Riunione Informativa Progetto HiRes

Metals in the high-z inter-galactic medium: future prospects with HiRes

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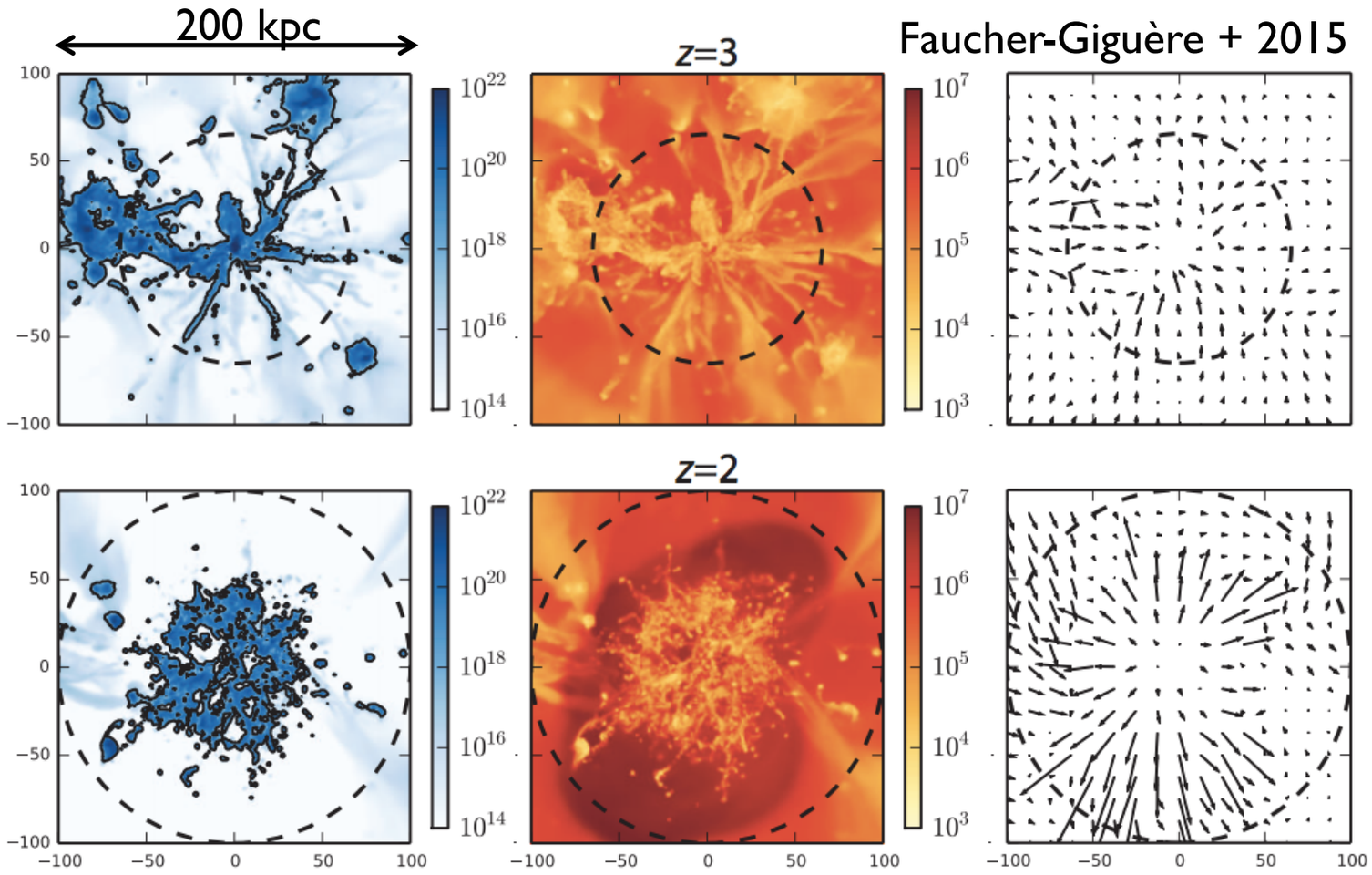
The cycle (and re-cycle) of baryons

- ✧ At z >1.5 about 90 % of the baryons are diffused in the IGM, the physical processes at work are simpler than for galaxies;
- ✧ The IGM acts as a reservoir of fresh gas for galaxy and stellar formation and as a sink for the products of galaxy/stellar evolution (radiation, chemical elements)

