Jet production efficiency in a sample of the youngest radio galaxies

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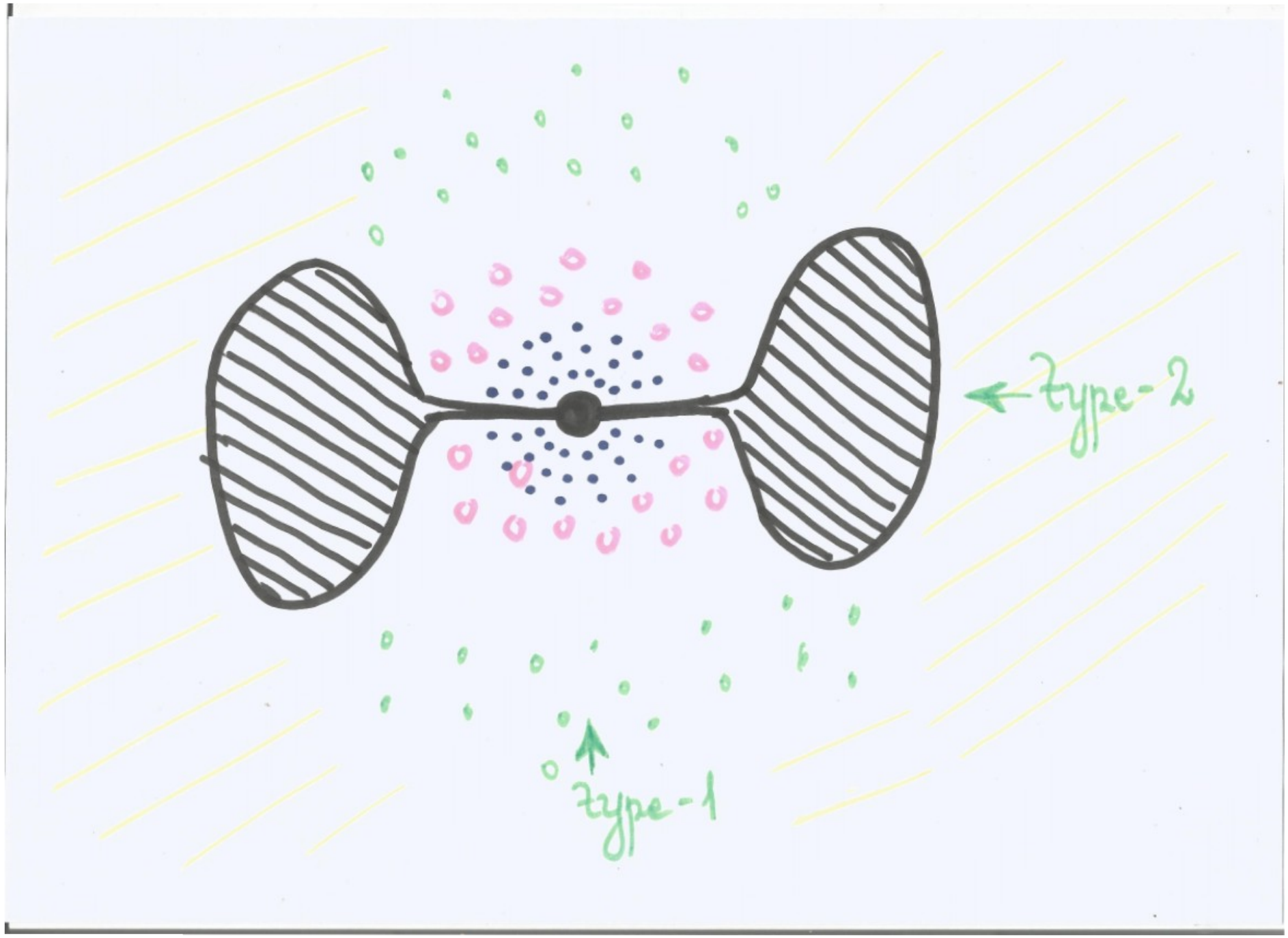
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