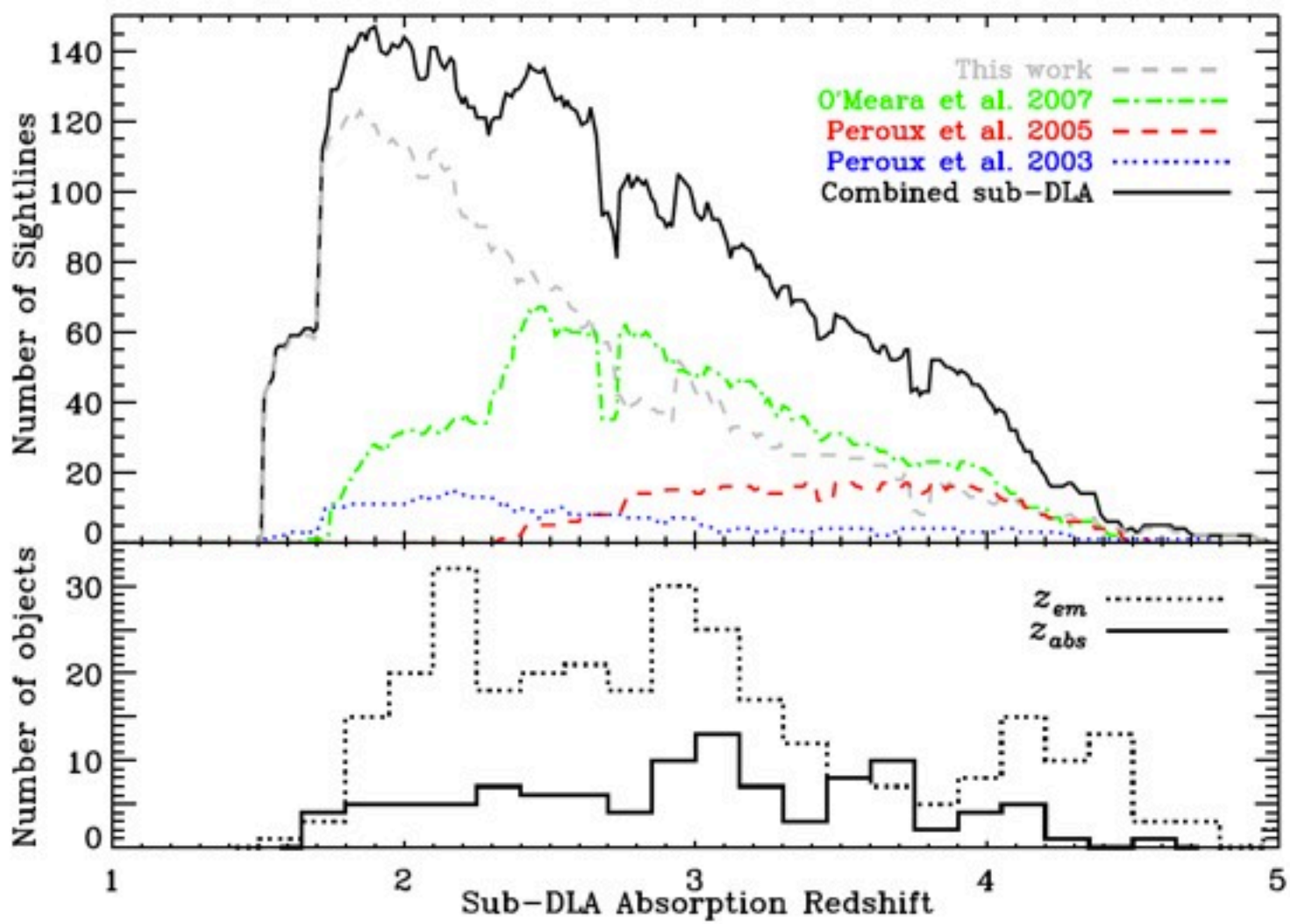
Sub-DLAs with
$19 < \log N_{HI} < 20.3$

Péroux et al. 2003

The UVES Sample

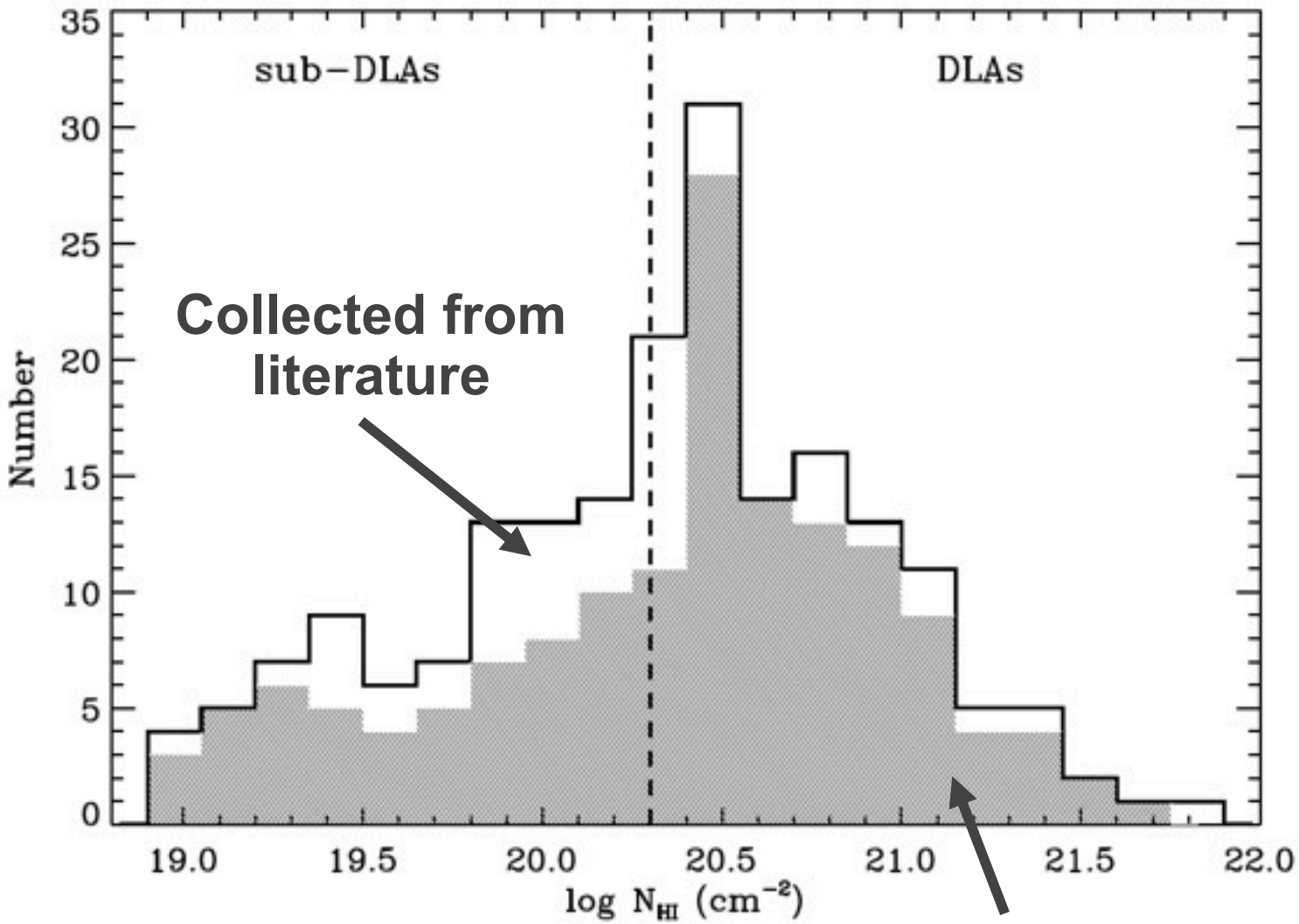
- High resolution ESO VLT/UVES advanced data products archival data
- A sample of 250 quasars is build ranging $0.2 < z_{em} < 6.3$ (1560 hours of VLT time)
- hundreds of quasar absorbers
- ever-growing sample

