The HI Universe

- Cold and dense gas : Large surveys 21cm absorption-emission
- Galaxy formation and evolution
- Star formation history
- Feedback, winds, metals in the IGM

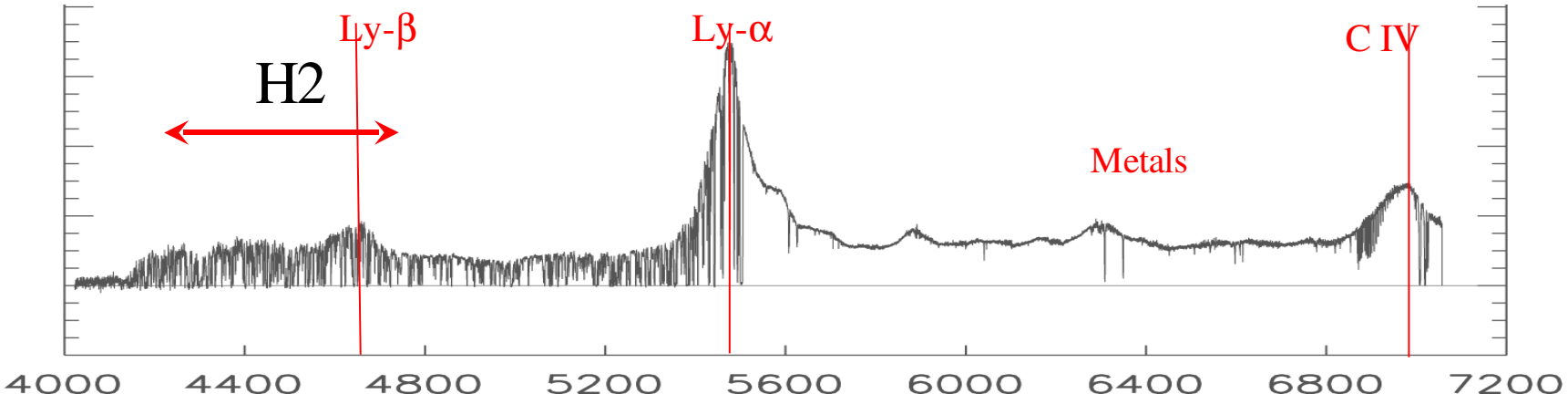
-> Census of OmegaHI in the SDSS -> reservoir for SF