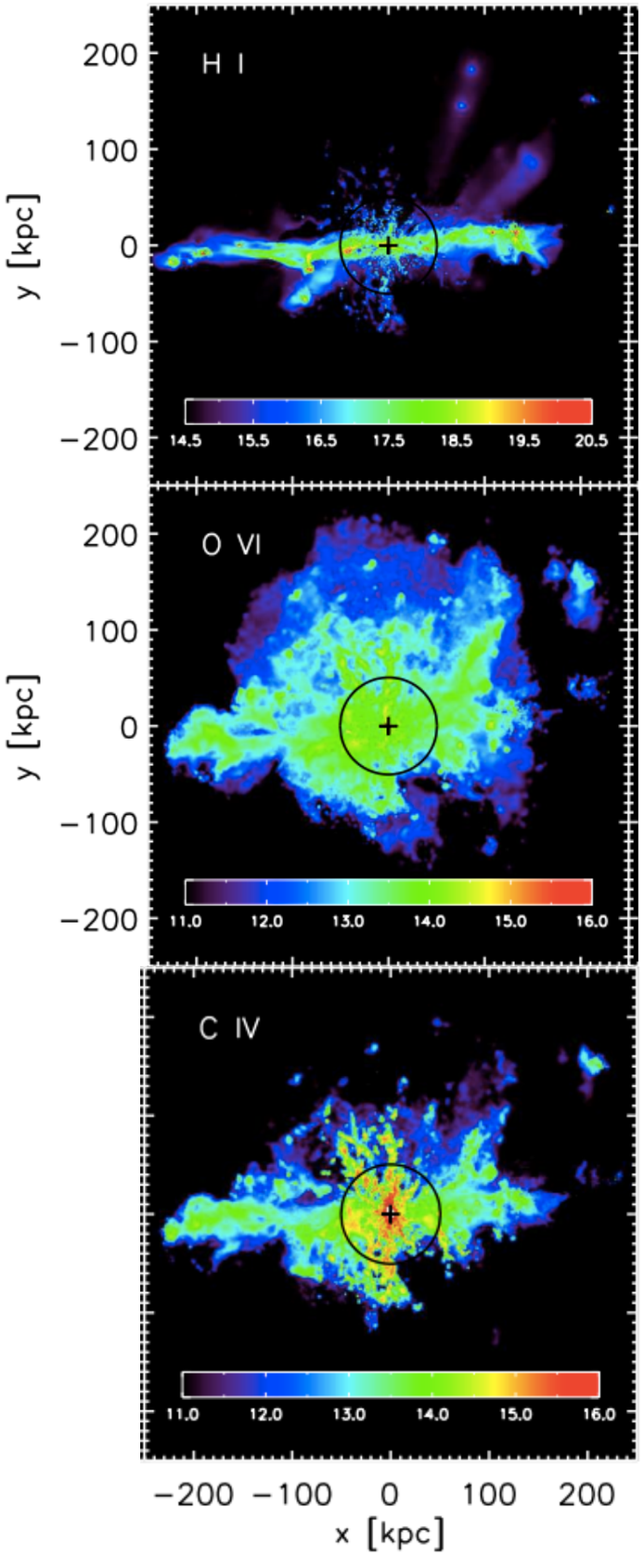
ACCRETION

SFR

OUTFLOWS



The cycle (and re-cycle) of baryons

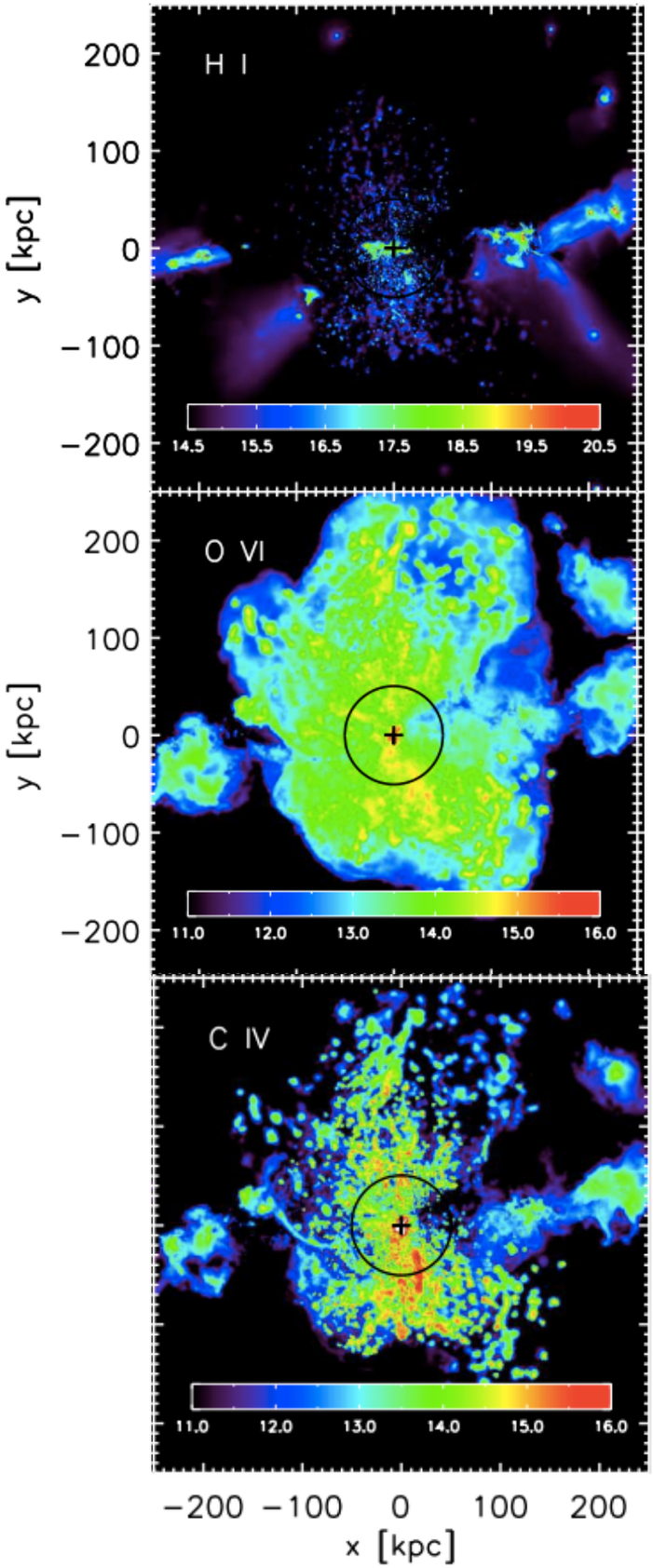


z=2.8

HI

OVI

CIV



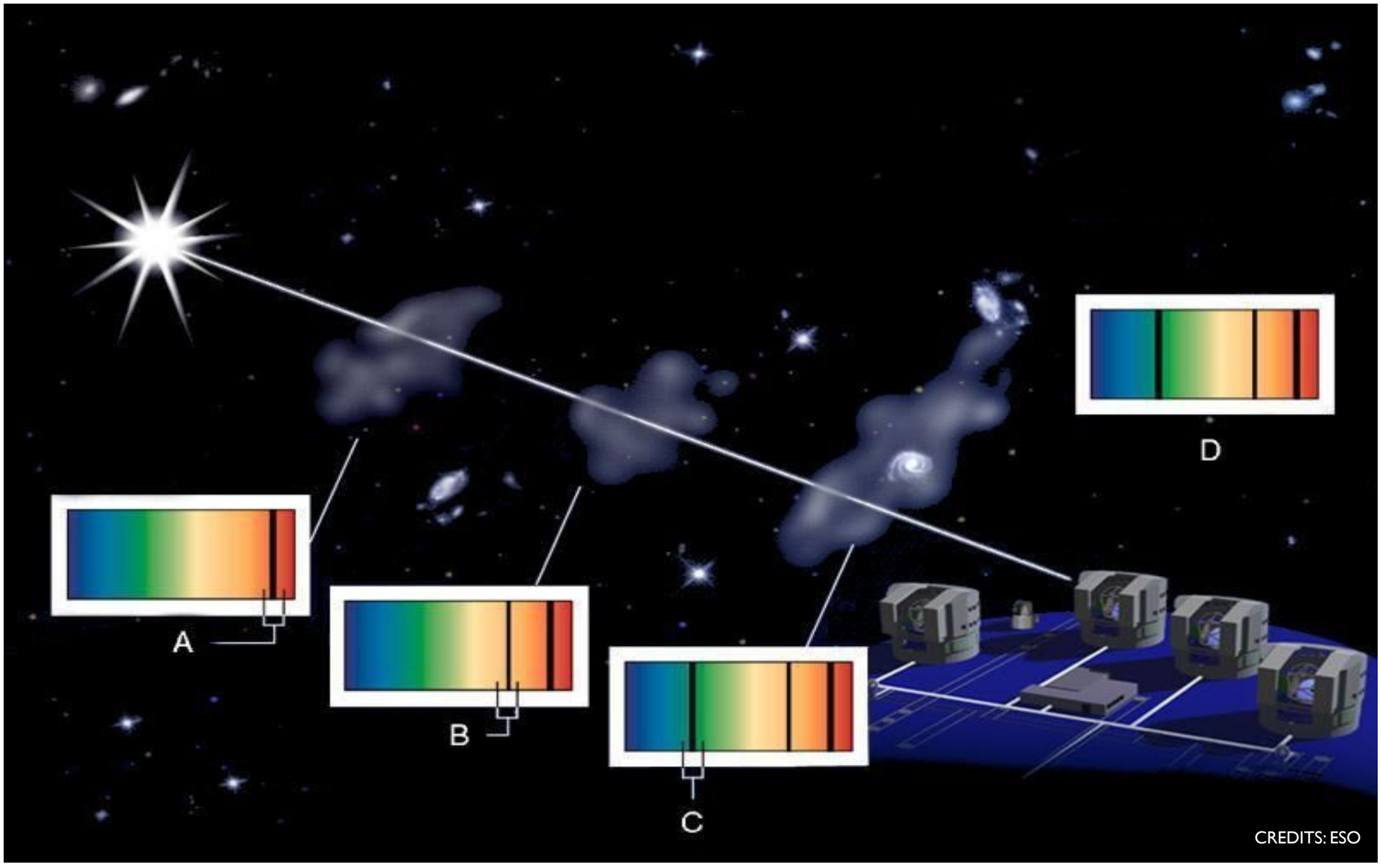
INFLOWING

OUTFLOWING

Shen et al 2012

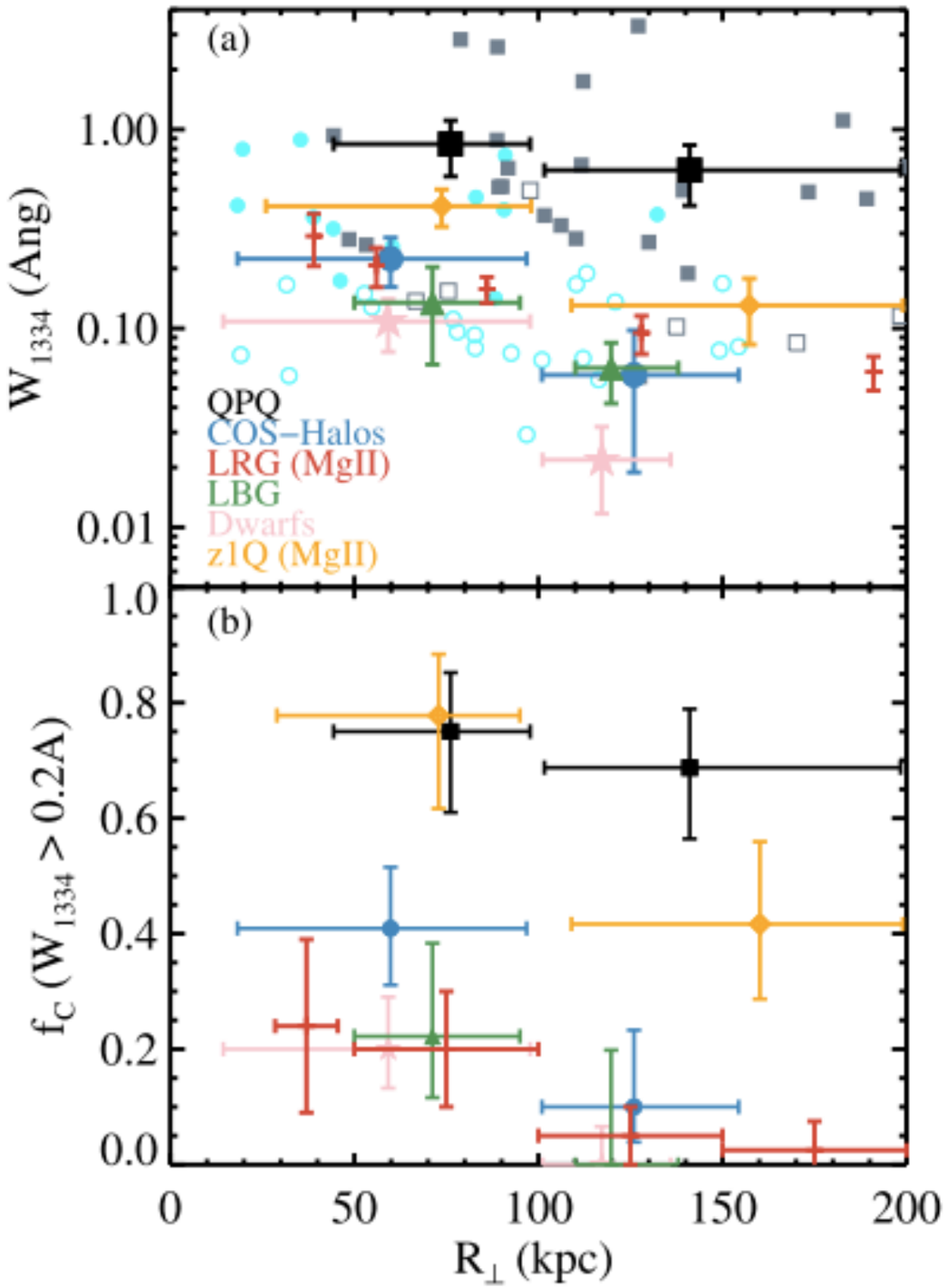
Investigation technique

Features due to ionic transitions in chemical elements detected in absorption in the UV/optical/NIR spectra of high-redshift, relatively bright background sources



Probe the tenuous gas

Metals are observed close to galaxies



What happens when we move further away, in the low density gas?