Redshift Distribution

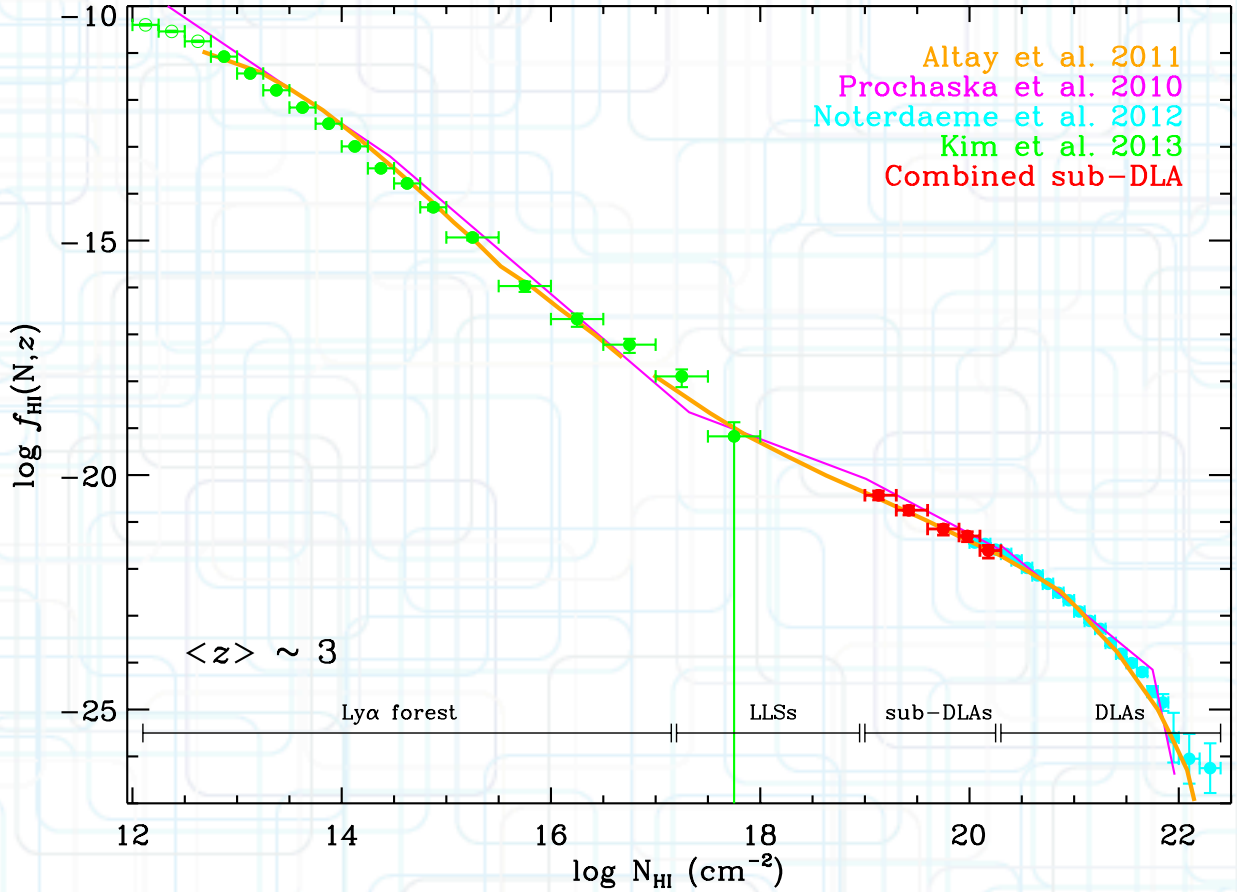


(Zafar et al., 2013a)