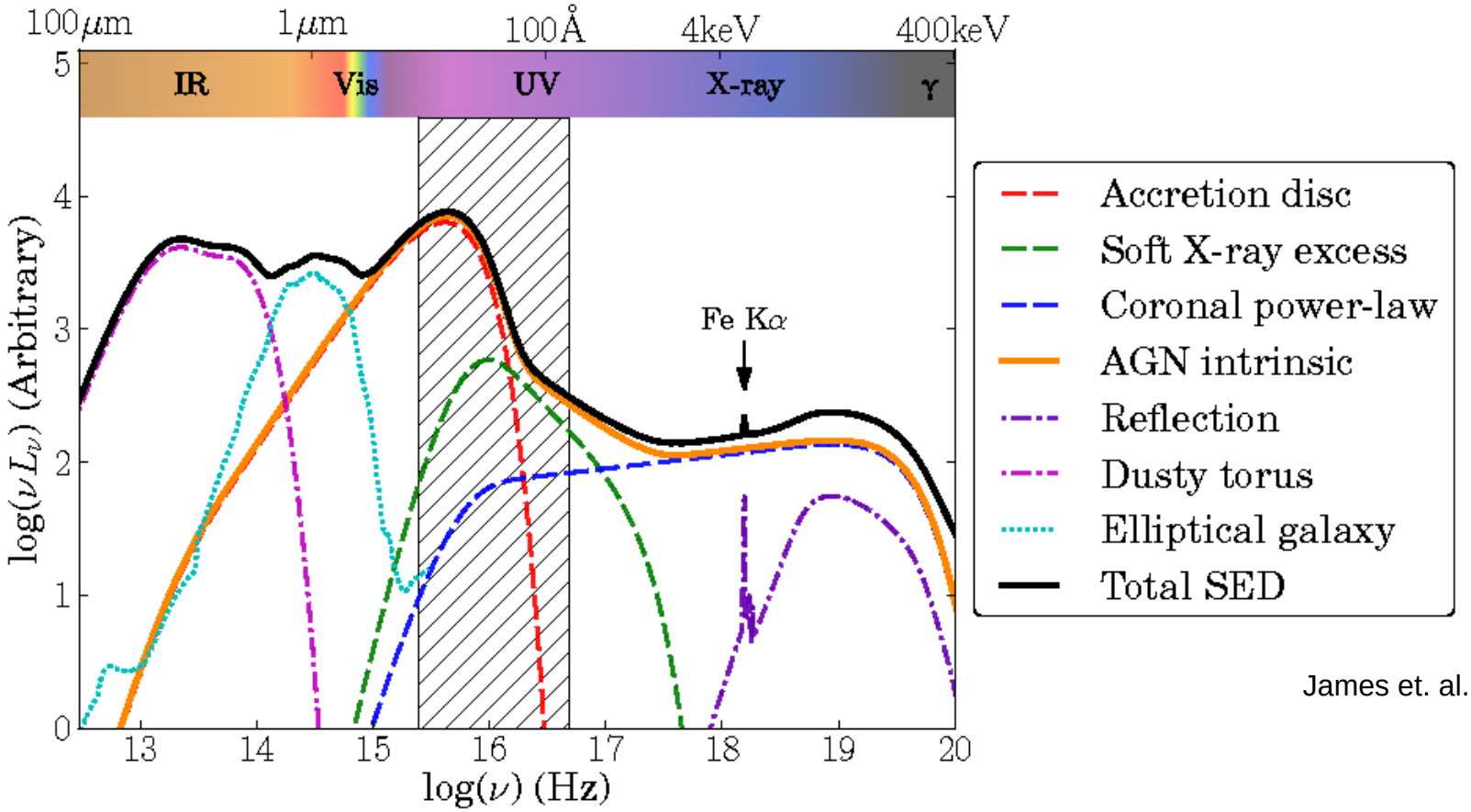
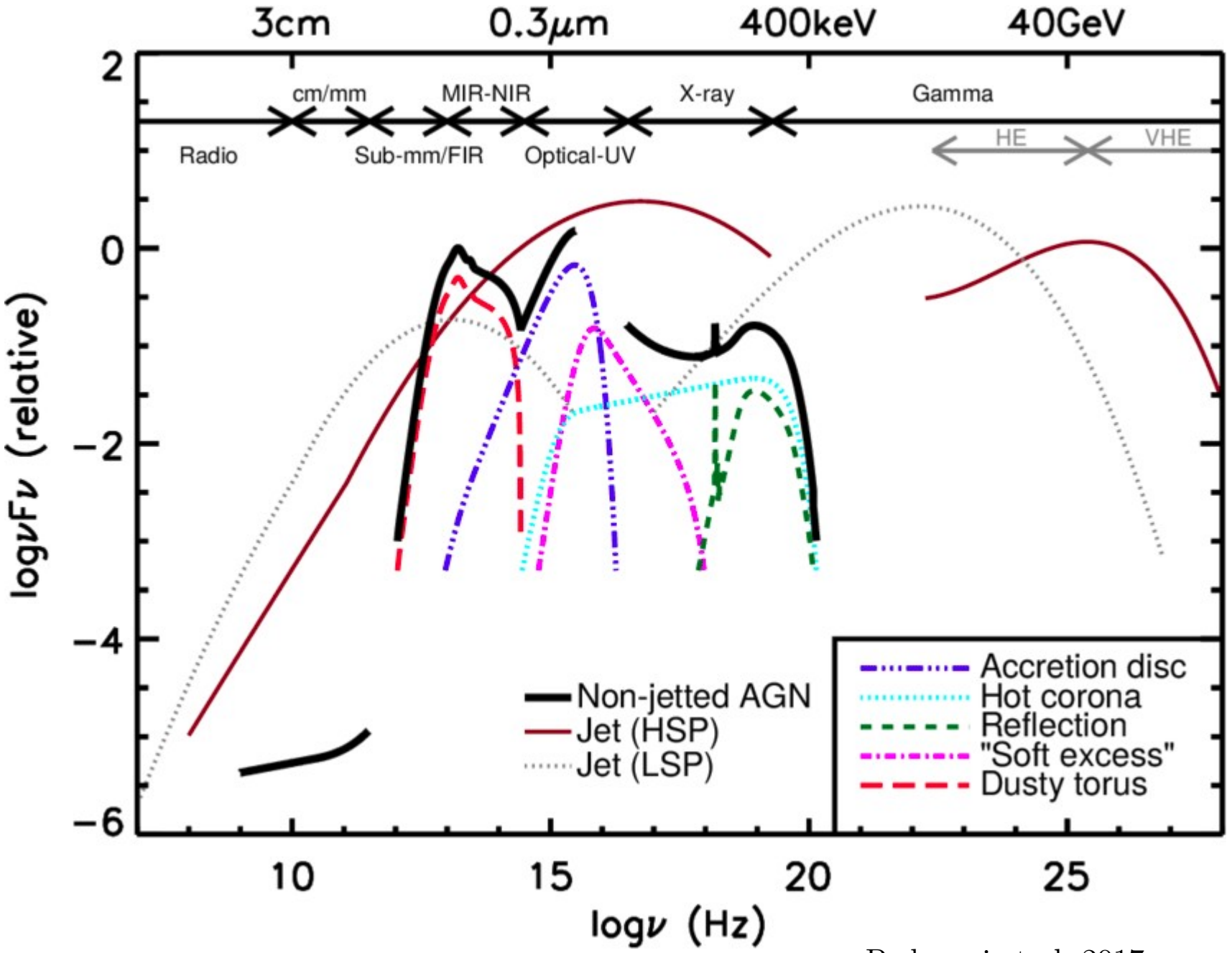
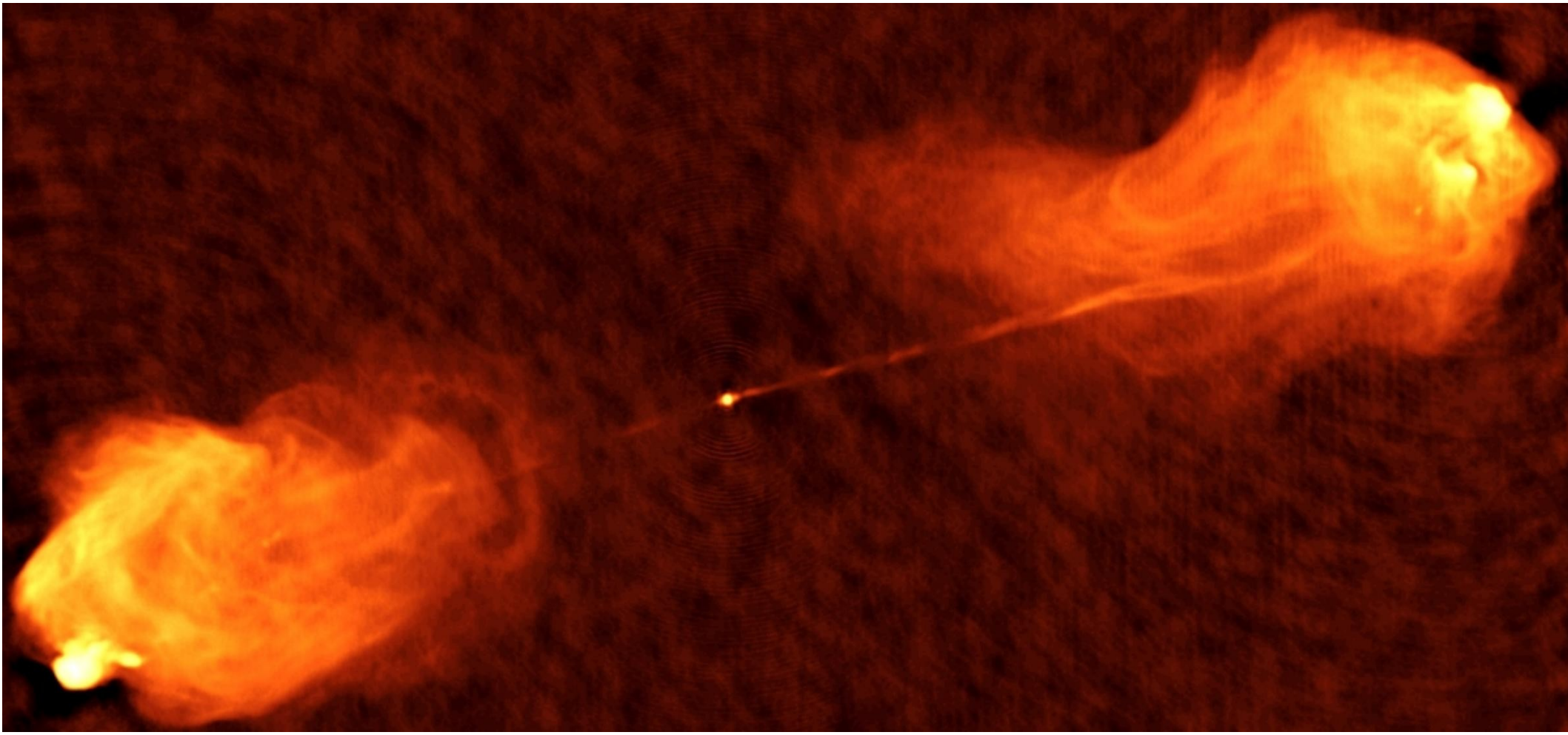


