RED QUASARS:

Evidence for steep extinction curves towards galactic centres

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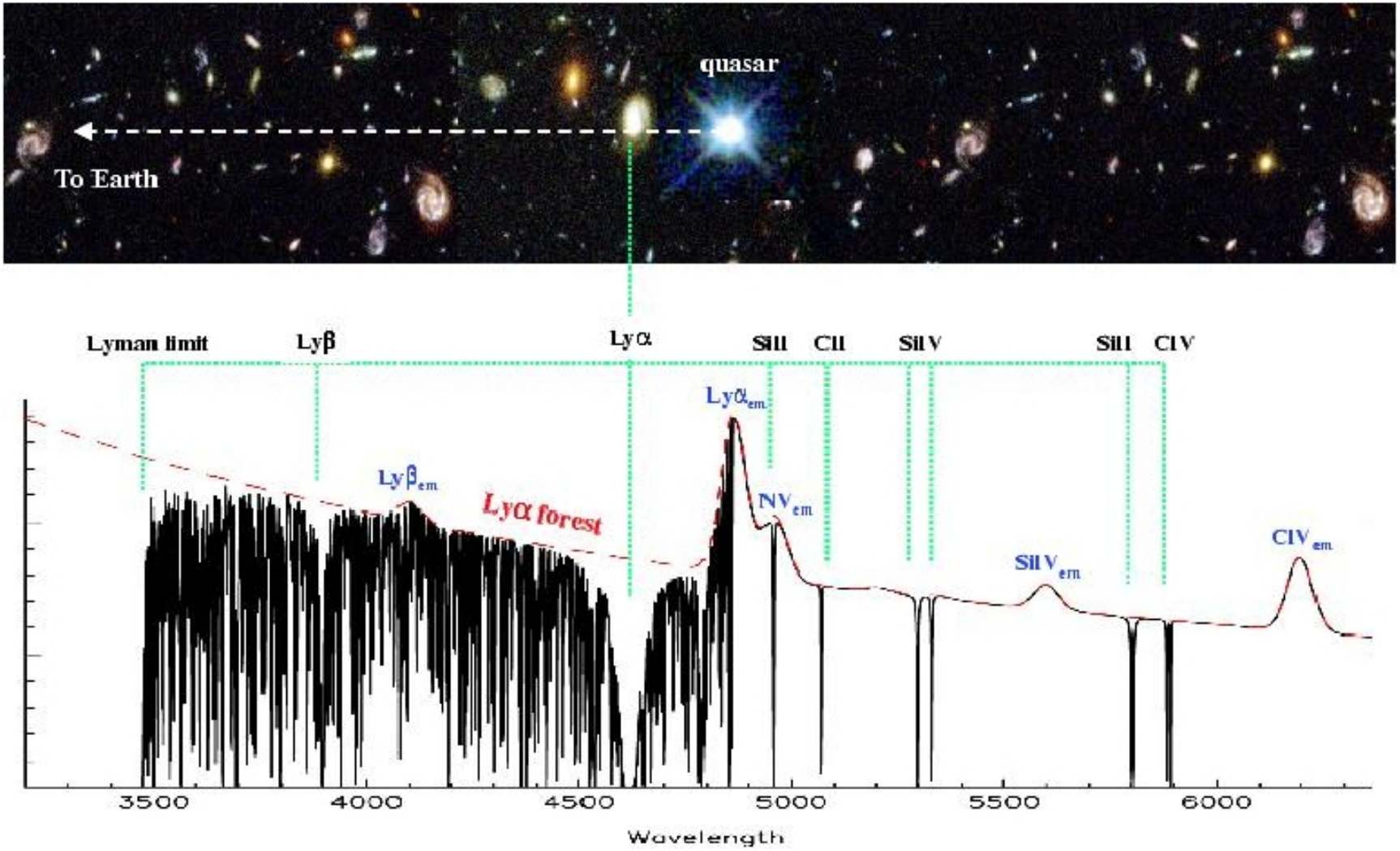
Tayyaba Zafar

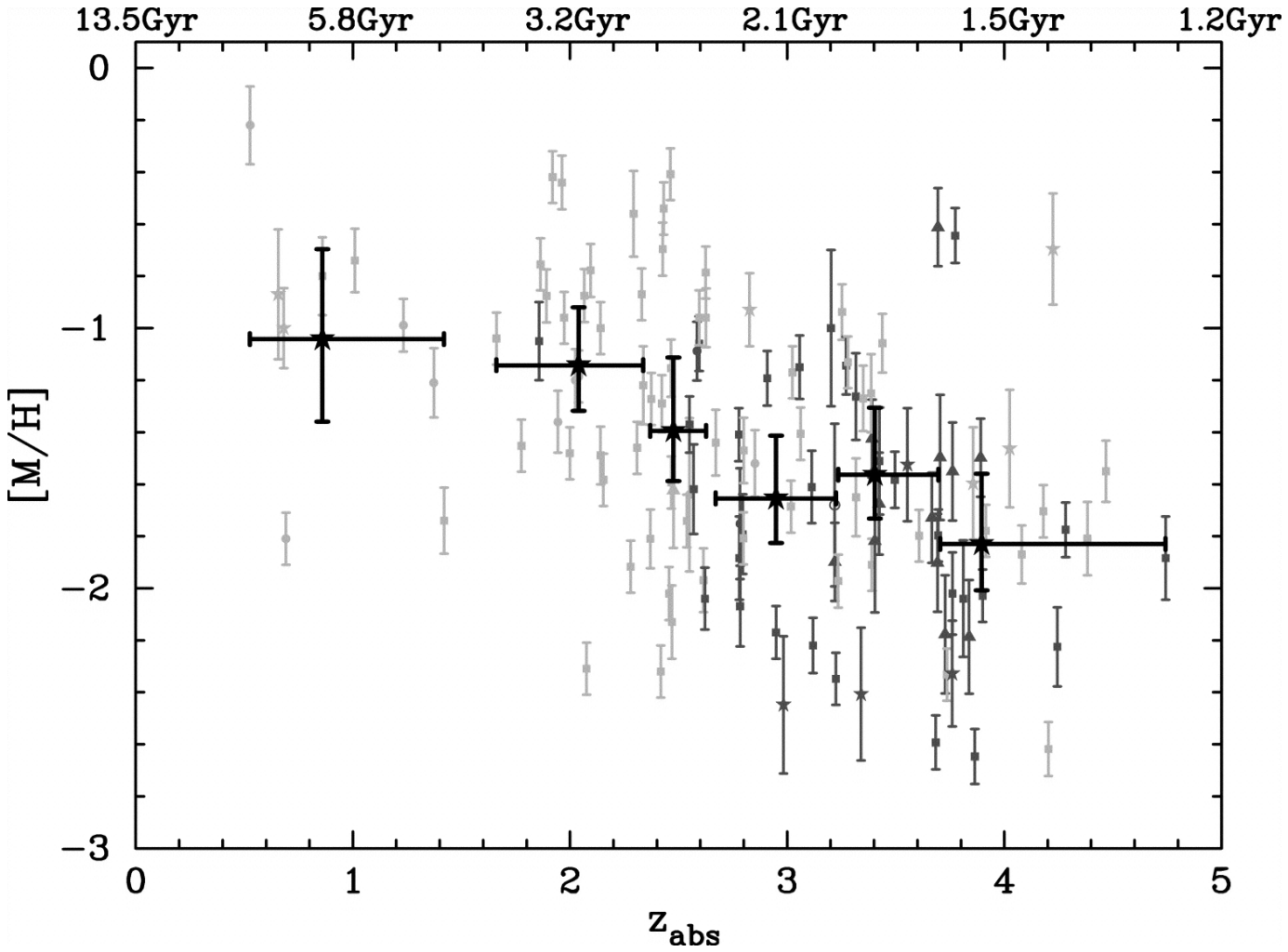
25th Oct 2012, Aarhus

Dark Cosmology Centre
Niels Bohr Institute

Damped Lyman-α Absorbers



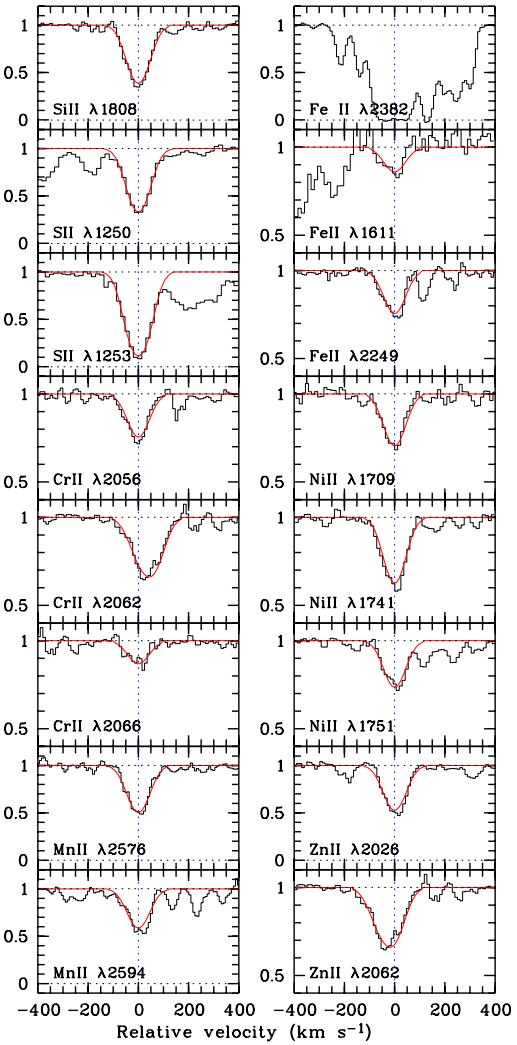
DLAs are important tracers of chemical evolution