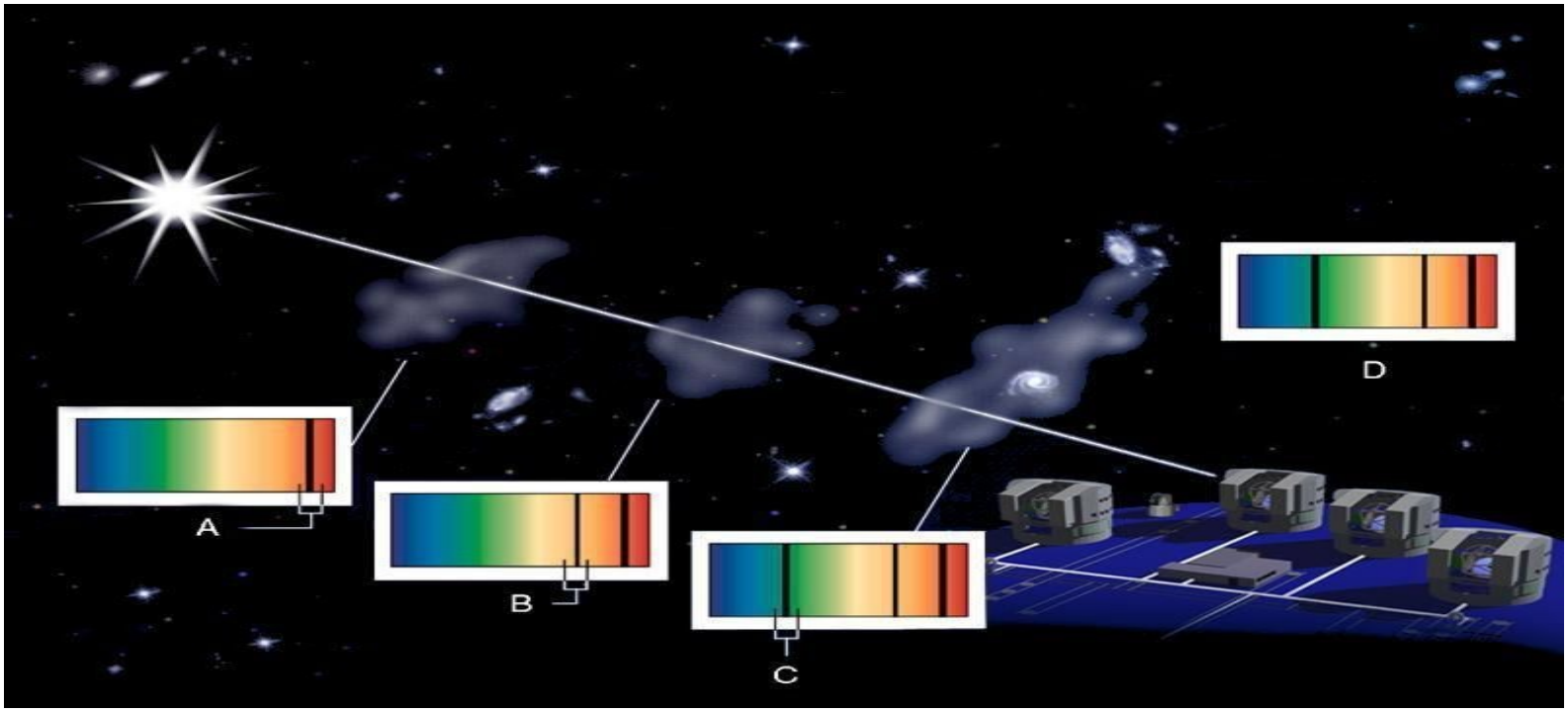
-> The interstellar medium at high-z

-> 21cm absorbers => Ts

P. Noterdaeme (IUCAA-IAP)

Quasar Absorption Lines -> Diffuse IGM and dense ISM





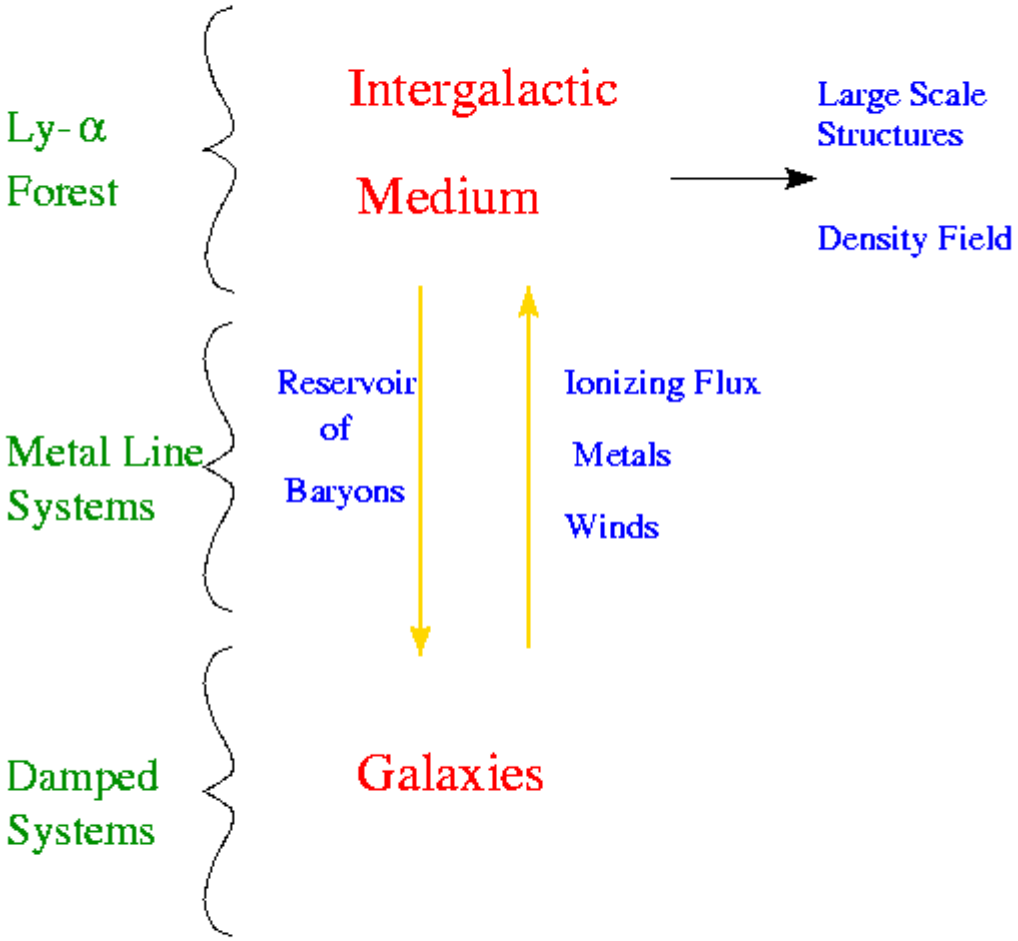
QSO (GRBs ?) Absorption Lines

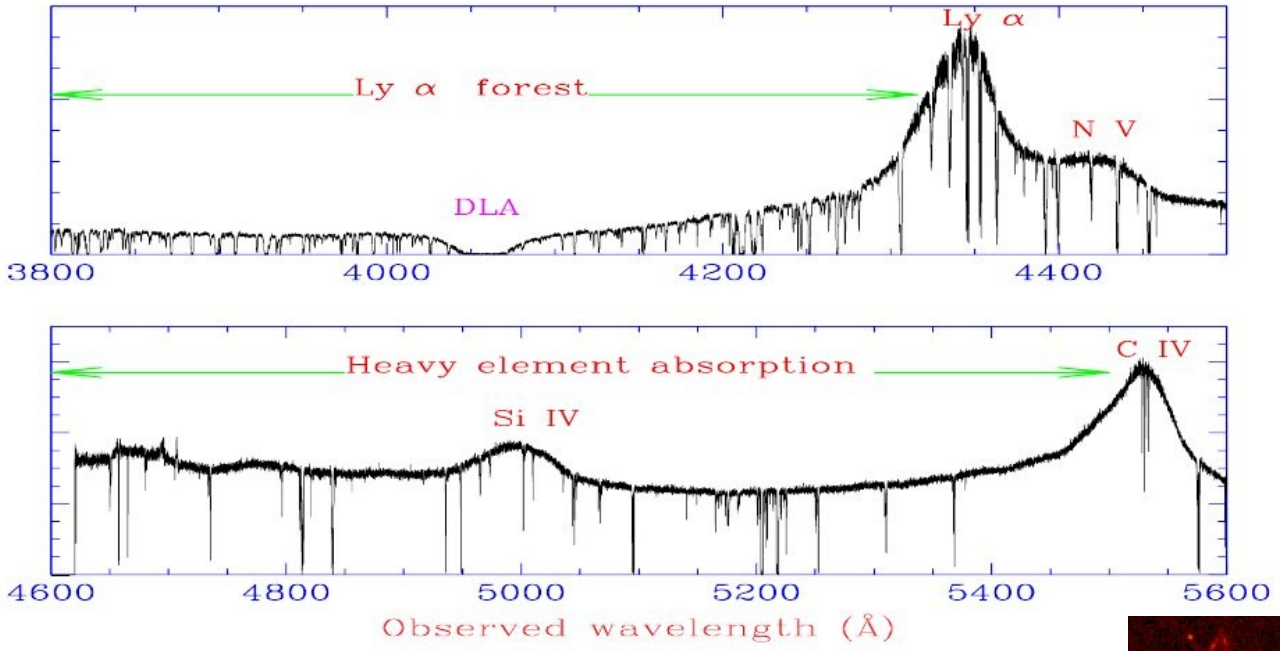
Metals in the IGM

Association with galaxies

Metallicities and SF

MIS at high-z





DLA z>1.6

Strong MgII z<1.6

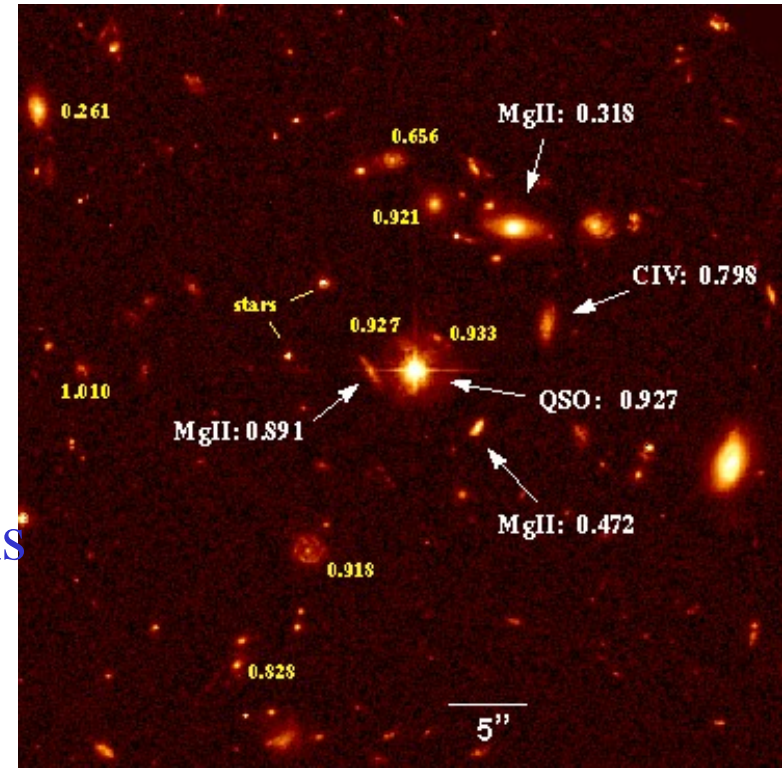
Selection of absorption systems

Automatic : 1 DLA in 10 los

1 MgII system in every los

SDSS: 1000 DLAs BigBoss: 100 000 DLAs

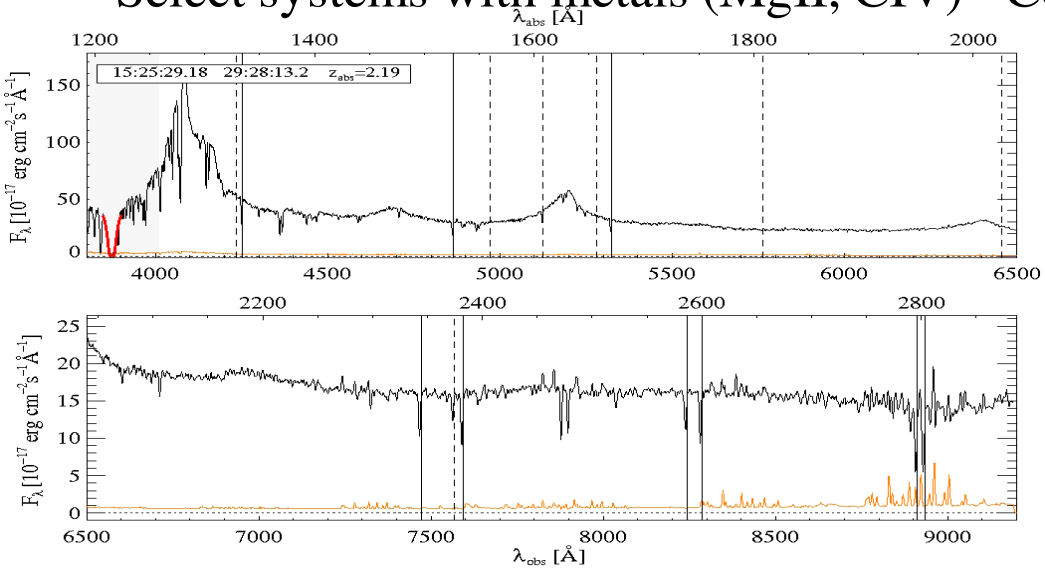