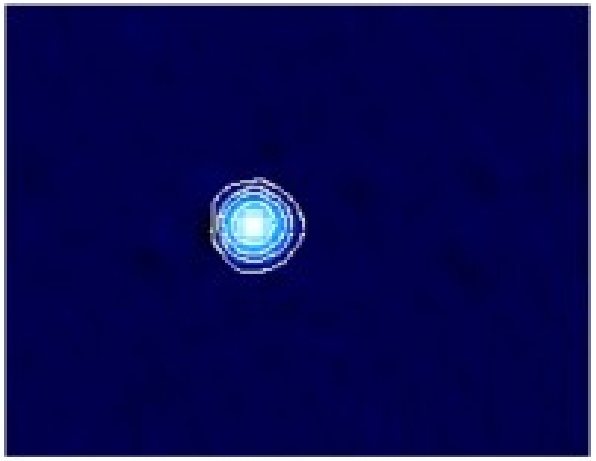
James et. al. 2017

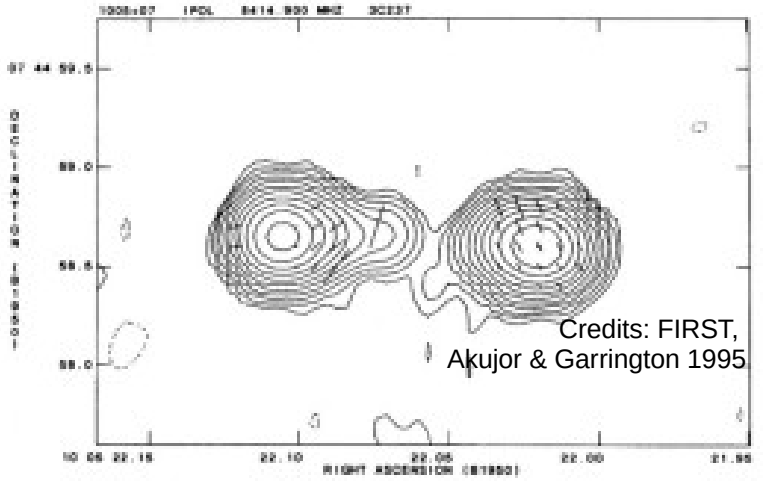


Padovani et al. 2017



Credit: NRAO





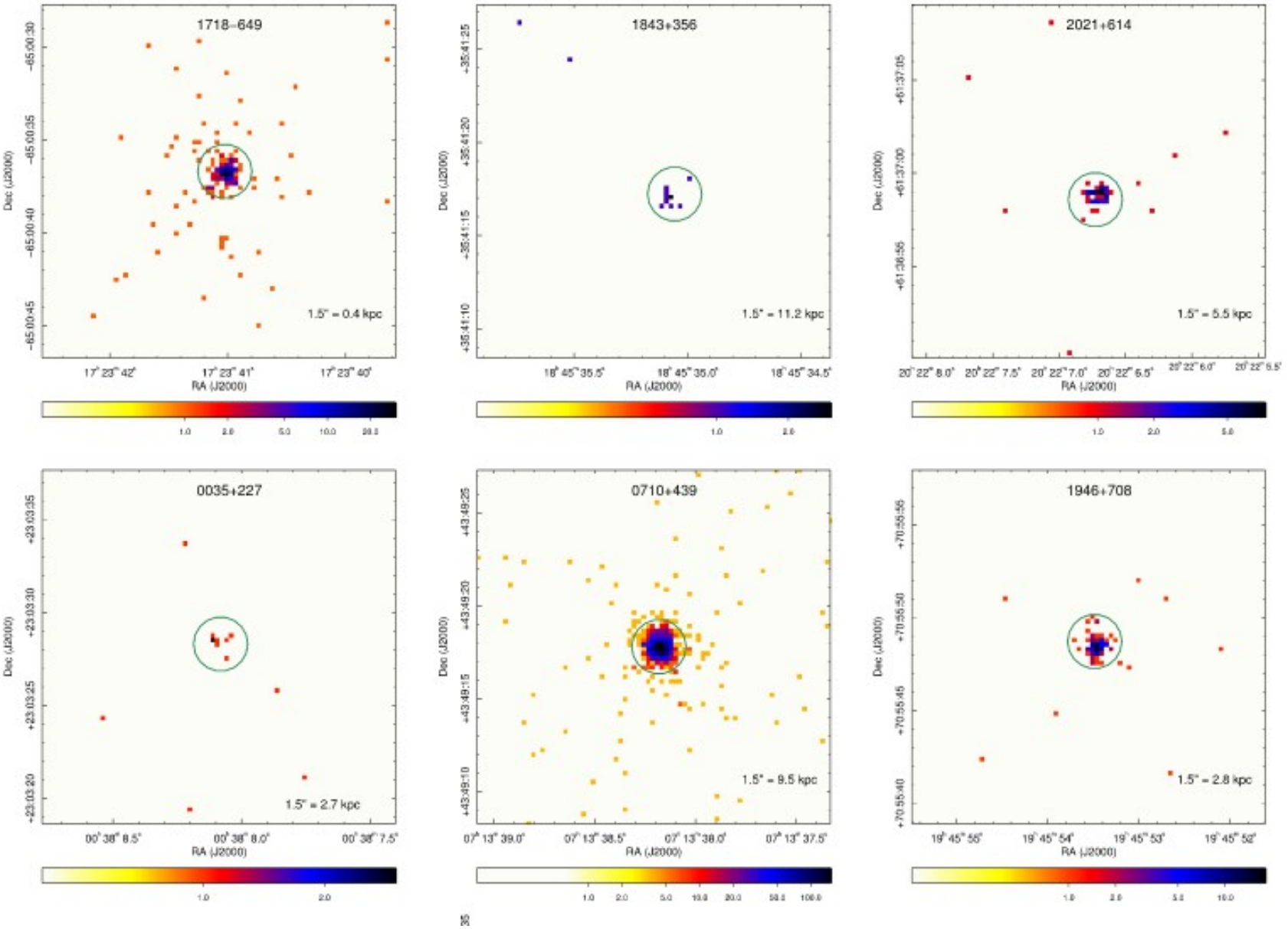
Credits: FIRST, Akujor & Garrington 1995

CSO- compact symmetric object

- Radio morphology
- No flux variation
- Young?
- Overabundance→ short-lived

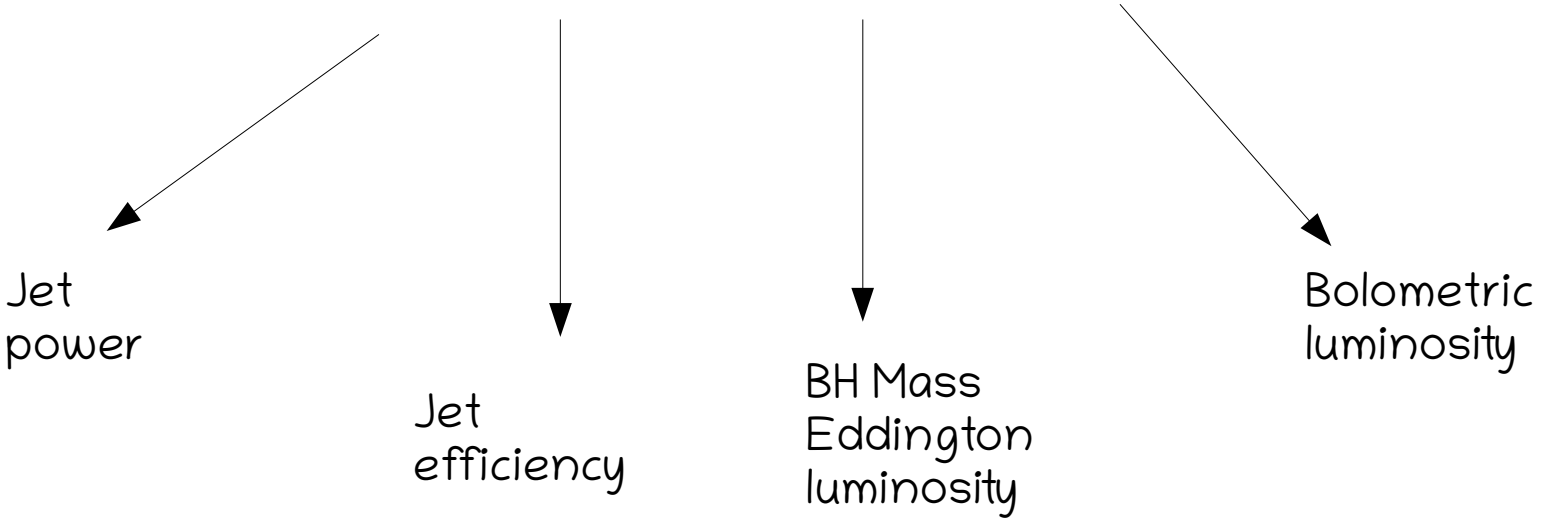
name	size (pc)	age (yrs)
1718–649	2.0	91
1843+356	22.3	180
2021+614	16.1	368
0035+227	21.8	450
0116+319	70.1	501
0710+439	87.7	932
1946+708	39.4	1261
1943+546	107.1	1308
1934–638	85.1	1603
1607+26	240	2200
1511+0518	7.3	300
1245+676	9.6	188
OQ+208	7.0	219
0108+388	22.7	404
1031+567	109.0	1836
2352+495	117.3	3003

High quality X-ray observations of Chandra



Siemiginowska et al. 2016

How to decribe AGN?

