Results from the UKIDSS high-redshift quasar survey

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(and a cast of hundreds, including many of you)

UKIDSS science case (2001)

All quasars $5.8<z<7.2$, $Y<19.0$ are selected by the criteria shown in Fig2.3. Beyond $z=7.2$ quasars redden rapidly in $Y-J$. The Y magnitude limit is set by the $i'-Y>3$ colour selection limit, and by the $i'=22$ limit of the Sloan survey i.e. we are picking the *very brightest* quasars in this redshift range, which are of course the most valuable for absorption-line spectroscopy. We can compute the expected numbers using the latest luminosity function of Fan et al. (2001a), as well as the older luminosity function of Schneider, Schmidt & Gunn (1995), based on lower-redshift data. The results are provided in Table 2.7. By surveying 4000 □° we can expect to find 10 quasars at $5.8<z<7.2$. These numbers can easily be increased

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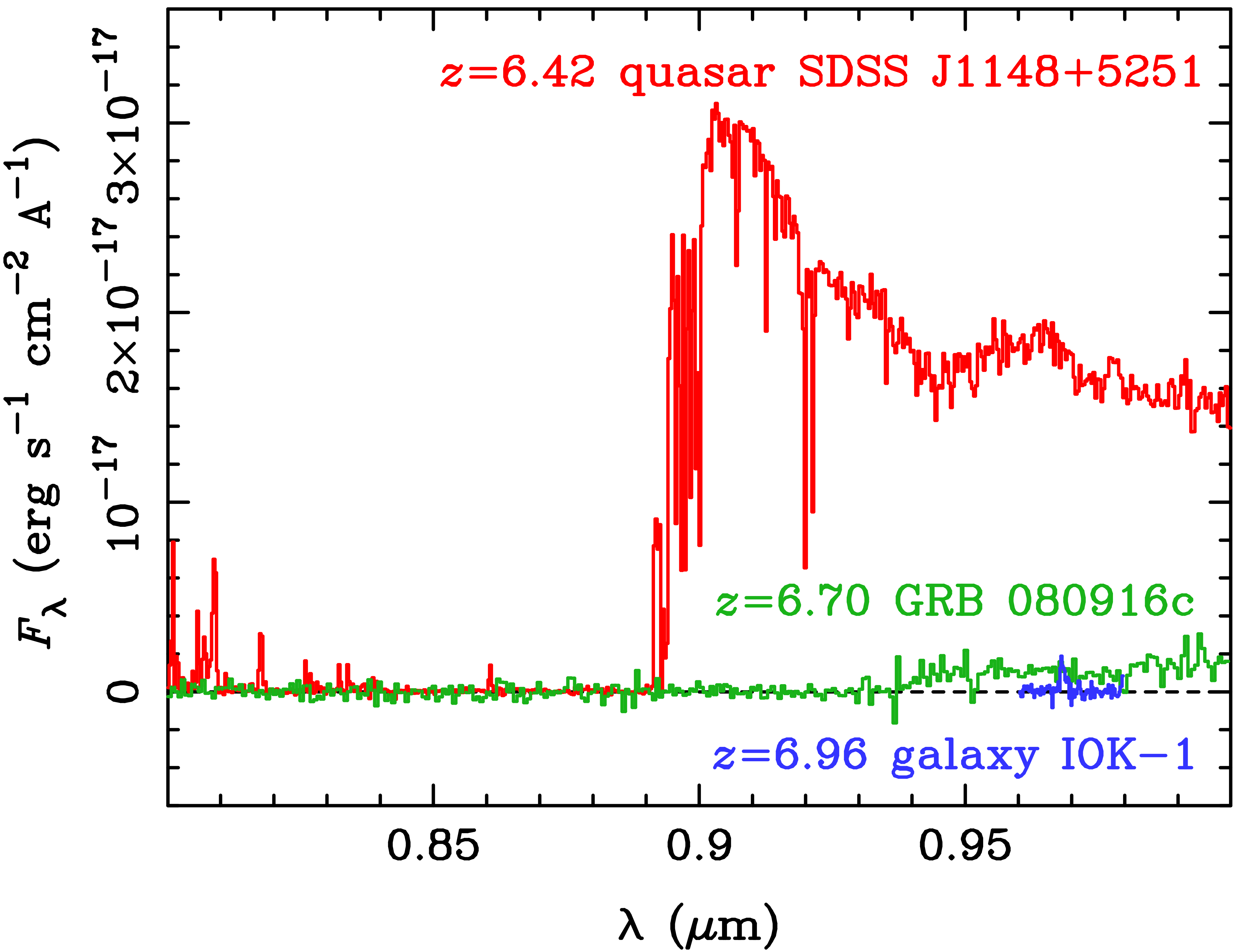
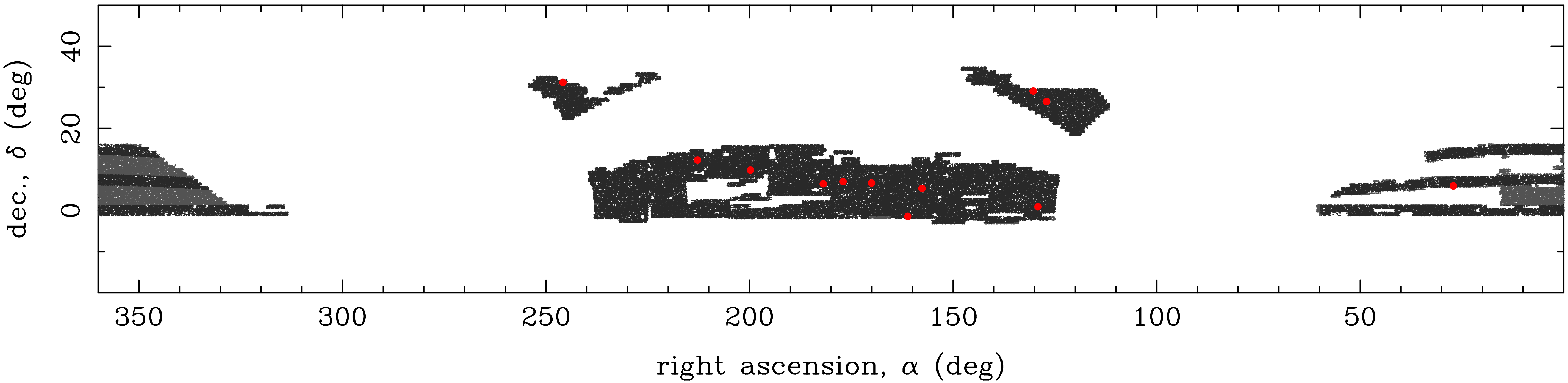
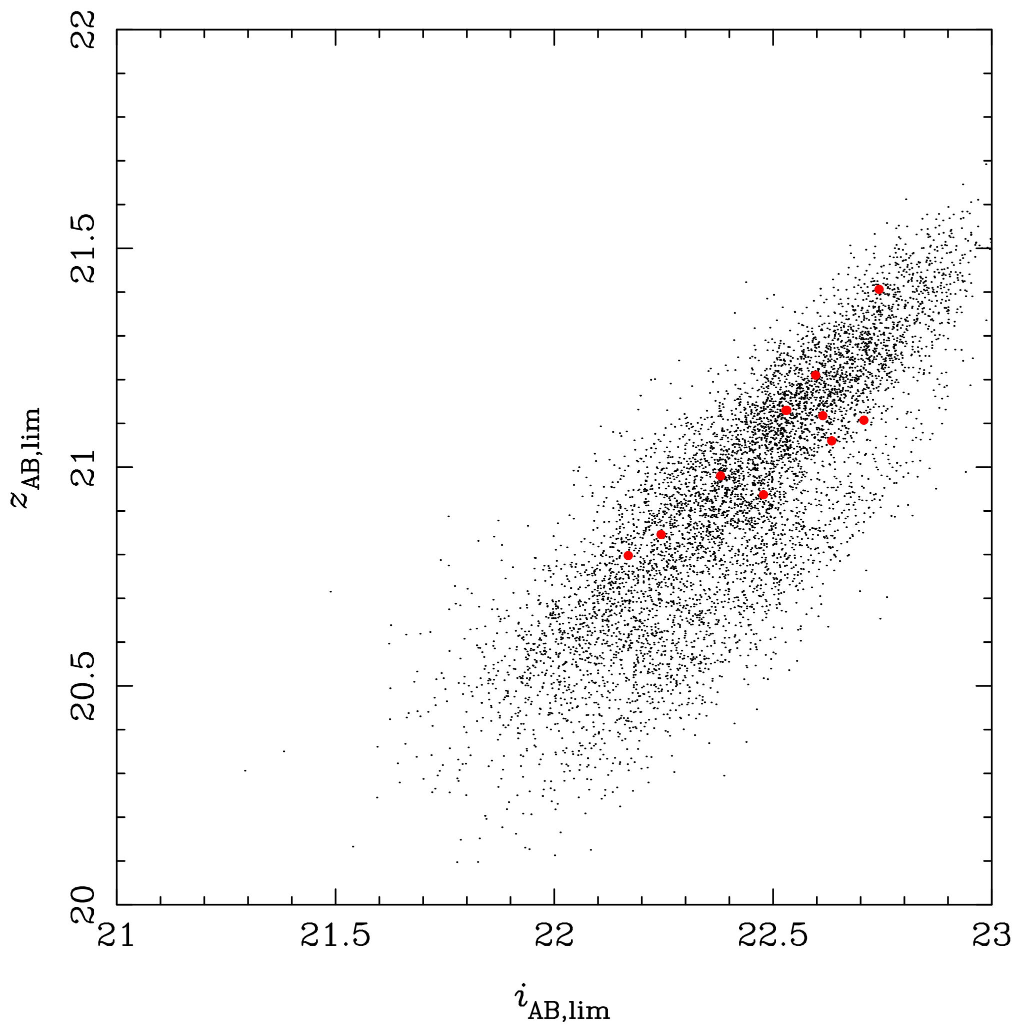
Some scepticism needs to be maintained about the importance of some specific goals. The one that immediately comes to mind is detecting a few z=7 quasars in the LAS. The yield of $z > 5.8$ quasars is *remarkably* small for the investment of resources, especially the added Y band imaging. The Y band imaging, which requires 20% of the LAS time (52 nights), appears to be mostly for the purpose of finding about a dozen quasars at $z > 5.8$. In the short time since the UKIDSS document was circulated the record for the highest redshift has risen from 5.8 to 6.3. It seems certain that by the time the UKIDSS begins the z=7 barrier will be cracked and we will already know some of the answers to questions posed by the Consortium.