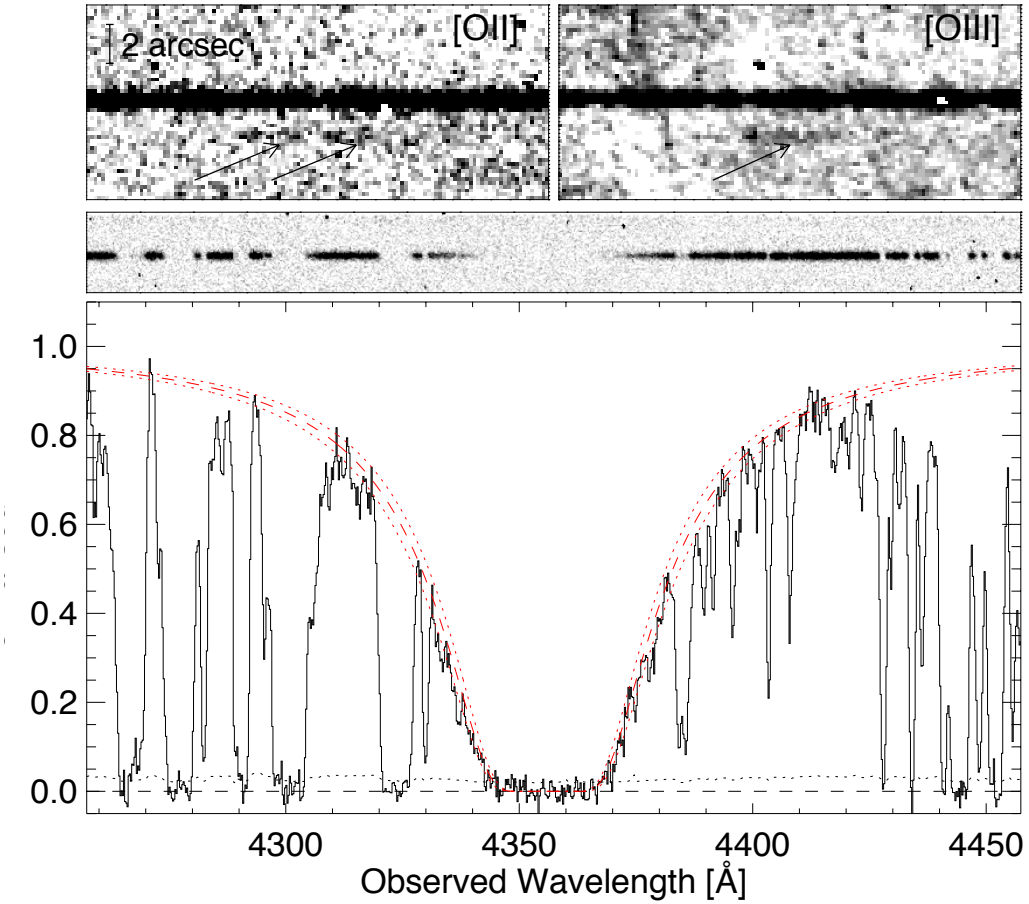


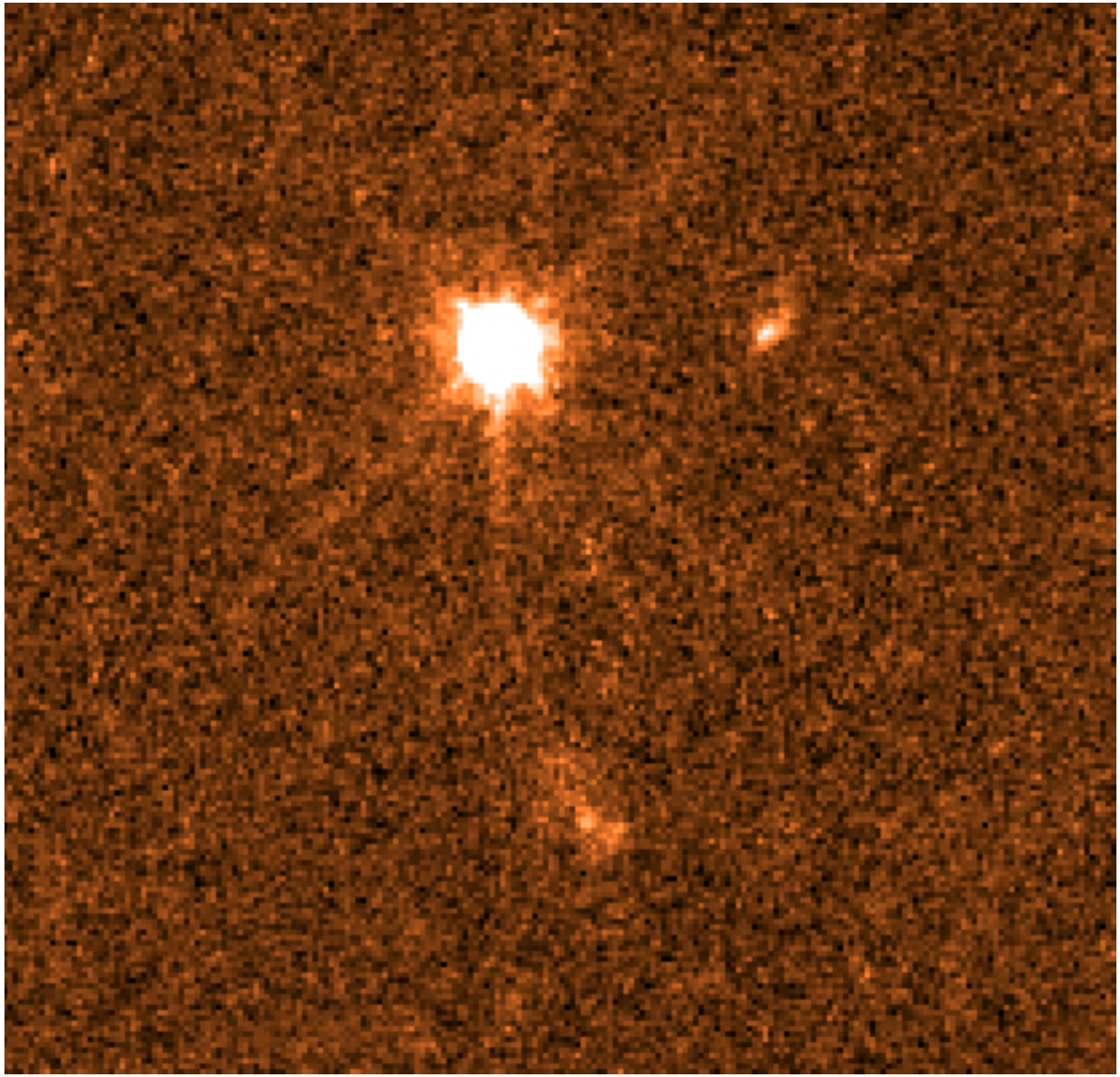
Prochaska et al. (2003)

z = 2.58 DLA towards Q0918+1636:

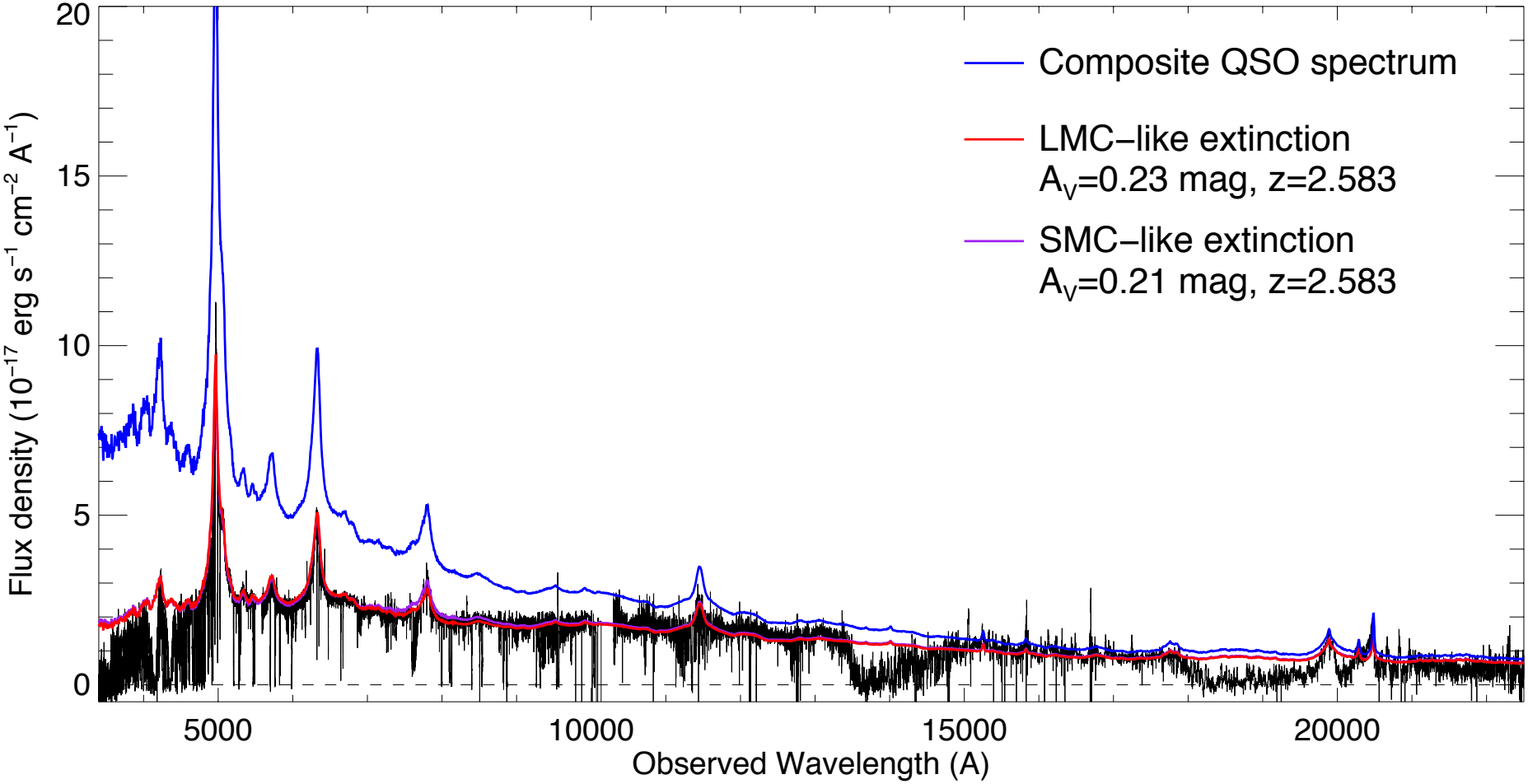
[Zn/H]=-0.12, H_2, CI, SFR≈20$M_\odot$/yr





