

A very powerful
radio loud AGN at $z=5.0$

BLAZAR or NOT?

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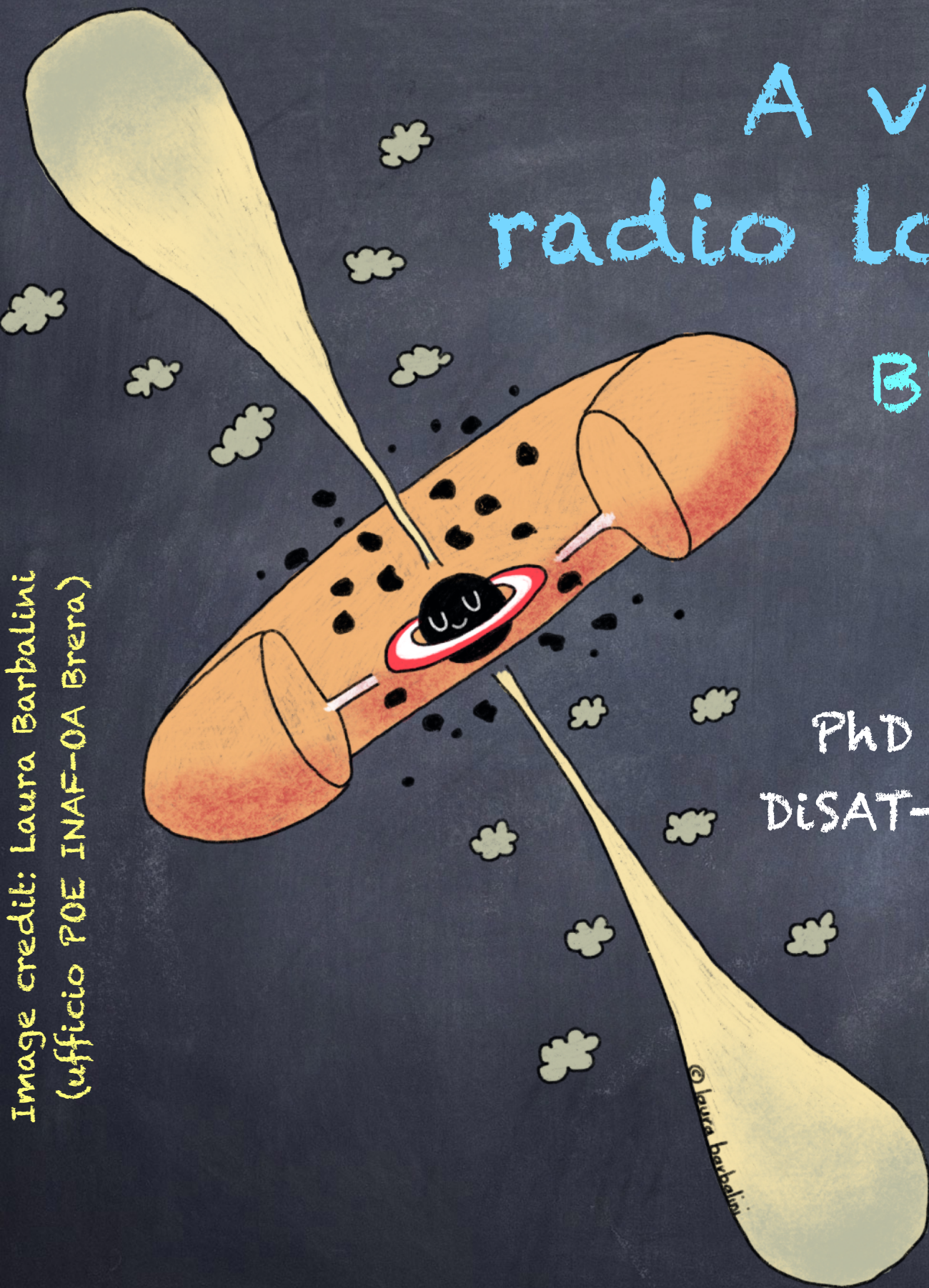
DISAT-University of Insubria (Co)

Co-authors: A. Moretti, A. Caccianiga,
C. Ciccone, G. Ghisellini, T. Sbarrato,
P. Severgnini, R. Della Ceca

AGN13-Beauty and the Beast

Milano 12/10/18

Image credit: Laura Barbalini
(ufficio POE INAF-OA Brera)



Looking for high- z BLAZAR



- Relativistic beaming $\rightarrow$ amplified luminosity
- No obscuration along the LoS

Census of high- z RL AGN:

$$N_{\text{tot}} = N_{\text{blazar}} \times 2\Gamma^2$$

Volonteri+11
Ghisellini+10

Up to now: 4 confirmed blazar at $z \geq 5$

(Romani+04 $z=5.47$; Sbarrato+12 $z=5.27$; Ghisellini+14 $z=5.0$; Ghisellini+15 $z=5.18$)



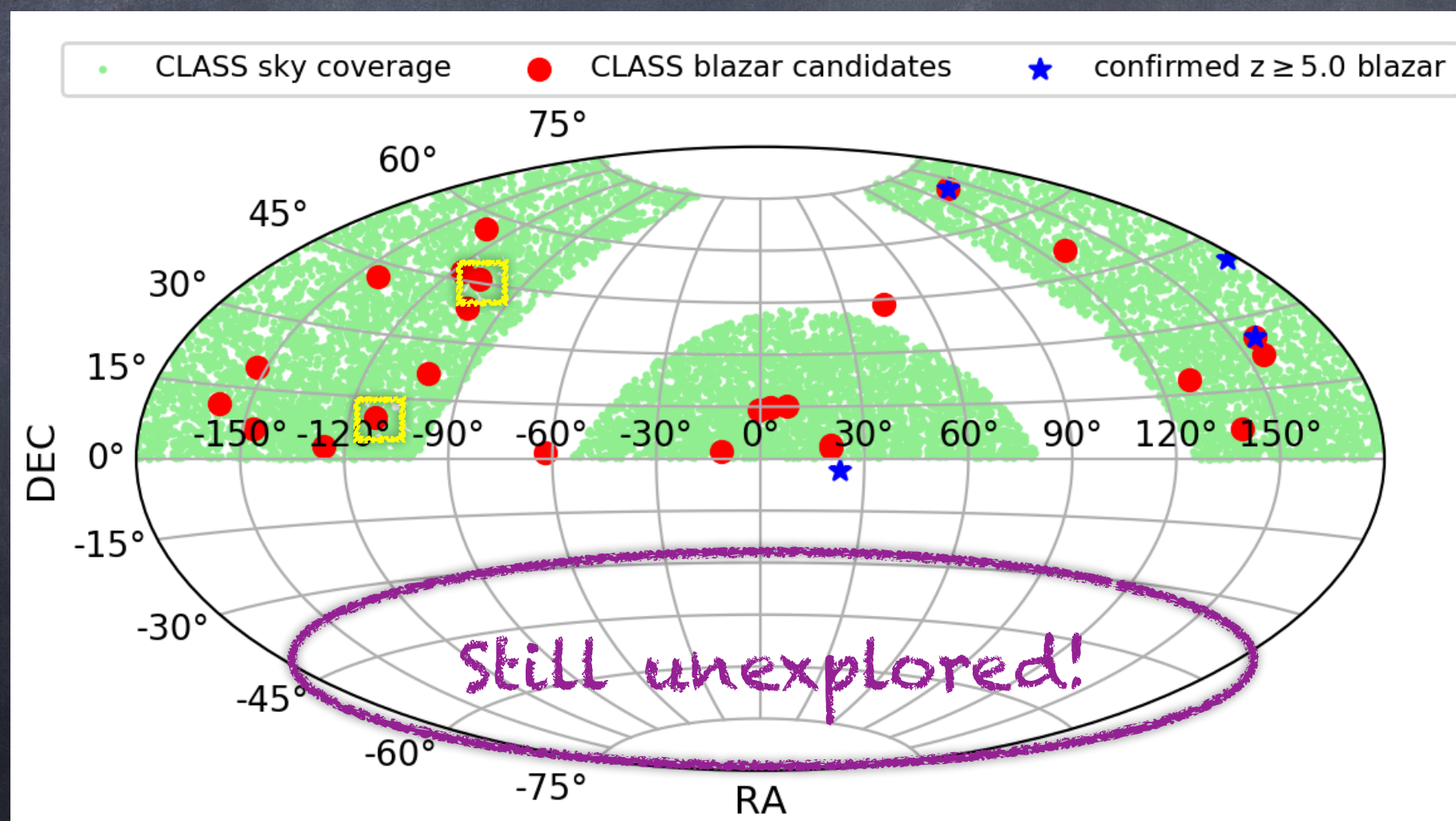
Need a well-defined
high-redshift blazar sample

High- z blazar candidates in the CLASS survey

(Myers et al. 2003)

