

# What more can we learn from QSO absorption systems?

KITP, 28 October 2004



## A panel discussion

with

Jaqueline Bergeron  
Martin Haehnelt  
Joop Schaye  
Chuck Steidel  
David Tytler  
Art Wolfe

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# What more can we learn from QSO absorption systems?

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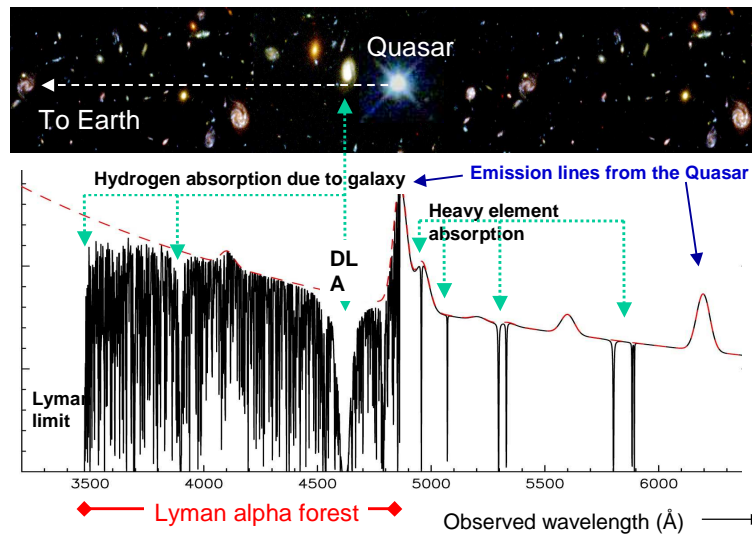
# A lot!

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More than we can discuss here!

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Figure by John Webb



## Lyman limit and damped Lyalpha systems

- sample sizes increase dramatically
- still don't know for sure what kind/what part of galaxies they are
- tracer of warm/cold gas
- trace metal evolution but of what?  
why is the metallicity so low?

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## Associated metal absorption systems probe

- probe spectral shape of the UV background
- probe metal enrichment by QSO/galactic winds
- fossil record of first light in the Universe?

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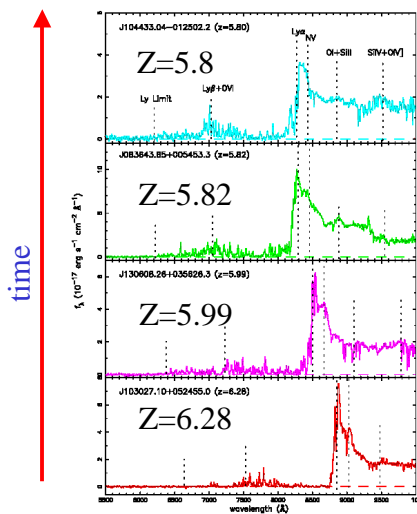
## The Ly $\alpha$ forest is a probe of

- reionization
- thermal history of the IGM
- amplitude of the UV background
- galactic winds
- LSS distribution of matter and cosmology

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## The SDDS quasars



The end of the epoch of hydrogen reionization has most likely been detected.

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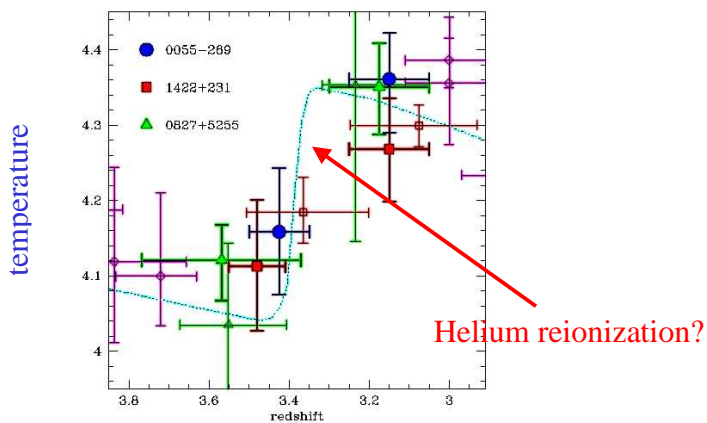
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## Temperature evolution of the IGM



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Schaye et al.