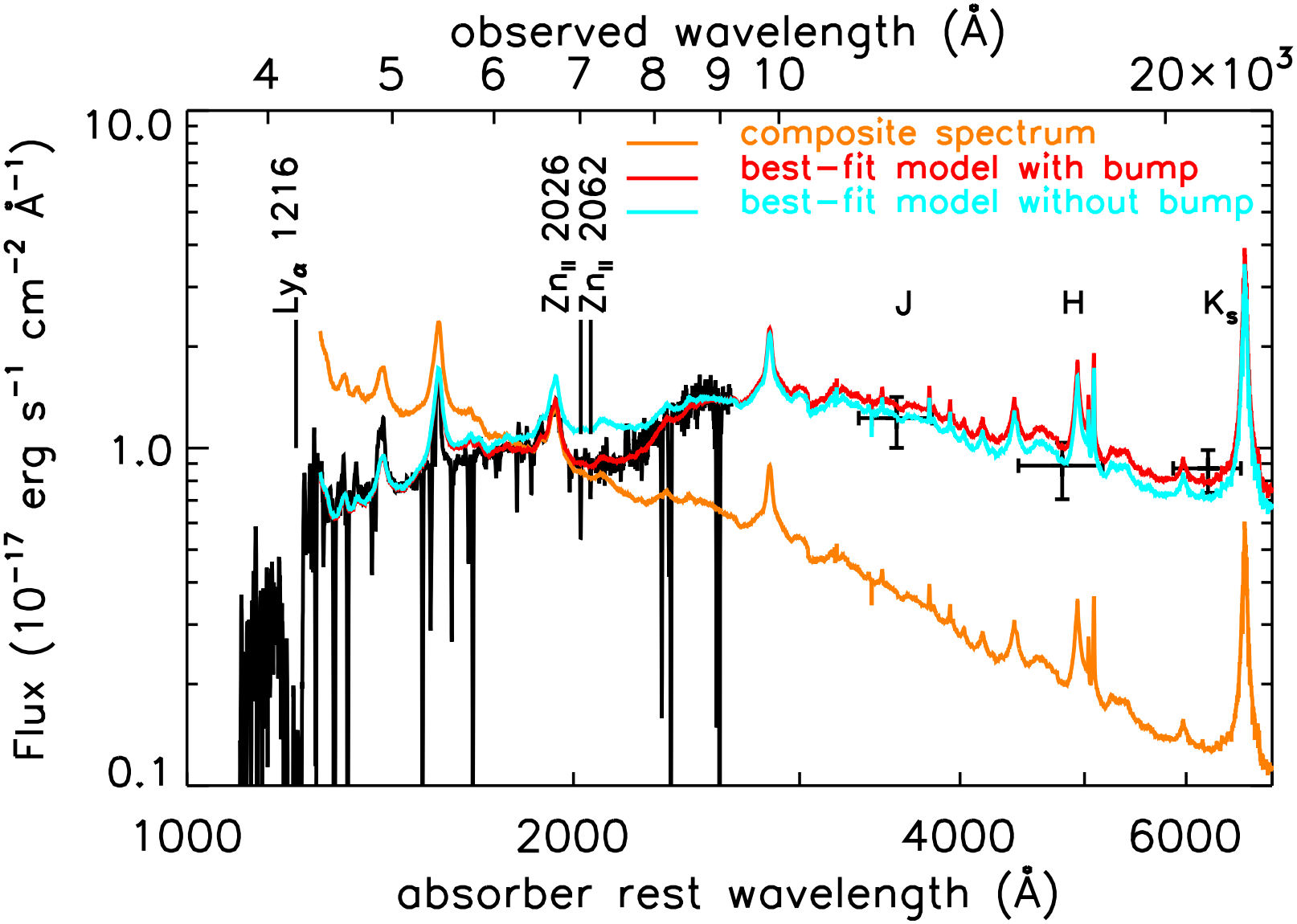


Evidence for extinction



New interesting case

(arXiv:1210.1154)



