From the Sublime to the Ridiculous: Quasars Astrophysics in 2023

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DESI Galaxies & Quasar Physics

MJD 57925

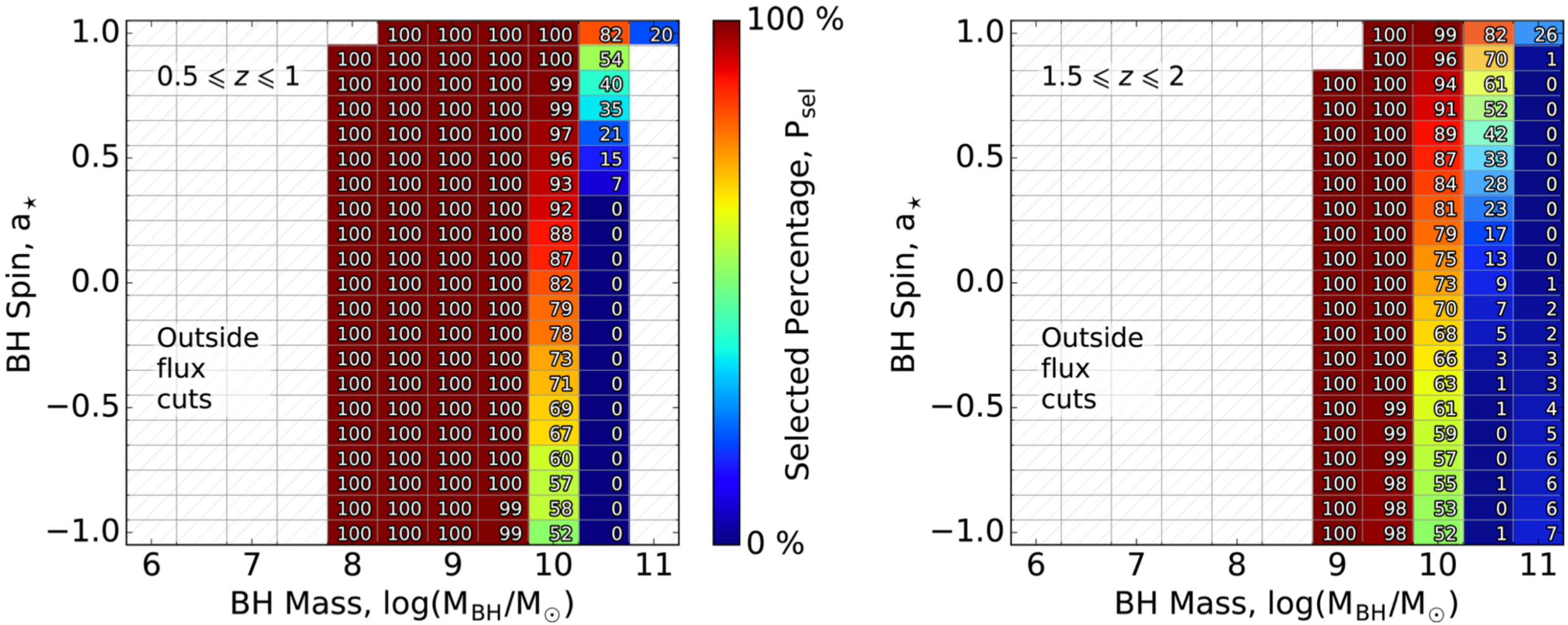
github.com/d80b2t

- A galaxy has ***two*** main sources of energy available: nuclear fusion and accretion onto a compact object

- After dark matter, ***dust*** is the most poorly understood constituent in a galaxy

- Black holes have no hair

SDSS misses high-mass low spin BHs

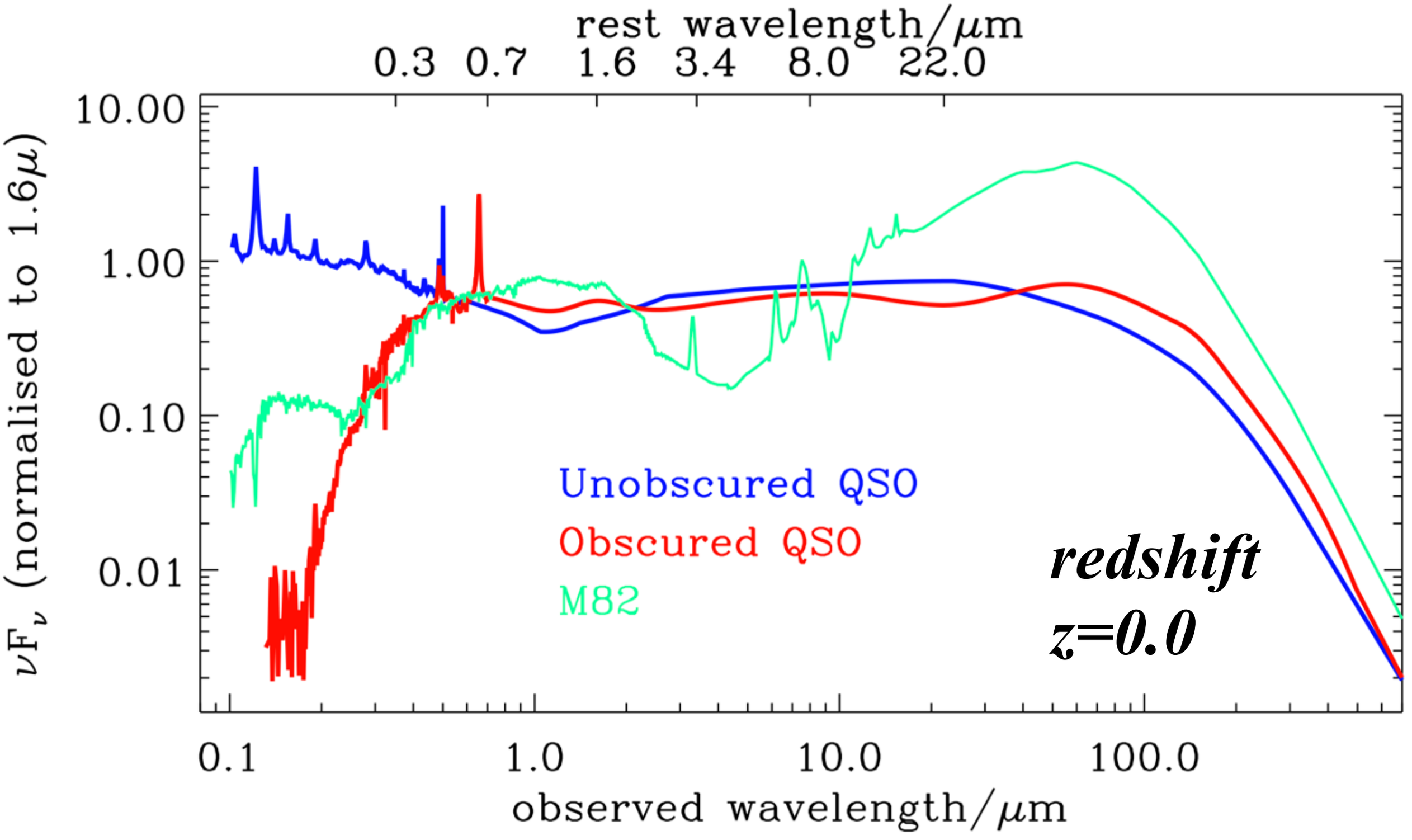


Bertemes et al., 2016, MNRAS, 463, 4041

- Do we have a full accounting for accretion? Function of $M_{\rm BH}$, $\dot{M}$, spin, obscuration.
- $L_{\rm bol} = \eta \, \dot{M}_{\rm acc} \, c^2$ What is eta??
- How does $M_{\rm BH} - M_\star$ at form, evolve?
- Understand the link between the torus and the gas in and around the galaxy (the ``narrow line region'' is basically the whole galaxy)
- What are the modifications we need for Shakura & Sunyaev (1973)?
- Understanding how the distribution of Radio Loudness works in Quasars
- Do Quasars power LAE nebulae/blobs?