10000 MgII 10^6 MgII

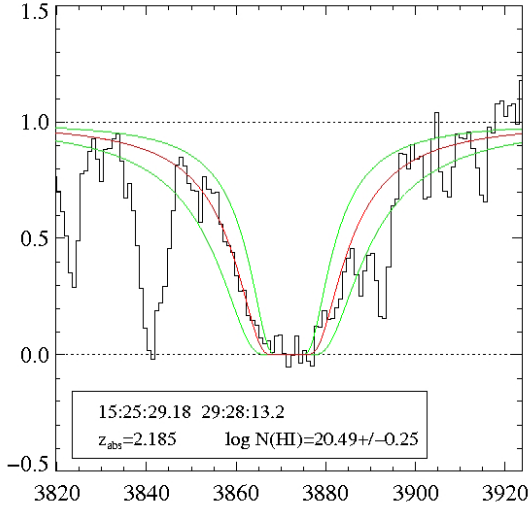


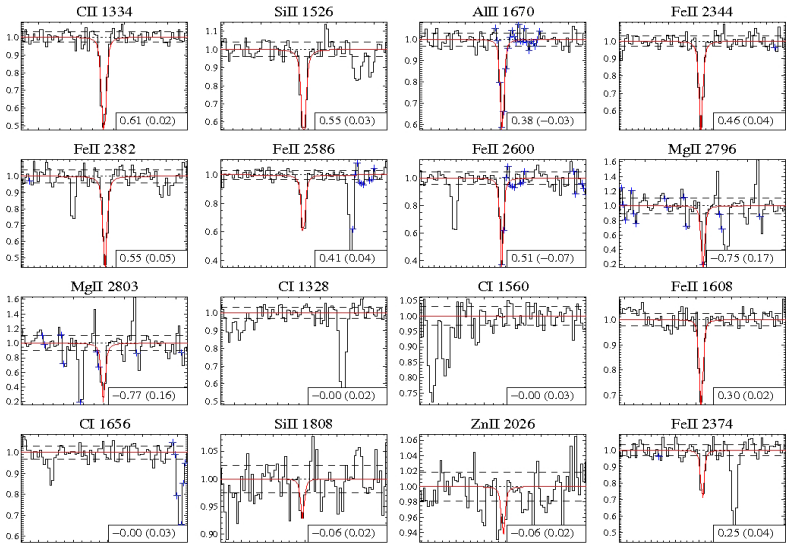
Selection of systems

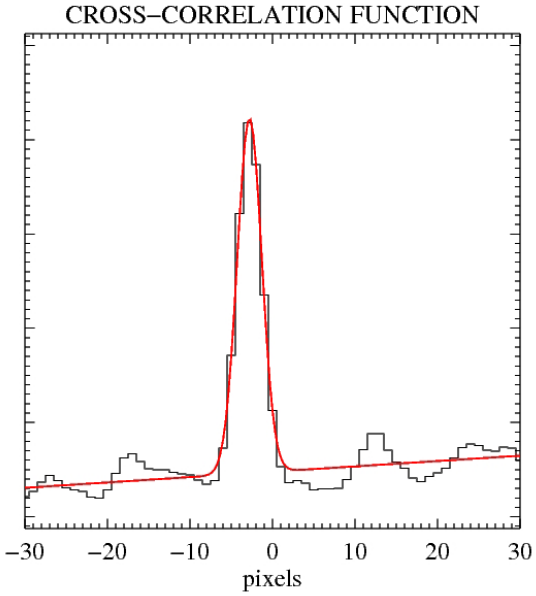
-Search the SDSS quasar spectra for DLAs : Fully automatic procedure

-Select systems with metals (MgII, CIV) - Cold gas-> CI









Once detected which projects ?

-Census of HI in the universe

-Dust : in individual objects : depletion – extinction

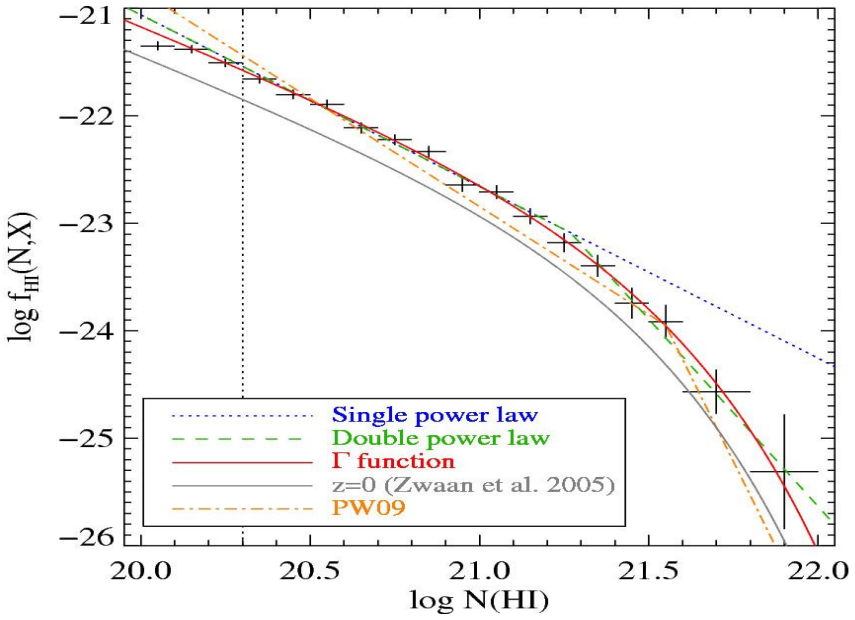
Stacking : detection of dust up to 1Mpc from galaxies

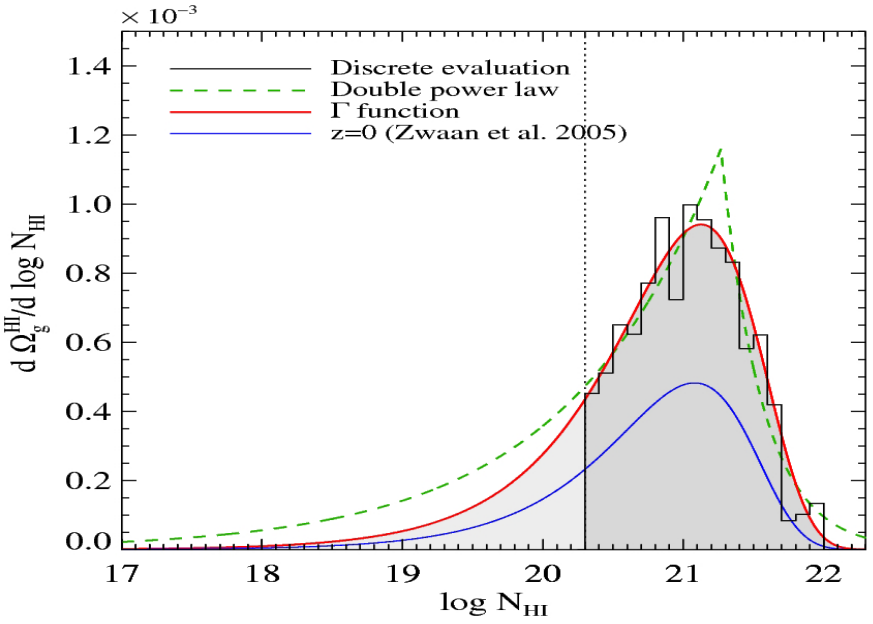
-Molecules (H2, HD, CO etc…)