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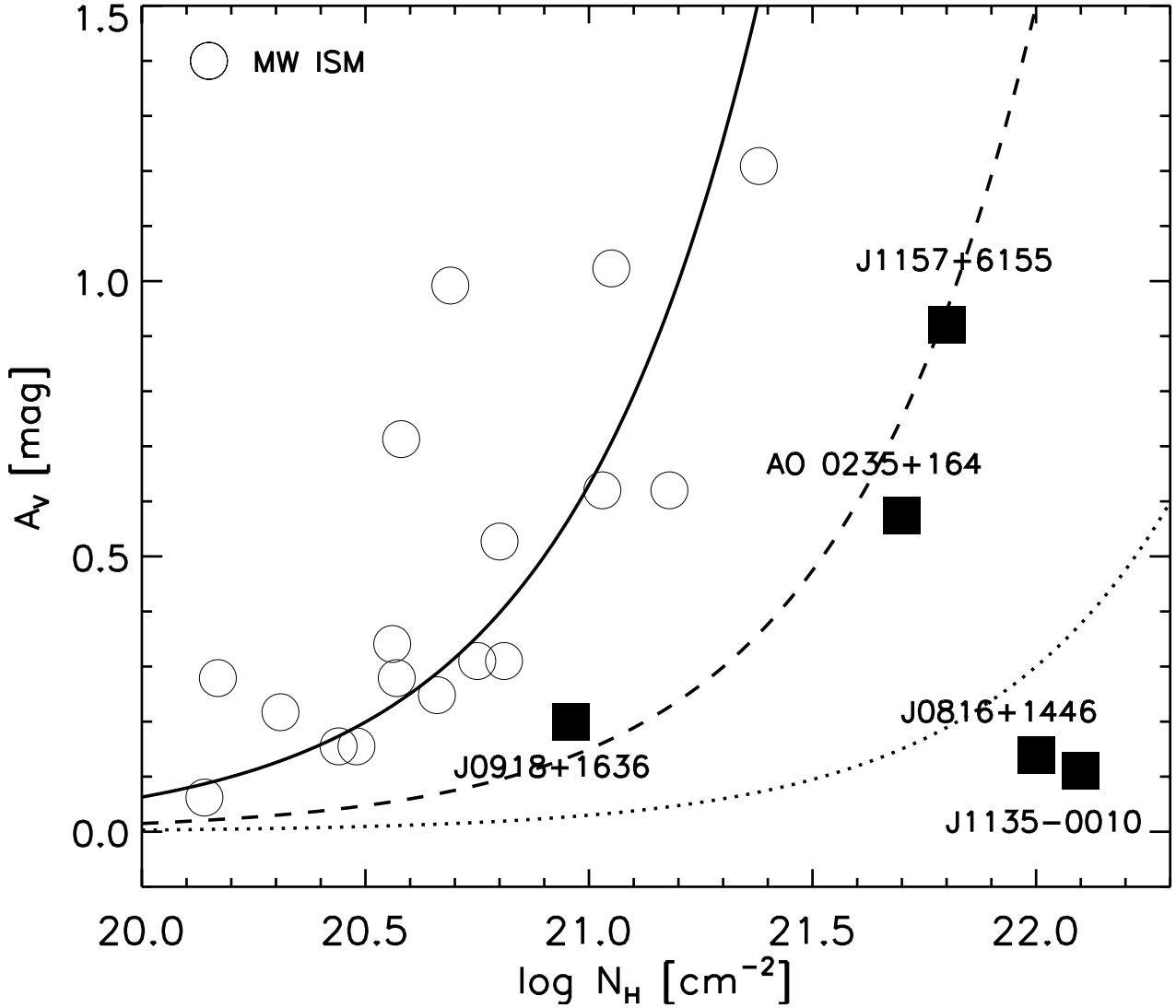
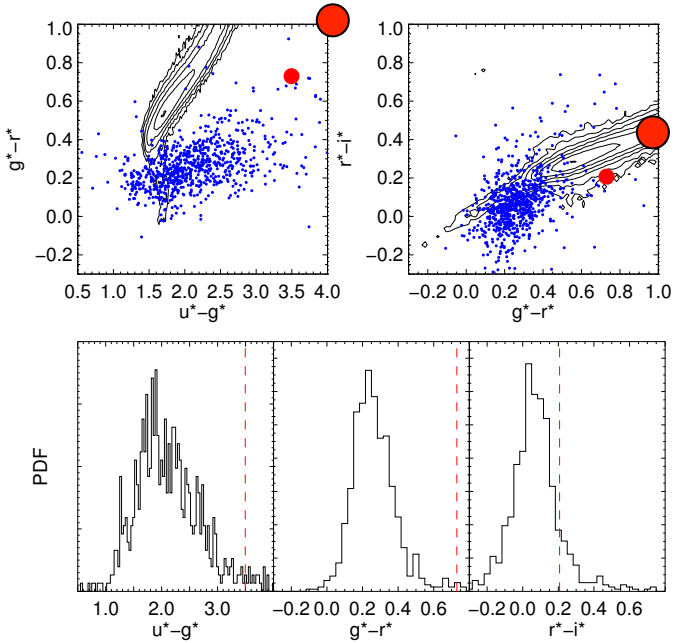
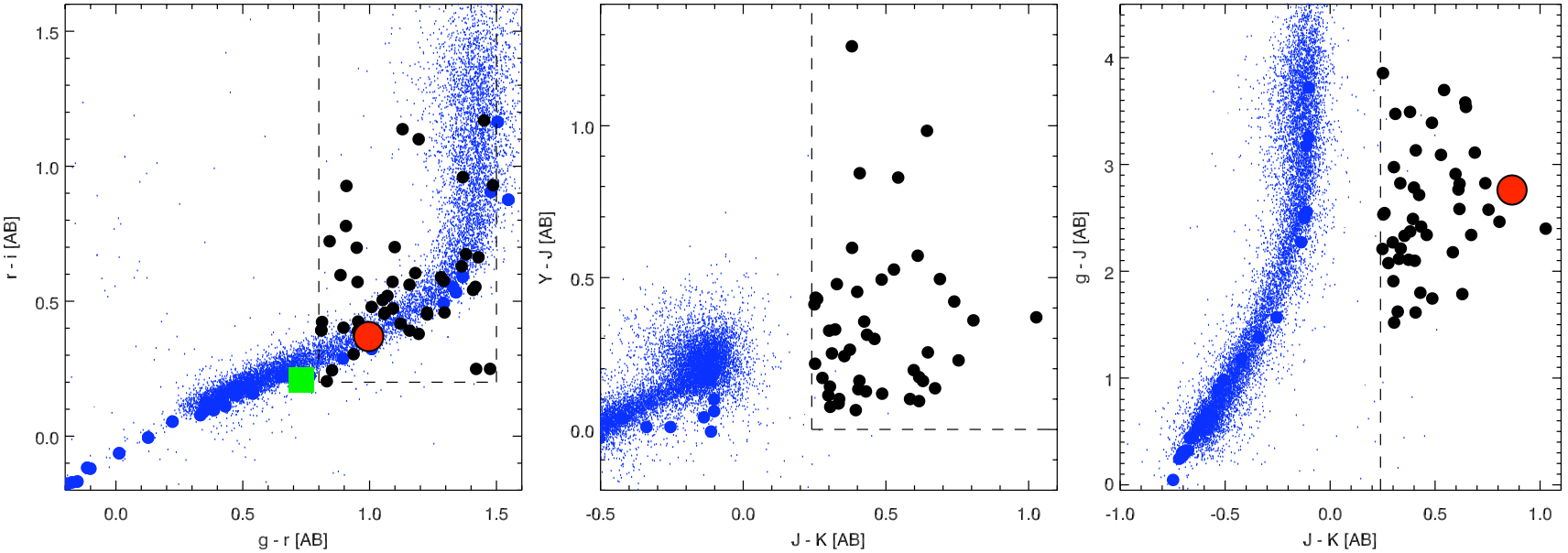


FINDING RED QSOS

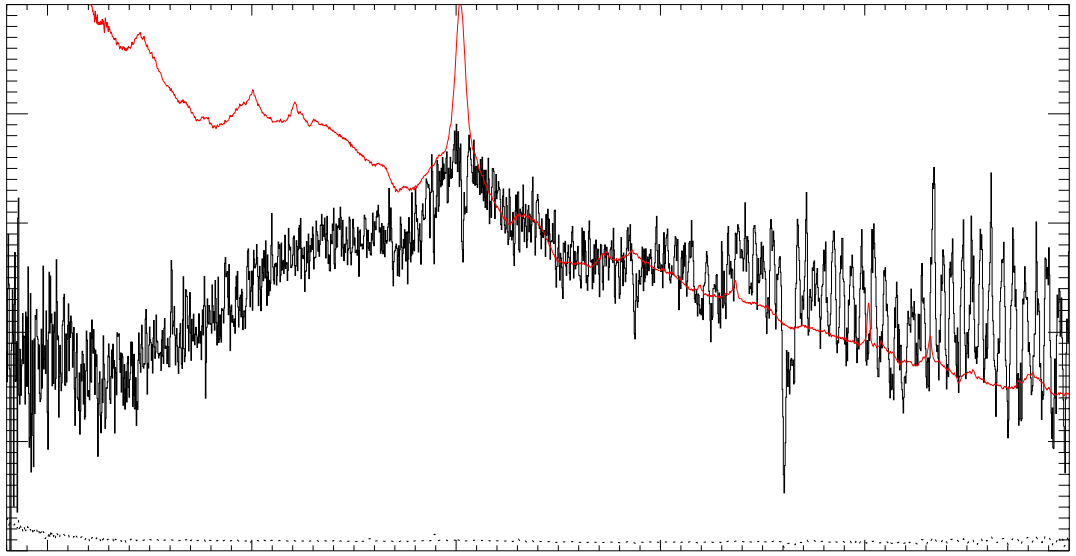
- Using UKIDSS + SDSS
  and later VISTA surveys

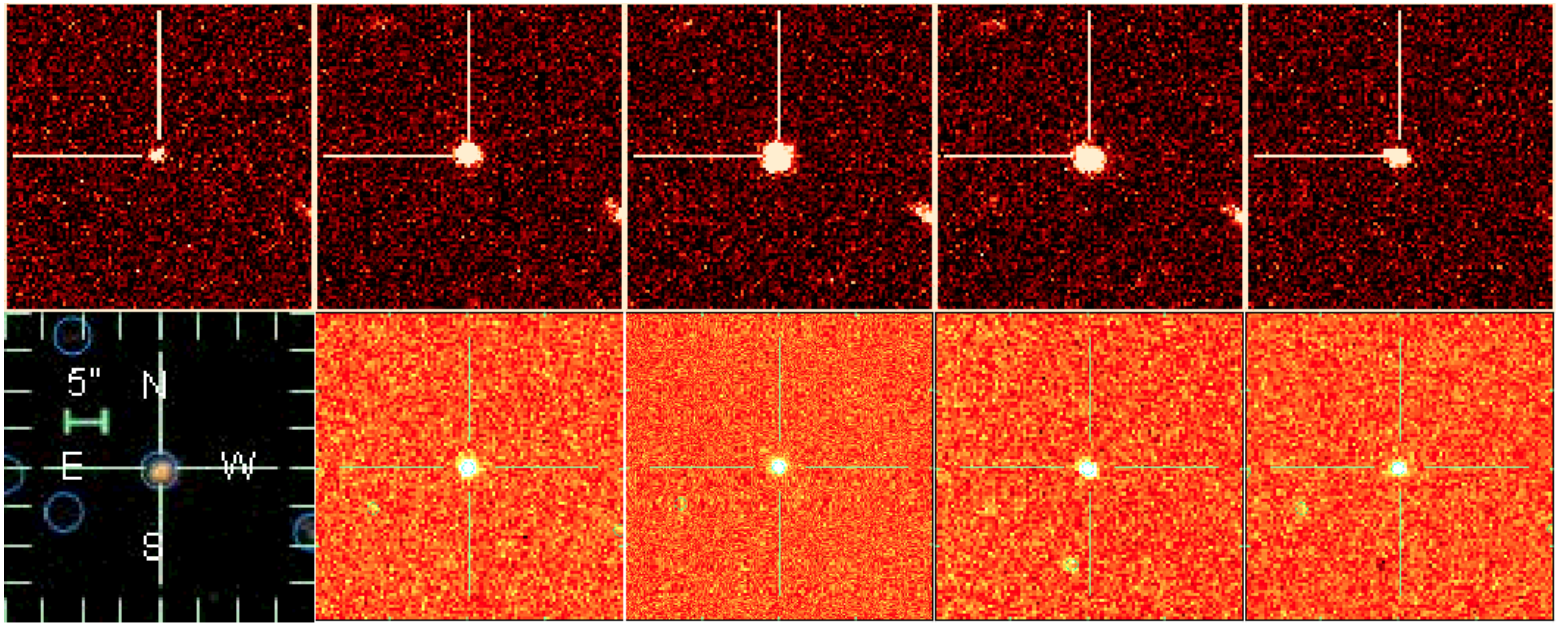




Spectroscopic follow-up

- First set of candidates selected in stripe 82
- 4 observed during NOT summer school in August 2011
- 3 nights for follow-up of targets with the NTT, November 2011.
- Nearly 80 candidates from a wider field subsequently observed with the Nordic Optical Telescope.