- area $\sim 13000 \text{ deg}^2$ ($|b| > 20^\circ$)
- Flux limited ($S_{\text{SGHz}} > 30 \text{ mJy}$)
- $\text{mag}_i < 21.0$
- $z \geq 4.0$
- **2** new blazar candidates at $z \geq 5.0$
(Caccianiga, Moretti, Belladitta et al. (in prep))

Poster di
L. Ighina #14

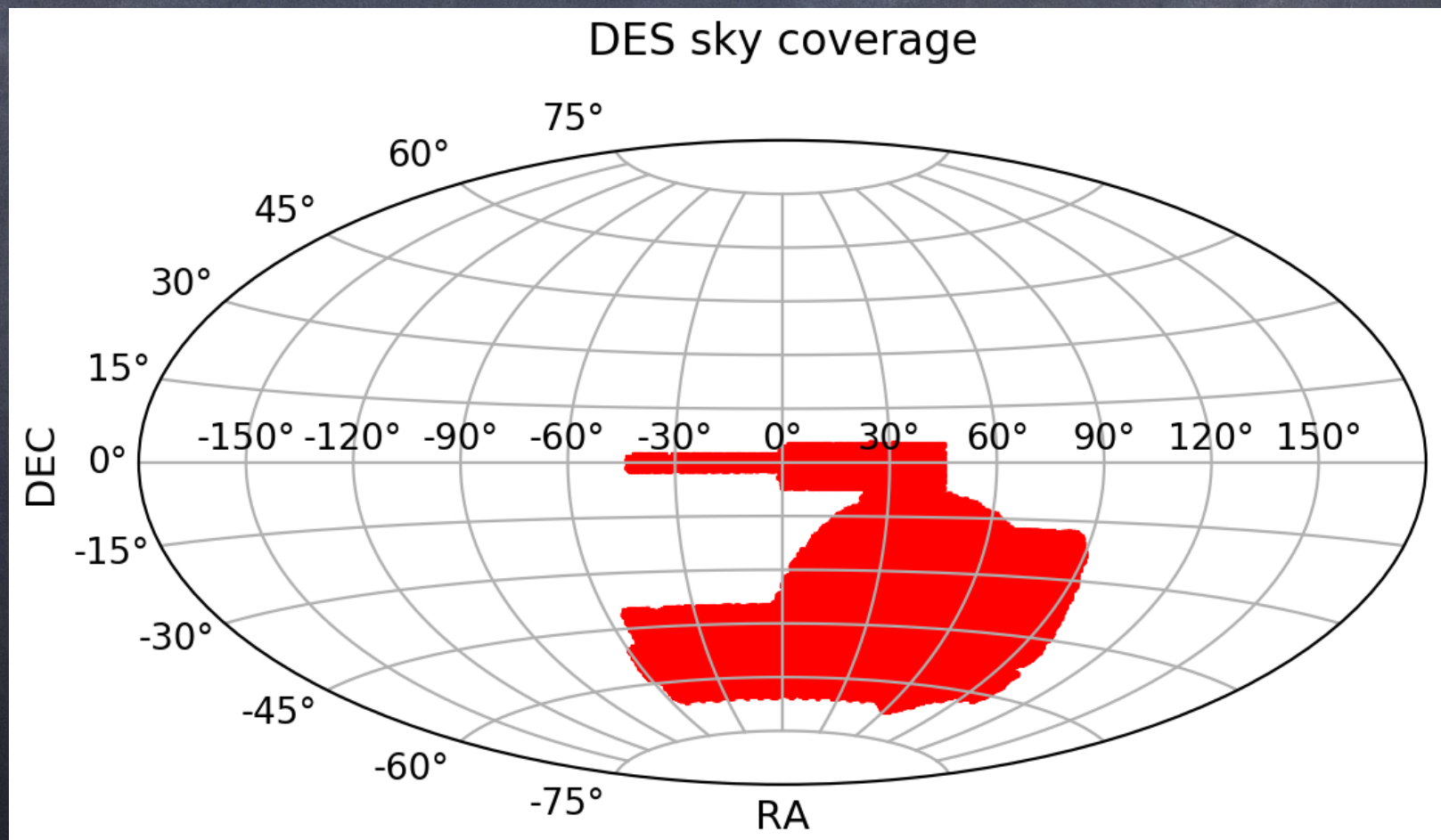


Dark Energy Survey (DES)

(Abbott et al. 2018)

g	r	i	z	y
24.33	24.08	23.44	22.69	21.44

· area: 5000 deg²



CANDIDATES SELECTION:

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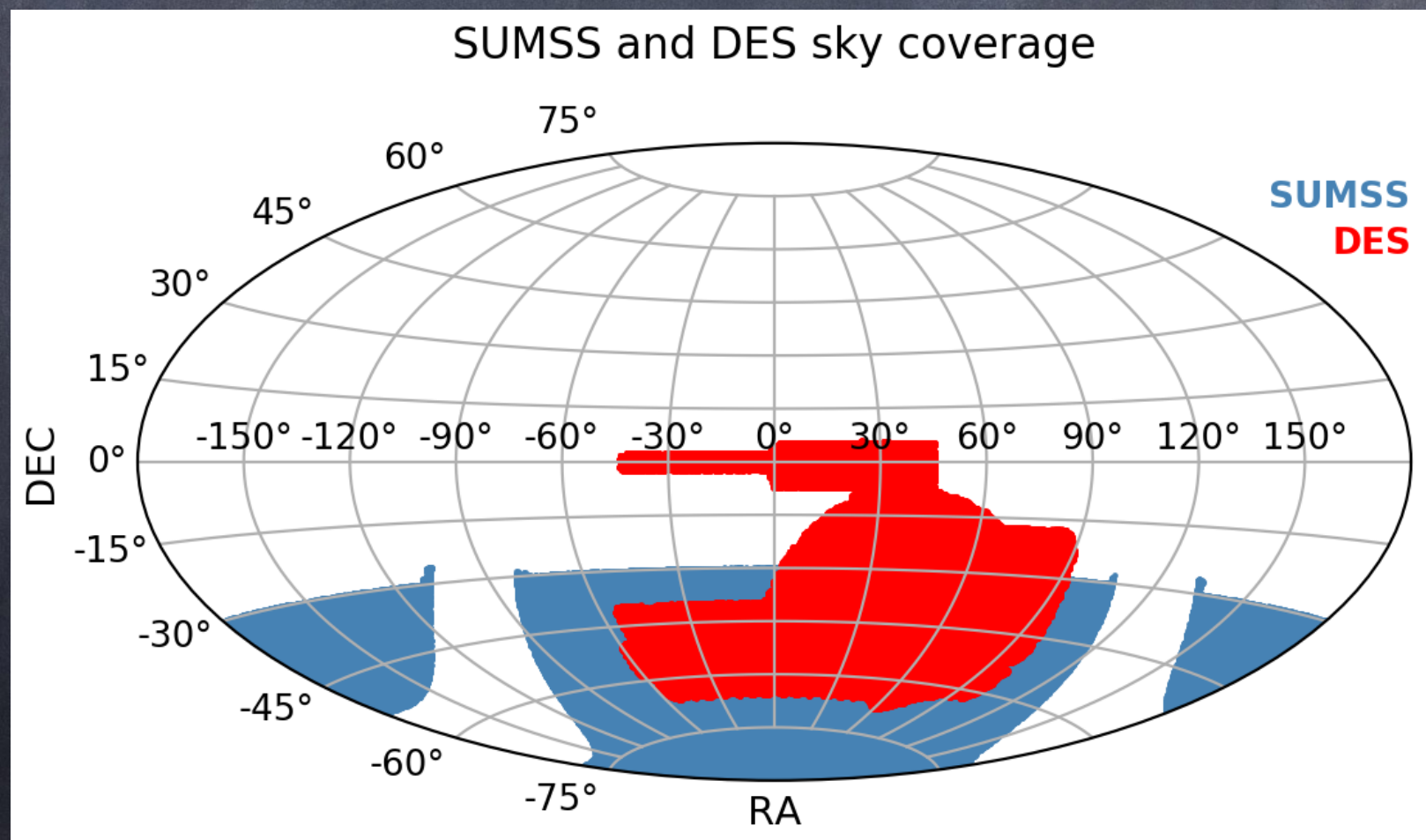
Sydney University
Molonglo Sky Survey (SUMSS)



· Frequency: 843 MHz
· Resolution: 43"
· Area: 8000 deg²
· Detection limit: 5 mJy

Common area: 3500 deg²

(Mauch et al. 2003)