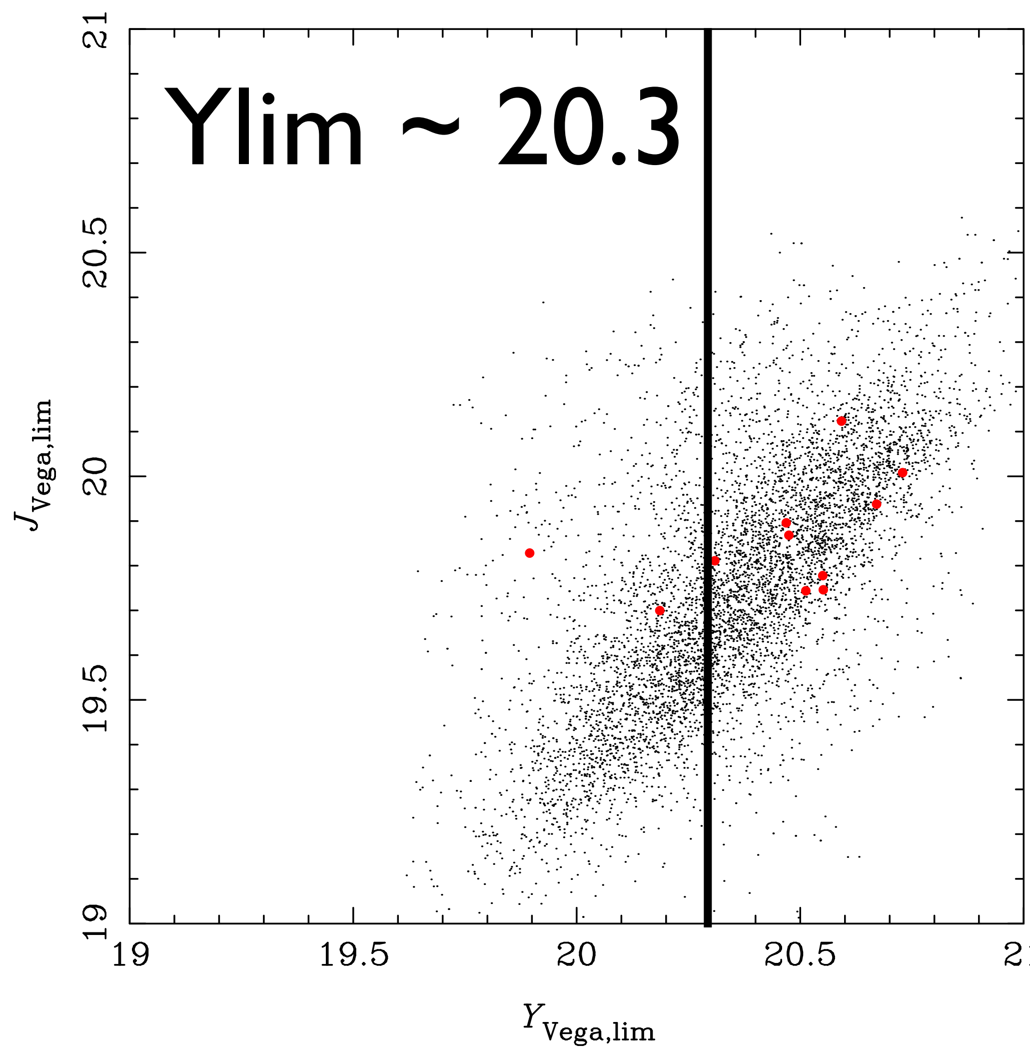
High-redshift sources



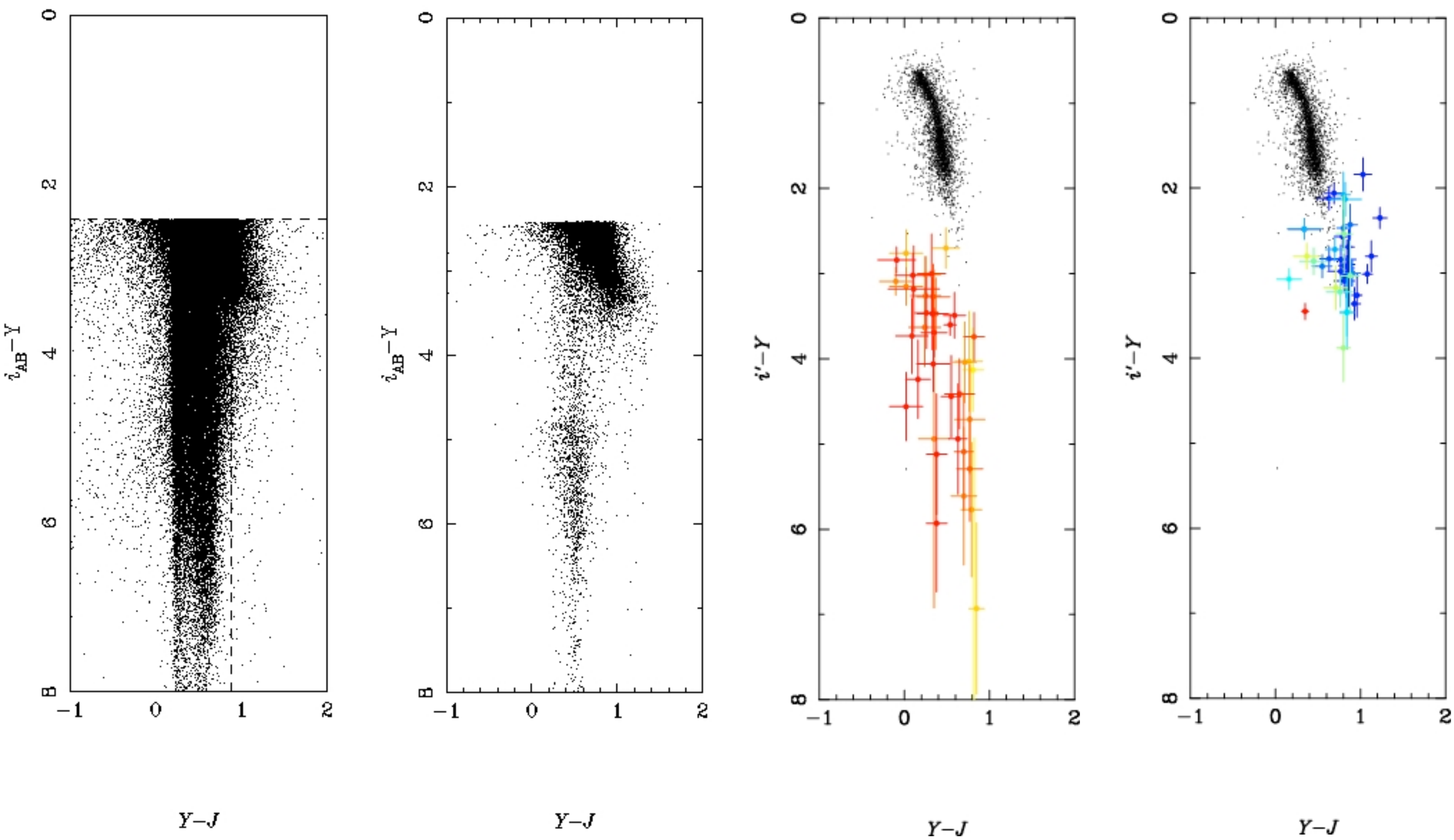
UKIDSS LAS DR8 coverage