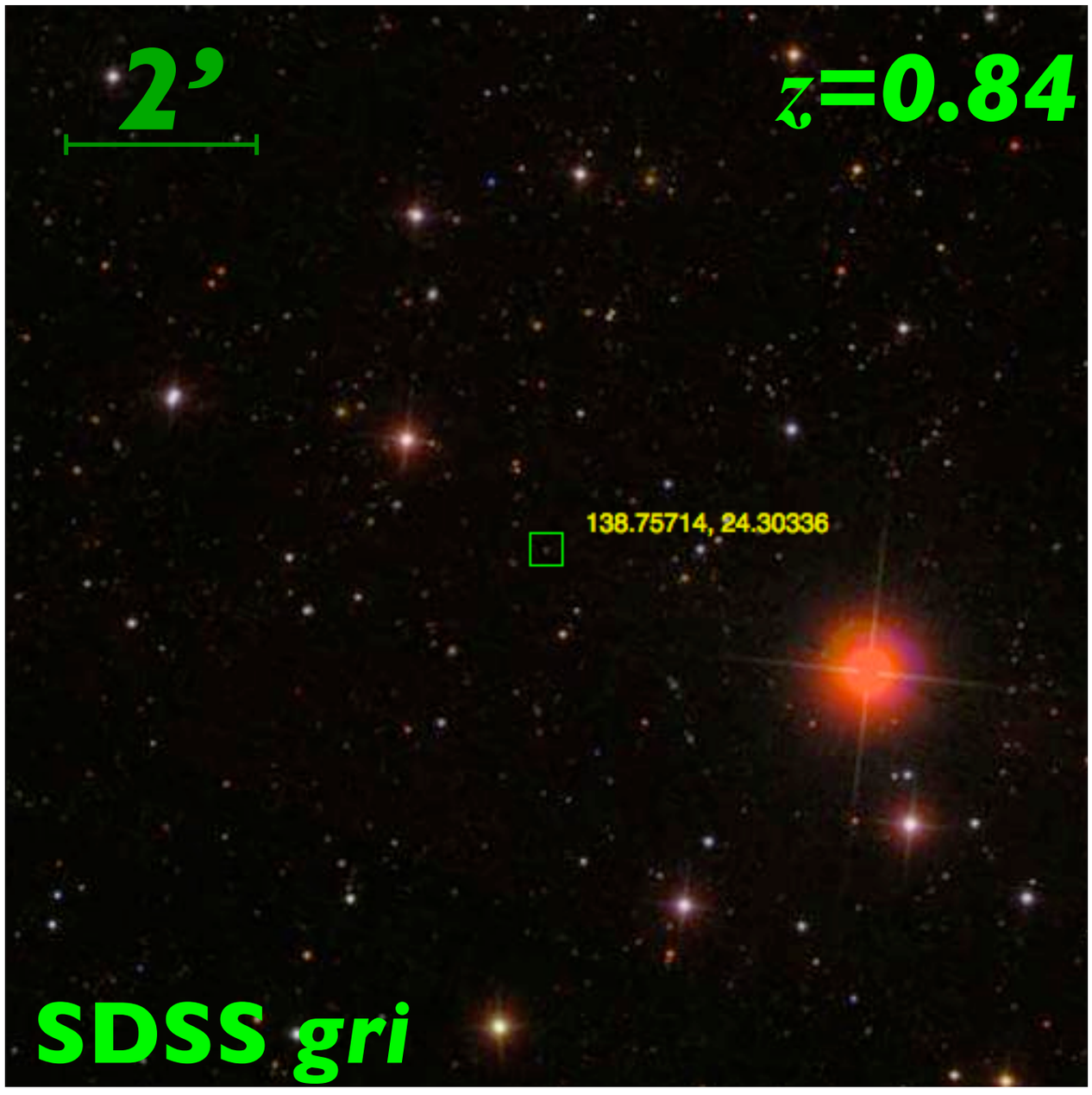
- Full MaNGA (SAMI) Sample
- Full HSC, DES (maybe), *Legacy*
- *Gaia* End of Mission
- *Hubble* and *James Webb* Space Telescopes
- *LSST* Commissioning
- Upto 1,250 deg^2 Euclid (NEP; 14-18h, +60deg).
- EM follow-up of GWs