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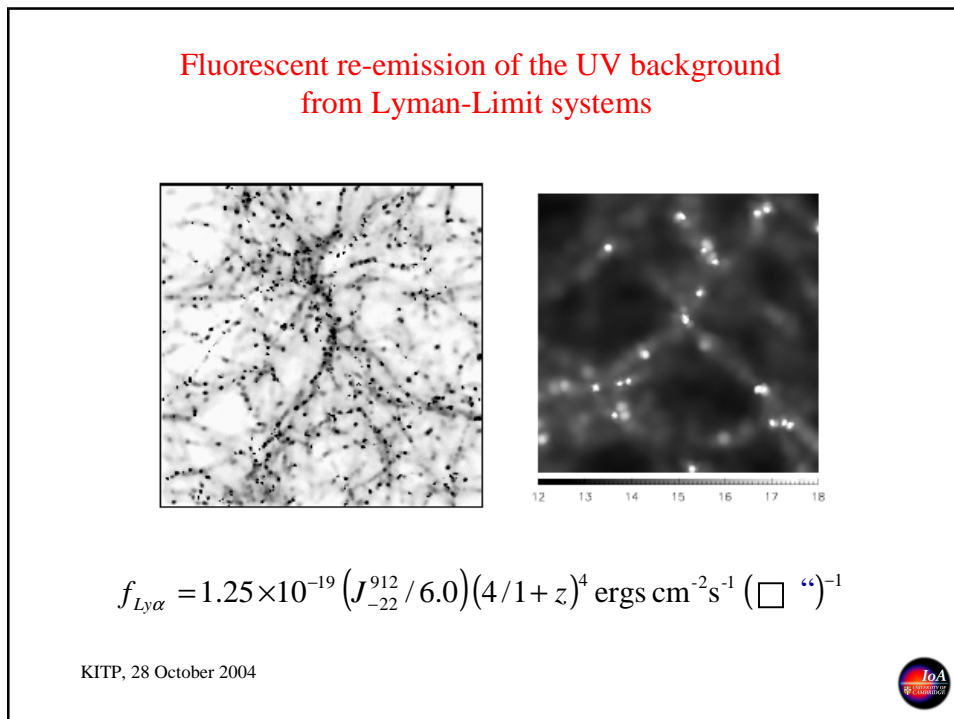
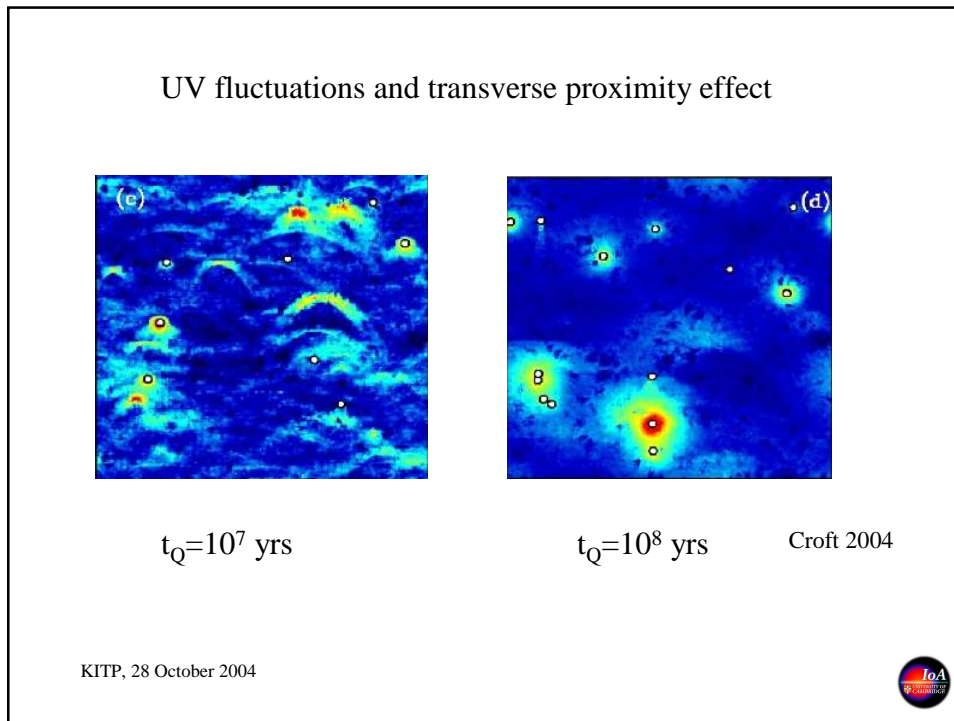


## Measuring the amplitude of the UV background

- proximity effect
- Ly alpha forest opacity
- integrated emissivity
- Ly alpha fluorescence