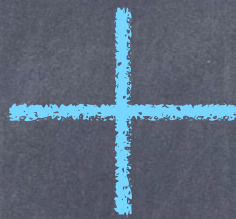
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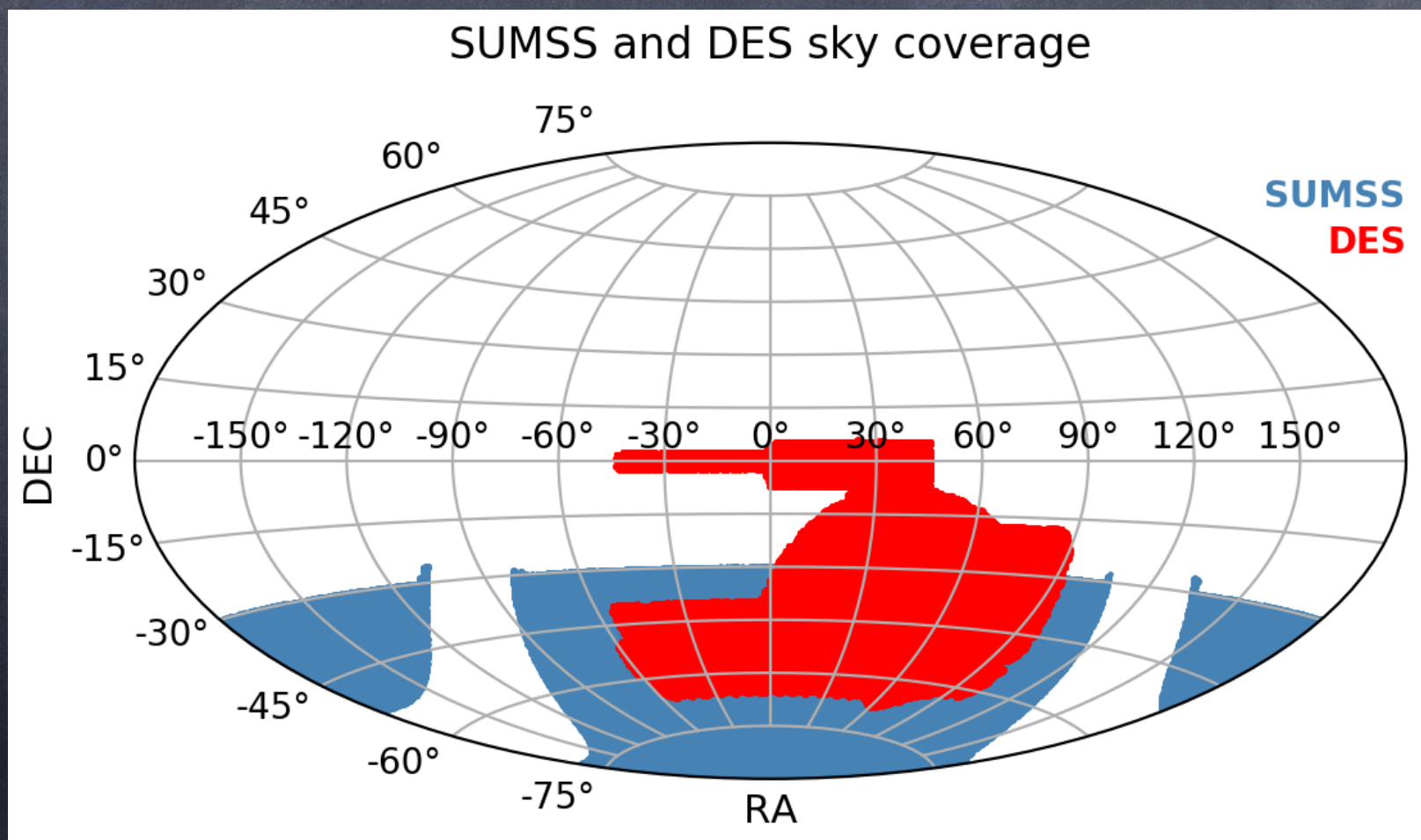
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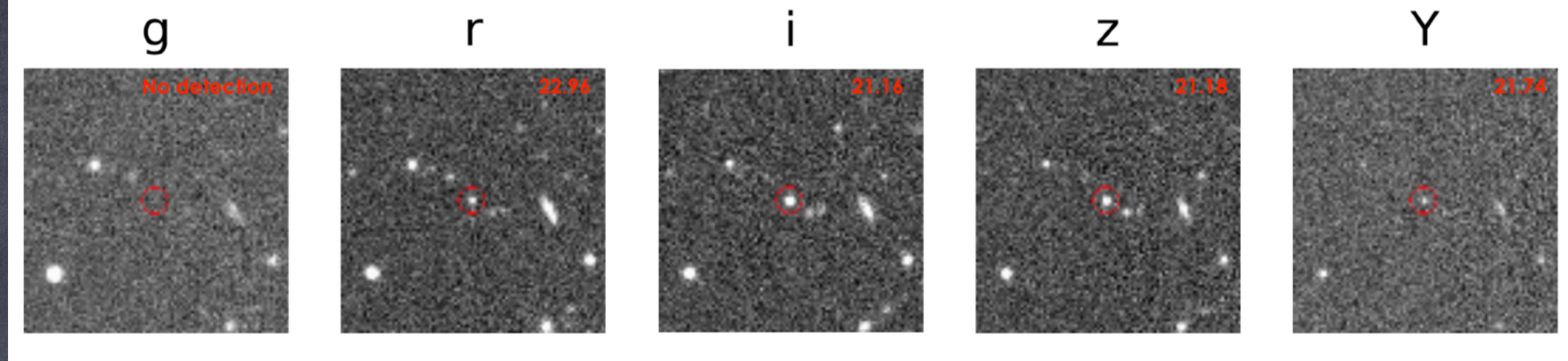
(Mauch et al. 2003)



Drop out
technique



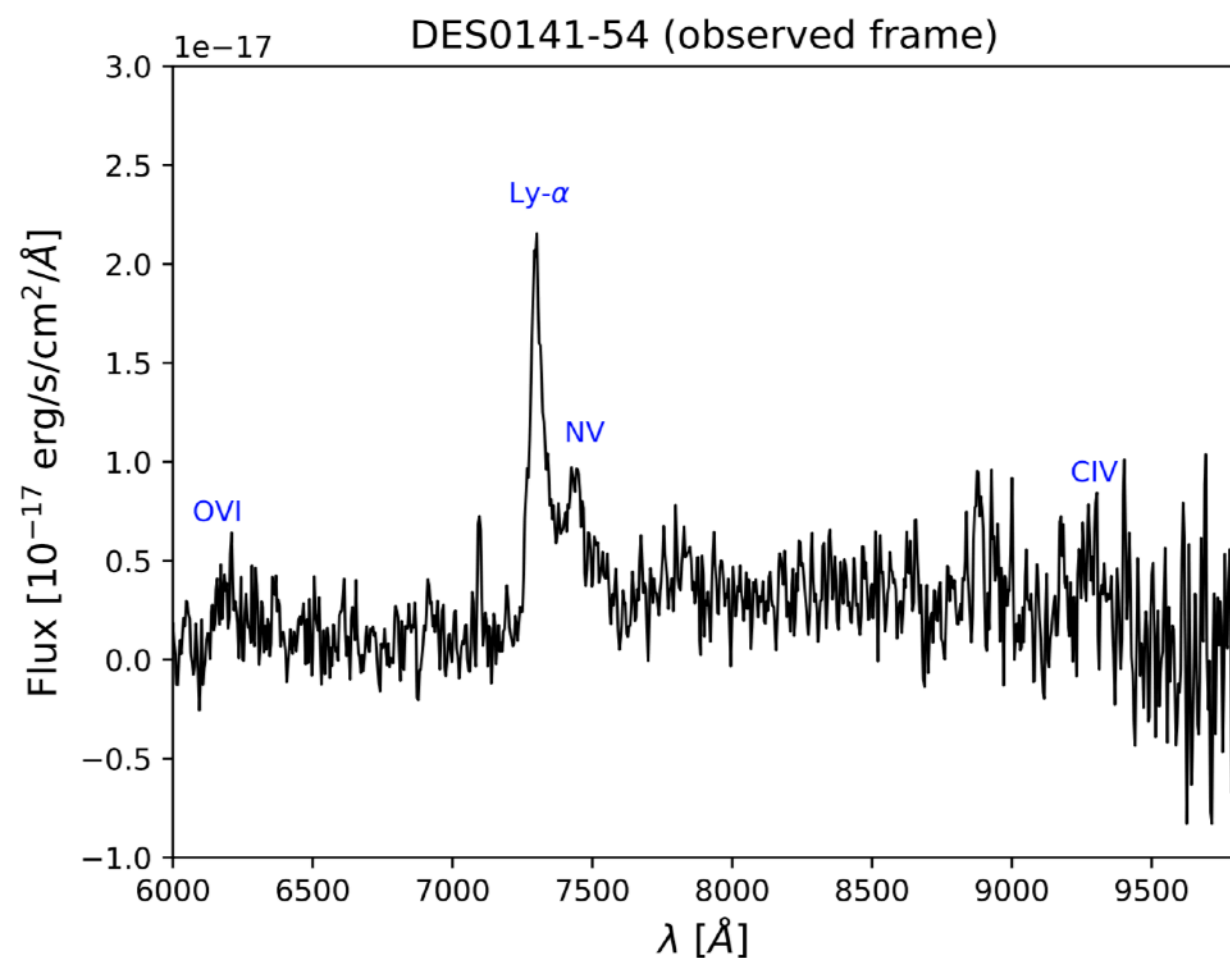
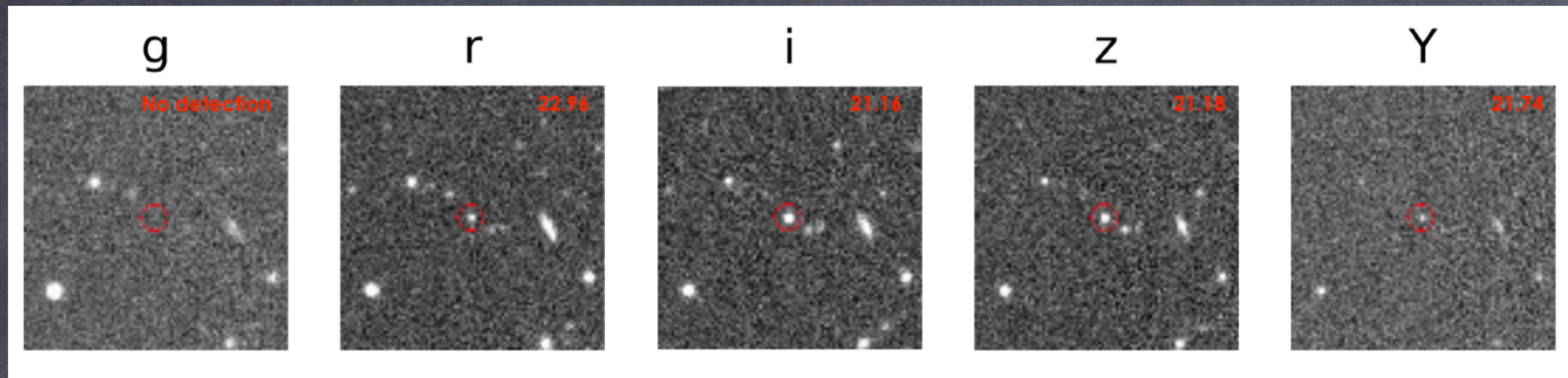
DES0141-54 → RA: 25.385 DEC: -54.464