umag = 20.30± 0.06
No: 28
ra: 01 27 02.52

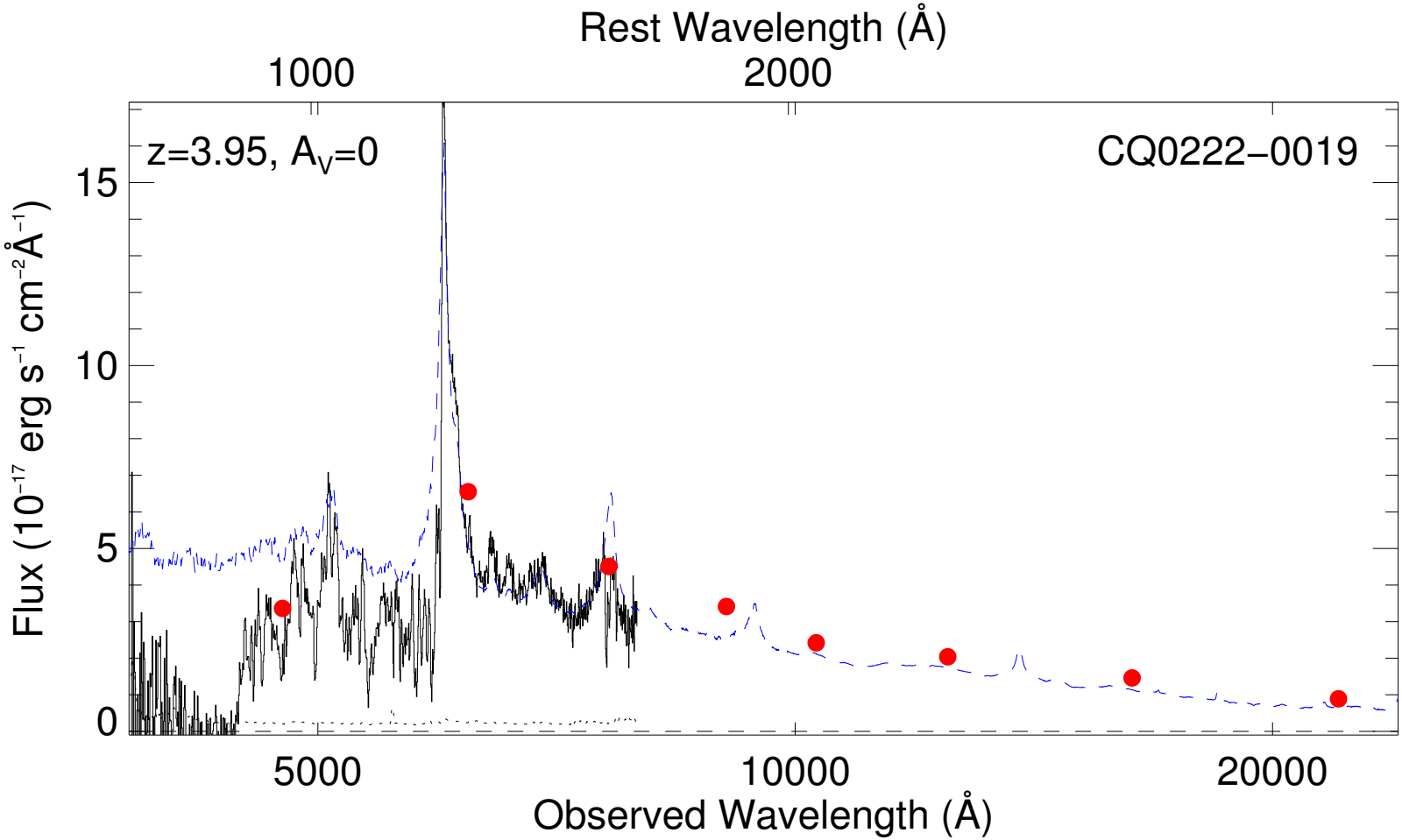
gmag = 18.82± 0.00
ymag = 17.05± 0.01
dec: +01 14 12.6

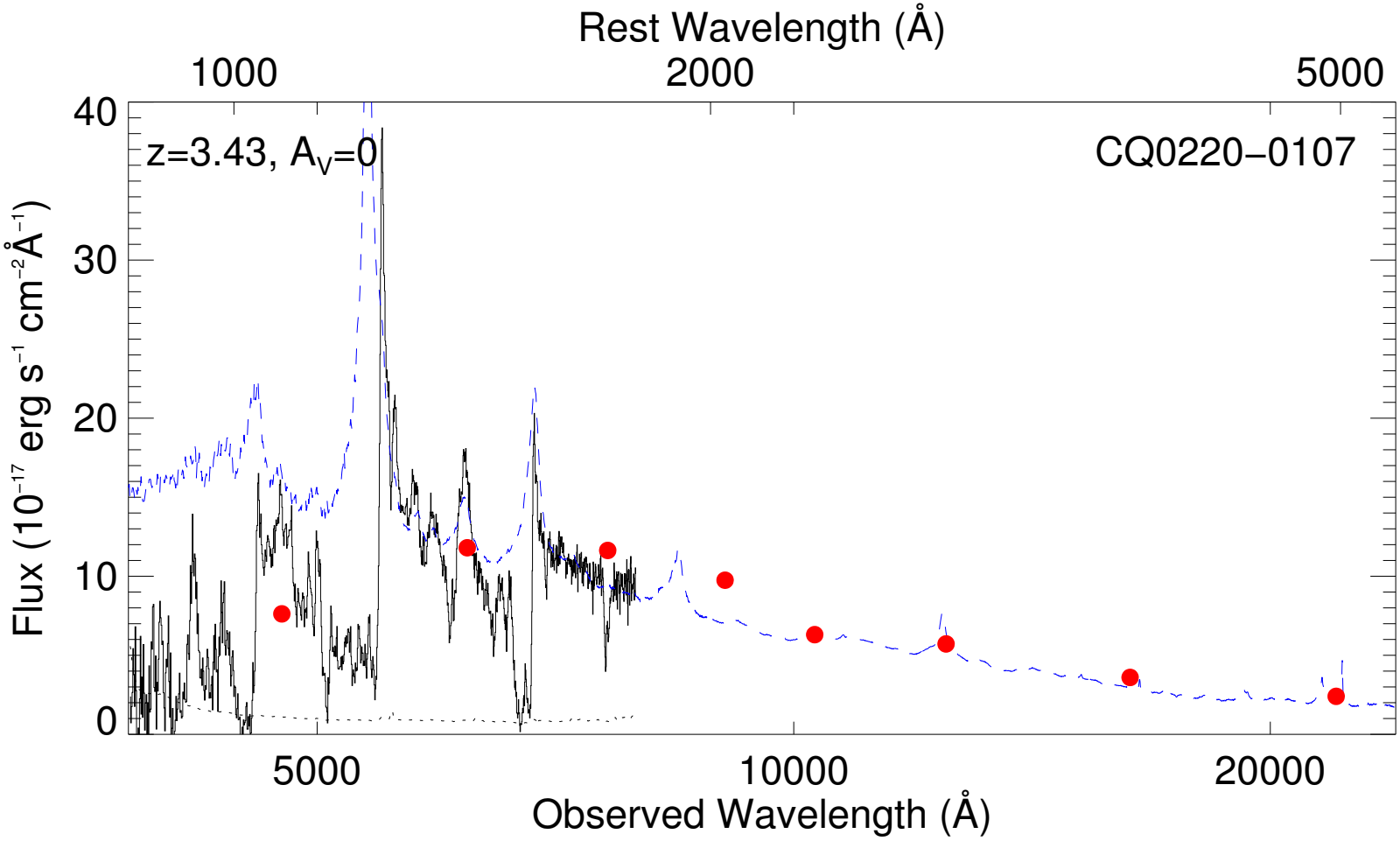
rmag = 17.83± 0.02
jmag = 16.88± 0.01
i-Y = 0.34