Column Density Distribution



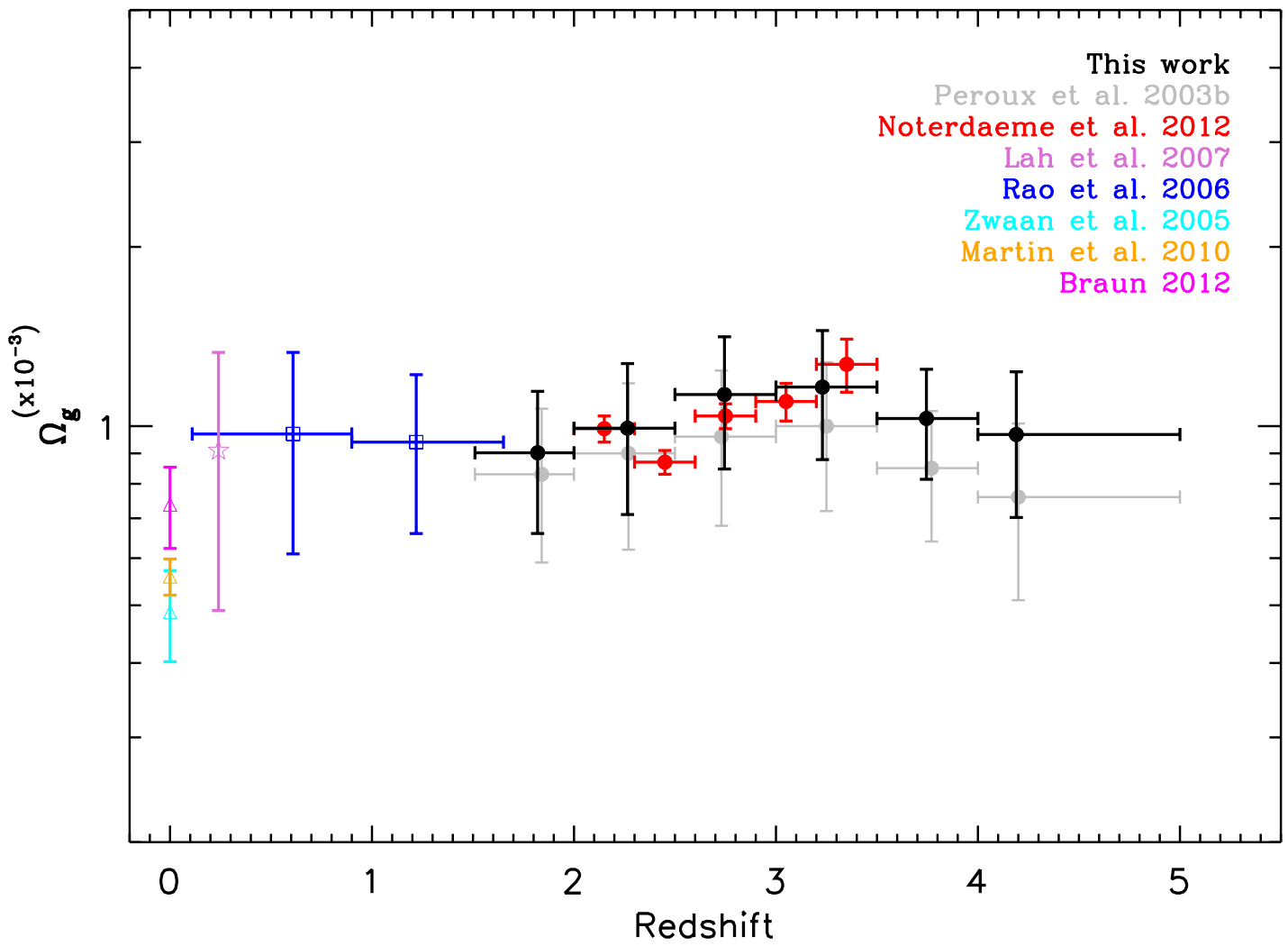
Column Density Distribution for Quasar Absorbers



$$\Omega_g(z) = \frac{\mu m_H H_0}{c\rho_{crit}} \int_{N_{min}}^{N_{max}} N_{HI} f_{HI}(N,z) dN,$$

(Zafar et al., 2013b)

Constraints at z>2: no evolution



(Zafar et al., 2013b)

Remaining Issues

- role of sub-DLAs: $N(HI)>10^{19}$
- possible bias by dust
- pencil beam approach
- $z<2$ poorly constrained
- $z<2$ is where much of the action is expected to take place

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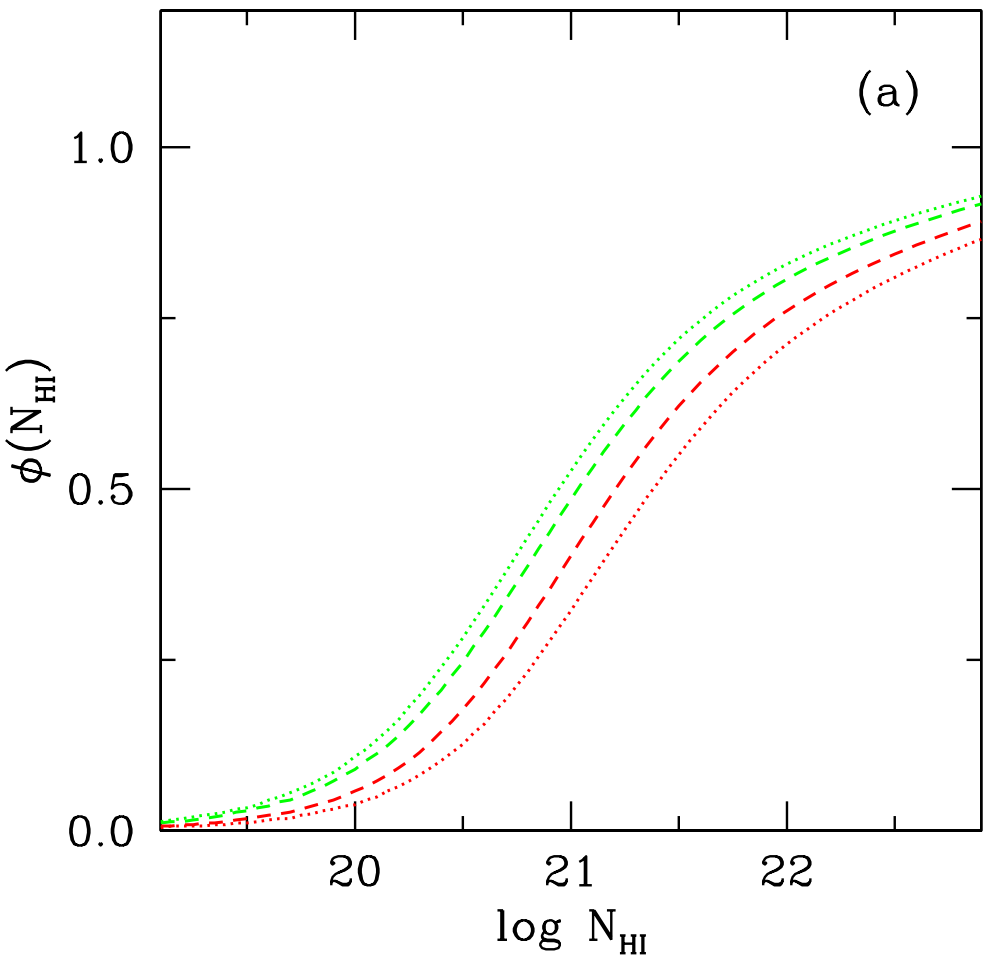