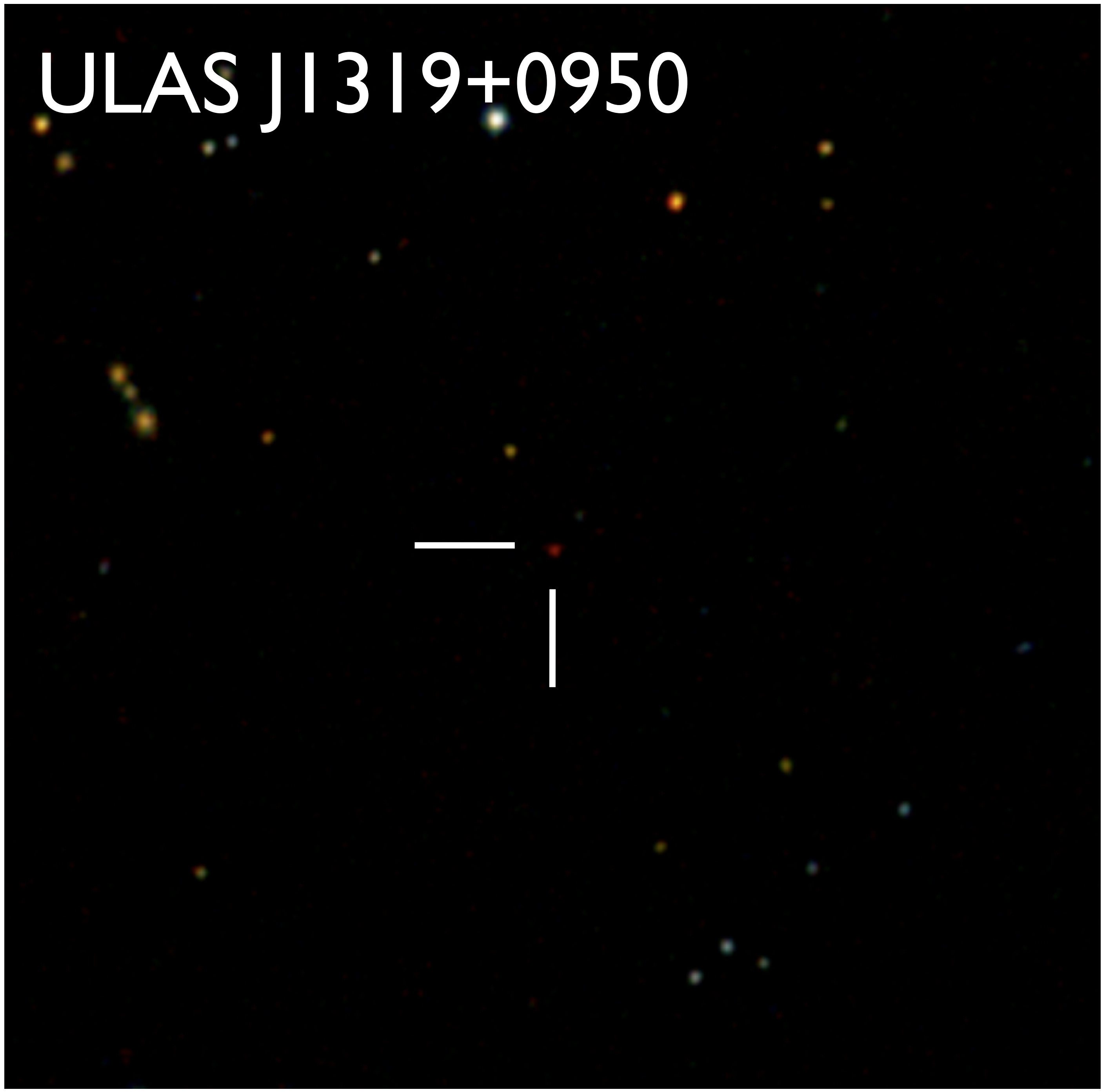




Quasar selection



Results



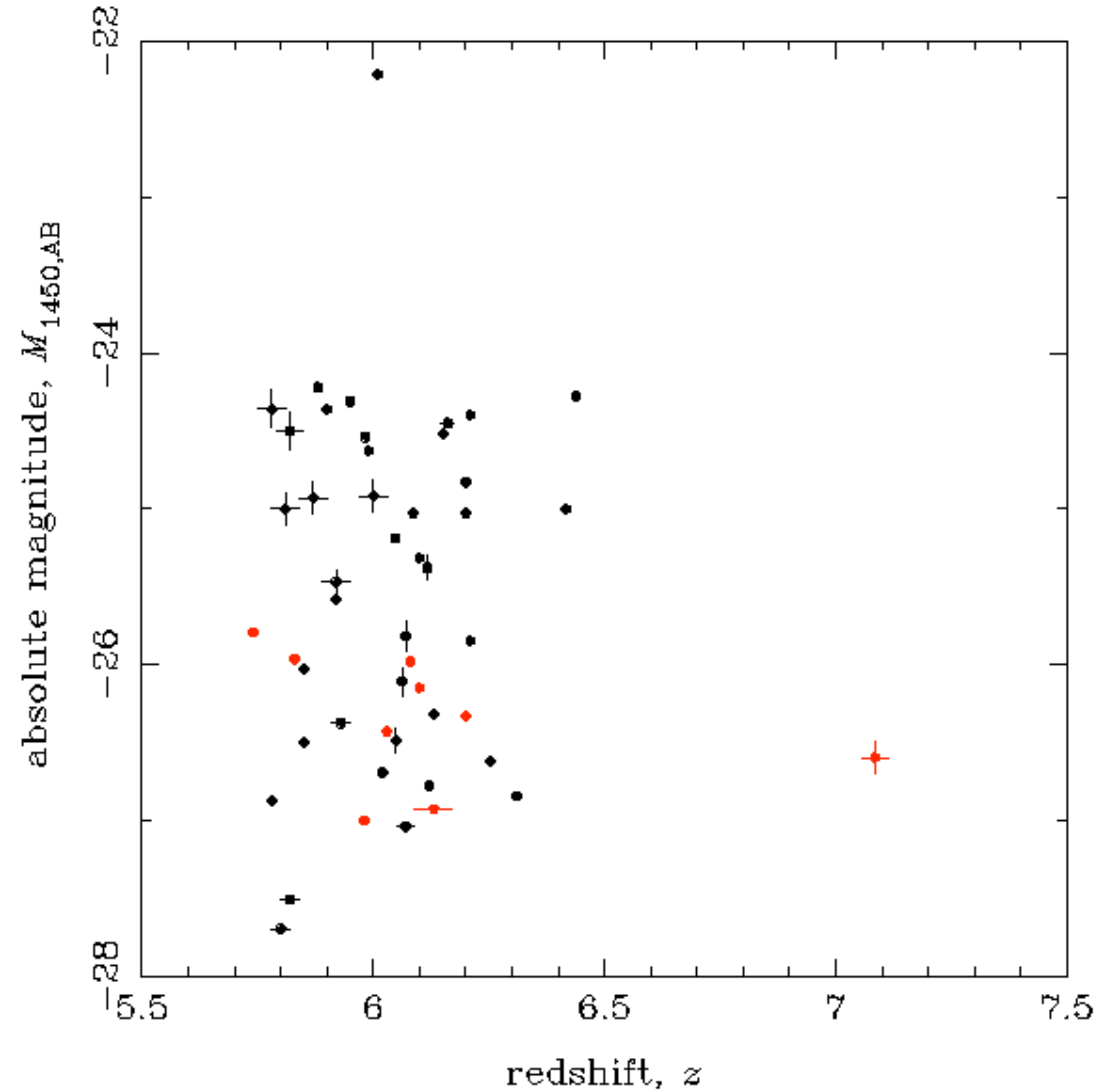
UKIDSS DR8 complete: 2270 sq. deg.

Discovered 8 new redshift ~6 quasars