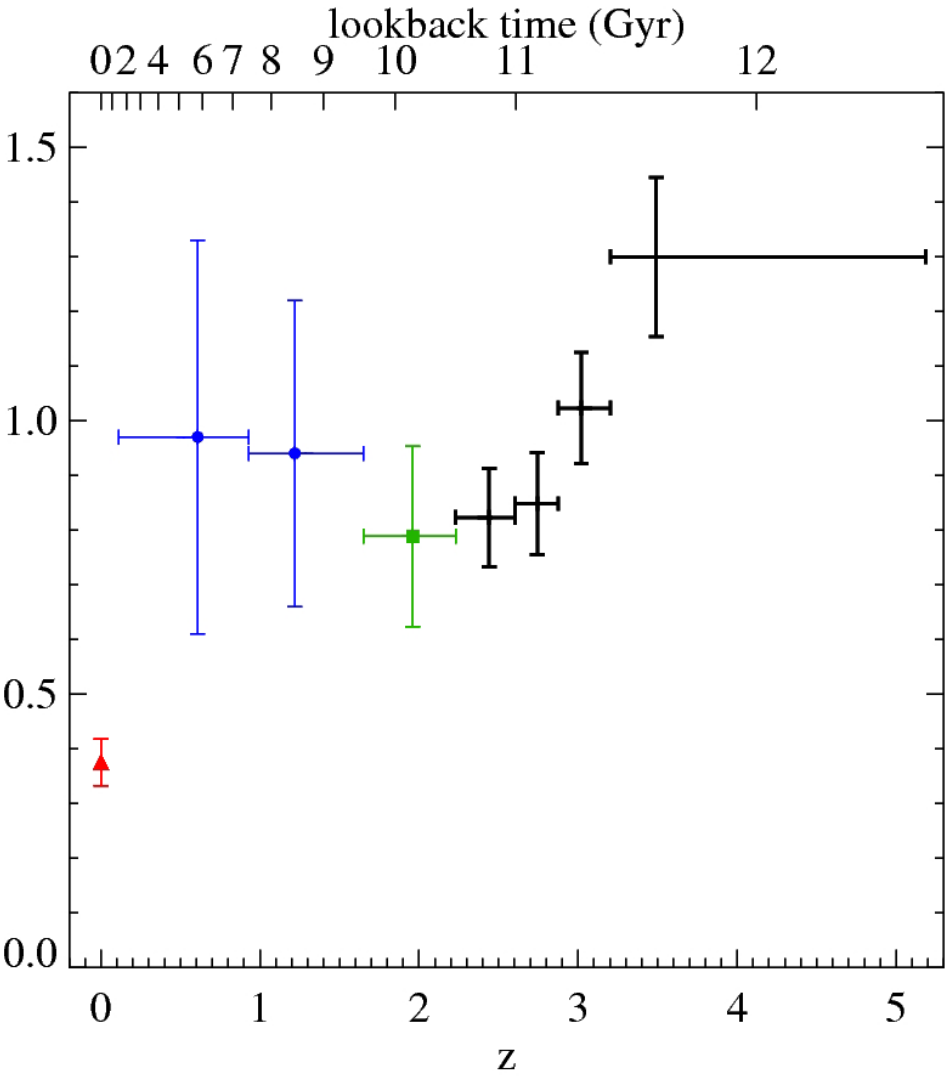
-21cm absorbers

-Associations with galaxies

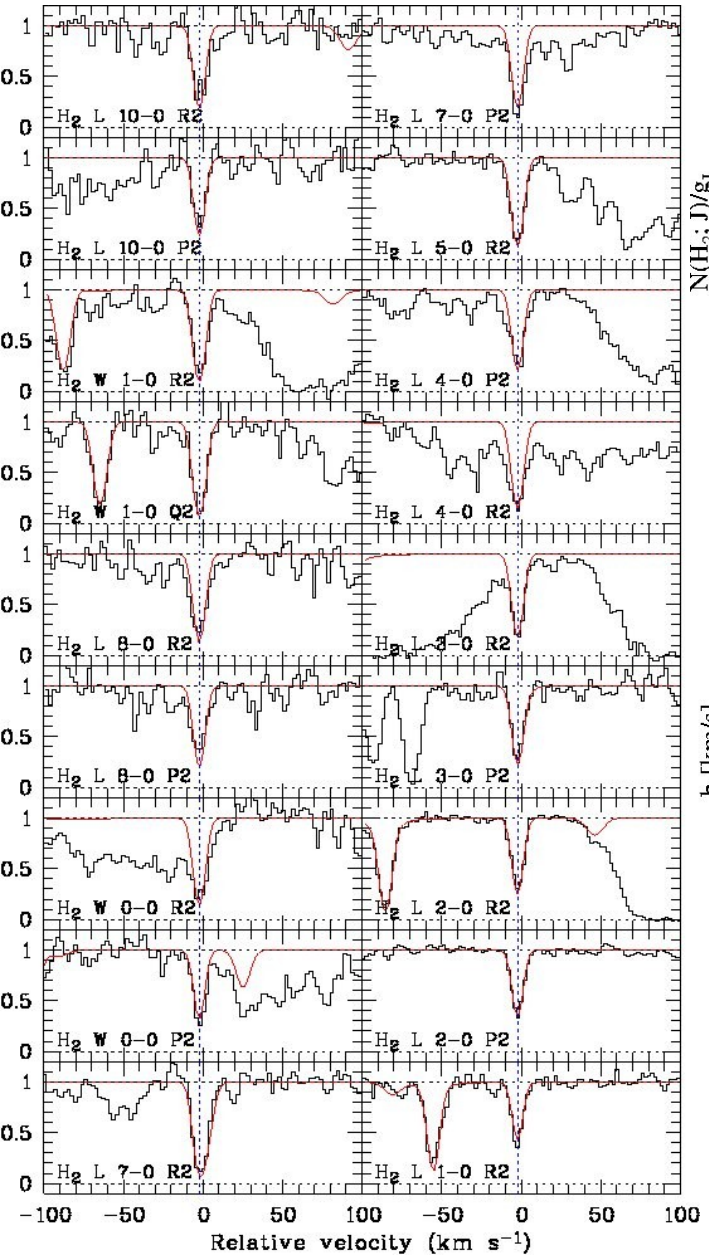
DLAs in the SDSS

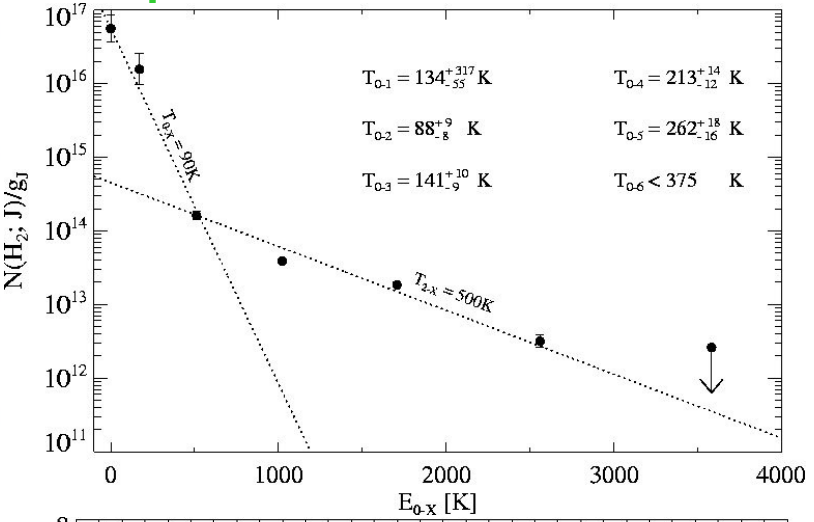


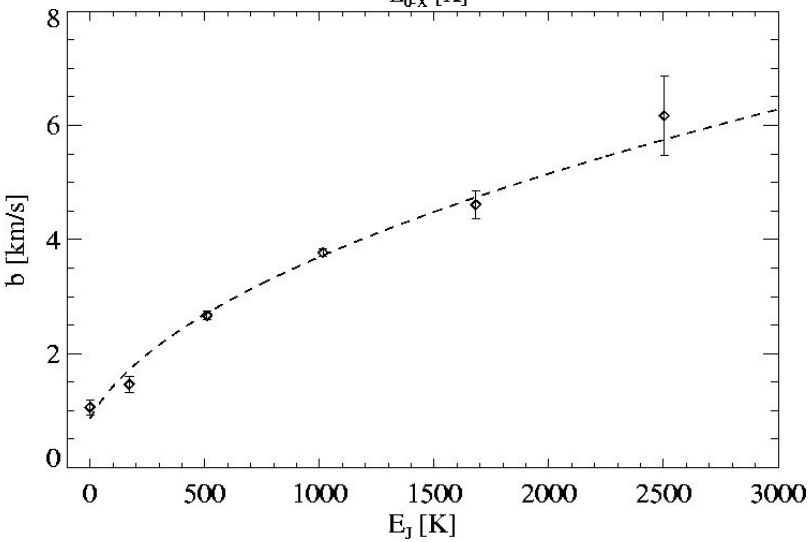




H2: detected in 10% of cases: Heating processes up to z=4.2







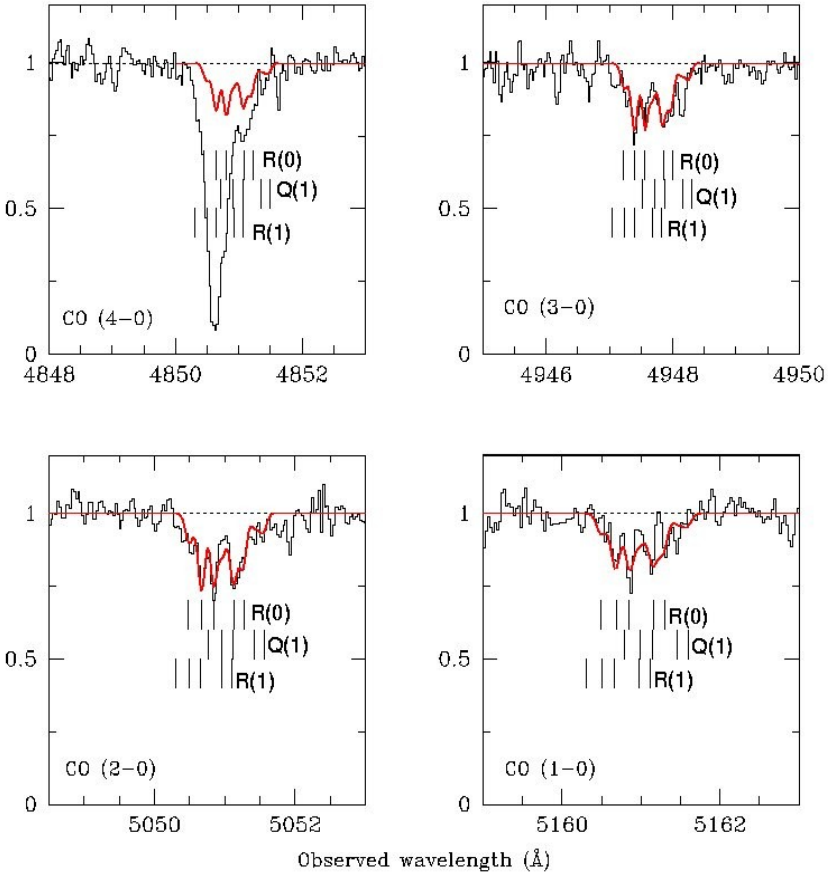