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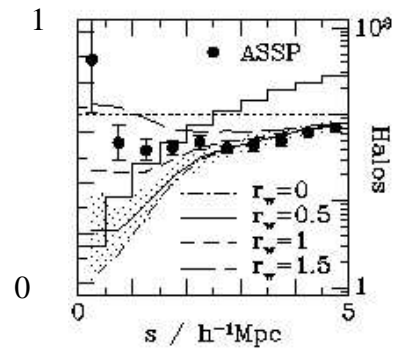
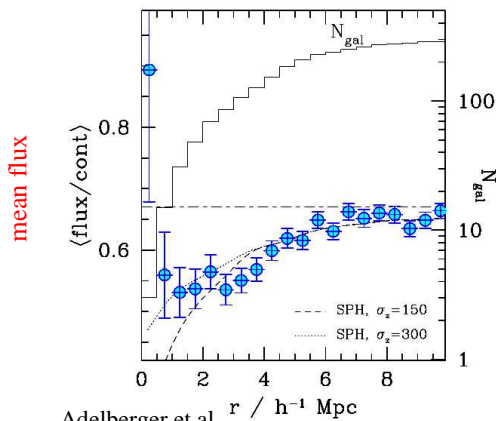
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## The influence of galactic winds on the IGM

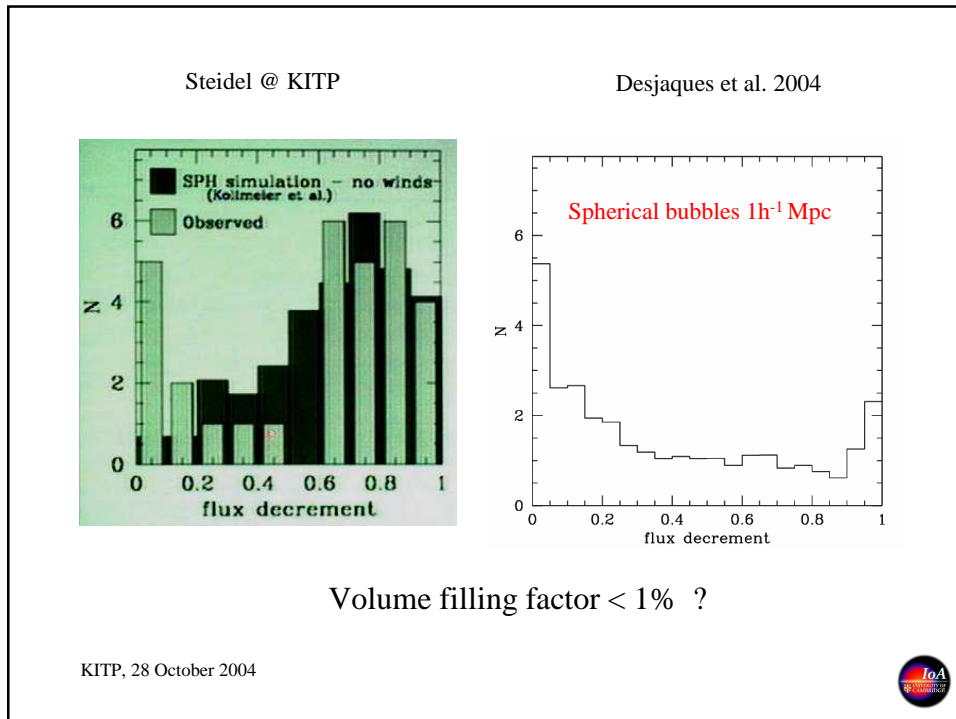
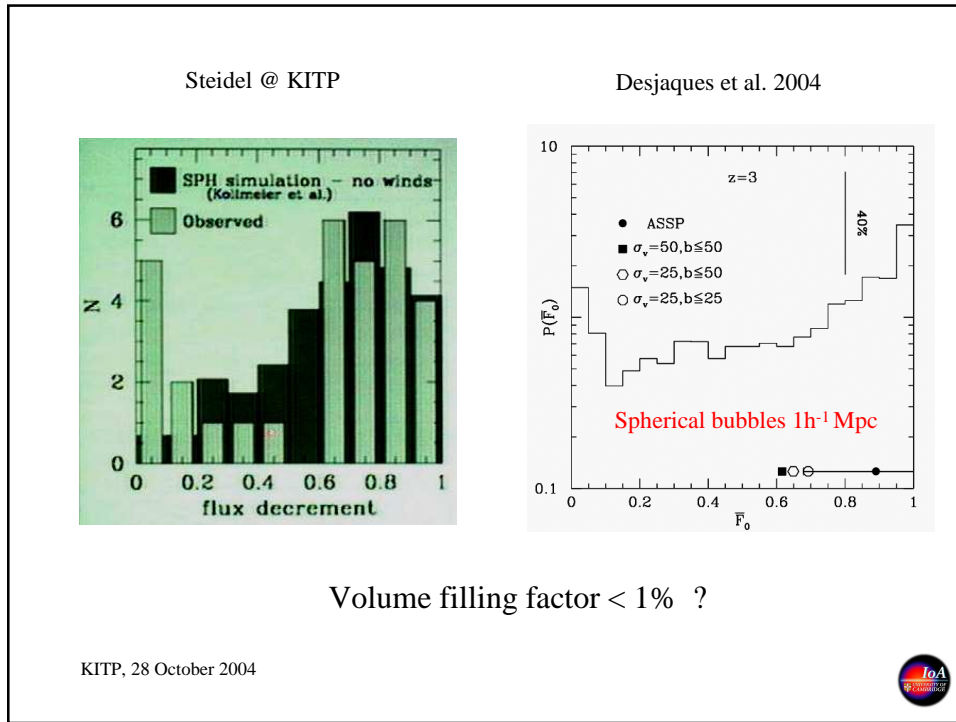