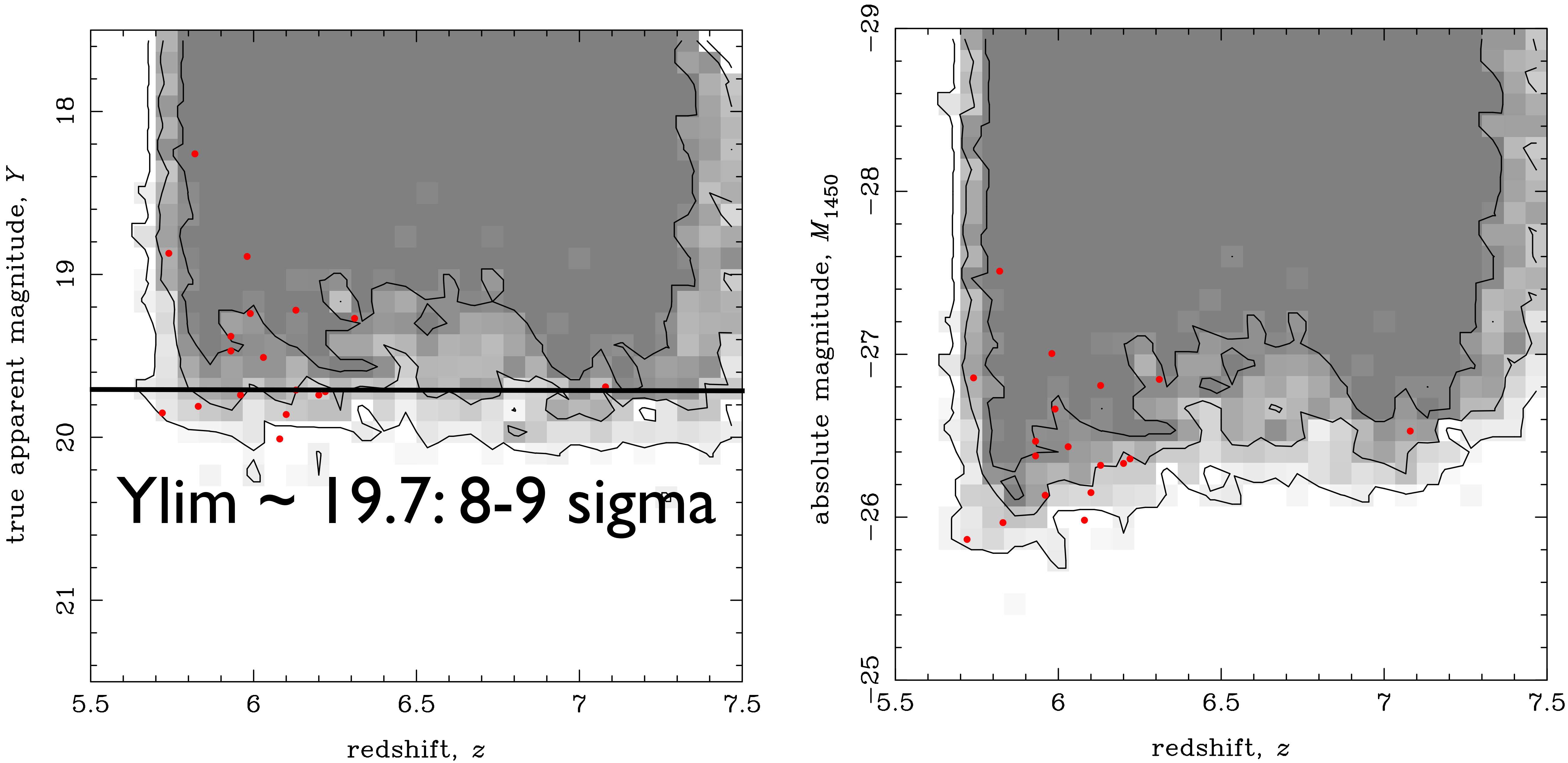
Recovered 6 SDSS redshift ~6 quasars

Second largest sample of bright z ~ 6 quasars (after SDSS)