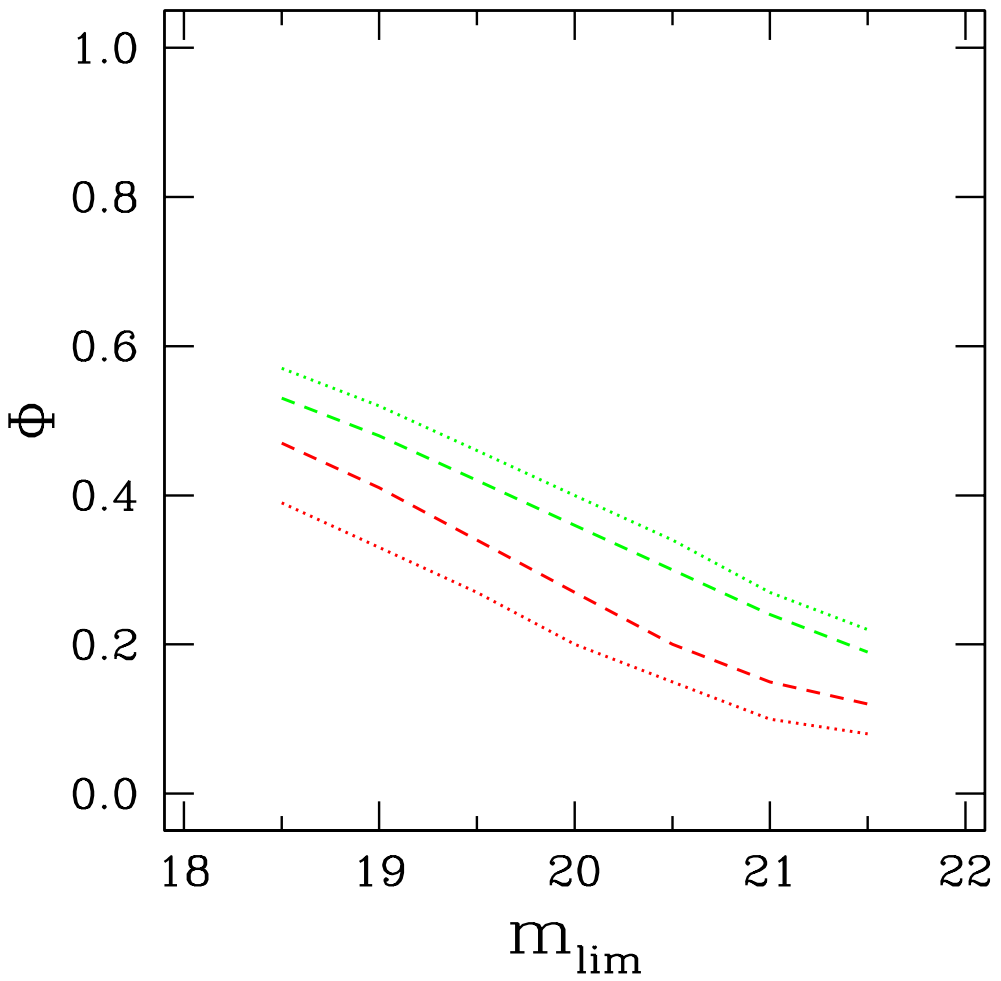

(Vladilo & Peroux 2005)

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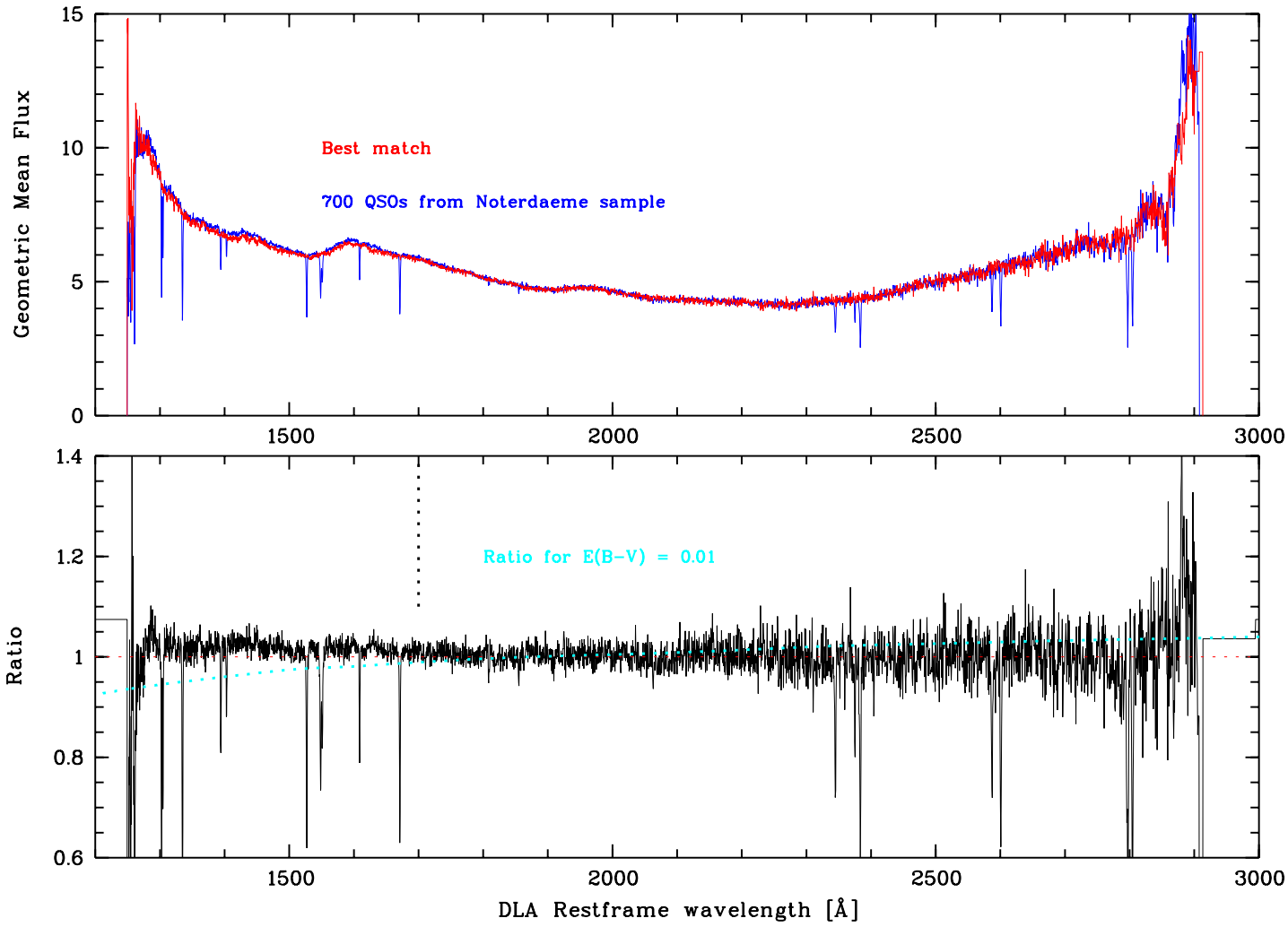