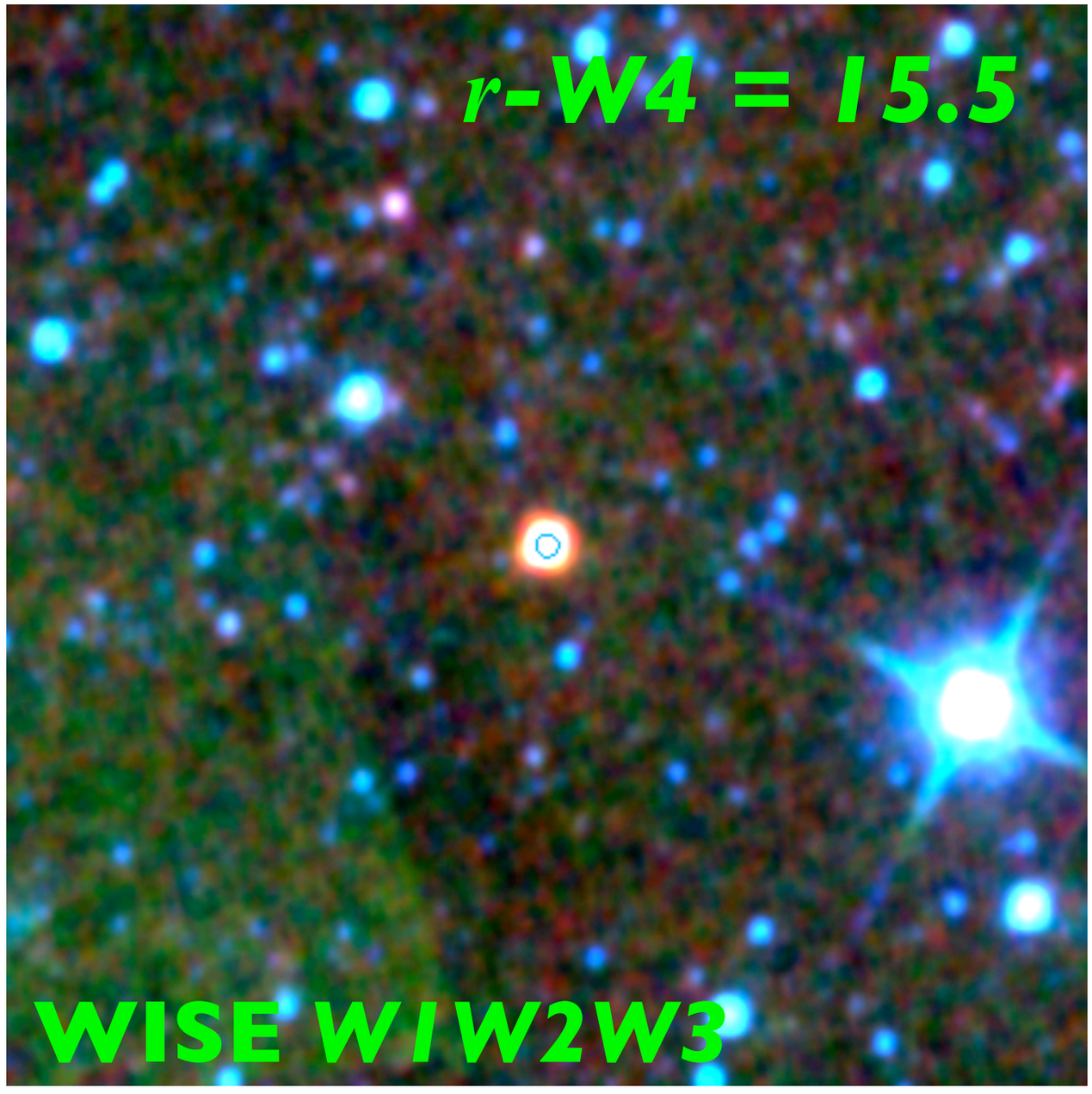
Quasars emit over the full EM spectrum



Extremely Red Quasars

$F_{IR} \geq 1000\ F_{opt}$

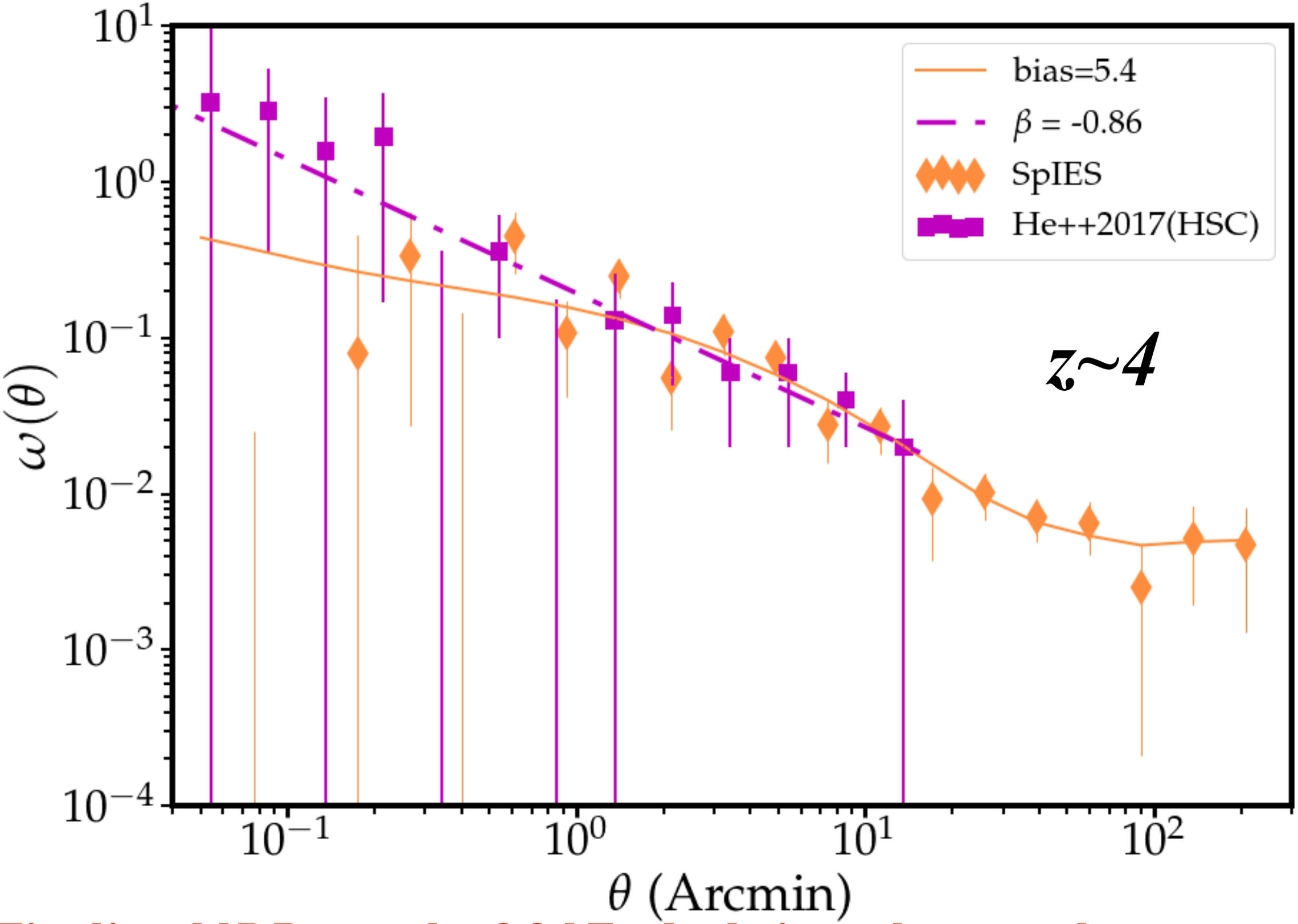




Ross et al., 2015, MNRAS, 453, *3932*
Zakamska et al., 2016, MNRAS, 459, *3144*
Hamann et al., 2017, MNRAS, 464, *3432*
Alexandroff et al., 2017, ApJ submitted

SDSS J0915+2418

SpIES: First IR QSO Clustering at $z>2$



Timlin, NPR et al., 2017, ApJ, in advanced prep.

Quasars have a whole lotta timescales

AGN Structure	physical size	angular size	t_{lt}	t_{dyn}	t_{snd}	t_{therm}
Inner disc	5 R_S	0.1μas	1.4hrs	4.3hrs	1.3 yrs	18.7days
Optical disc	50 R_S	1μas	14hrs	5.7days	23 yrs	1.6yrs
Broad Line Region	1000 R_S	20μas	11days	1.4yrs	800 yrs	–
Obscuring Region	$10^5 R_S$	2mas	3.1yrs	1.4kyrs	350 kyrs	–