2 components ?

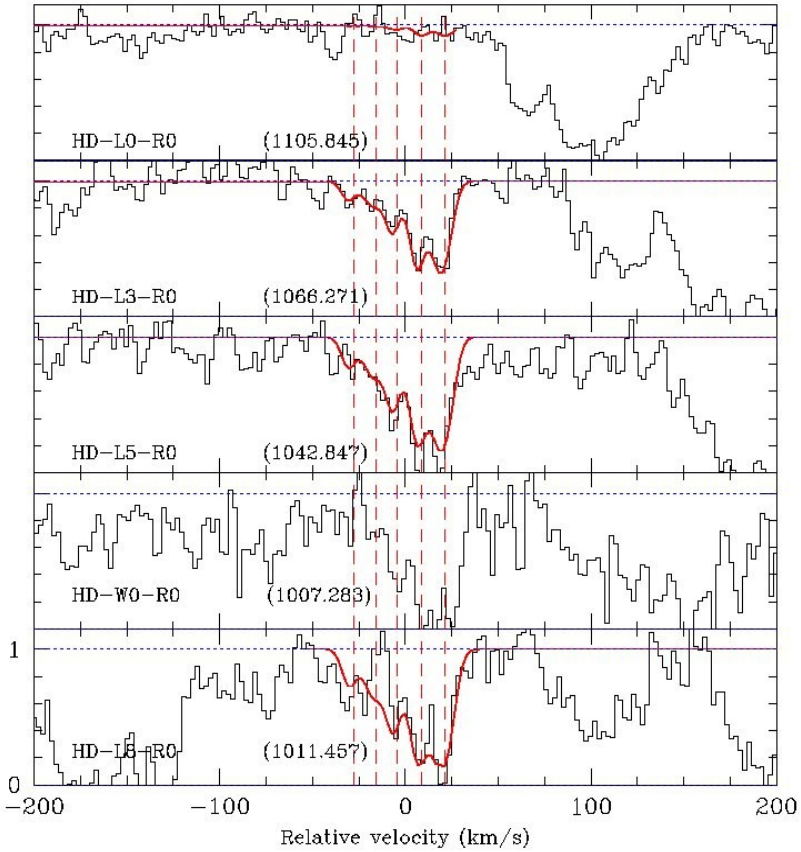
No shift – Ad'hoc

⇒New Heating Process

Doppler parameter increases with J

CO and HD : CI selection (50 systems)





Log(f) = -0.3 (highest in DLAs) ; CO/H2 = 3×10^{-6} ; Solar metallicity

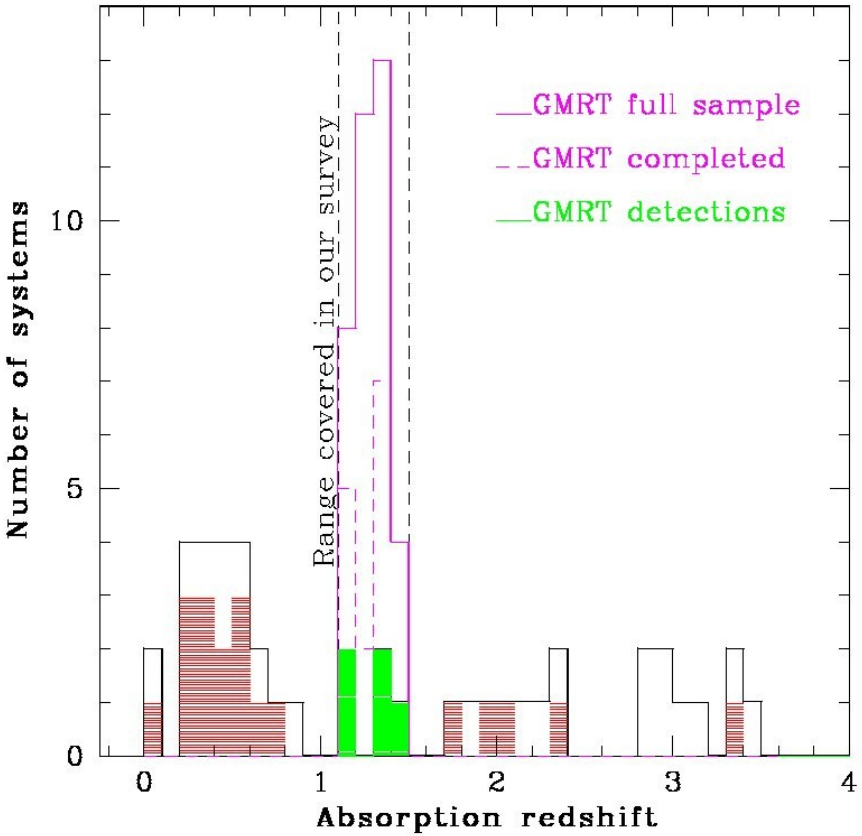
HD/2H2 = 1.9×10^{-5} (Galactic local ISM)