- $r-i = 1.8$ / $i-z = -0.02$
- $S_{0.8\text{GHz}} = 178.3 \text{ mJy}$
- Point source: $S_{\text{int}}/S_{\text{peak}} = 1.1$



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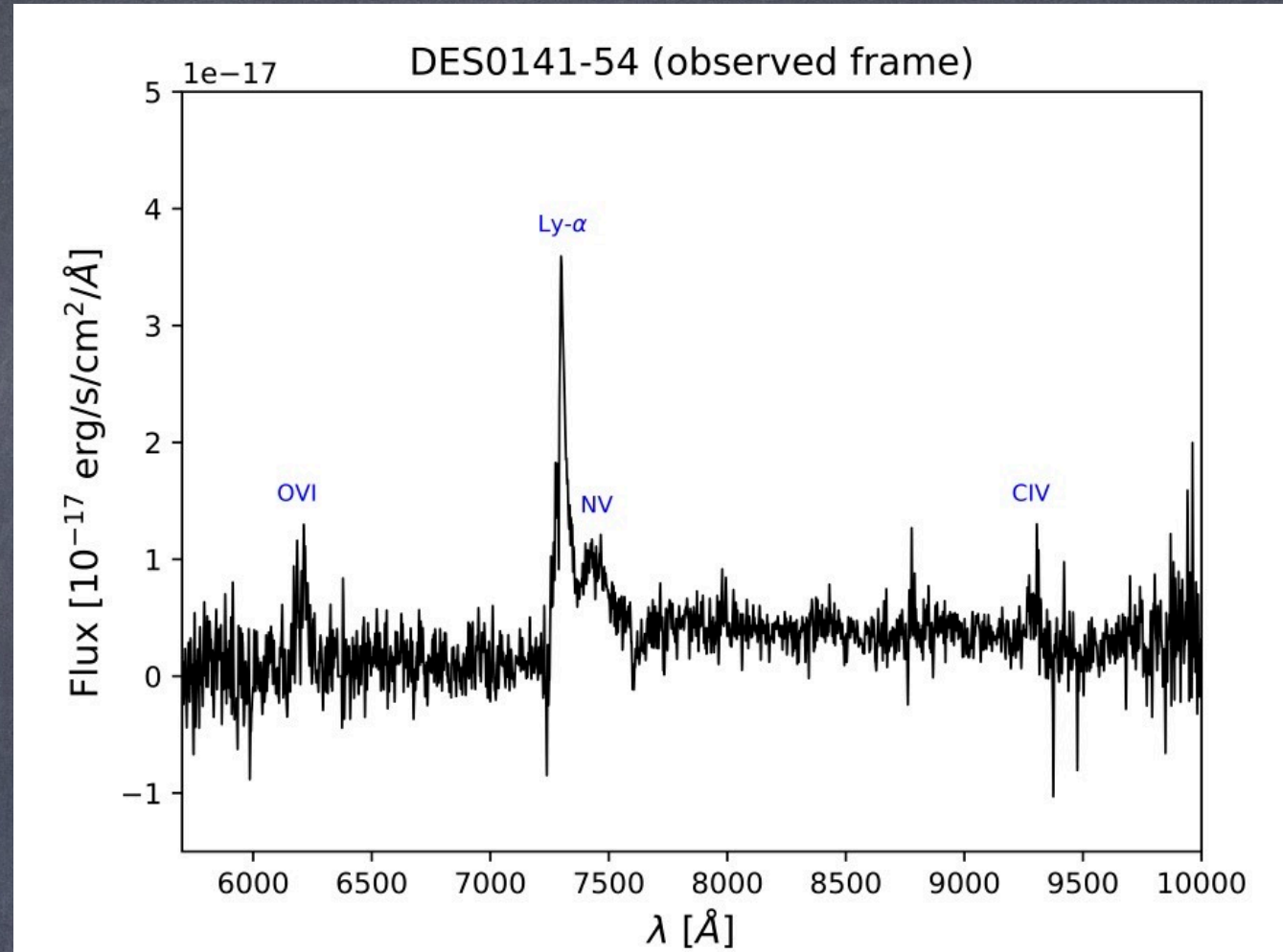
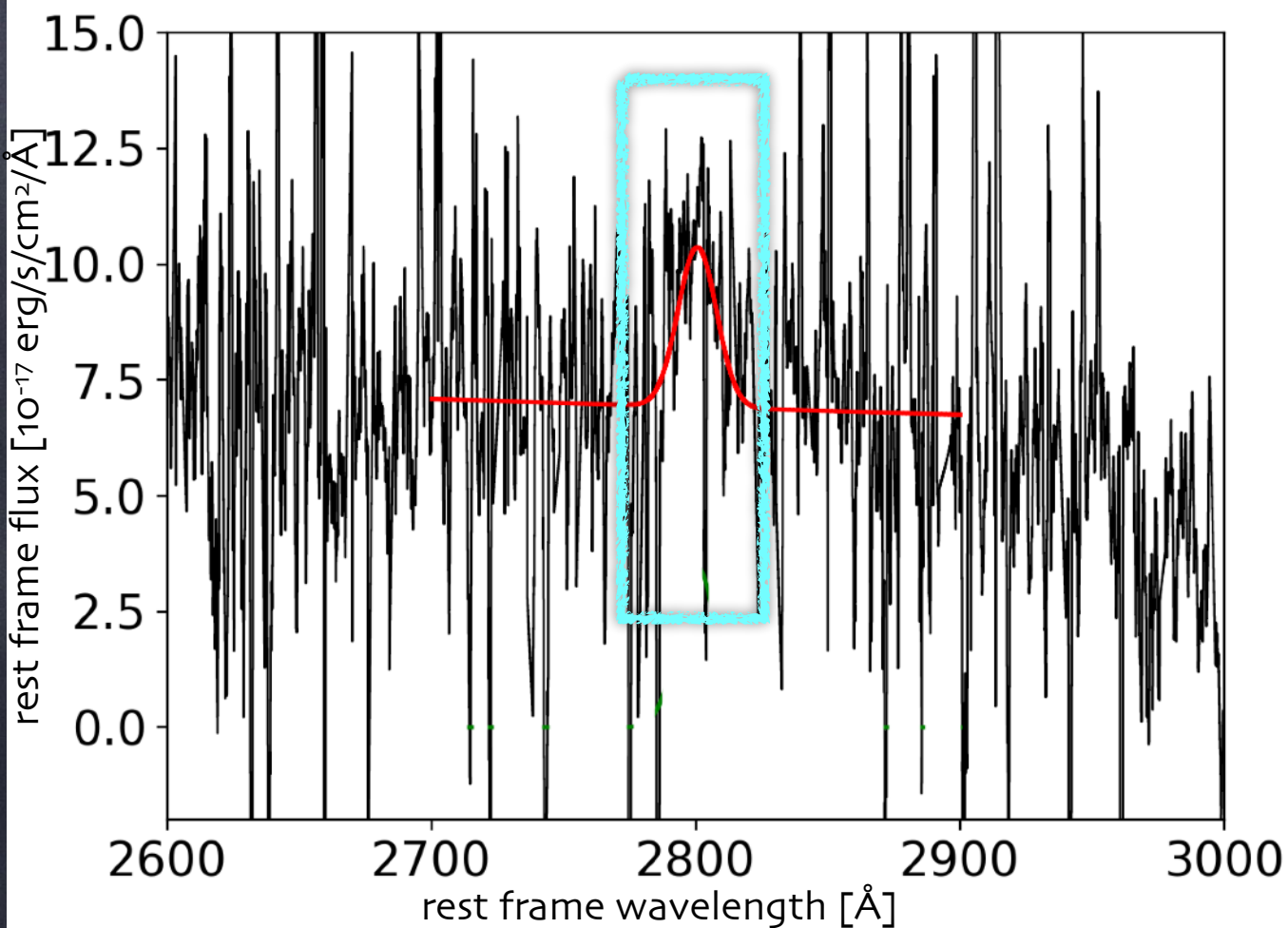
EFOSC2/NTT