Quasar demographics



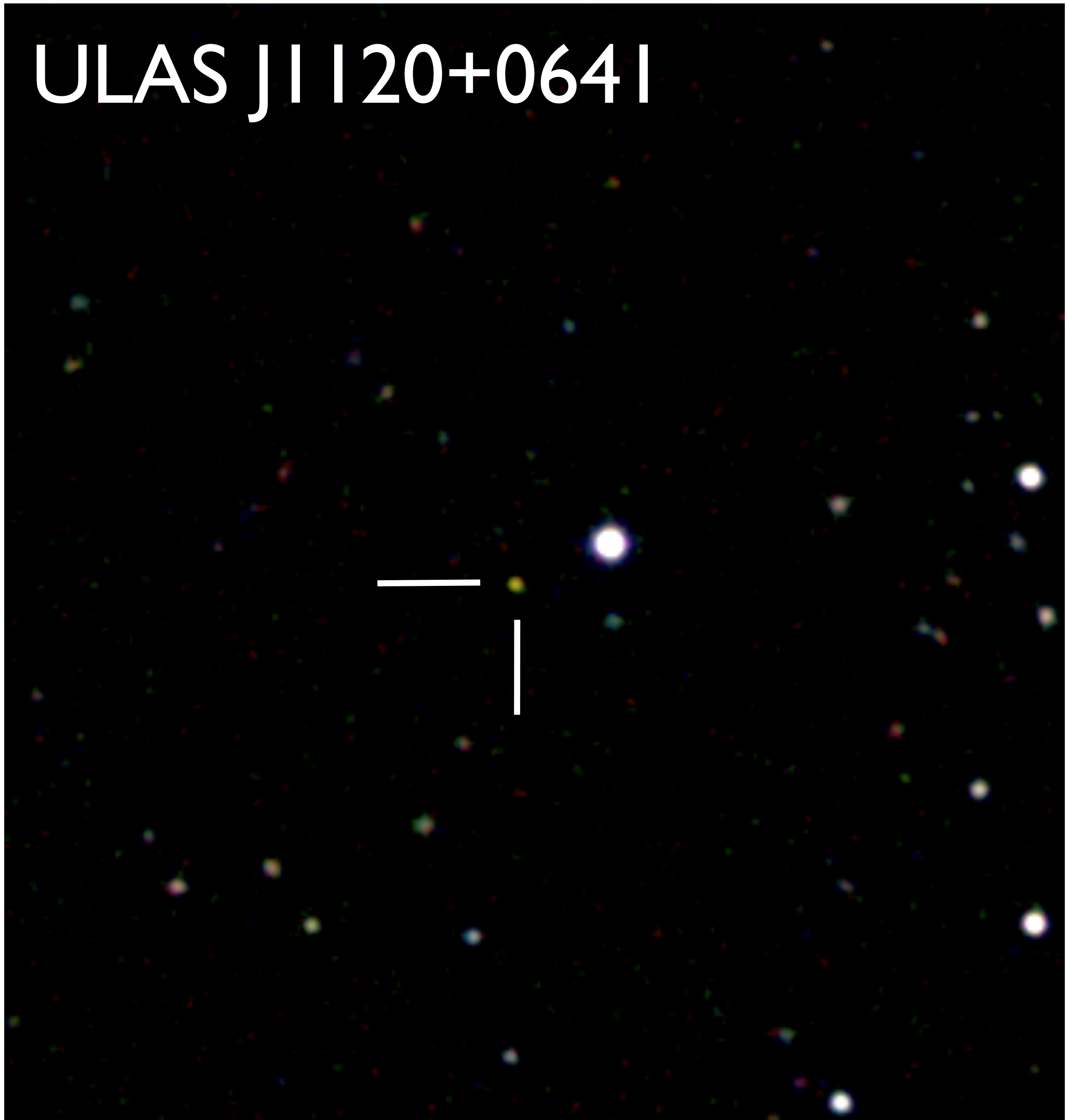
Selection function



Preliminary: too noisy; too sensitive at z ~ 7.3

Luminosity function

A redshift 7.085 quasar



Seen 100 Myr earlier than any other non-transient source of similar luminosity

Just ~100 brighter and more distant sources on whole sky

Only one z >6.5 quasar, but close to high-z limit of search

nature

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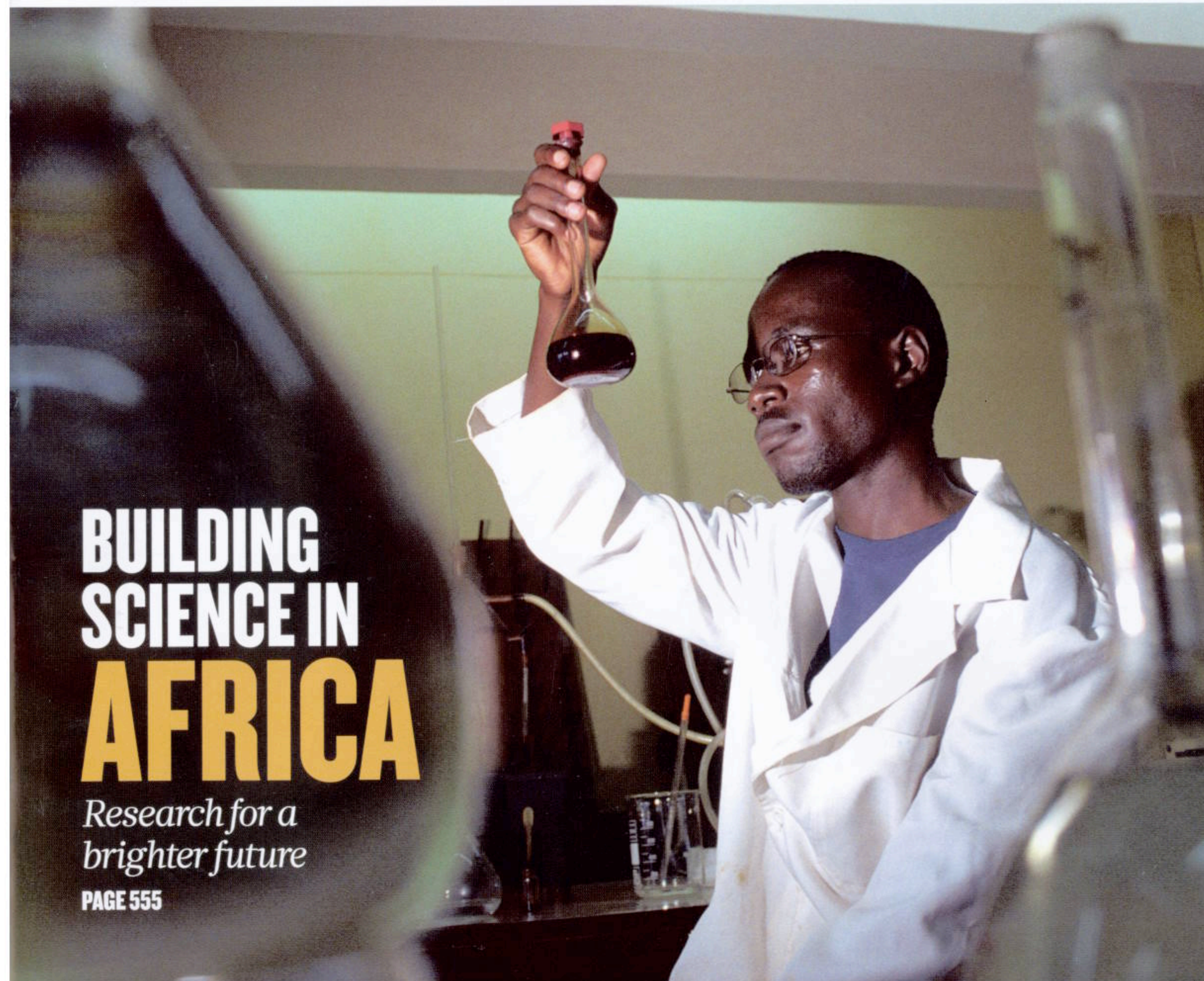