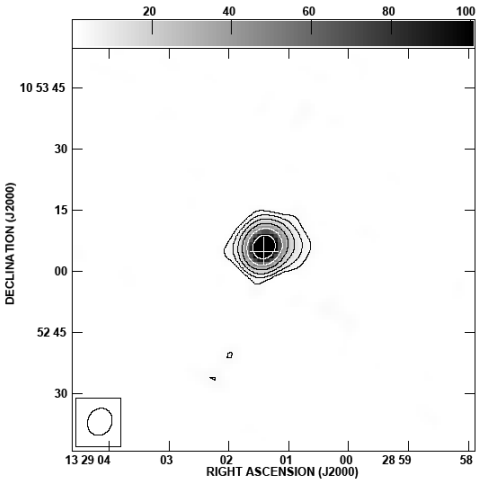
Last run in April 2009 : 6 detections -> 20 by the end of the survey

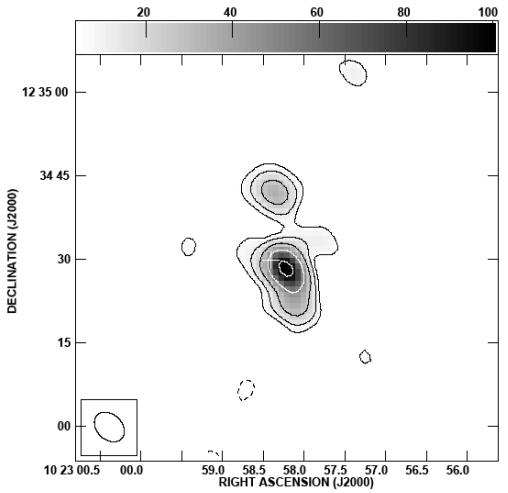
Srianand et al. (2008) A&A, 482, L39 - Noterdaeme et al. (2008) A&A, 491, 397

Cold gaz at intermediate z
SDSS-GMRT Sample of MgII Systems : 21cm absorption

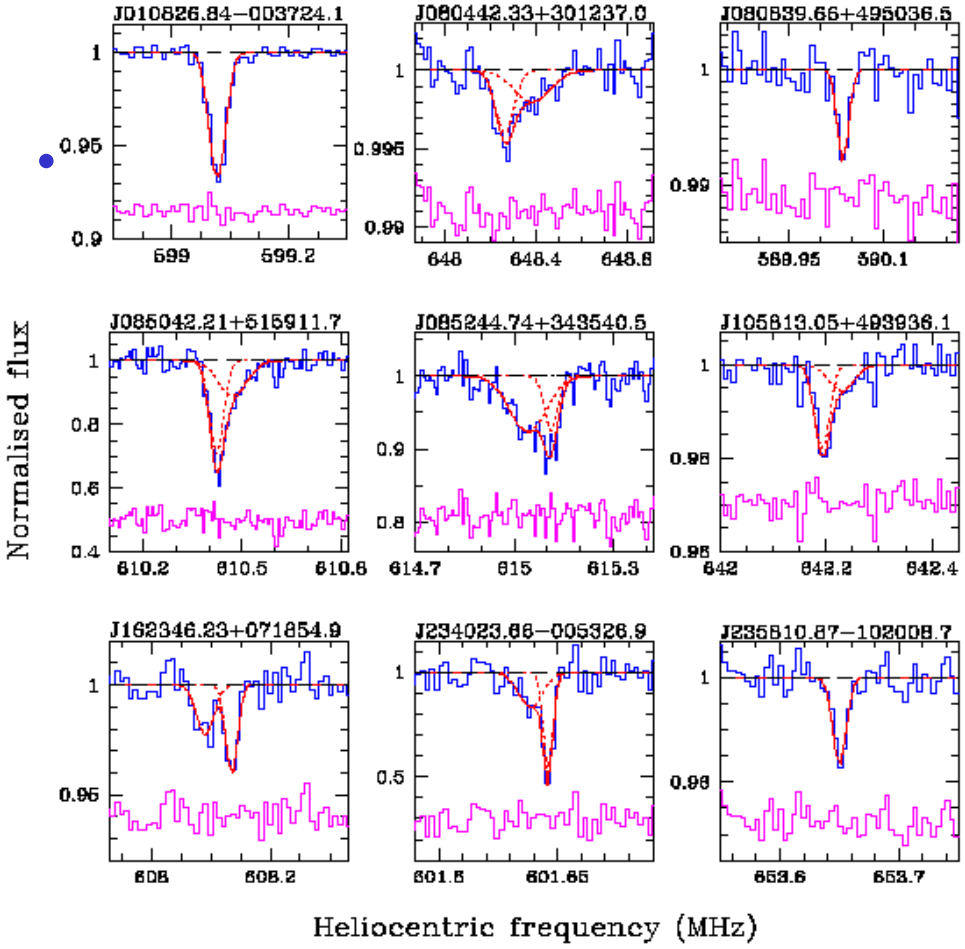
400 hours at GMRT







New detections



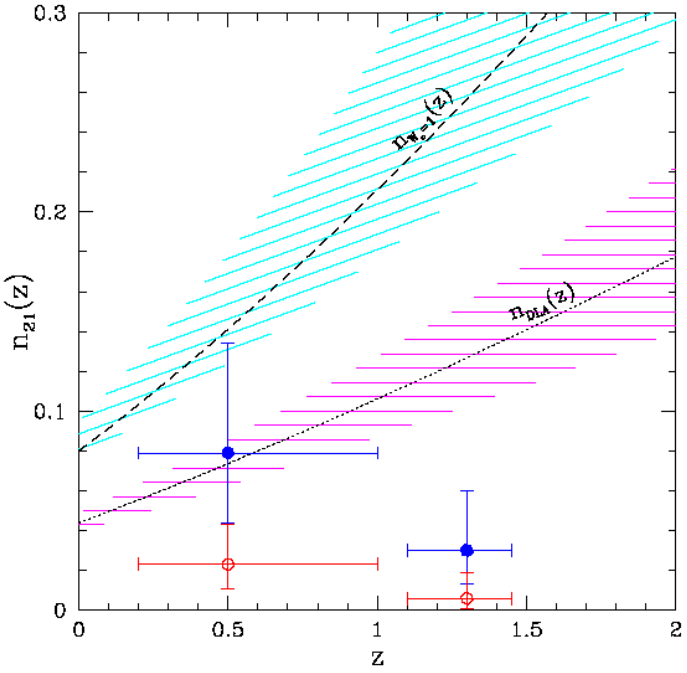
- High resolution : 1 km/s
- Delta v small < 100 km/s
- Well defined component