for a 10^8 $M_\odot$ black hole at 100 Mpc

t_{lt}: light crossing timescale, $t_{lt} \sim R/c$

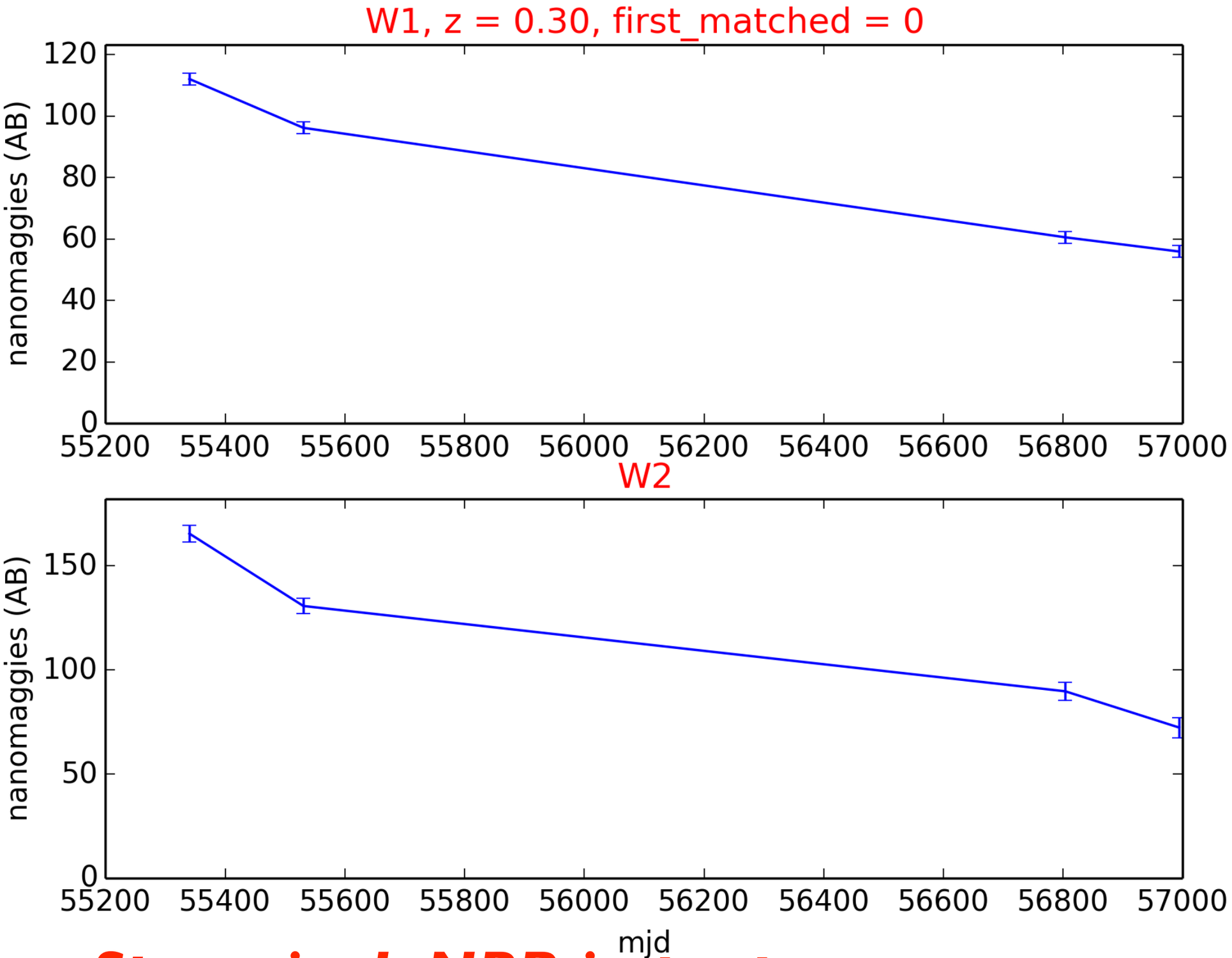
t_{dyn}: dynamical timescale, $t_{dyn} \sim \sqrt{(R^3/GM)}$

t_{snd}: sound crossing timescale $t_{snd} = R/v_{snd}$.

t_{therm}: `energy spike' to dissipate within the disc

e.g. Lawrence, 2016, *ASPC*, **505**, *107*

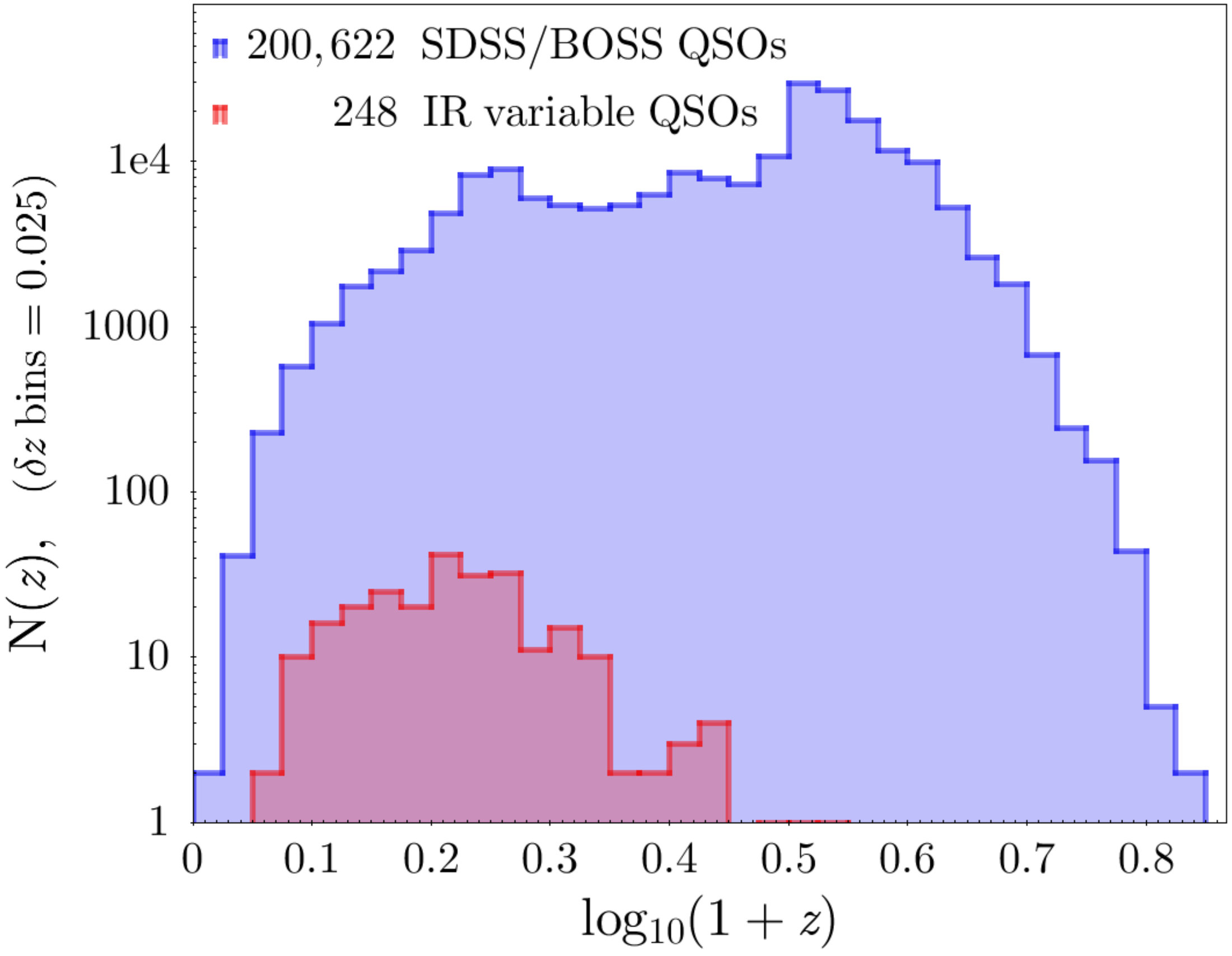
Quasars with $|\Delta W_{1,2}| > 0.5$ mag