imag = 17.39± 0.00
hmag = 16.71± 0.01
z-J = 0.20

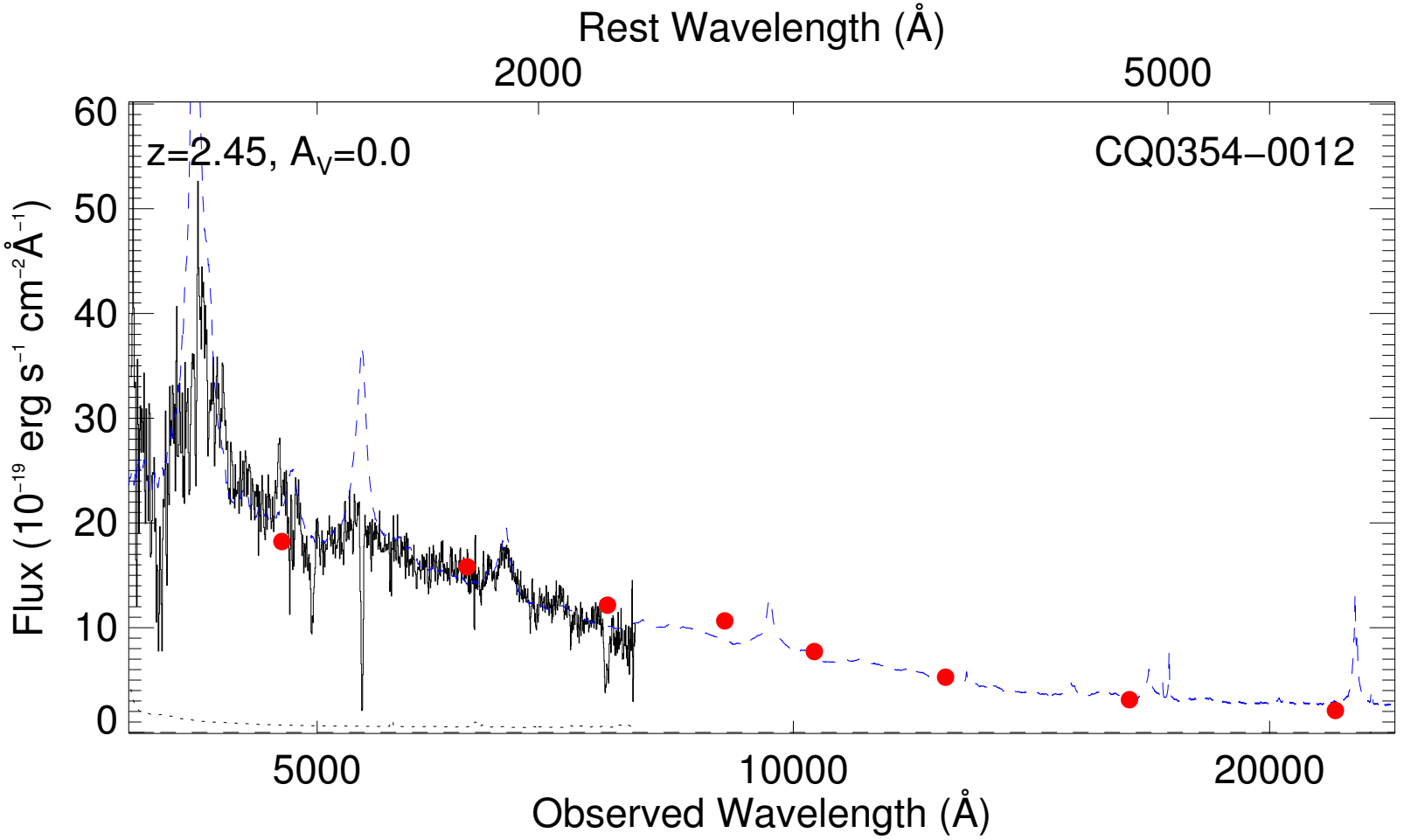
zmag = 17.08± 0.01
kmag = 16.61± 0.01
i-z = 0.31

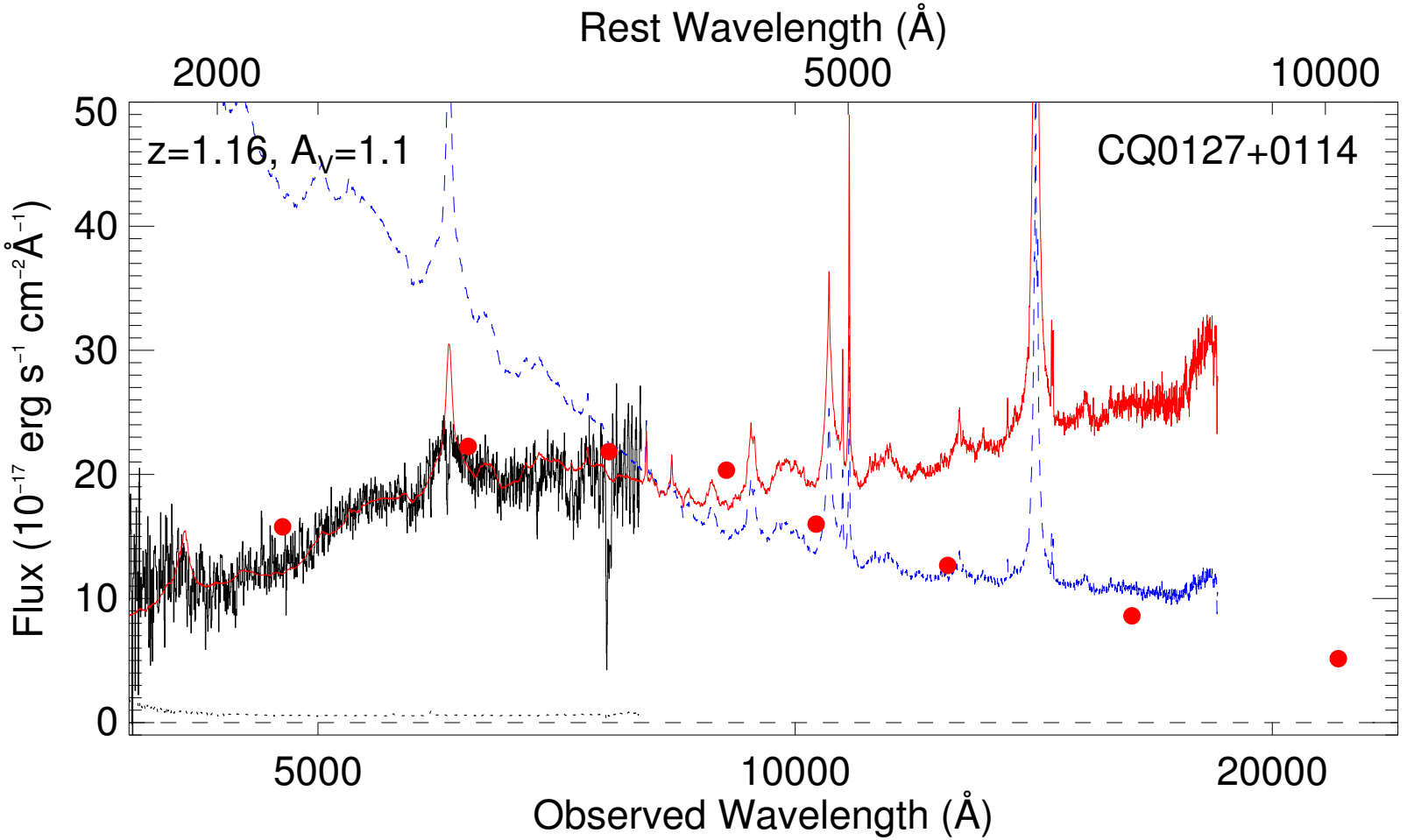
Examples from the NTT run November 2011

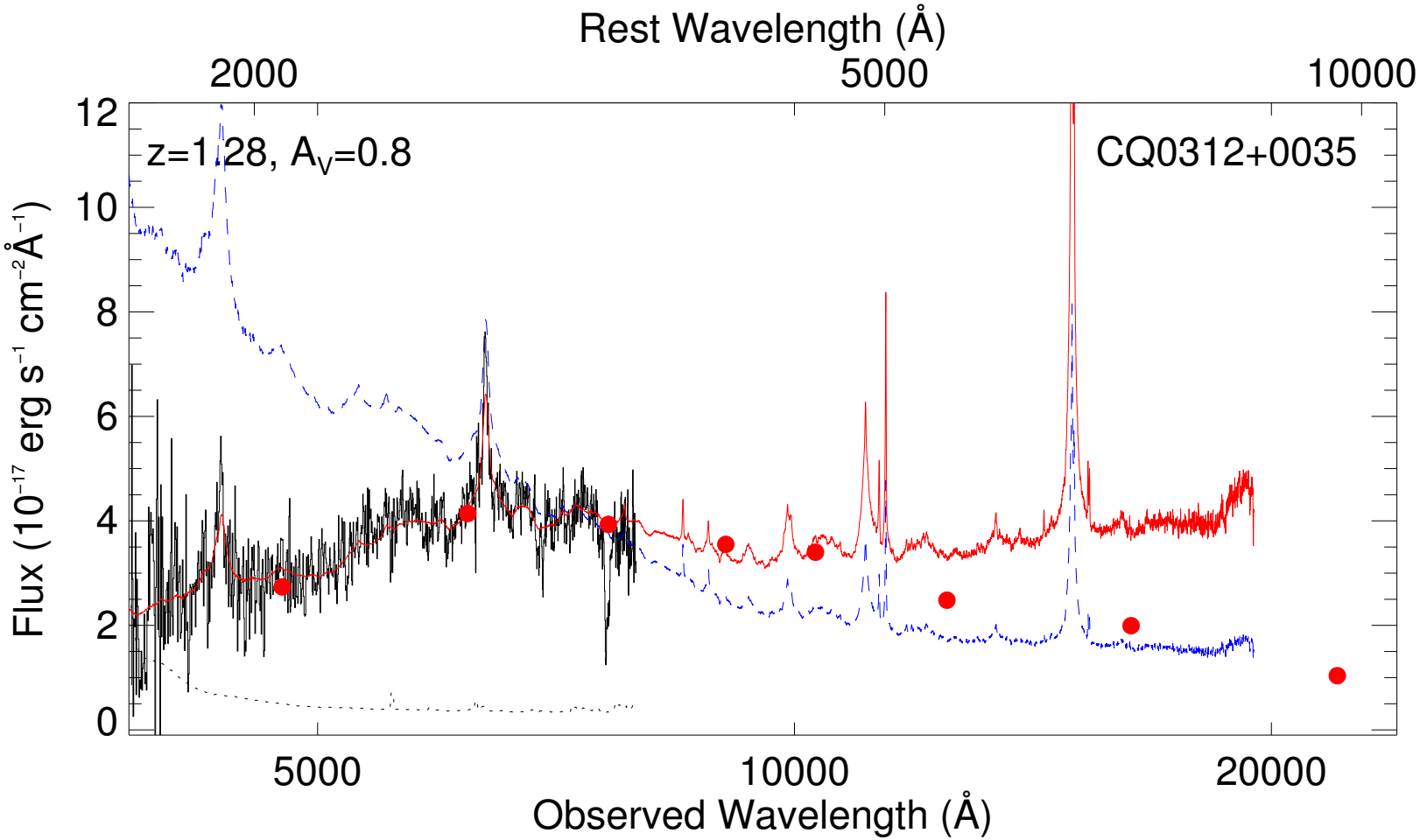



Rest Wavelength (Å)
1000
2000
5000
z=3.43, A_V=0
CQ0220−0107
Flux (10^-17 erg s^-1 cm^-2 Å^-1)
40
30
20
10
0
5000
10000
20000
Observed Wavelength (Å)