⇒Askap

⇒Alma: [CII] emission

SFR

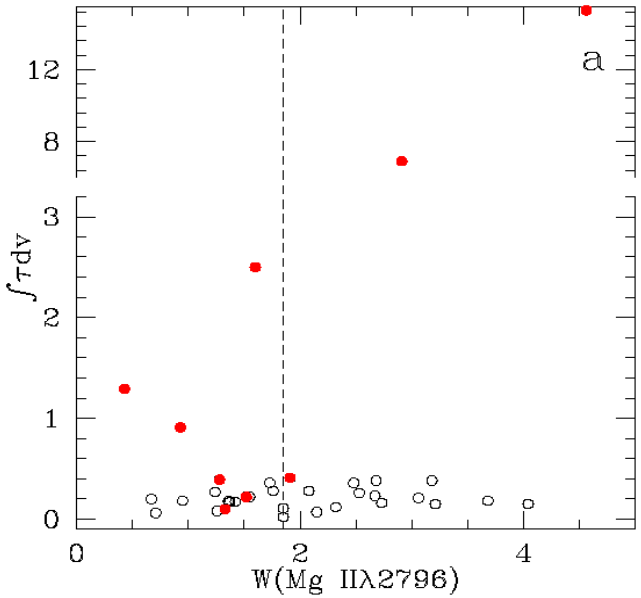
Results

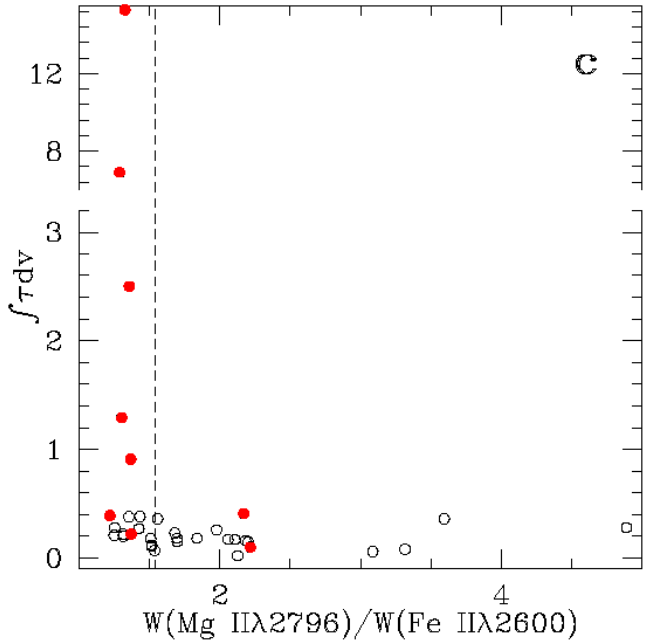


Number density decreases with z

Higher Ts at high z ?

Cold gas with high optical depth

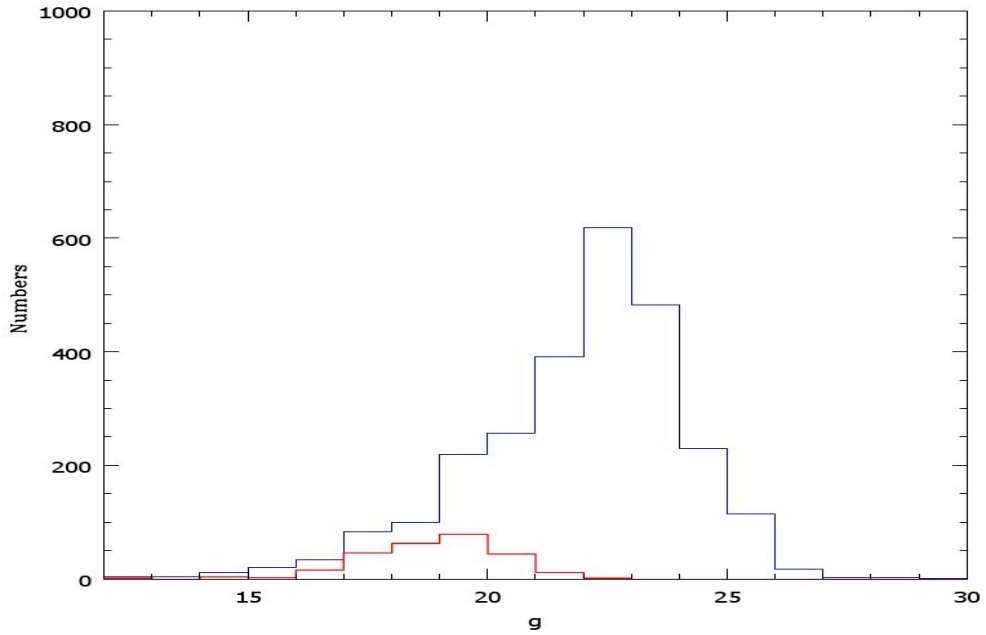




Blind search for HI absorbers z<1

Askap proposal -> 1200 deg^2 for 4000 hours

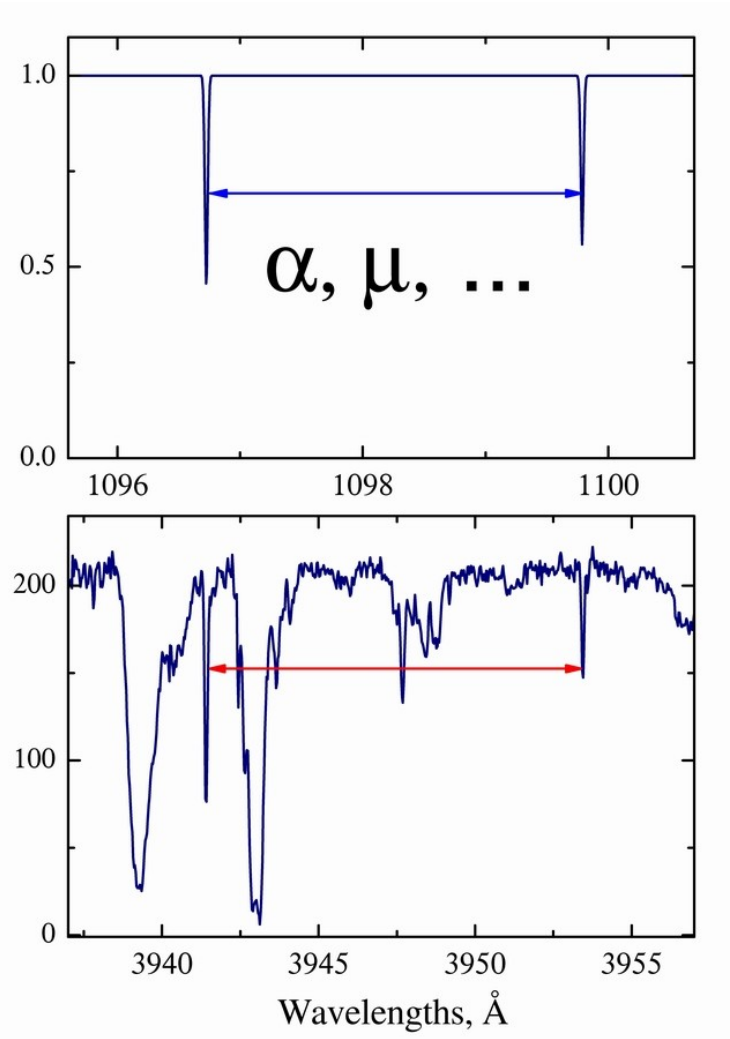
Search for HI and OH absorbers : 200 systems expected