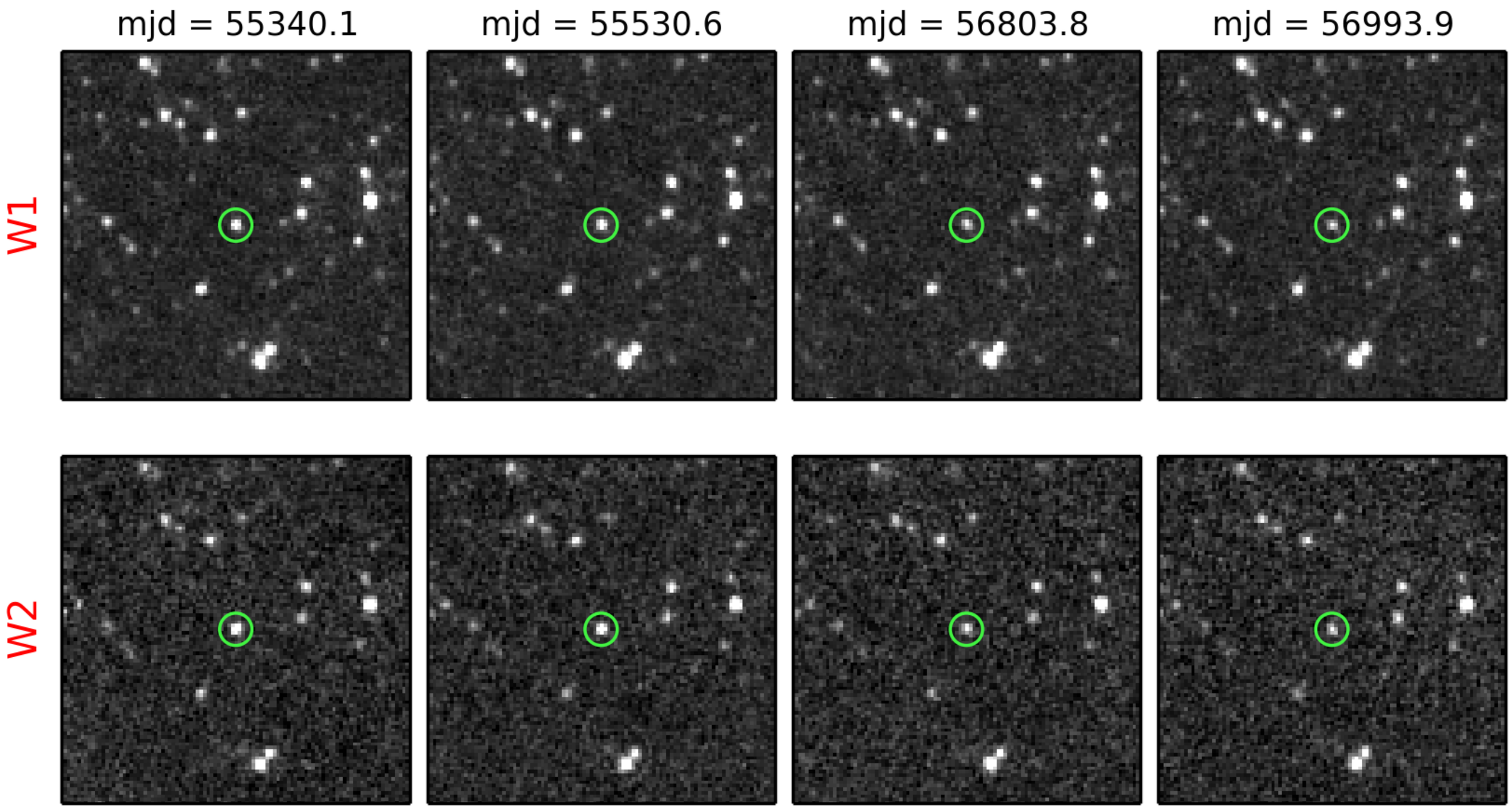
Meisner, Stern, incl. NPR in prep.

also: Qian Yang

Quasars with $|\Delta W_{1,2}| > 0.5$ mag



SDSS J105203.55+151929.5



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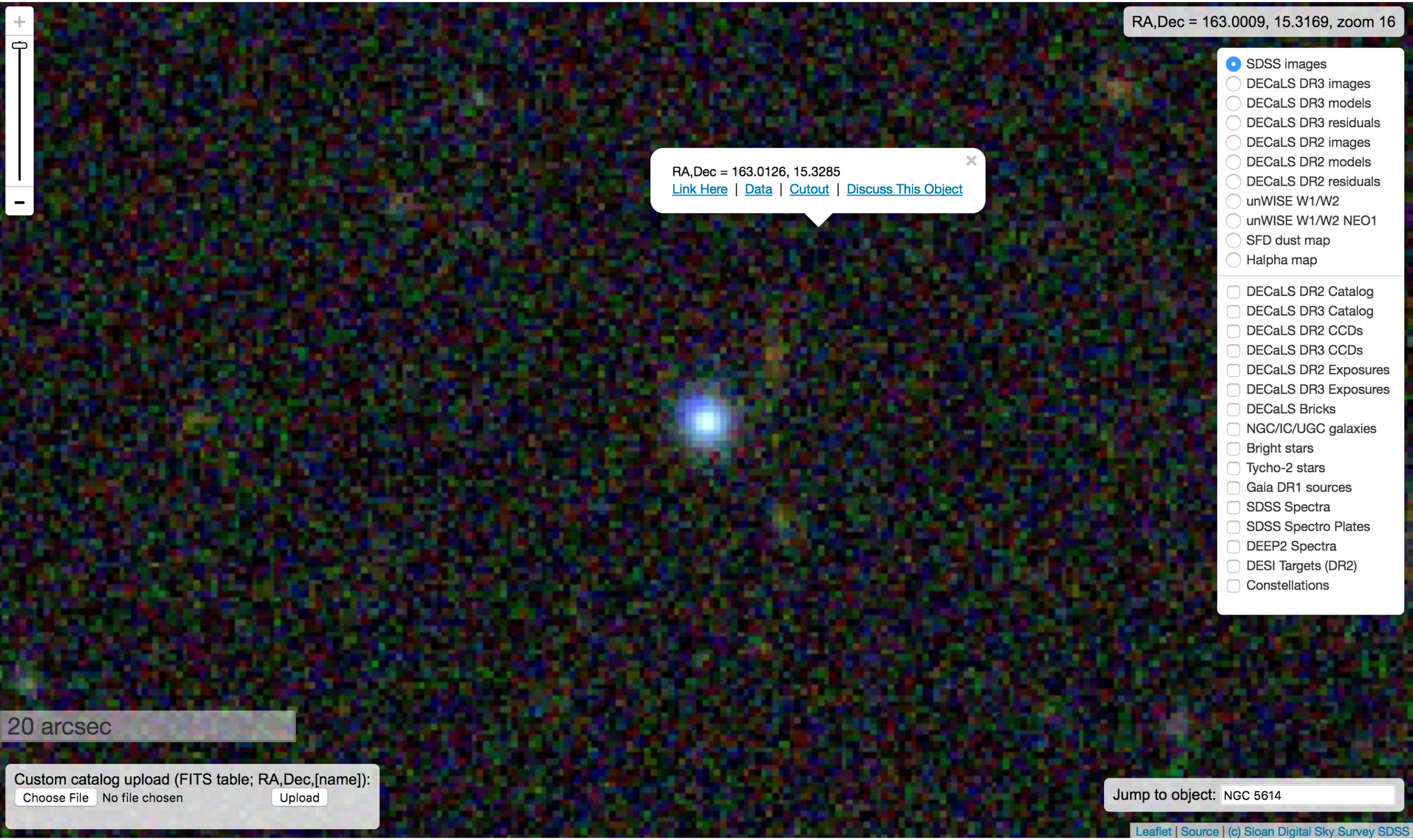