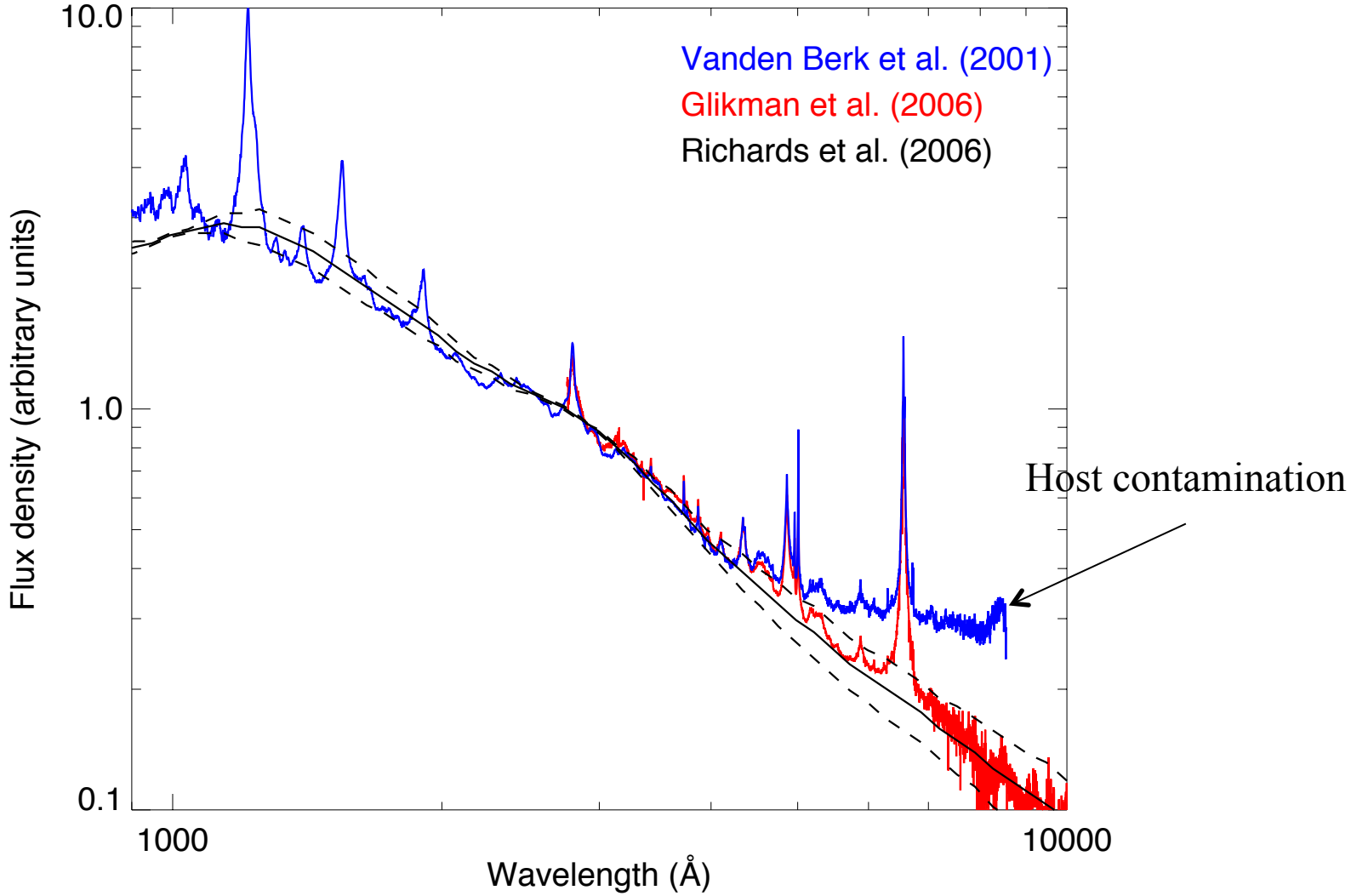
E(B-V) = 0.45 (Galactic). After de-reddening the template fits well.




Rest Wavelength (Å)
2000
5000
10000
z=1.16, A$_V$=1.1
CQ0127+0114
Flux (10^{-17} erg s^{-1} cm^{-2}Å^{-1})
50
40
30
20
10
0
5000
10000
20000
Observed Wavelength (Å)


Rest Wavelength (Å)
2000
5000
10000
z=1.28, A$_V$=0.8
CQ0312+0035
Flux (10^{-17} erg s^{-1} cm^{-2}Å^{-1})
0
2
4
6
8
10
12
5000
10000
20000
Observed Wavelength (Å)

Problem with the composite QSO spectrum?



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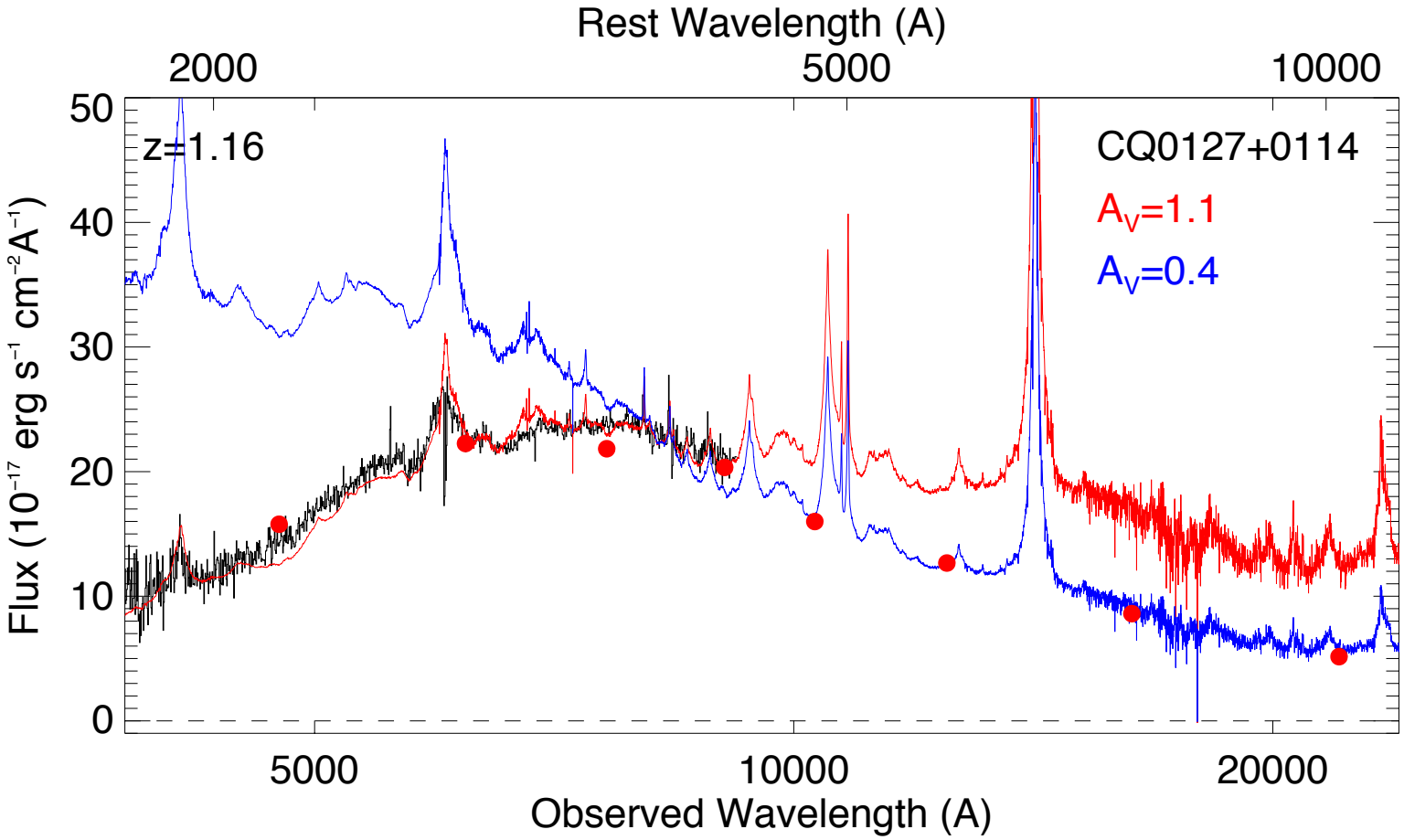