Probe the tenuous gas

Only TWO quasar spectra observed at high resolution with high enough SNR

UVES DEEP SPECTRUM (P.I. S. Cristiani) QSO at z_{em}~3.0 with V=16.9 T_{exp}=64 h

CIV DETECTION RATE at the low N(HI)s is LOW

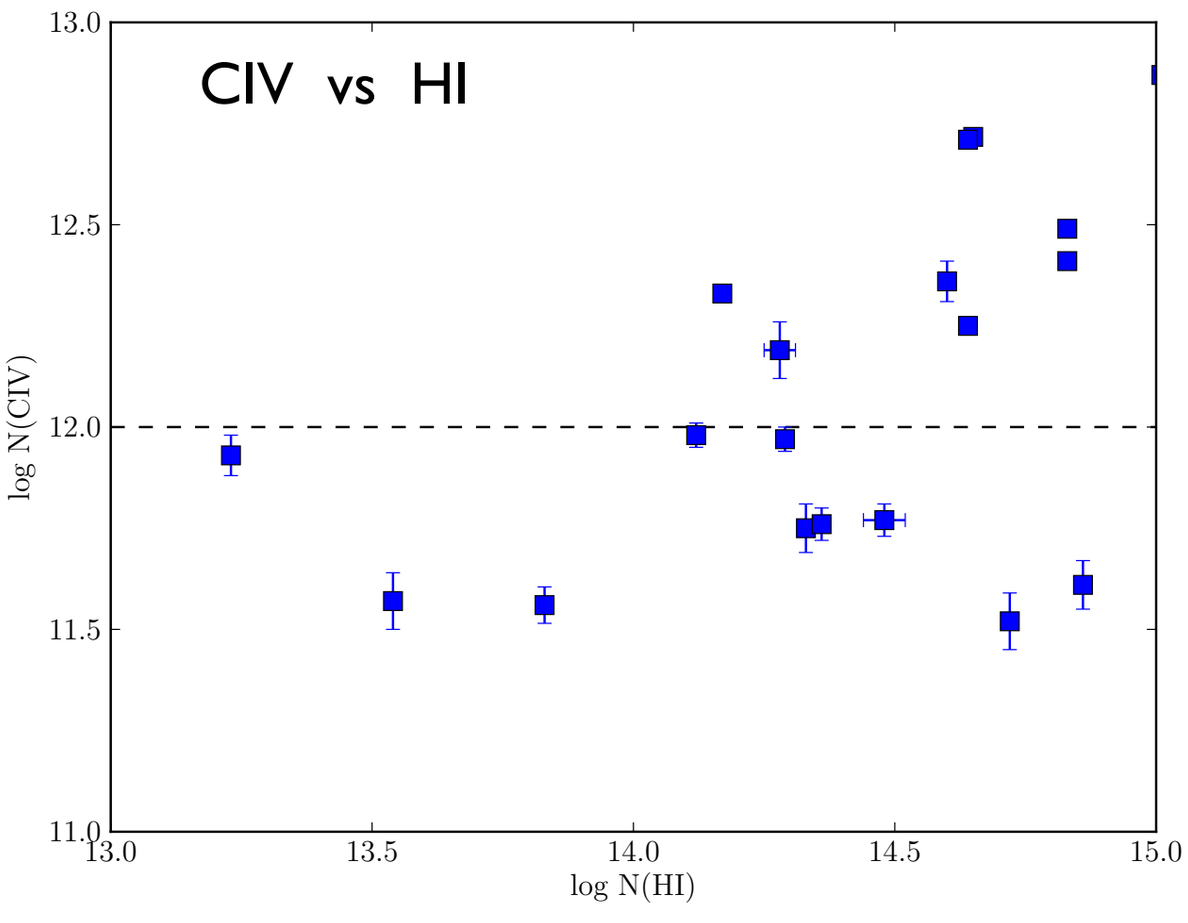
13 < logN(HI) < 13.5 ➔ ~1%