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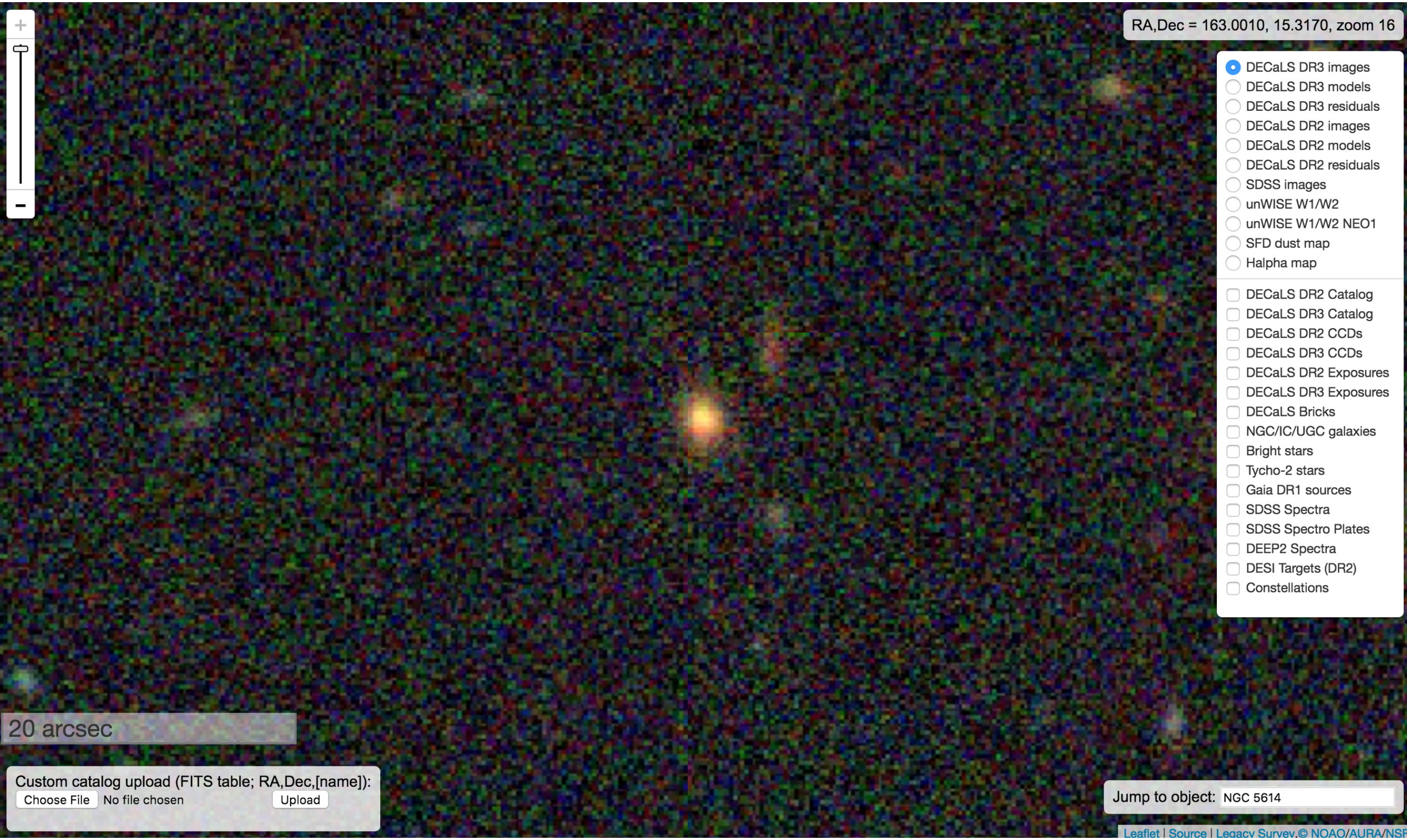


Meisner, Stern, incl. NPR in prep.

WISE J105203.55+151929.5

Palomar/DBSP – UT 2017 February 25

SDSS – UT 2006 April 27

z=0.303

MgII

[NeIII]

[NeV]

[OII]

[NeIII]

[NeIII]

Hδ

Hγ

[OIII]

Hβ

[OIII]

Hα+[NII]

F_λ (10^{-17} erg cm^{-2} s^{-1} Å^{-1})