(Frank & Peroux 2010)

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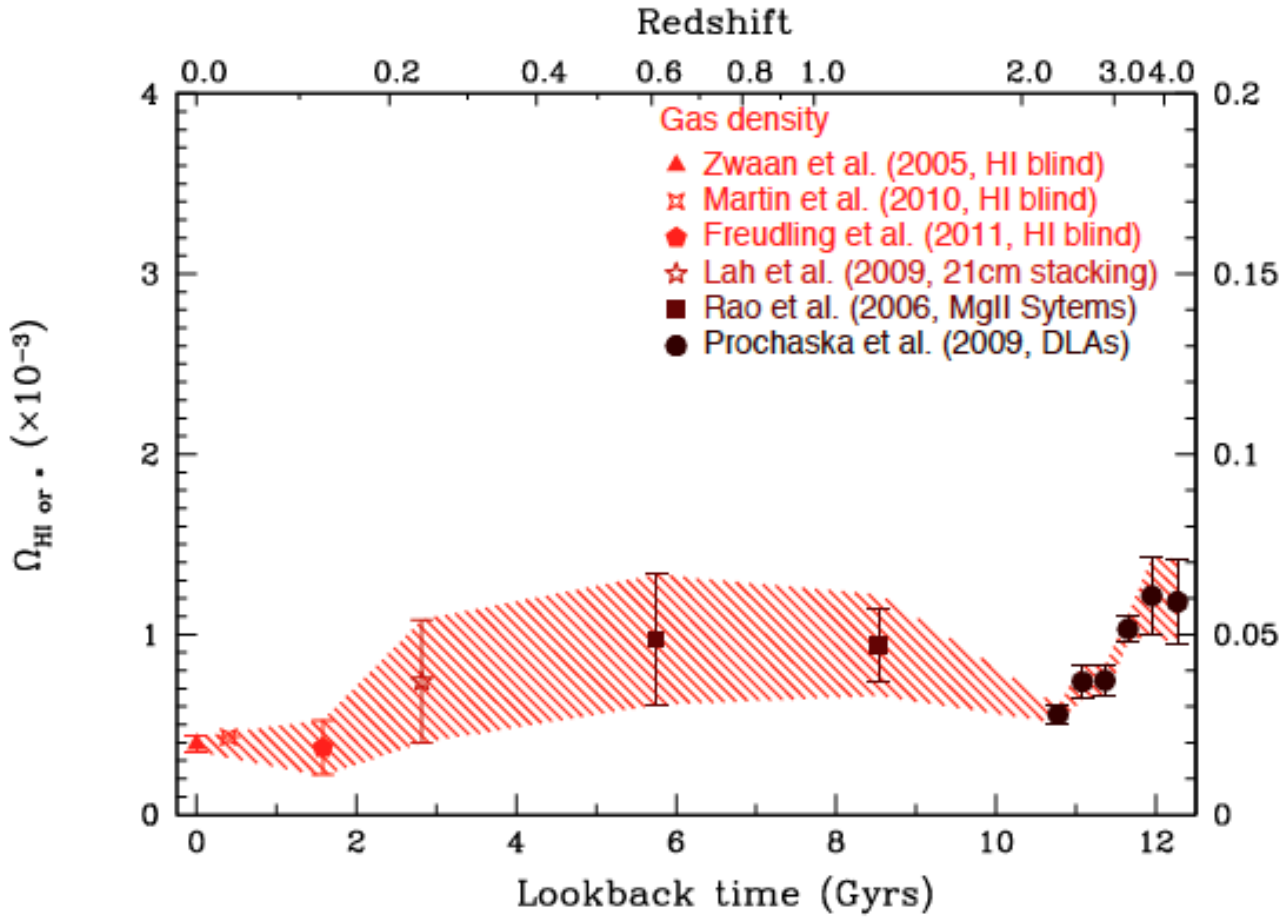