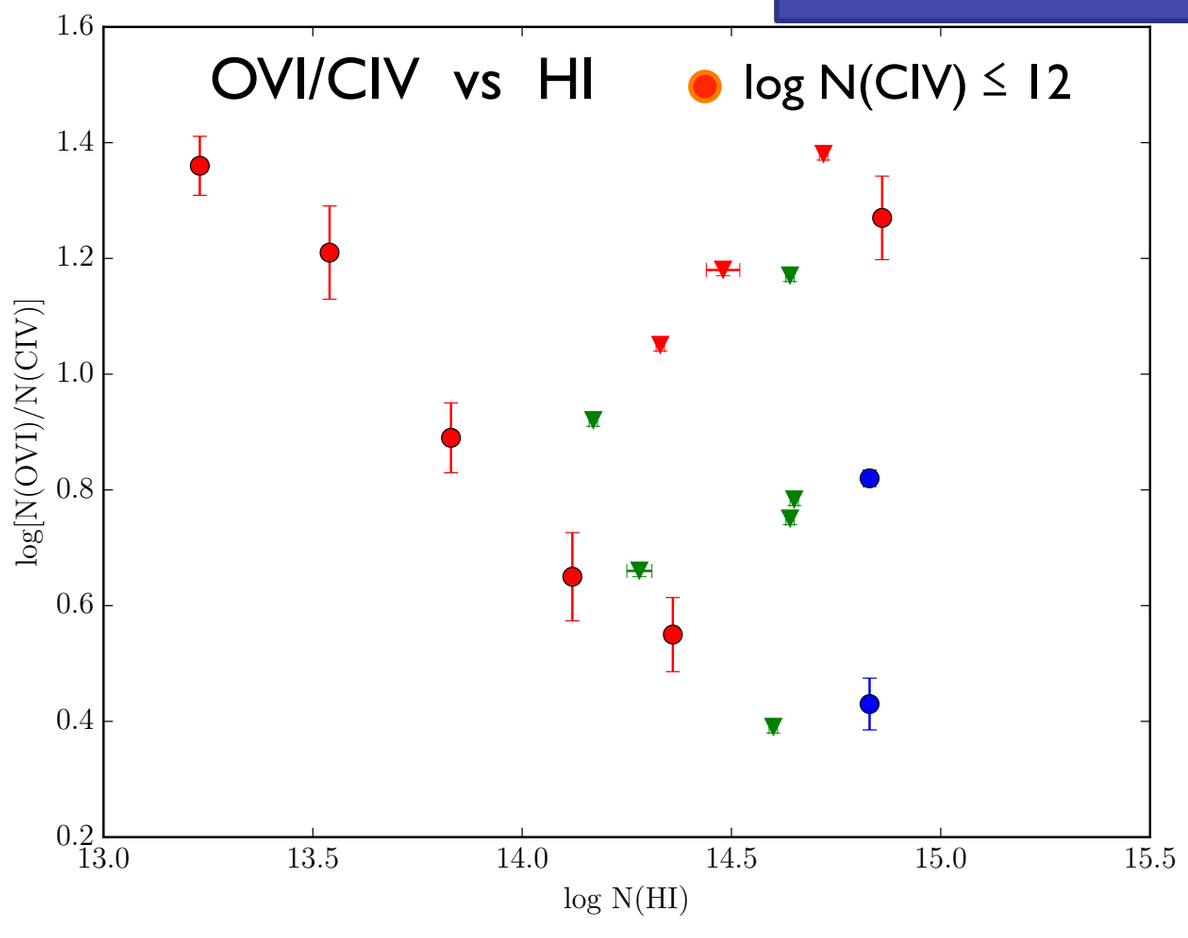
13.5 < logN(HI) < 14 ➔ ~4%

14 < logN(HI) < 14.5 ➔ ~20%

14.5 < logN(HI) < 15 ➔ ~60%

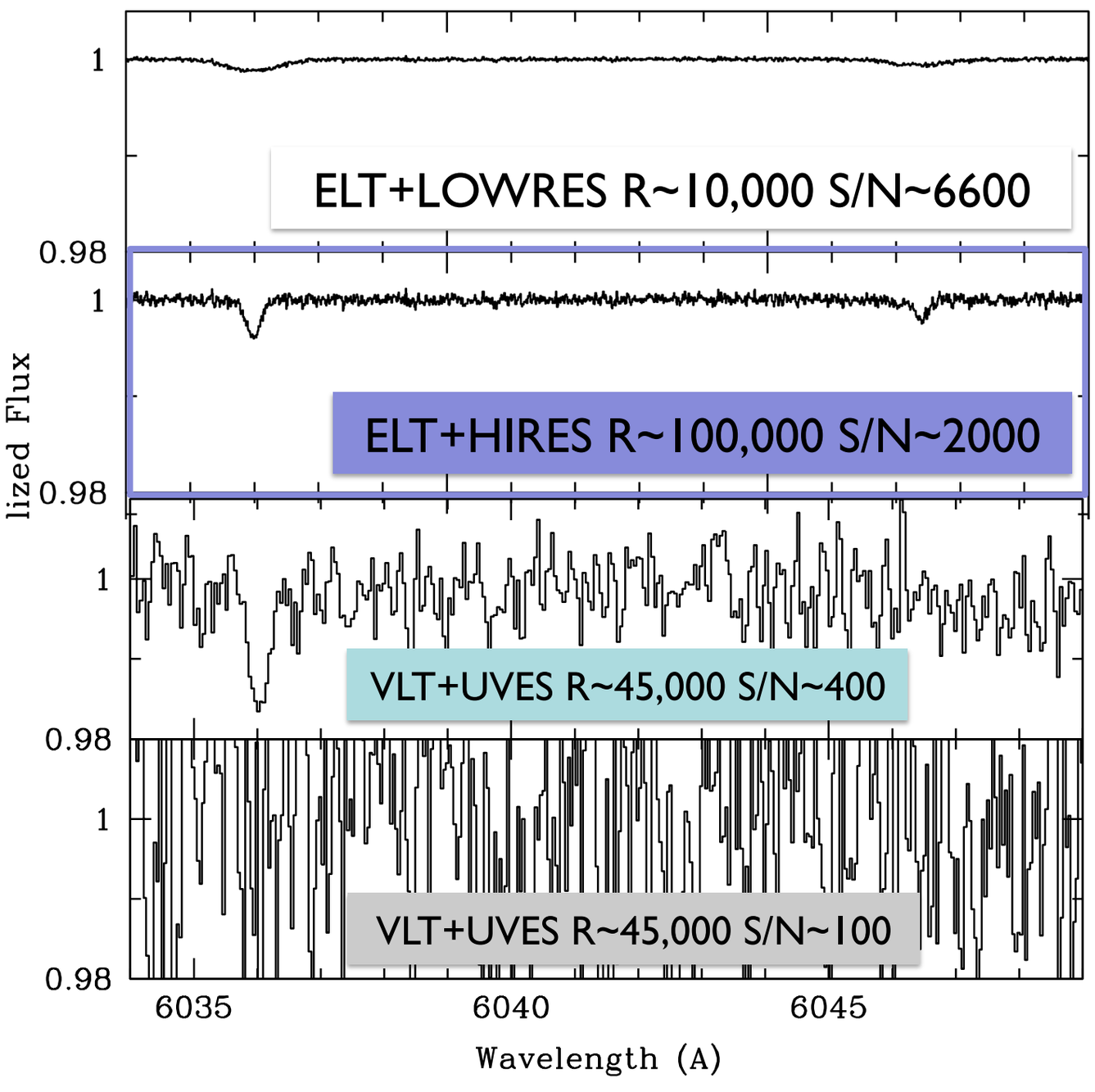
PRELIMINARY





HiRes@E-ELT for the IGM

Metal enrichment of the low density IGM at z~2-4 with CIV and OVI ➔ UV ARM