30

20

10

0

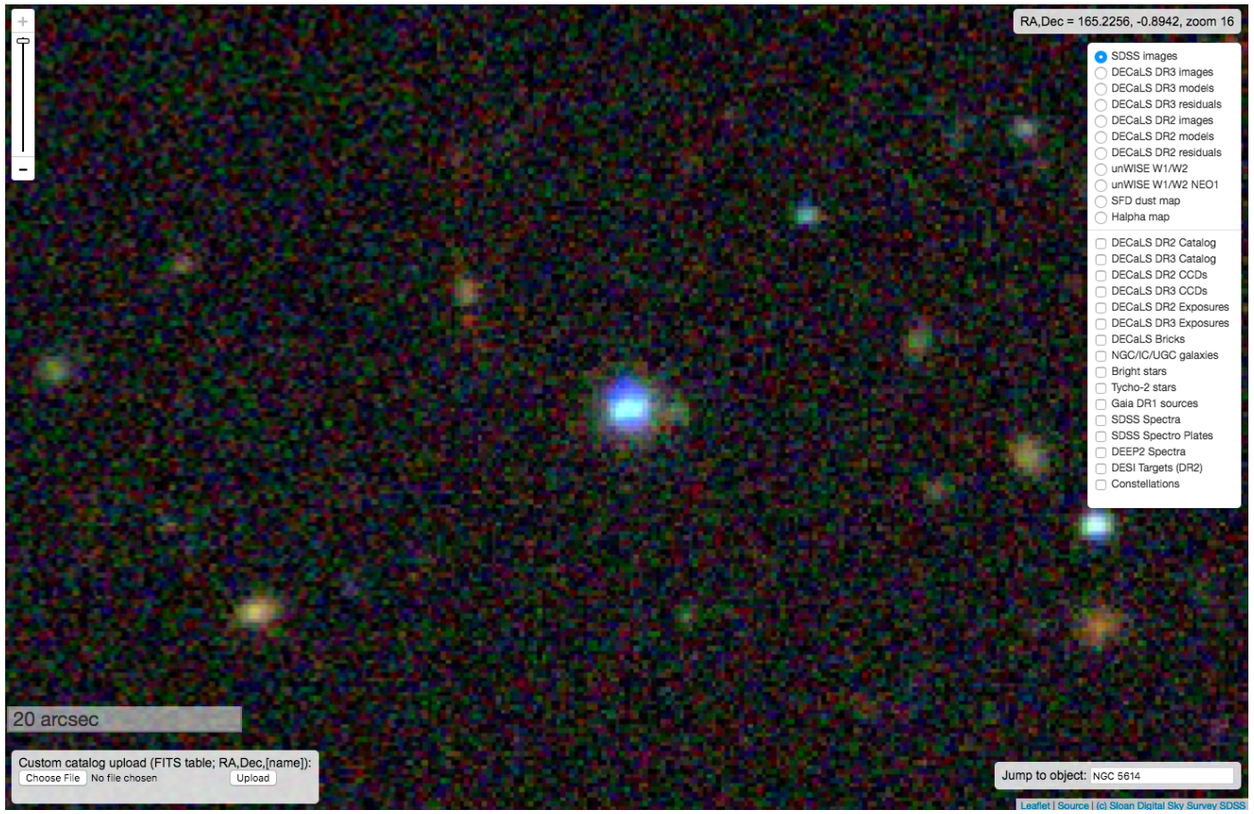
4000

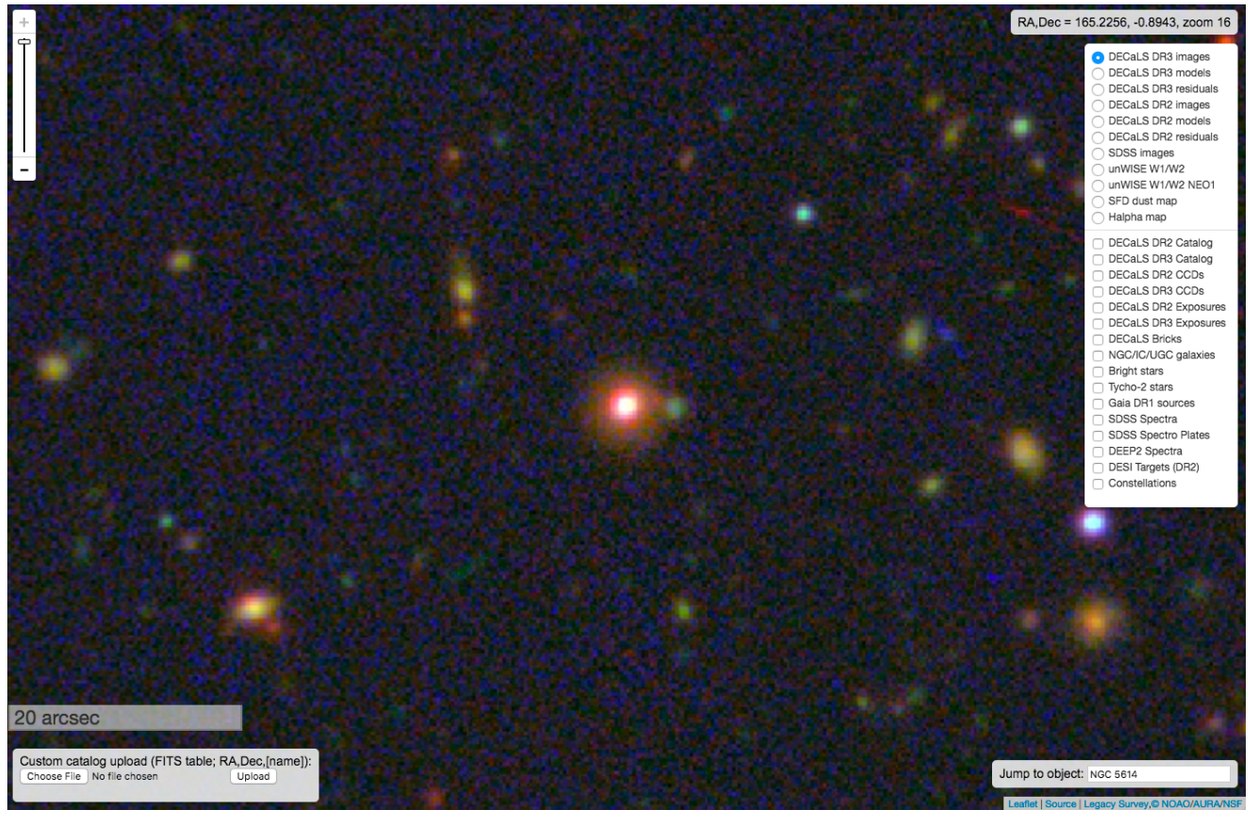
6000

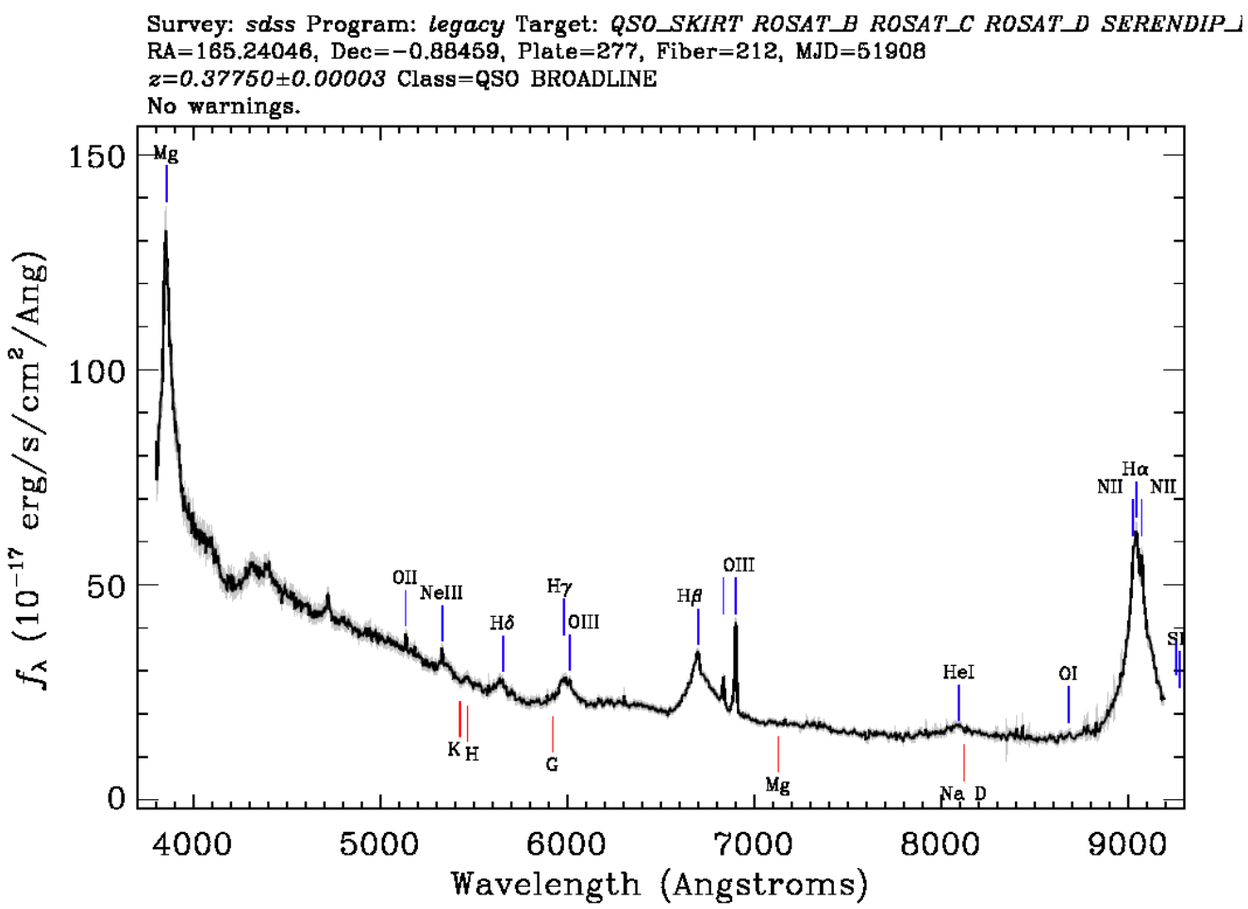
8000

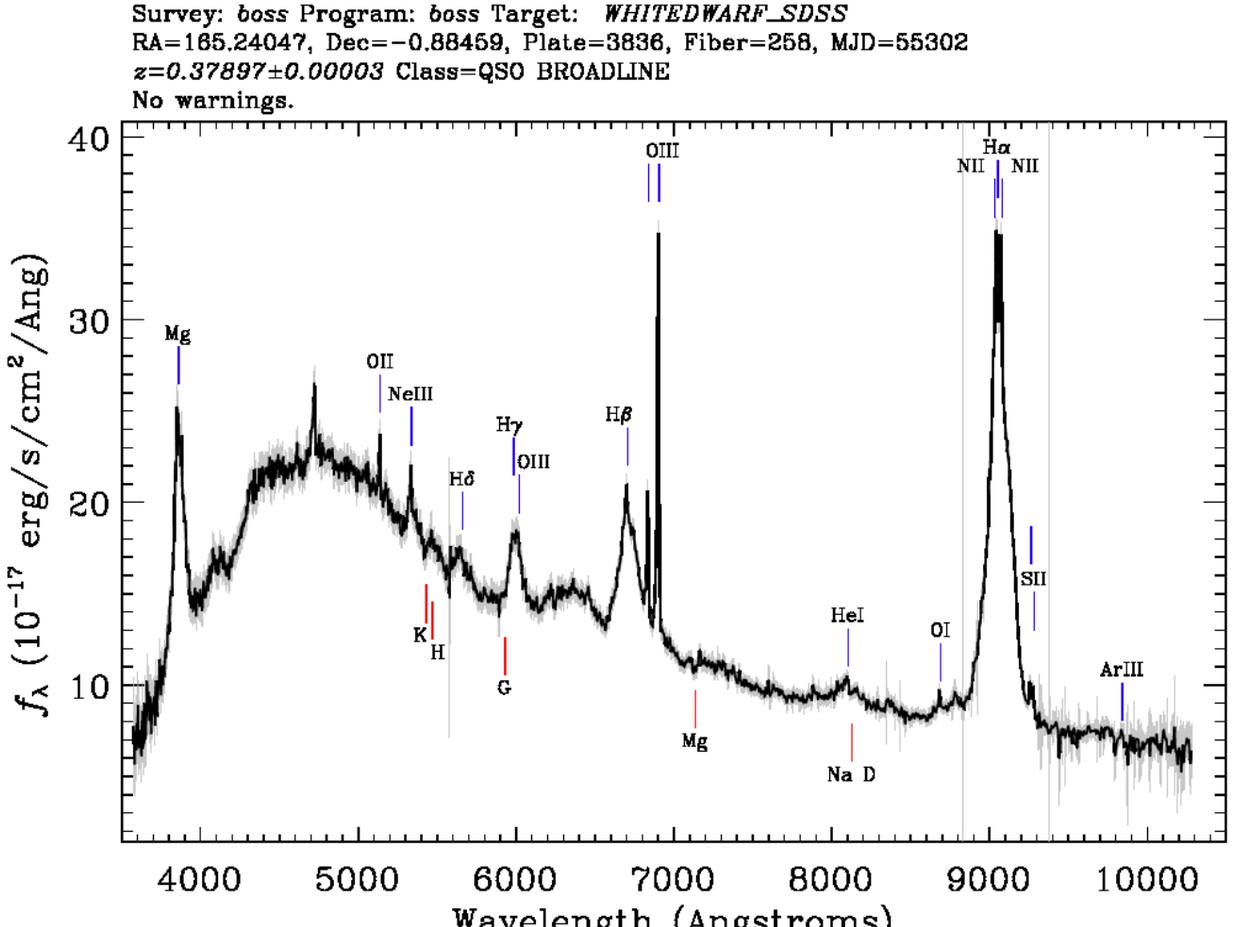
Observed Wavelength (Å)

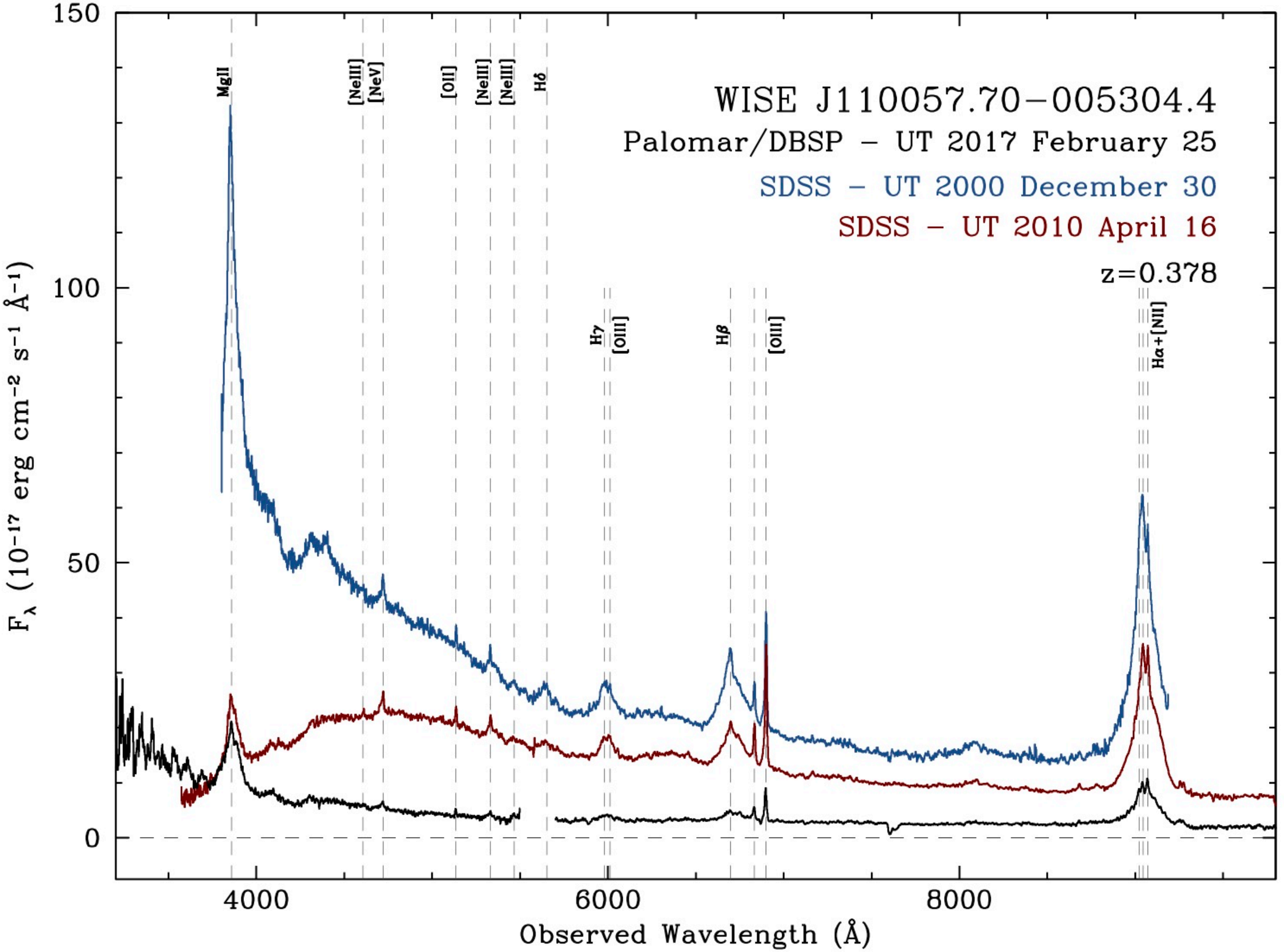
SDSS J110057.71-005304.5










WISE J110057.70−005304.4
Palomar/DBSP – UT 2017 February 25
SDSS – UT 2000 December 30
SDSS – UT 2010 April 16
z=0.378
MgII
[NeIII]
[NeV]
[OII]
[NeIII]
[NeIII]
Hδ
Hγ
[OIII]
Hβ
[OIII]
Hα+[NII]
150
100
50
0
4000
6000
8000
Observed Wavelength (Å)
F_λ (10^-17 erg cm^-2 s^-1 Å^-1)

SDSS vs. DECaLS

Ian McGreer

The

- **DESI** finds interesting galaxy/quasar turning on/off

- *HST* COS UV 1150-3200 Å measurements on High-Ionization lines rest-frame EUV/FUV/ NUV

- Can you see the torus respond/reverberated?
  ⇒ *JWST* MIRI MRS

  5 - 28.5um, also high-Ionization lines in the IR