$z = 5.002$



DDT follow-up with VLT/X-Shooter

$z = 5.005$



	Virial M_{BH}
C IV	$2.0 \pm 1.5 \times 10^8 M_{\odot}$
Mg II	$6.0 \pm 3.0 \times 10^8 M_{\odot}$

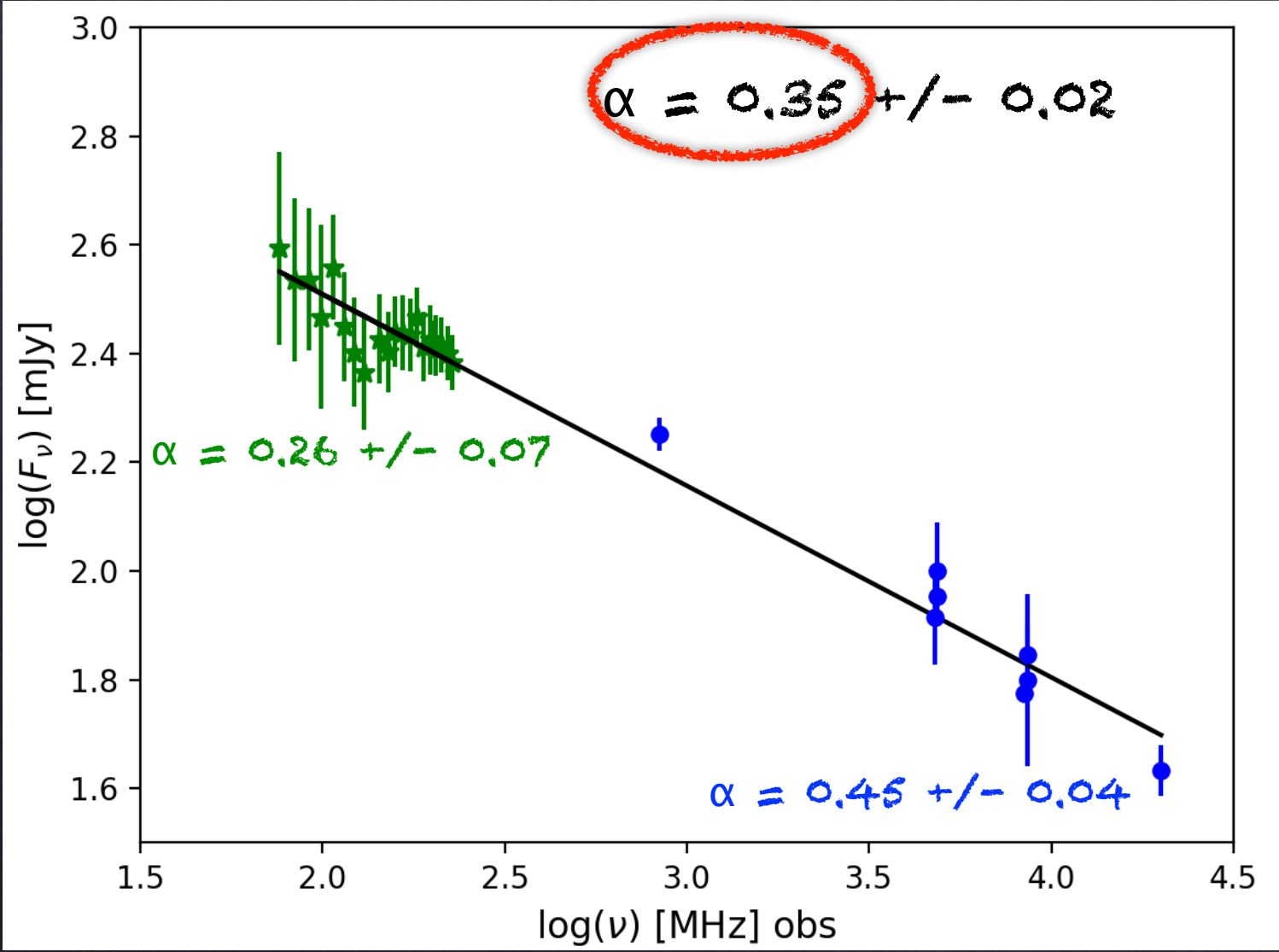
L_{bol} (10^{46} erg/s)
5.0 ± 1.6

~one order of mag lower than
 $z \geq 5$ confirmed blazar



RADIO properties:

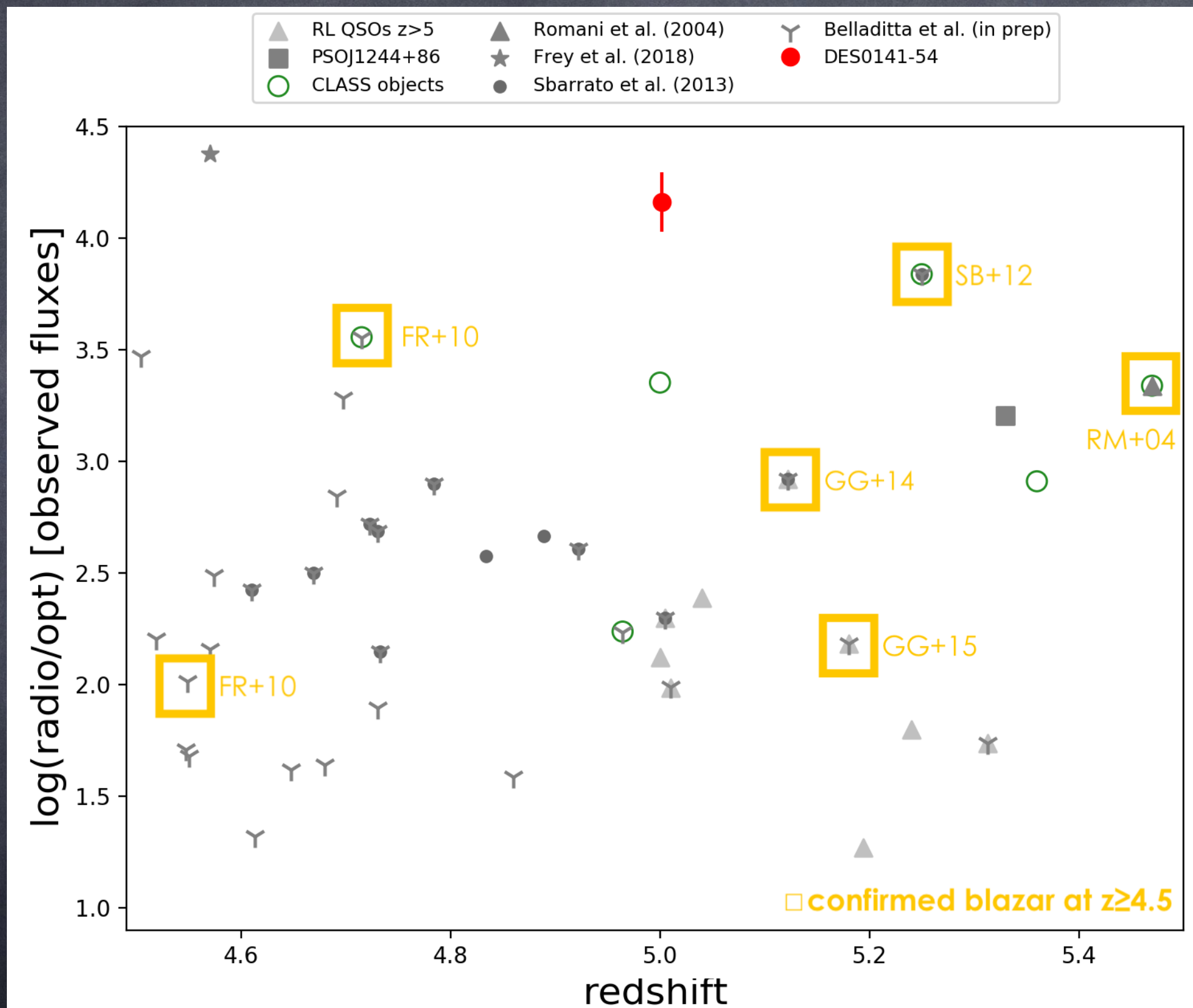
band(GHz)	flux(mJy)	survey
20.0	43.0 ± 2.0	AT20
8.6	70.0 ± 4.0	AT20 _{follow-up}
8.6	63.0 ± 10.0	ATPMN
8.4	59.5	CRATES
4.85	100.0 ± 9.0	PMN
4.85	90.0 ± 5.0	AT20 _{follow-up}
4.8	82.0 ± 7.0	ATPMN
843	178.3 ± 5.5	SUMSS
0.076-0.231	392.5 - 241.9	GLEAM