T_{exp}~20 h
for an R~16 QSO at z~3

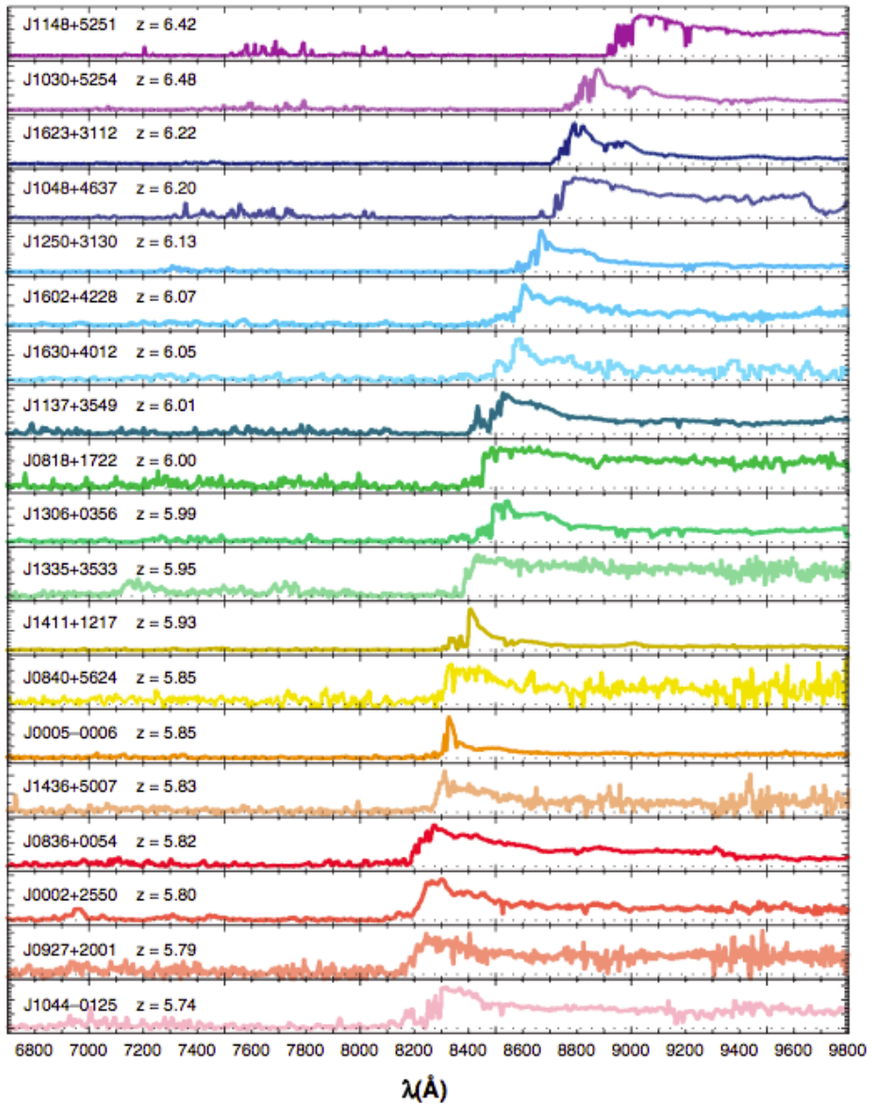
Scaled to the mean density:
log N(CIV) ~ 11

Present limit with T_{exp}~64 h
log N(CIV) ~ 11.5

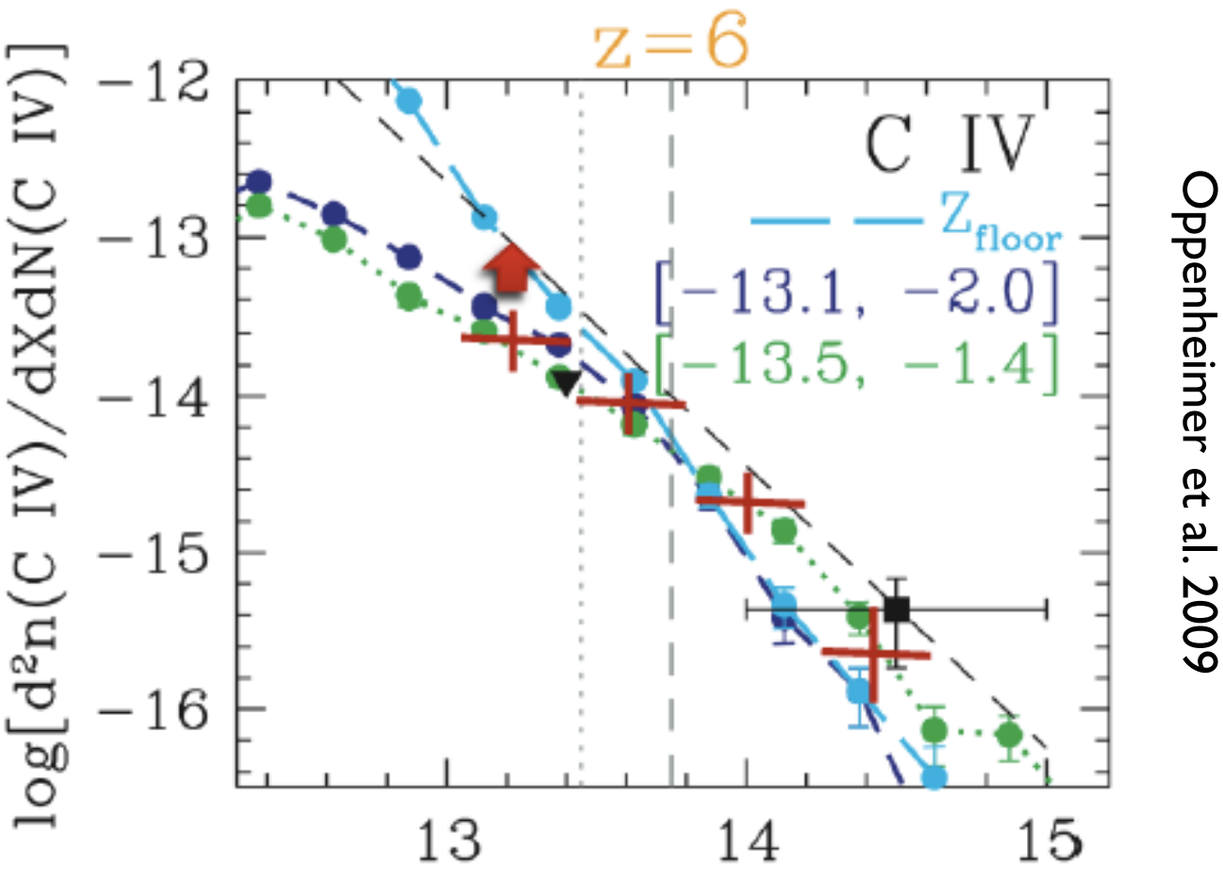
VLT Large Programme
(Bergeron et al. 2004)