Mon. Not. R. Astron. Soc. **394,** 2247–2254 (2009) doi:10.1111/j.1365-2966.2009.14493.x

The complex, variable near-infrared extinction towards the Nuclear Bulge

THE ASTROPHYSICAL JOURNAL, 696:1407–1417, 2009 May 10 doi:10.1088/0004-637X/696/2/1407

INTERSTELLAR EXTINCTION LAW TOWARD THE GALACTIC CENTER III: J, H, K_S BANDS IN THE 2MASS AND THE MKO SYSTEMS, AND 3.6, 4.5, 5.8, 8.0 μm IN THE *SPITZER*/IRAC SYSTEM

Mon. Not. R. Astron. Soc. **349,** 193–204 (2004) doi:10.1111/j.1365-2966.2004.07482.x

Extinction map of the Galactic centre: OGLE-II Galactic bulge fields

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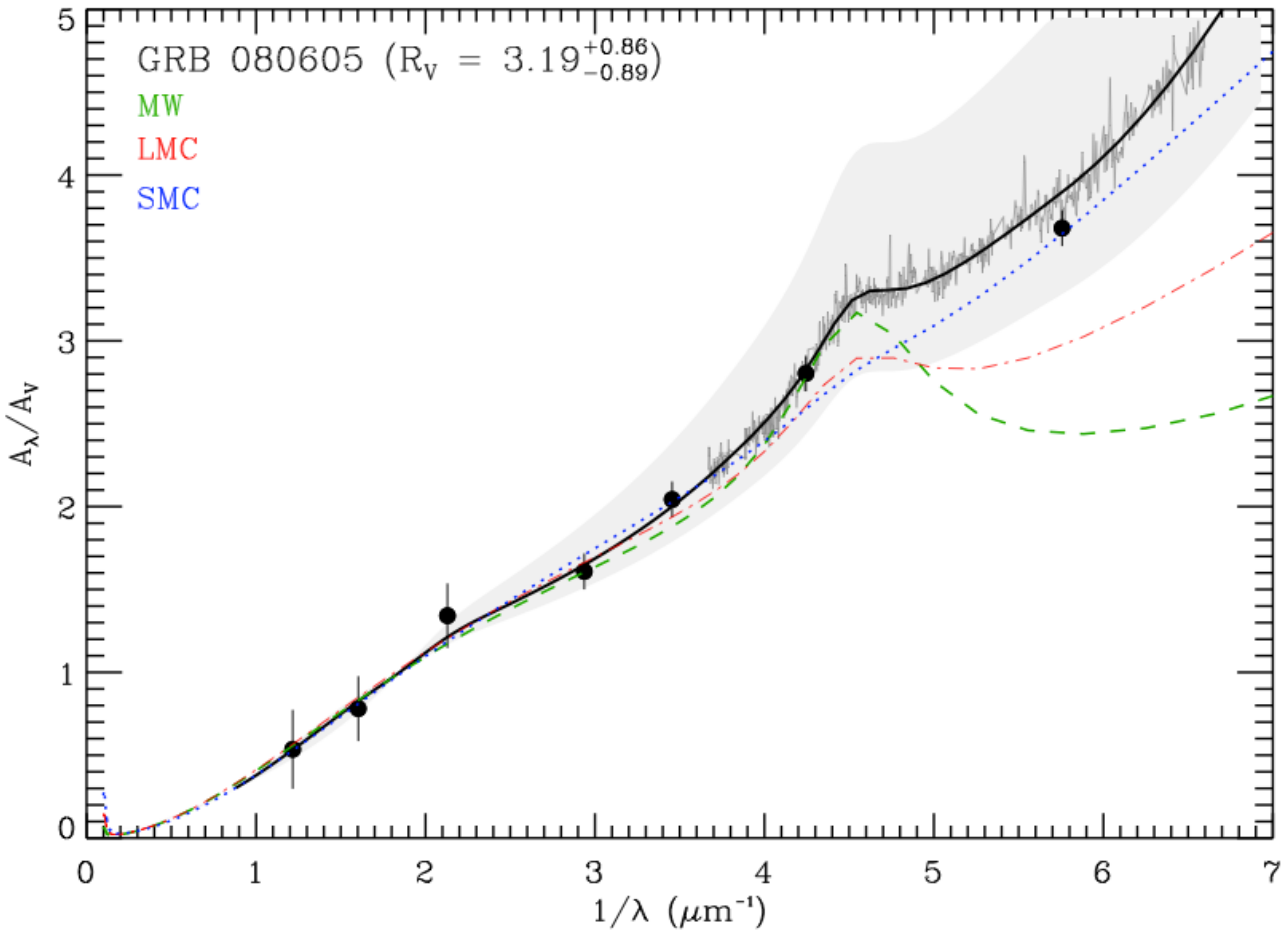
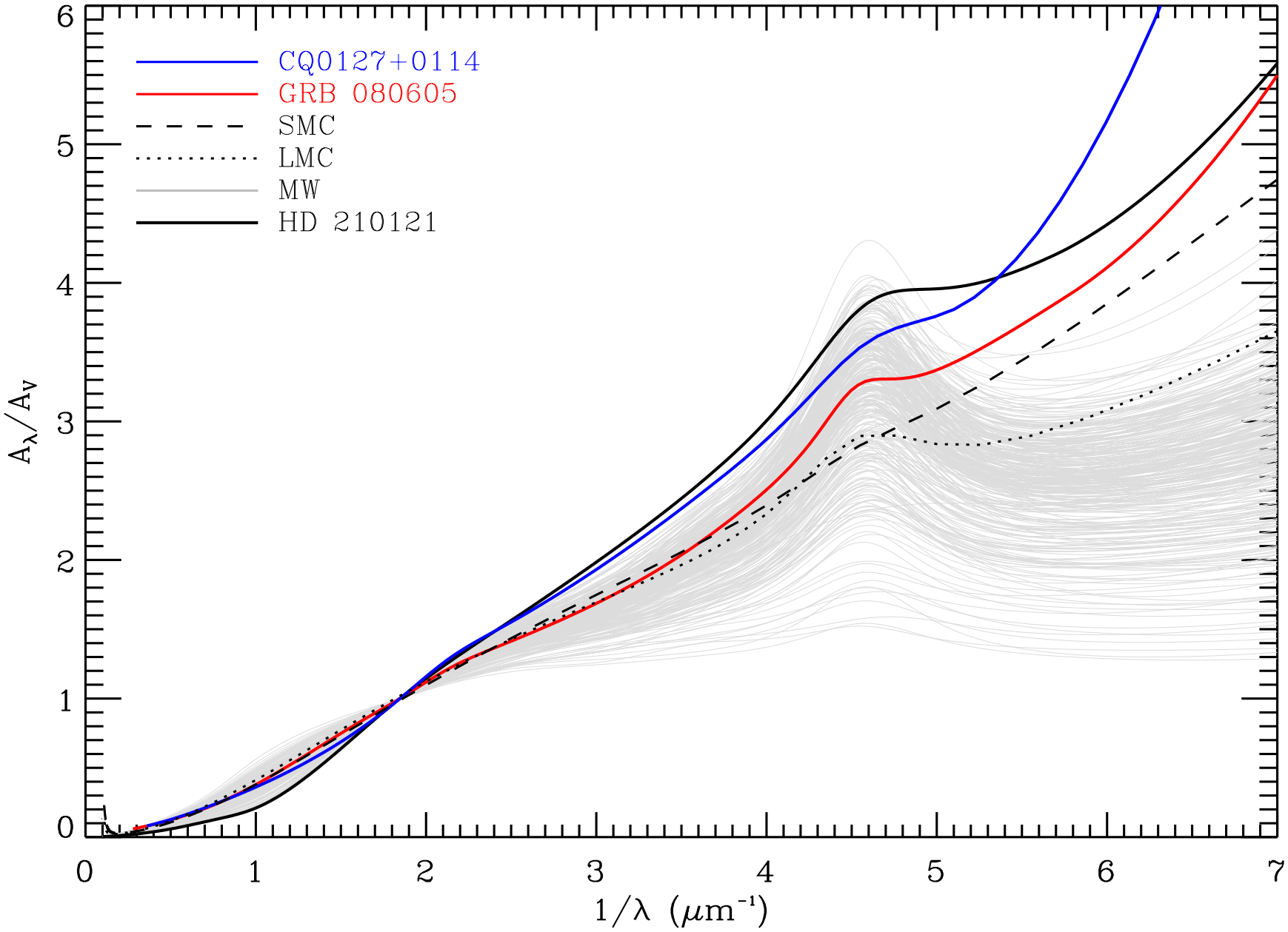


Afterglow derived extinction curve with 2175 Å extinction bump (z=1.65, A_V=0.5 mag)

Zafar et al. (2012)


CQ0127+0114
GRB 080605
SMC
LMC
MW
HD 210121
A_λ/A_V
$1/\lambda$ (μm^{-1})
0
1
2
3
4
5
6
7

Summary

- A search for dust-reddened QSOs found many QSOs missed by the SDSS QSO criteria.
- Some of these are apparently reddened by anomalous intrinsic dust.
- An attempt to extract the extinction curve for one particular QSO shows that it is very steep in the UV.
- Qualitatively similar extinction is seen towards the Galactic Centre and towards one GRB afterglow.
- Next step: a more systematic analysis of extinction curves based on this sample.