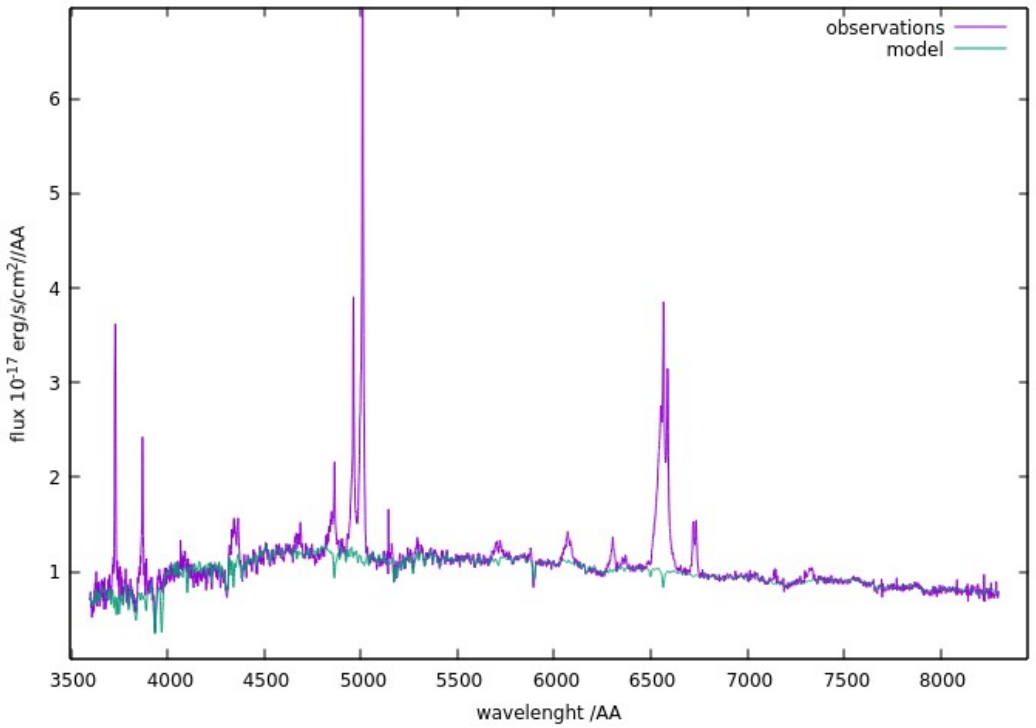


Extracting spectra...

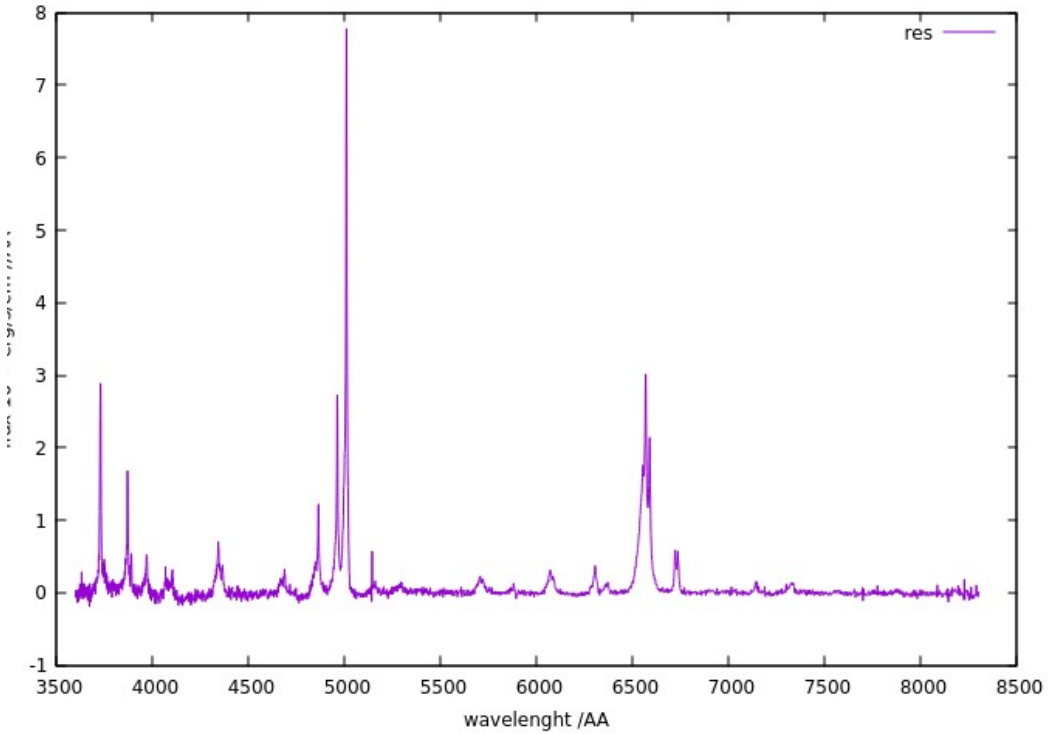
- SDSS – 4 objects (spectrum quality)
- In literature – 7 more