The IGM at the end of the re-ionization epoch

Fan et al. 2006

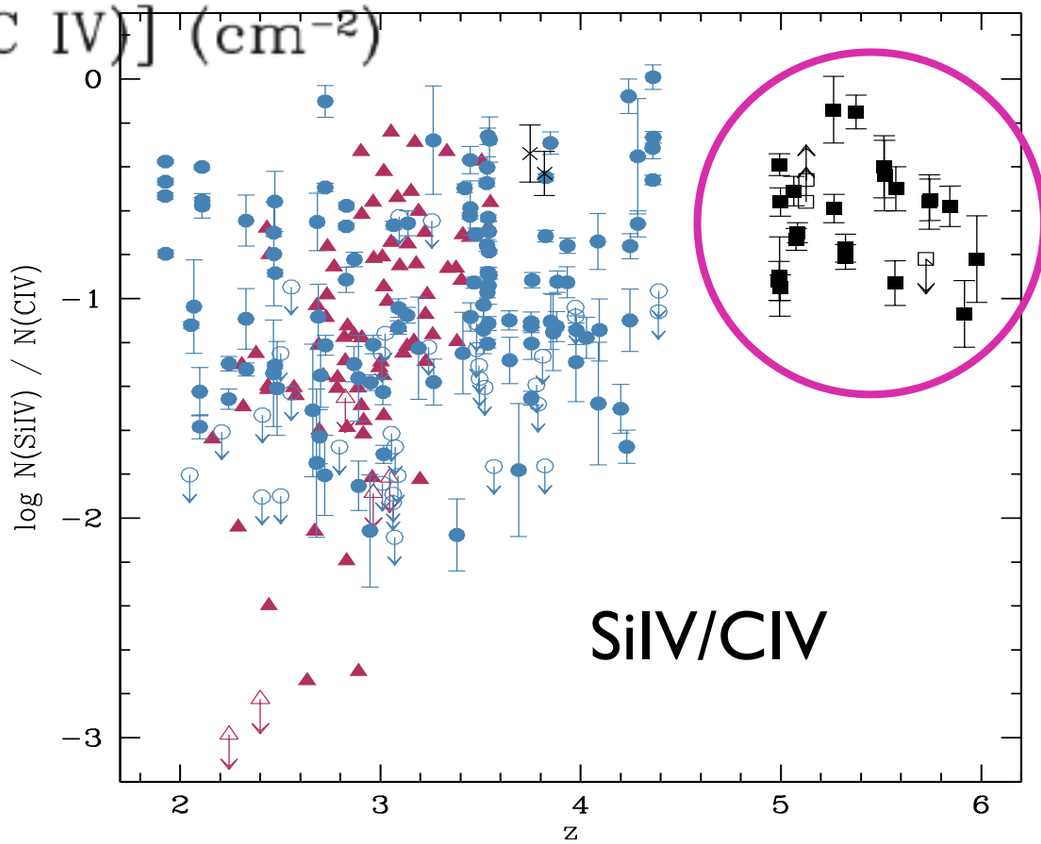


z > 5.5 No information on gas distribution and detailed ionization state from Lyman forest.



Oppenheimer et al. 2009

Xshooter data for 6 QSO spectra at z~6: 25 SiIV and CIV systems (D'Odorico et al. 2013)