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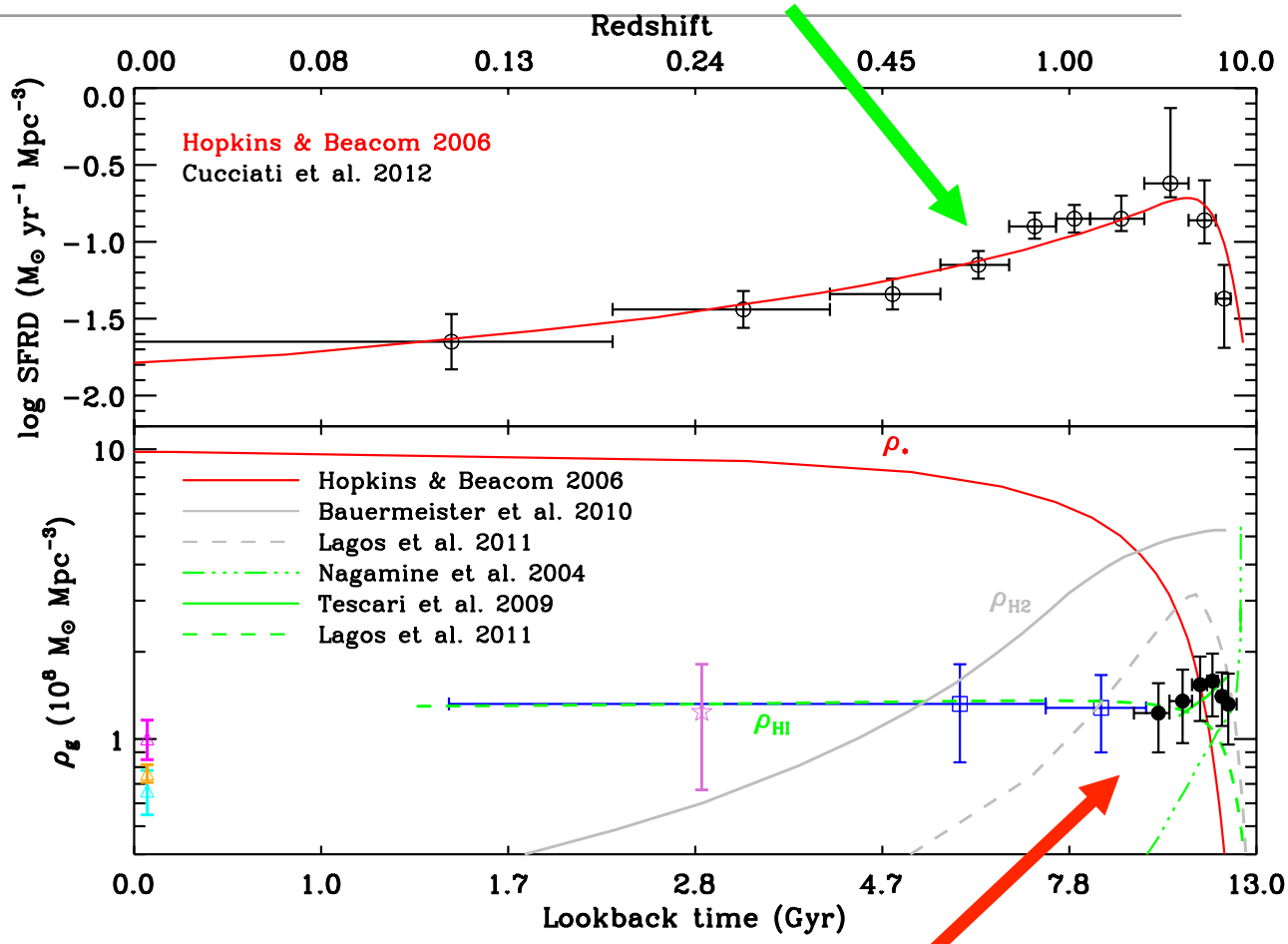
Star Formation Rate

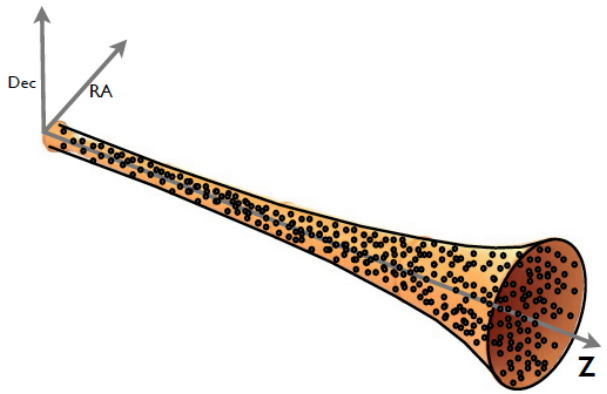


Neutral Gas

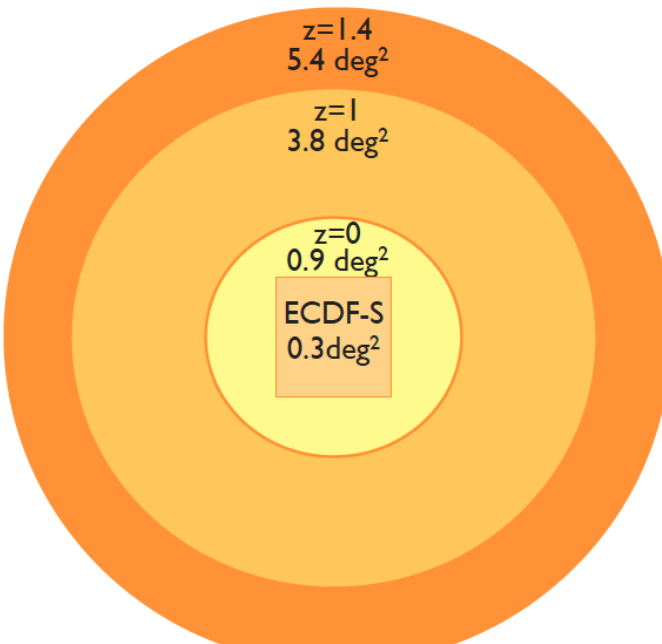
(Zafar et al., 2013b)

LADUMA on MeerKAT

- 21 cm line emission
- direct detection z<0.6, stacked z<1.4
- 5000 hrs
- 0.9 deg^2 @ z=0; 5.4 deg^2 @ z=1.2
- Extended Chandra Deep Field South = already 4000 z known & 10,000-20,000 more needed