distance to next LBG

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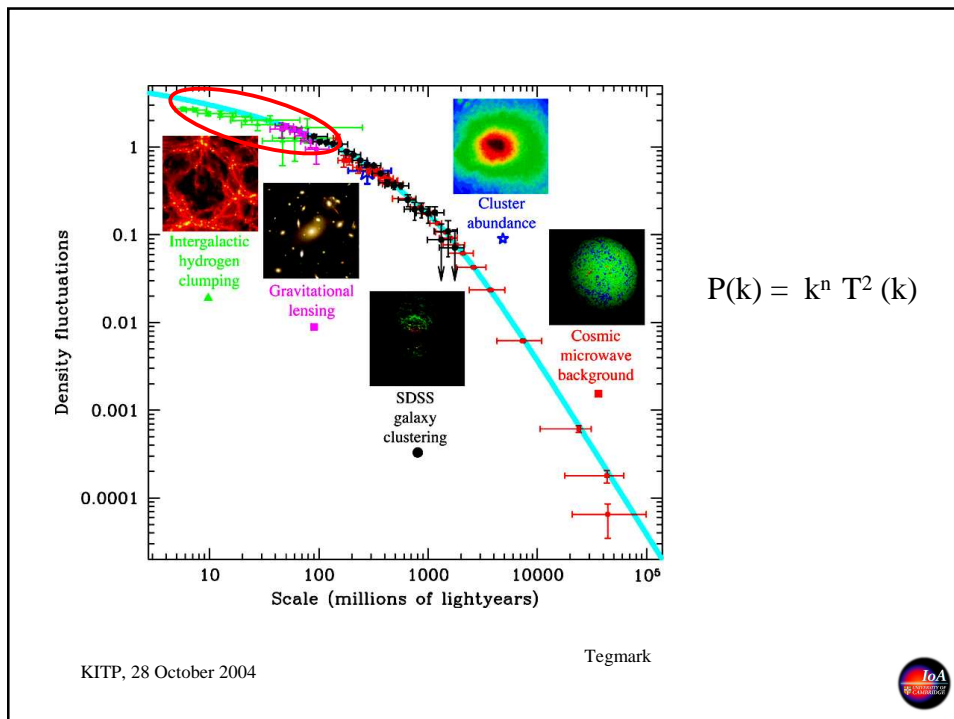
Panel Discussion: What More can we Learn from QSO Absorption Systems?



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How big is the impact of galactic/QSO winds?

Which are more important: QSOs or galaxies?

How do we find out how winds work?

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Do we have a complete census of metals?

What is the volume filling factor of metals?

How do find out what did the metal enrichment?

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What will we learn about the WHIM  
and the missing baryons at low redshift  
from X-ray/UV absorption studies?

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How do we improve constraints on the  
amplitude and spectral shape  
of the ionizing UV background?

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Was helium really reionized at  $z \sim 3$ ?

What do we have to do to be sure?

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How do we identify damped Lyalpha systems?

Why is their metallicity so low?

Can we detect them with ALMA?

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