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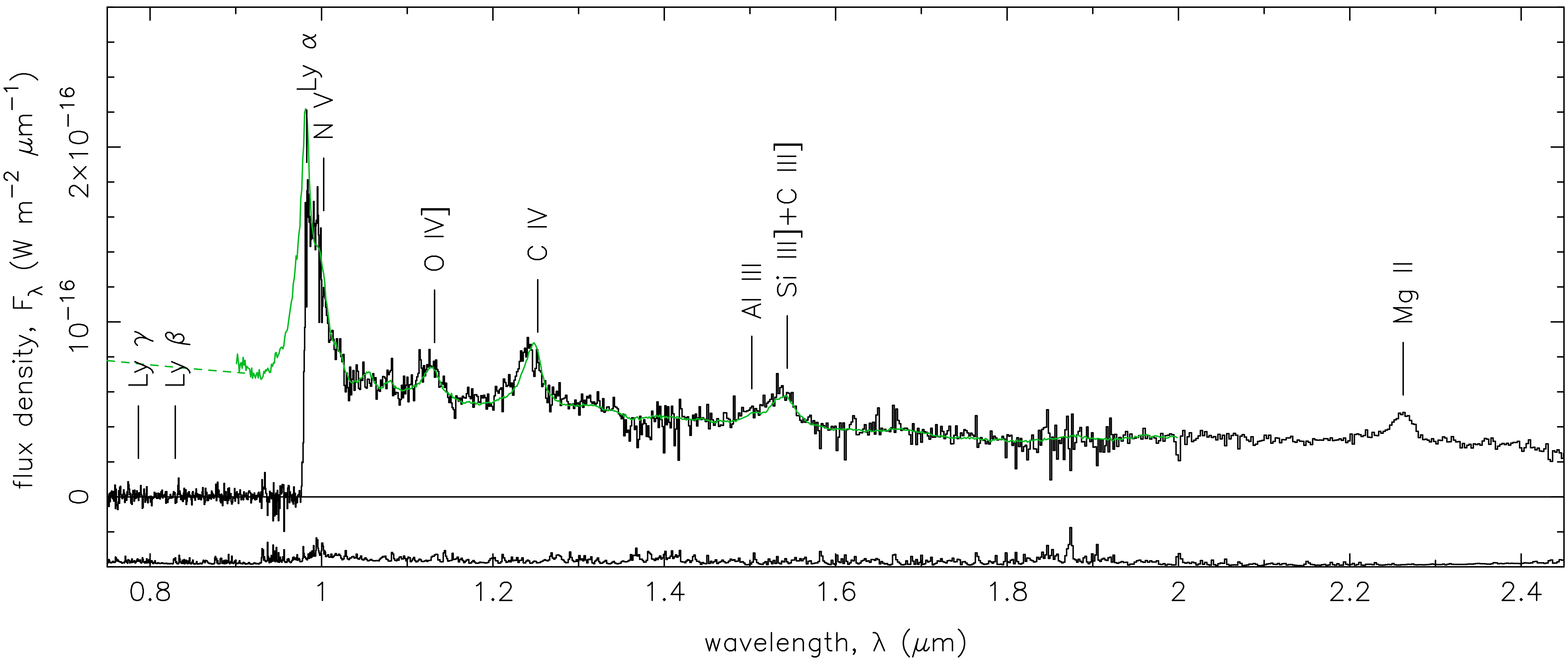
Optical/NIR spectrum



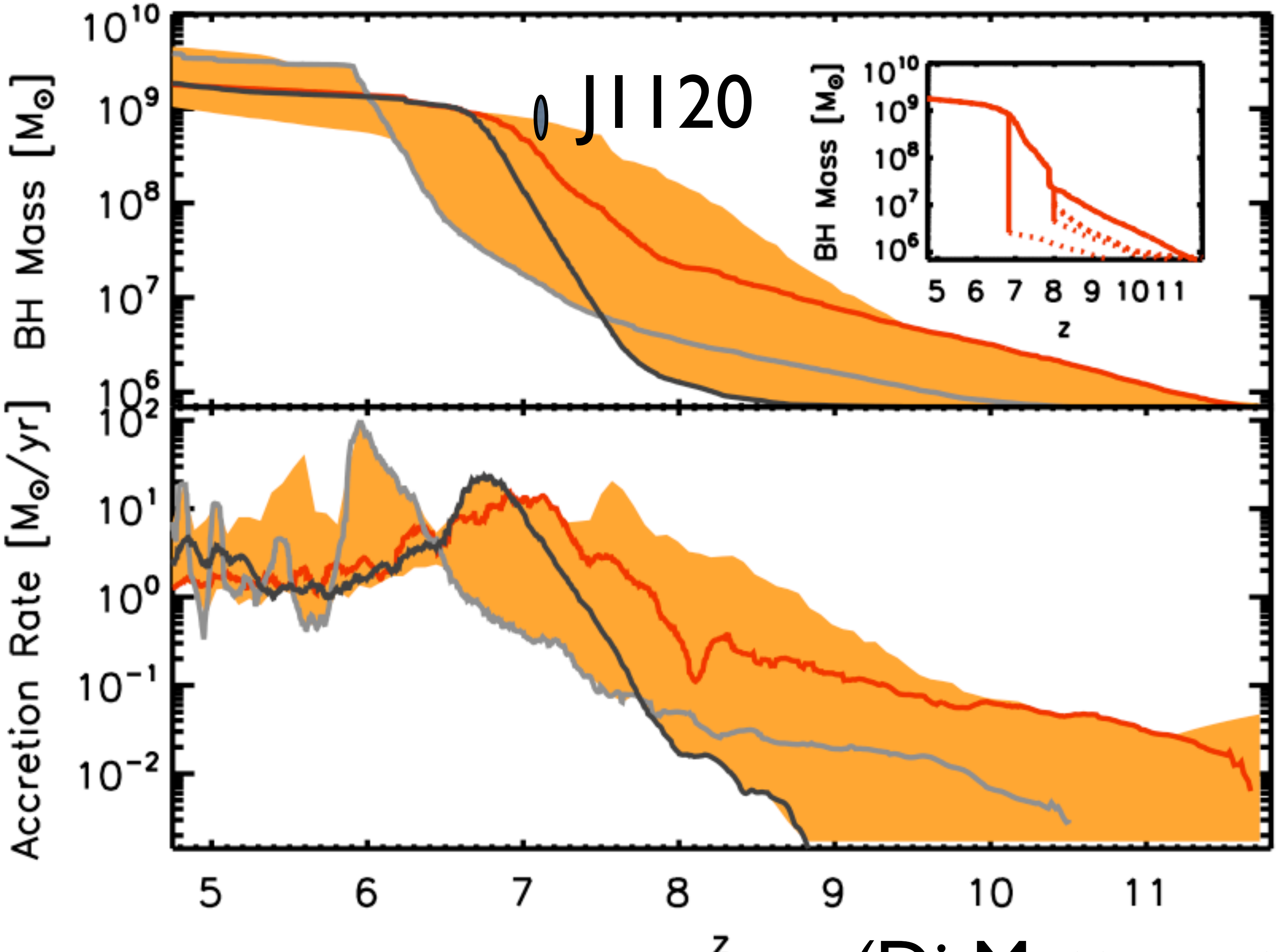
Unabsorbed spectrum very similar to low-z quasars