- By z=1, the MeerKAT footprint overwhelms the ECDF-S coverage

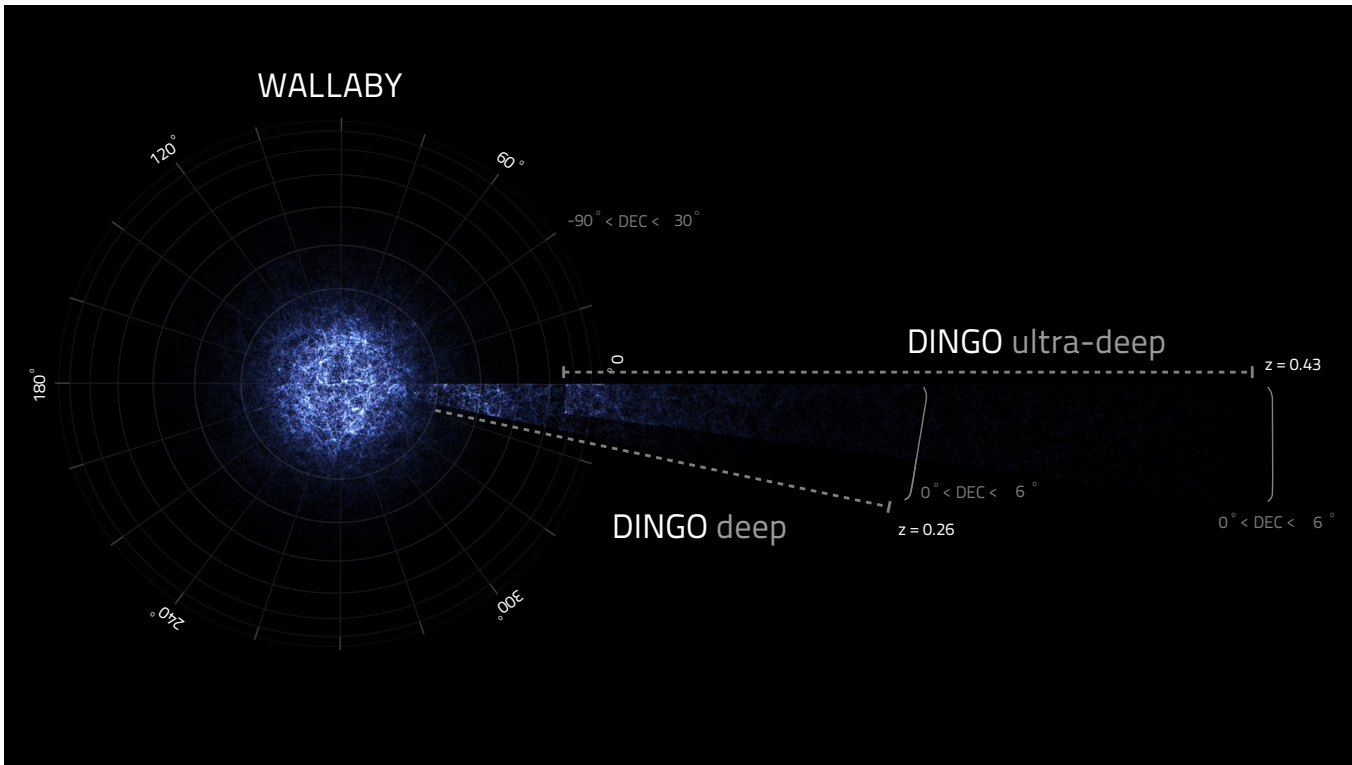


MALS on MeerKAT

- Absorption line survey for 21 cm and OH absorber
- >600 intervening abs @ z<1.8
- 4000 hrs, 2 hrs/pointing
- spatial resolution 10” @1GHz, spectral rms=0.7 mJy