Optical follow-up of radio sources

…. Rejected but…

Variation of constants

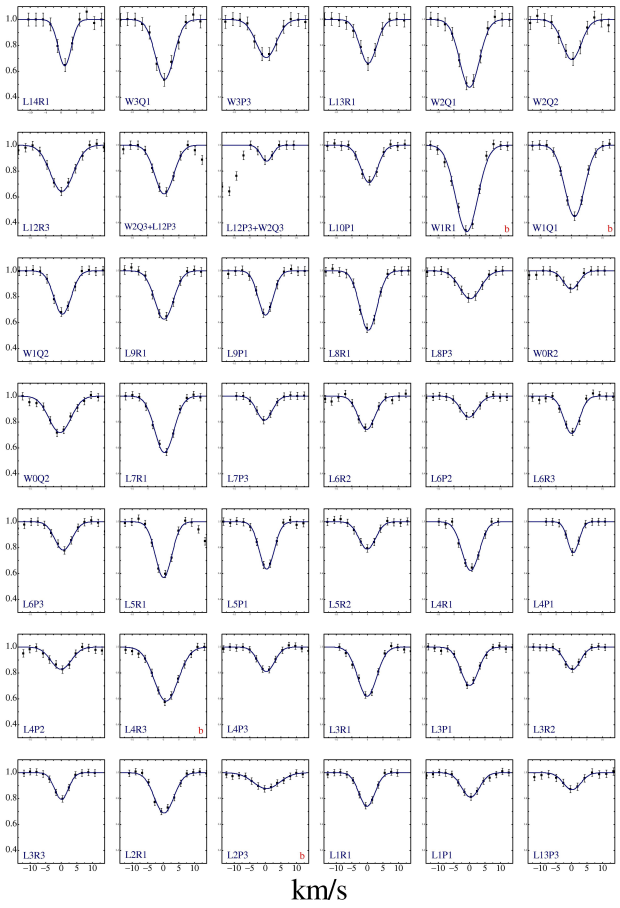


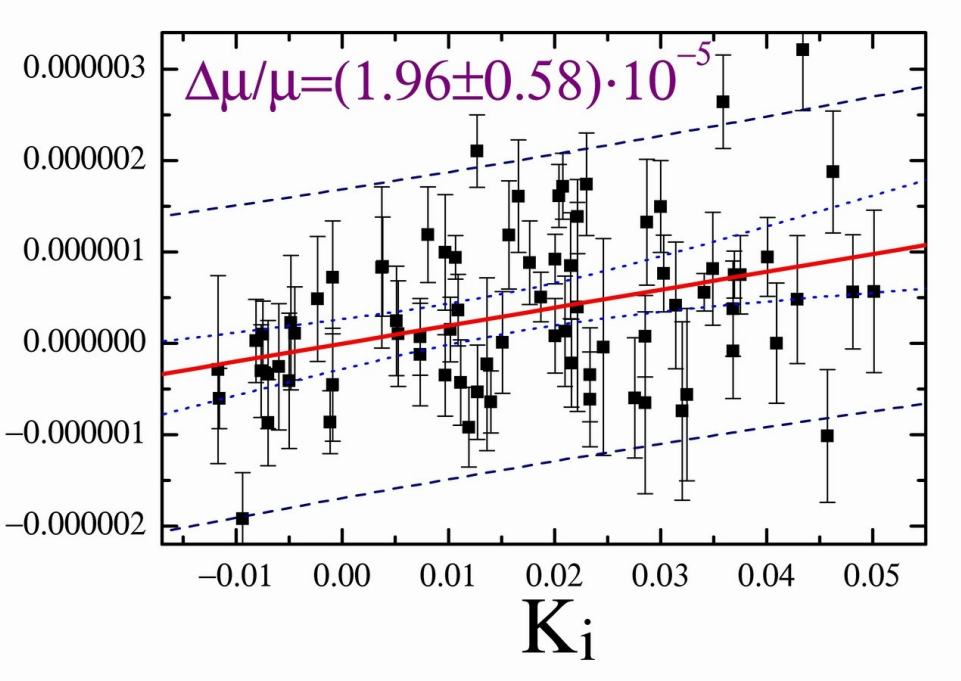
$$\frac{\lambda_i^{obs}}{\lambda_i^{lab}} = (1 + z_{abs})\left(1 + K_i \frac{\Delta\mu}{\mu}\right)$$

$$\lambda_i^{obs}, \quad \lambda_i^{lab}, \quad K_i$$

$\mu = m_p/m_e$: H2

Q0347-383





King et al. (2008) PRL 101, 251304

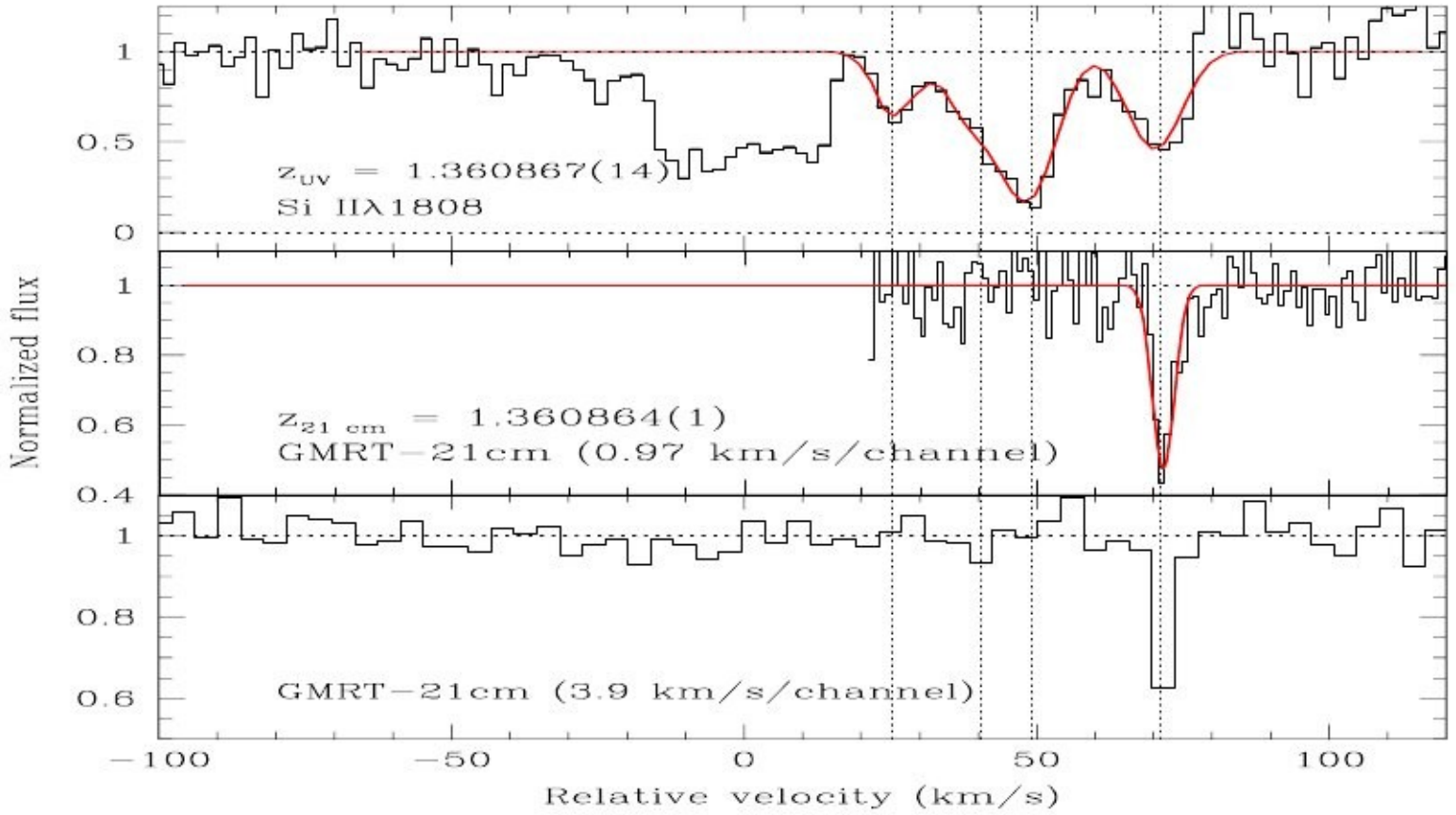
/ $< 10^{-5}$

UVES: 20 hours per line of sight – Only two cases

High Resolution : Blending - Narrow lines

GMRT sample of 21-cm absorption:

$$\Delta x/x = (1.27 \pm 2.96) \times 10^{-6}$$



x= ^2g_p/

Conclusion

Blind survey for 21cm absorbers at z up to 1

The ISM of high-z galaxies

Variation of fundamental constants