- No variability
- Flat spectrum



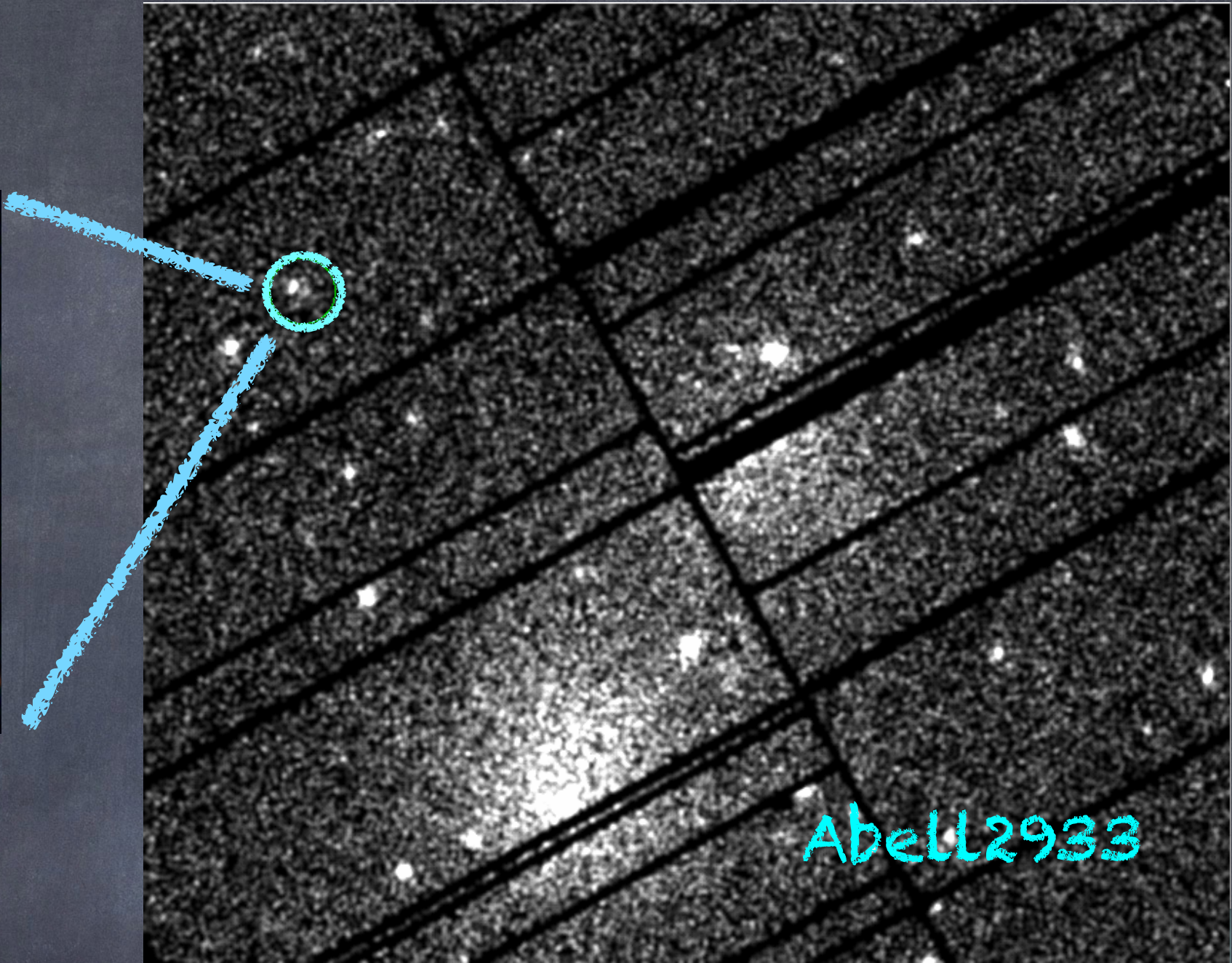
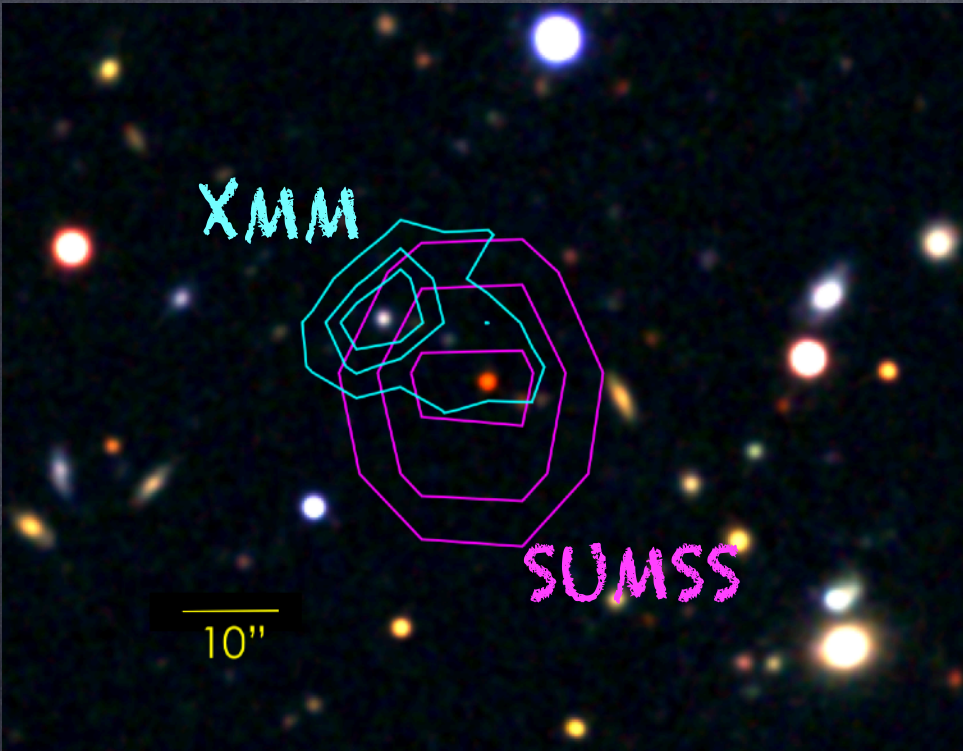
Comparison: radio/optical ratio