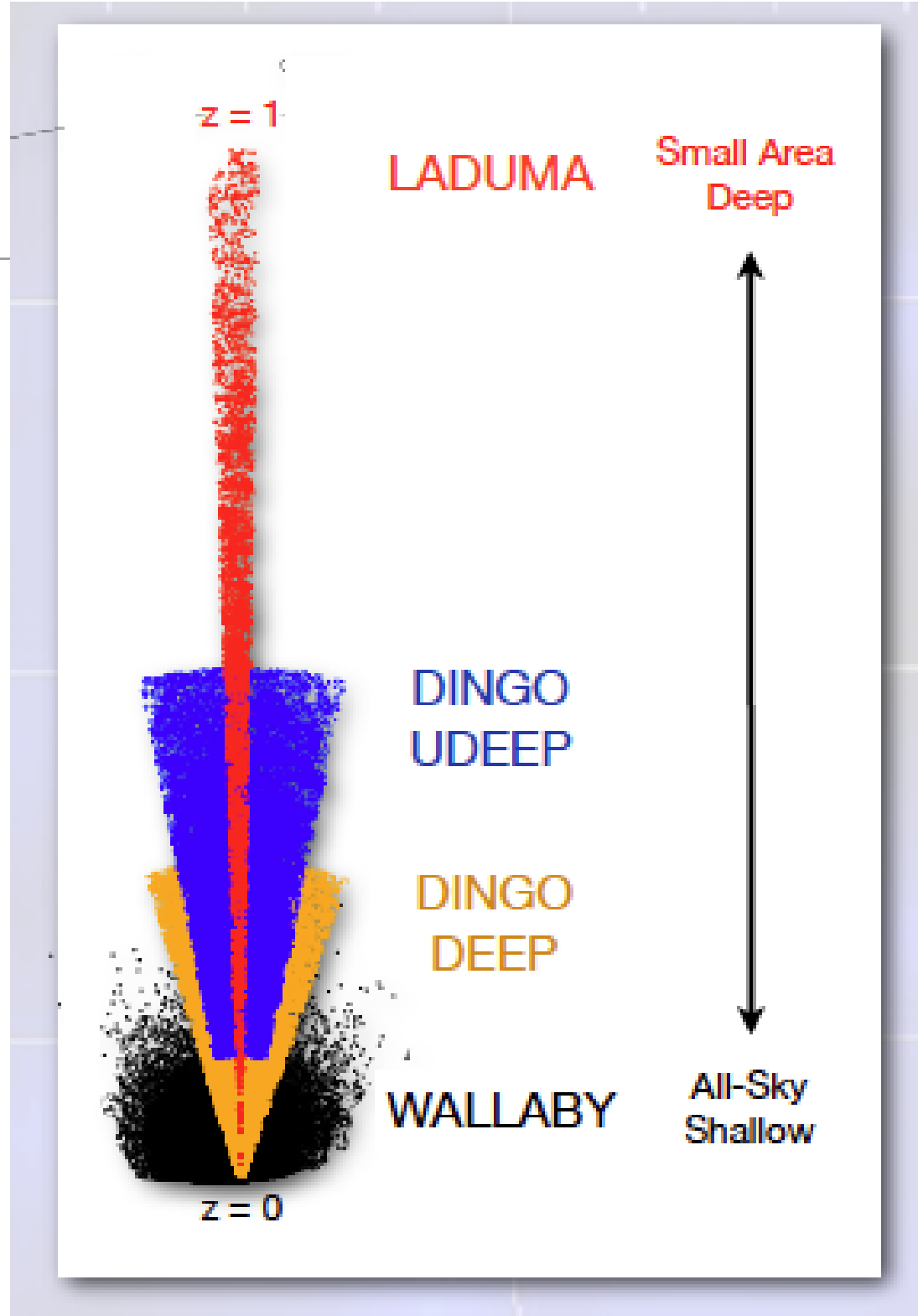
WALLABY on ASKAP

- HI emission: direct detections + stacking IR 6dFGS
- 500,000 gal (1000 resolved); z<0.26 (lookback time ~ 3Gyr), mean z~0.05
- 9600 hrs; 8 hrs per pointing
- 30 000 deg^2 (75% of sky); N(HI)>1.7x10^{19} = sub-DLA



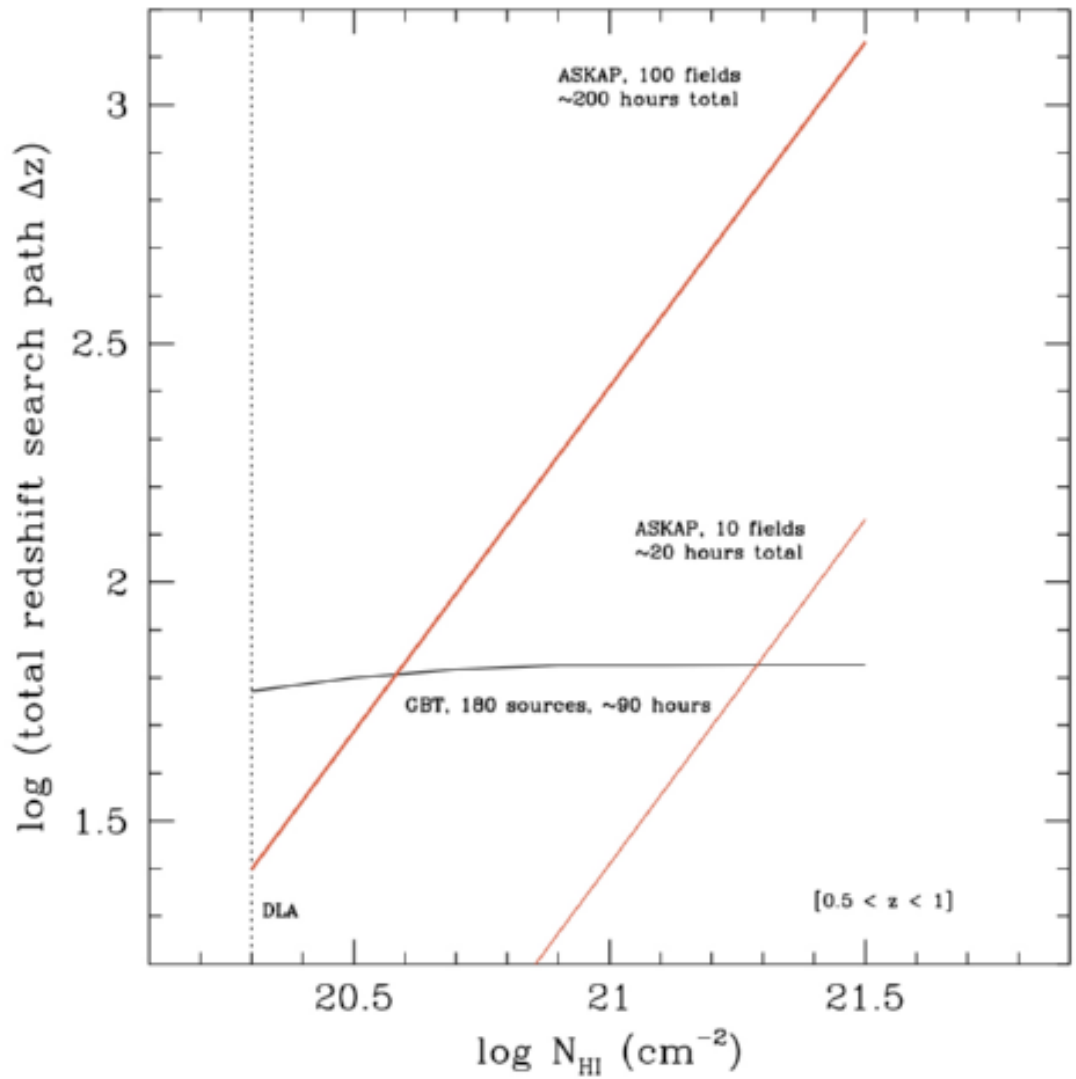
DINGO on ASKAP

- HI emission:
  deep (N(HI)>2.1x10^{18})/
  ultra-deep (N(HI)>1.0x10^{18})
- 40,000 gal; 0.1<z<0.48 (lookback time ~ 4Gyr)
- 150 deg^2 @ z<0.26/
  60 deg^2 @ z<0.48
- T_exp=500/2500hrs per pointing
- on GAMA region



FLASH on ASKAP

- blind HI absorption line
- 150 000 los, 450 intervening abs, 600 associated abs; 0.5<z<1
- Texp total=1600 hrs, 2 hrs per field
- survey area = 2500 deg^2, N(HI)~3.4x10^{19}; angular resolution = 30”



Conclusions

- Cosmological evolution of neutral gas mass is a key component to our understanding of galaxy evolution
- 21cm line provides an important probe up to $z<2$ in a so-far little-probed range
- new outcomes to expect from upcoming surveys (APERTIF...) and ultimately SKA
- intensity mapping [Chang et al. 2010]