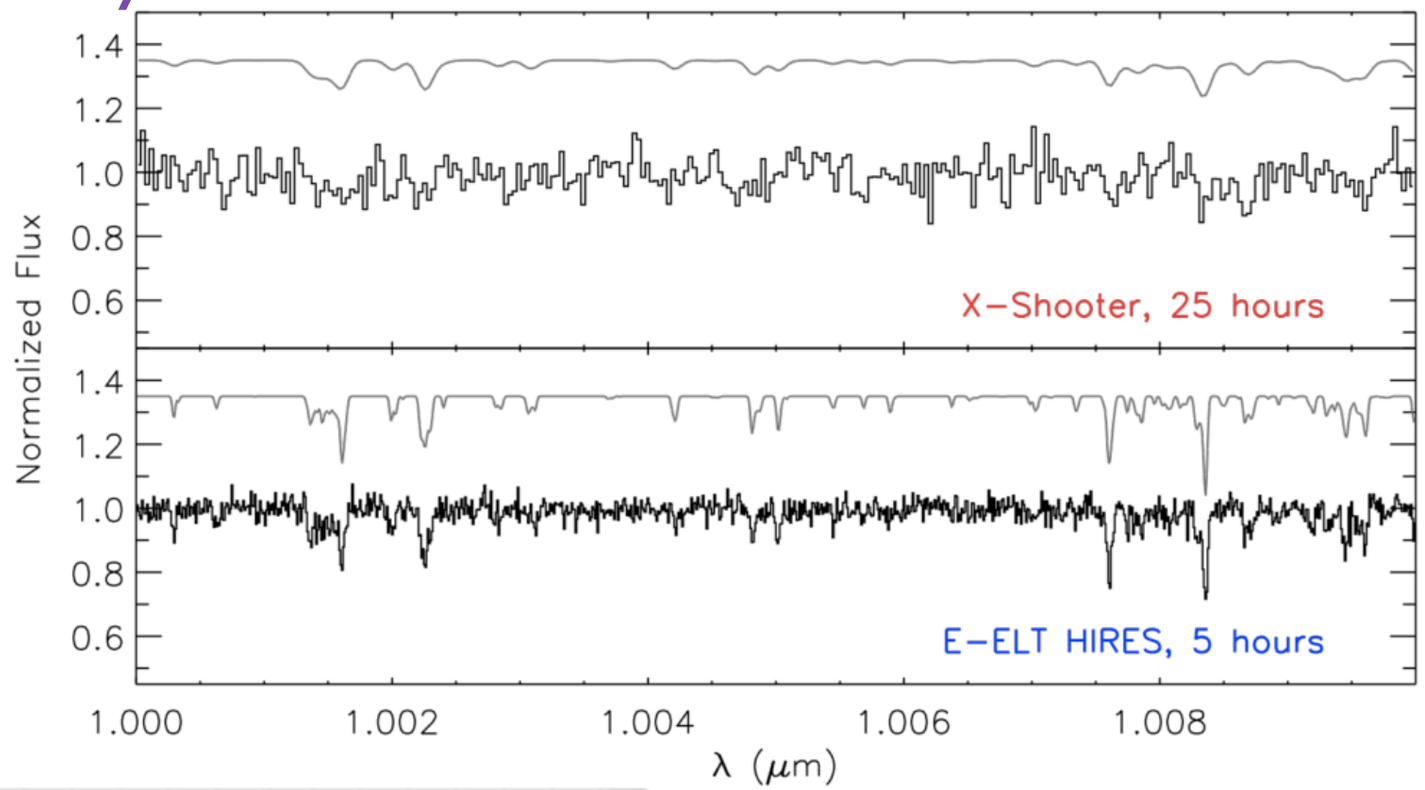


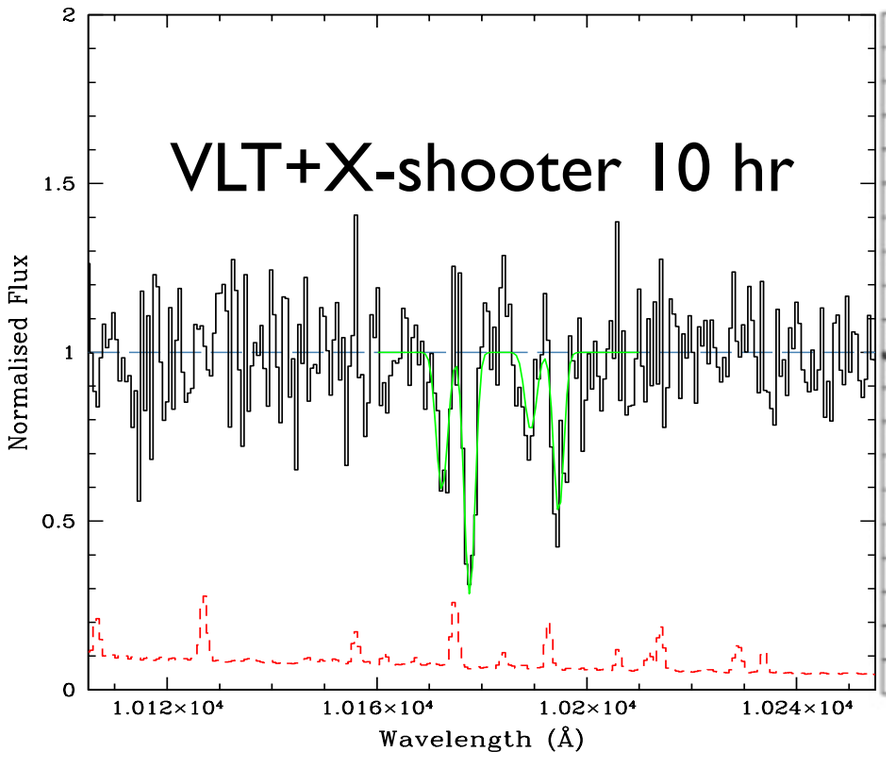
HIRES@E-ELT for the IGM

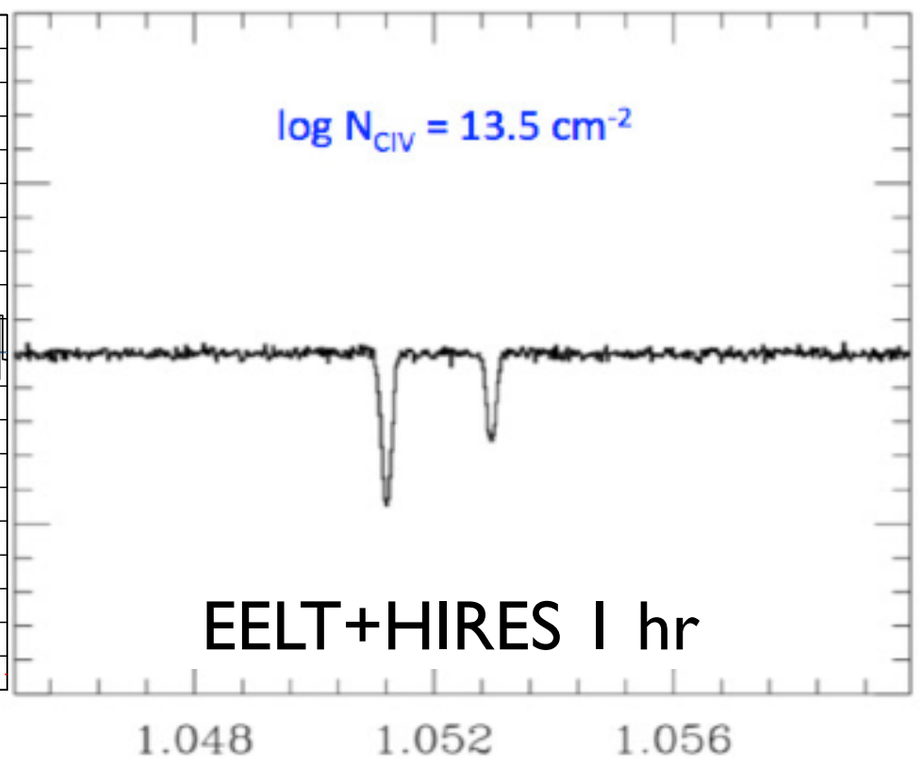
The reionization epoch with the Lyα forest and metal lines

NIR spectral range

Detect the O I forest at z~6-7 as a proxy of the H I distribution to constrain the reionization history







Detect lines due to several ionic transitions at z ≥ 6 to constrain the shape and intensity of the ionzing background and the enriching sources

Conclusions

- The IGM is a precious tool probing from the large scale distribution of matter to the feedback processes in the CGM;

- High-resolution spectroscopy with 8-10m class telescopes has reached the "photon starving" regime for many of the IGM hot topics

- HIRES@E-ELT will represent the real breakthrough for the study of:
  - the metal enrichment and ionization state of the gas at the mean density at z~2-4;
  - the distribution of gas and its properties at the edge of the re-ionization process at z~6-7.