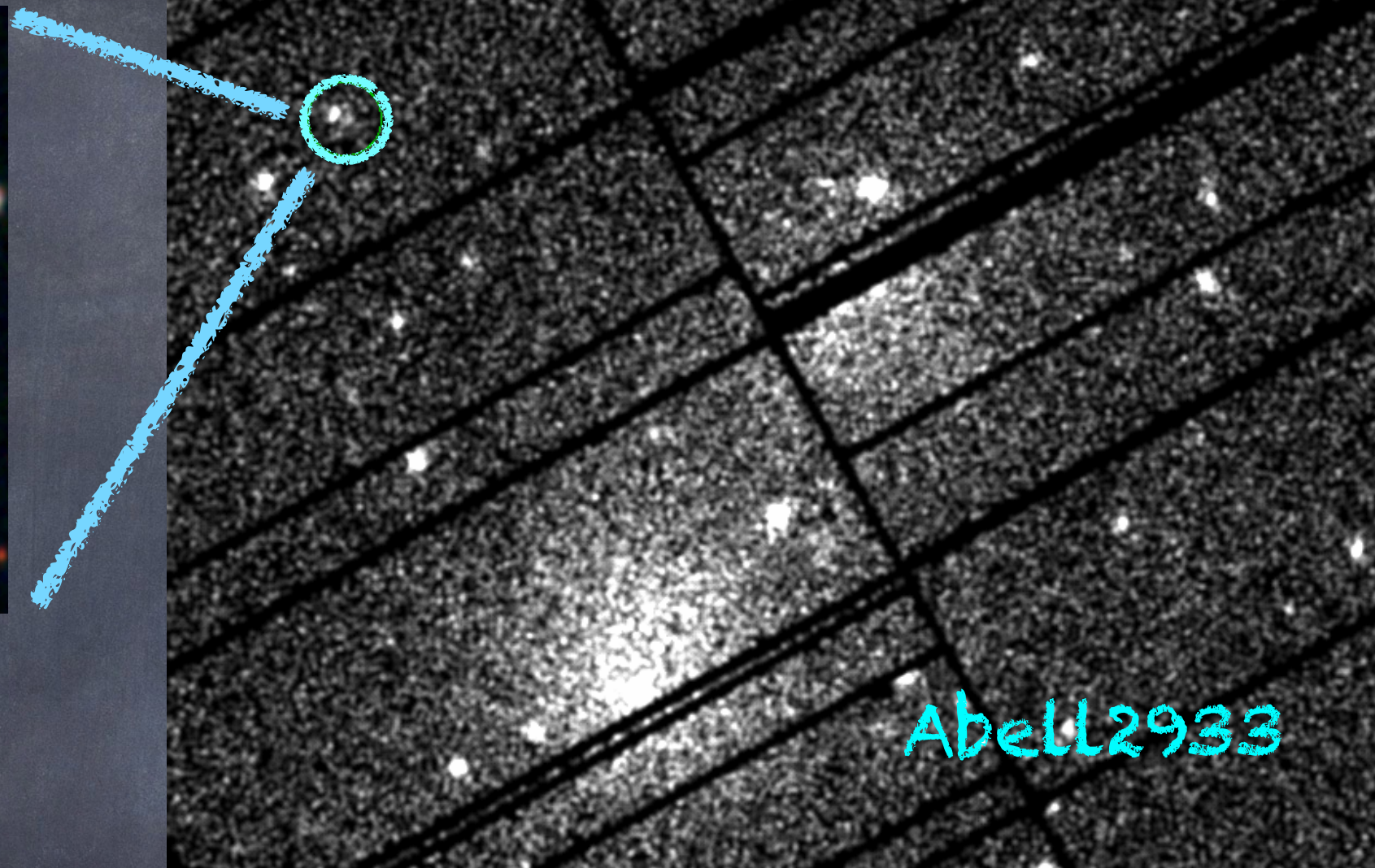
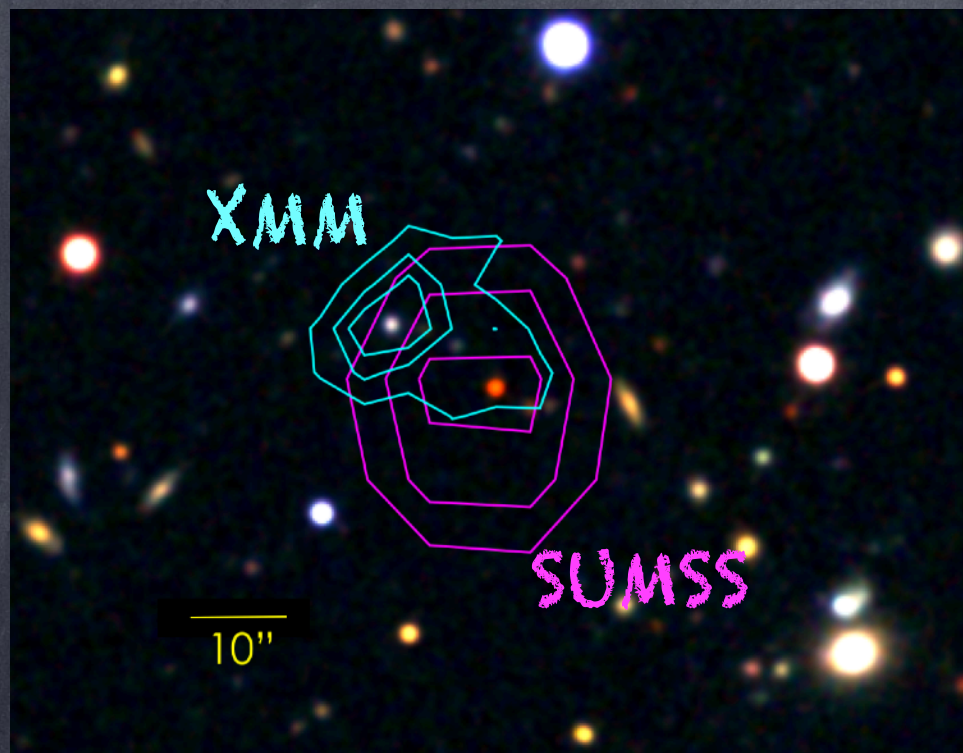
Highest radio/optical ratio at $z \geq 5.0$



X-ray properties:



X-ray properties:



Abell 2933

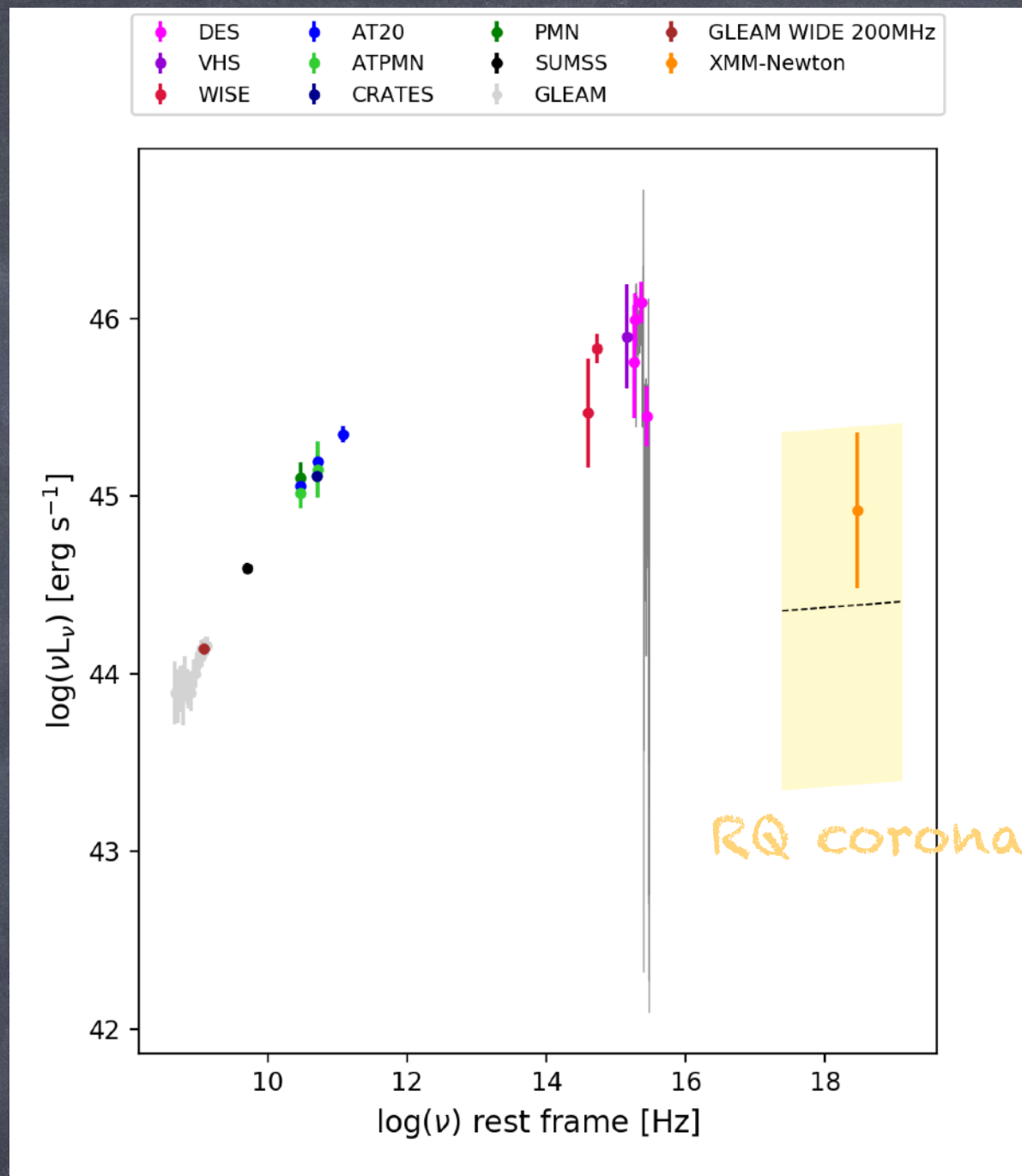
$$F_{(0.5-10\text{keV})} = 9.94 \times 10^{-15} \text{ (erg/s/cm}^2\text{)}$$

Archival XMM weak

$$F_{(0.5-10\text{keV})} < 1.3 \times 10^{-14} \text{ (erg/s/cm}^2\text{)}$$

Follow-up Swift (Too time):
not detected

X-ray properties:



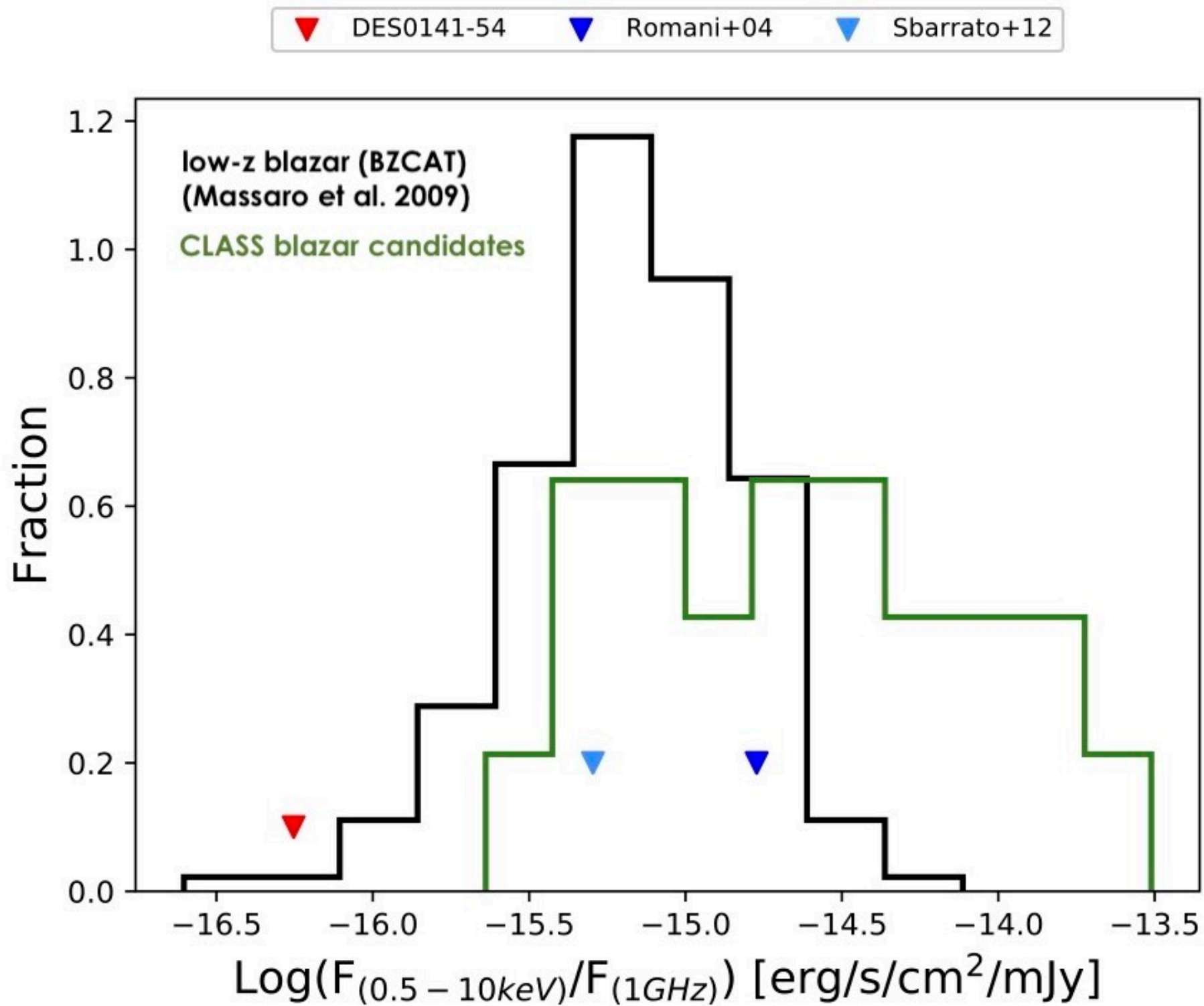
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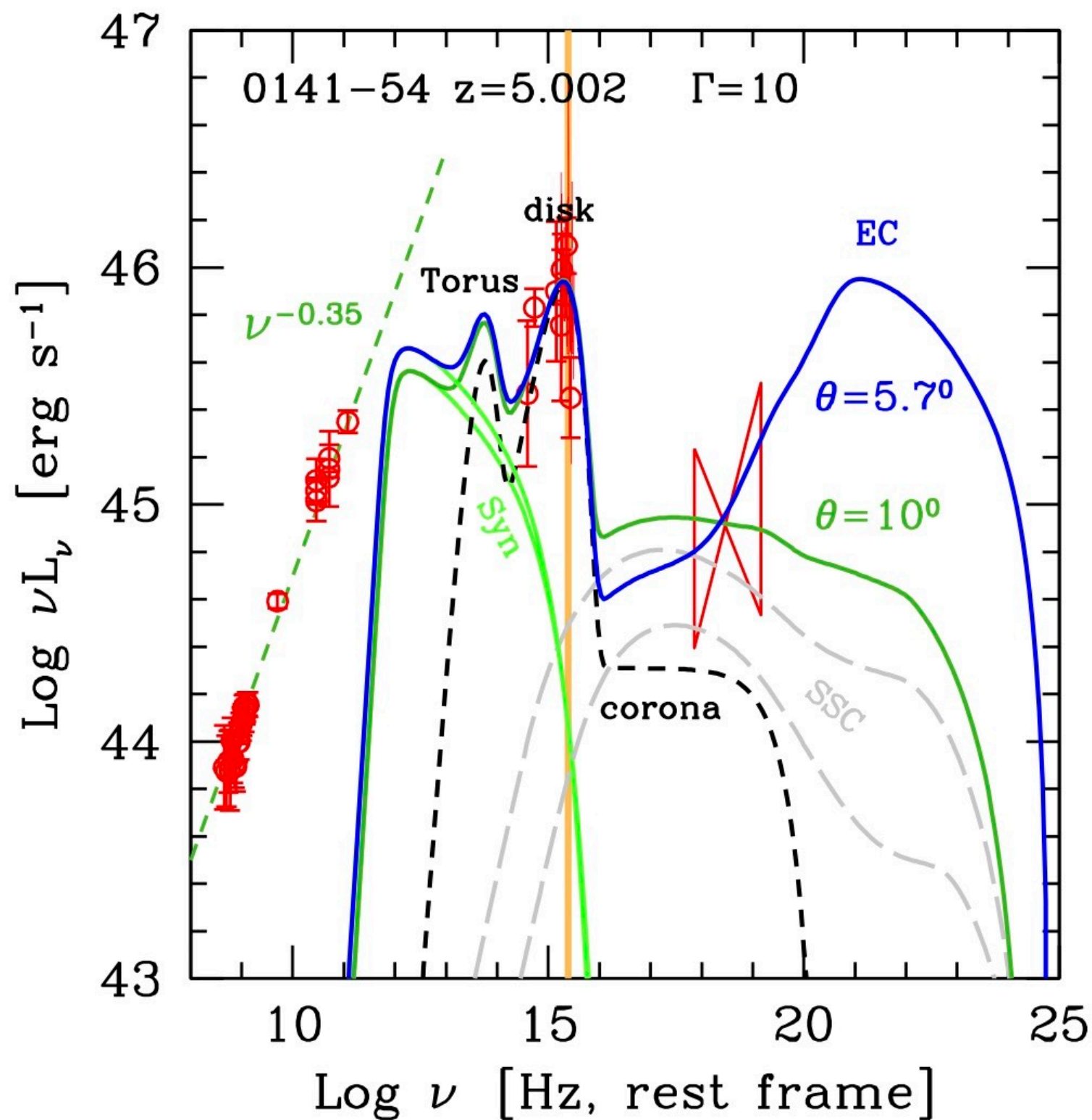
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not detected

Comparison: X-ray/radio ratio



SED modeling

Ghisellini-Tavecchio (2009)



Blazar

Very weak in X-ray



anomalous?

a new class of blazar?

variability?

Non-blazar

Powerful radio jet

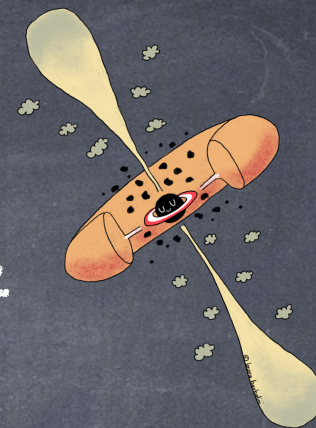


Fast spinning BH?

GPS?



Summary and conclusions:



- Looking for high- z blazar: census of RL AGNs in the early Universe
 - increase the statistics
 - building up a well-defined samples $\rightarrow$ CLASS
- Southern sky: DES $\rightarrow$ wide and deep, still unexplored
- DES0141-54 (Belladitta et al. (in prep):
 - the most south very powerful RL at $z \geq 5.0$
 - hybrid properties
- DES0141-54 Next steps:
 - high radio frequency observation (≥ 20 GHz)
 - X-ray observation with CHANDRA
 - simultaneous observations

Thanks for your attention!