Data from FORS2@VLT and GNIRS@Gemini

Implied black hole mass of 2x10^9 M_Sun at 770 Myr

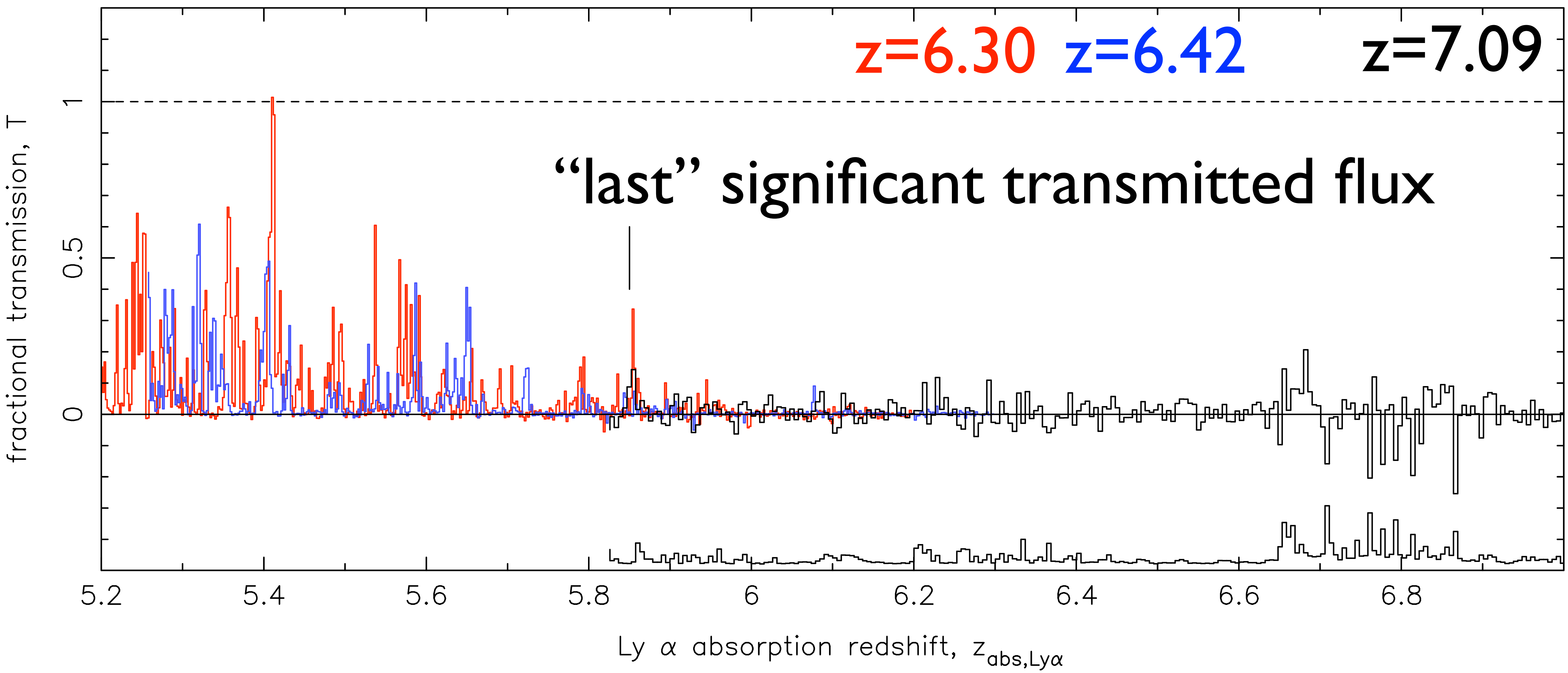
Super-massive black hole

A $2 \times 10^9 M_\odot$ black hole just 800 Myr after the Big Bang



(Di Matteo et al. 2012)

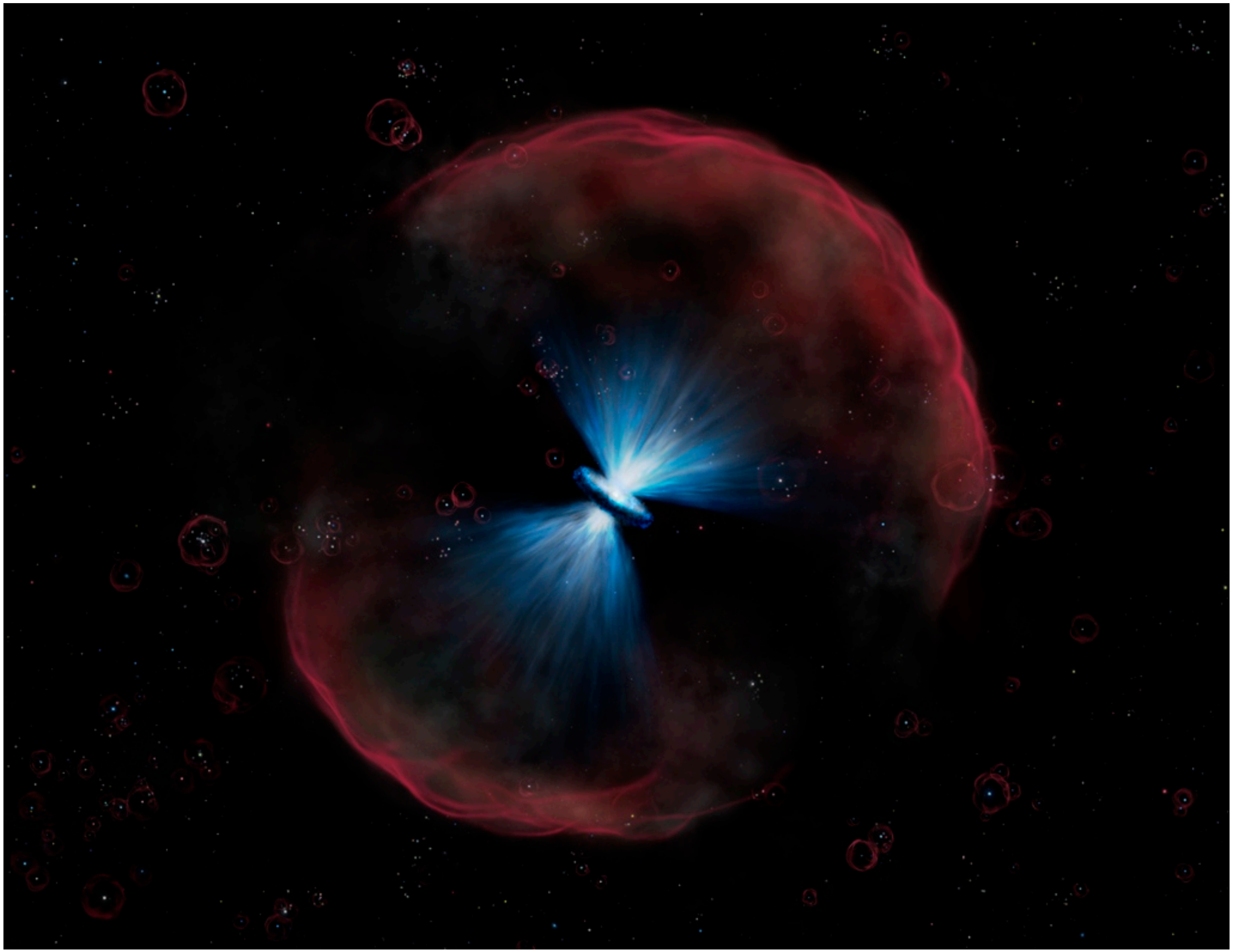
Ly alpha IGM absorption



Complete Gunn-Peterson (1965) trough from z ~ 5.85

Optical depth too high to probe easily through Ly alpha

Quasar near zones



(image: Gemini/AURA by Lynette Cook)