STARLIGHT

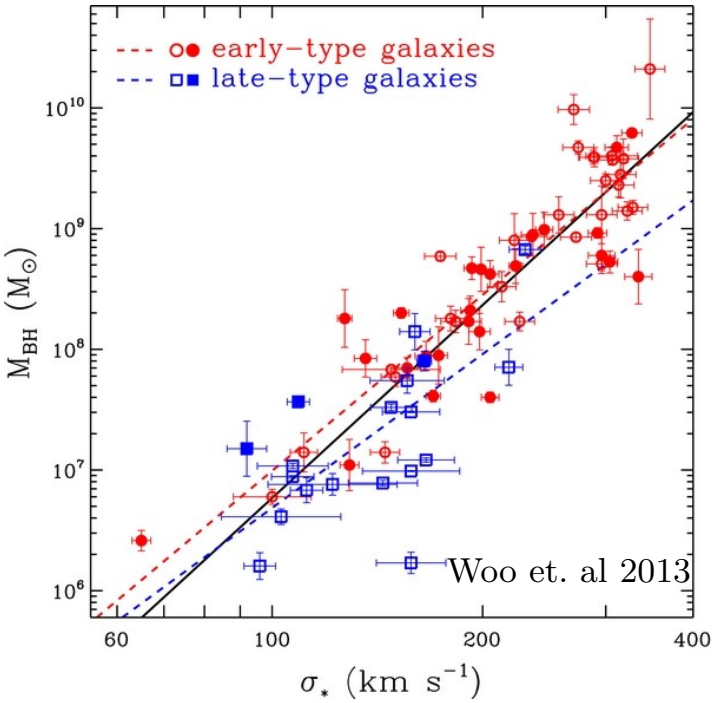
Spectral Synthesis Code



Green line: mixed population synthetic stellar spectra (Bruzual & Charlot 2003)+AGN continuum (assuming Calzetti 2000 extincion law)



Extracted emission spectrum of AGN

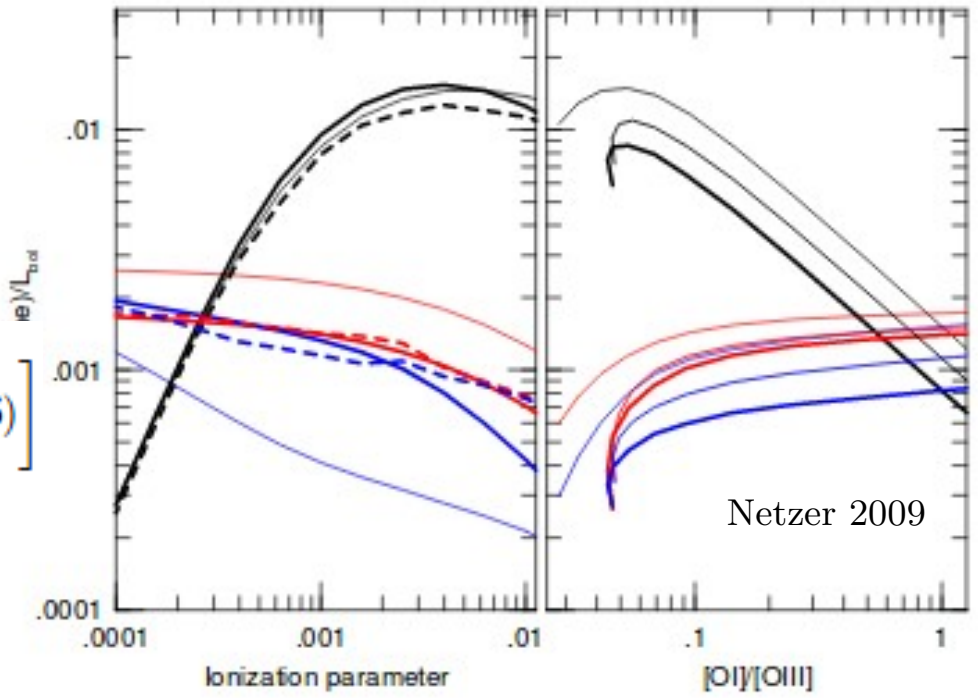


How to derrive BH mass?