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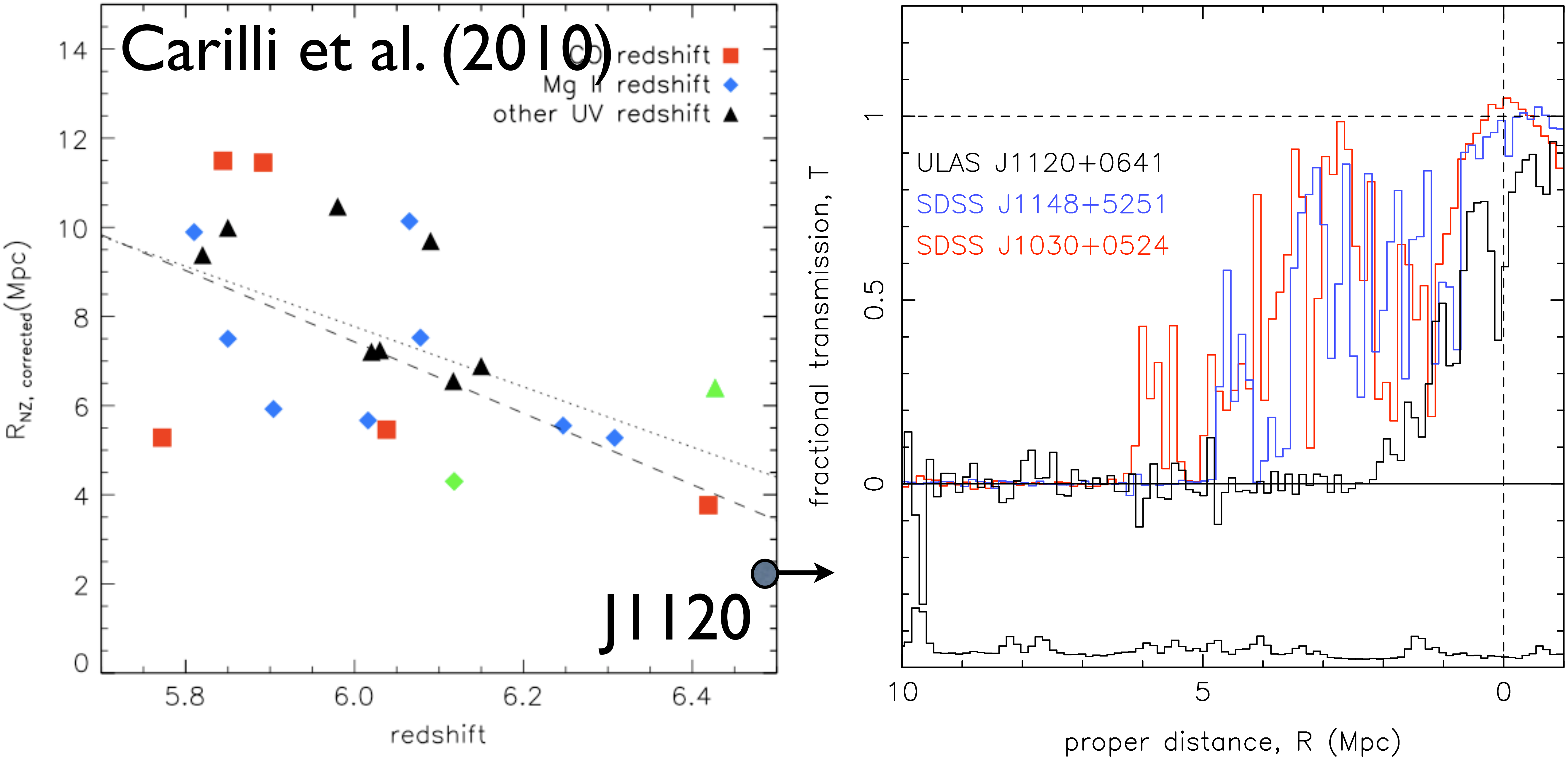
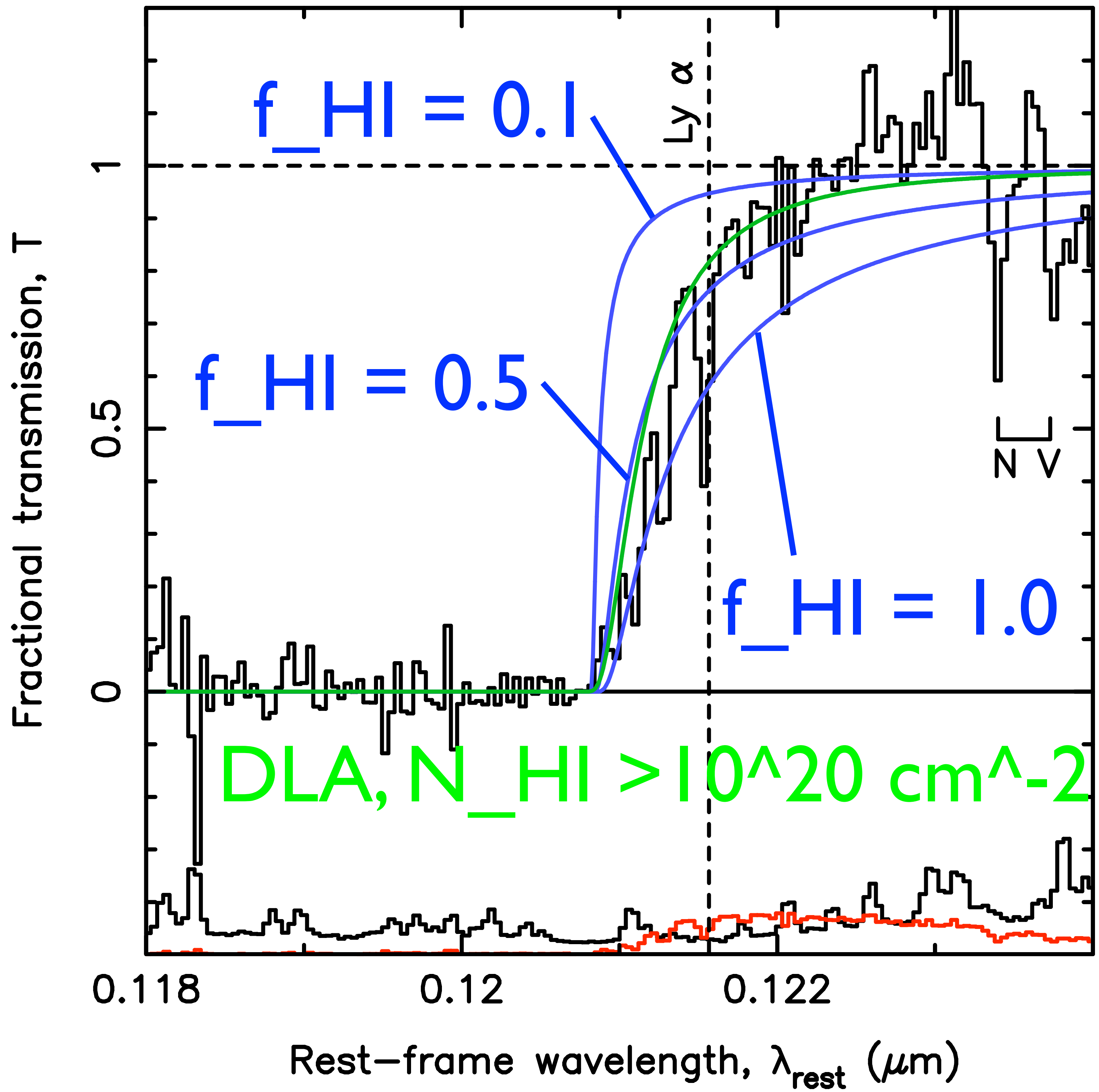


Quasar near zone ~10 times smaller than at z = 6.4

Extent due to ionization front or recombination?

Ly alpha damping wing?



What next?

- VLT X-Shooter spectroscopy (30 hours): Ly alpha profile and dark gaps
- HAWK-I narrow-band imaging (30 hours) to look for recombination Ly alpha
- Finish UKIDSS $5.8 < z < 7.2$ quasar search: one more bright $z > 6.5$ quasar?
- Extend to $8 < z < 9$ using both UKIDSS and VISTA data