$$\log(M_{\rm BH}/M_\odot) = \alpha + \beta \log(\sigma/\sigma_0)\ ,$$

Disk luminosity estimate

$$\log L_{bol} = \log L(H_\beta) + 3.48 + max\left[0., 0.31(\log \frac{[OIII]}{H_\beta} - 0.6)\right]$$



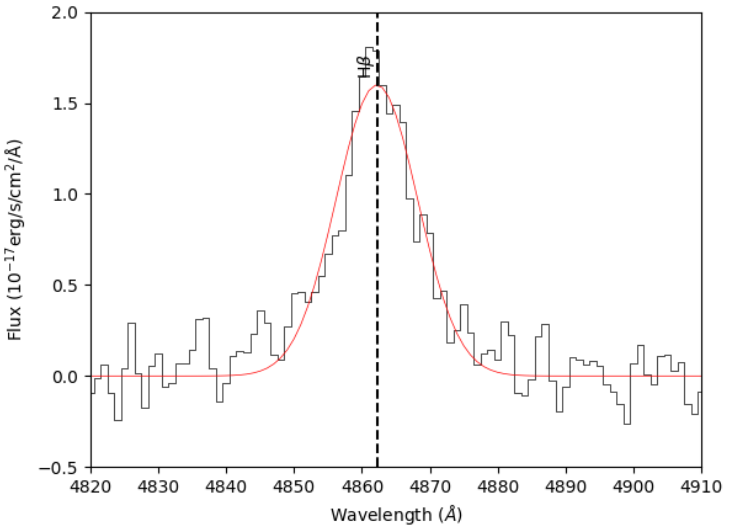
Bolometric luminosities estimate

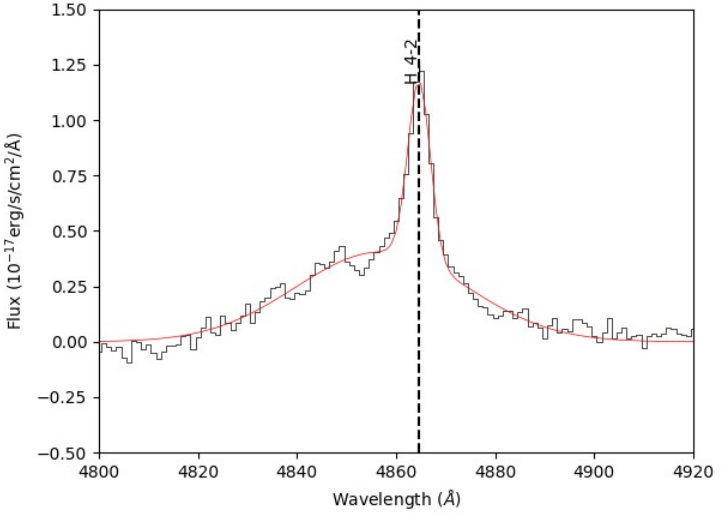
Table 1
Measured velocity dispersion and narrow $H\beta$ fluxes for objects with available SDSS spectra.

name	Ref.	$\sigma_\star$ $[kms^{-1}]$	$F_{H\beta}$ $[\frac{erg}{scm^2}]$	comments
1607+26	SDSS	255.33	1.39E-15	Type-2 AGN
1511+0518	SDSS	199.75	8.33E-17	Type-1 AGN
OQ+208	SDSS	259.95	4.85E-17	Type-1 AGN
1031+567	SDSS	217.55	2.01E-16	Type-2 AGN

Table 2
Bolometric luminosities estimated from measured $H\beta$ luminosities in the literature.

name	method	$H\alpha/H\beta$	$L_{H\beta\_cor}$ [erg/s]	L_{bol} [erg/s]
0035+227	averaged	2.73	1.98E+041	5.97E+044
1245+676	averaged	1.84	1.36E+041	4.11E+044
2352+496	$H\alpha/H\beta$	4.57	2.65E+041	8.00E+044
1031+567	averaged	2.75	3.53E+041	1.06E+045
0710+439	averaged	–	1.54E+042	4.65E+045
1718–649	$H\alpha/H\beta$	3.4	1.25E+41	3.77E+044
1934–634	$H\alpha/H\beta$	5	1.45E+041	7.88E+045

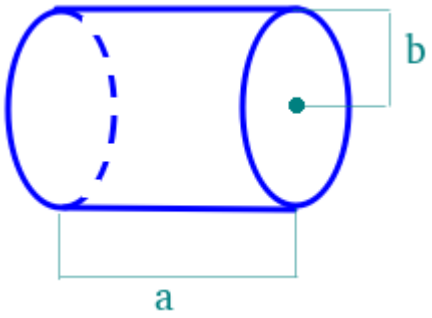


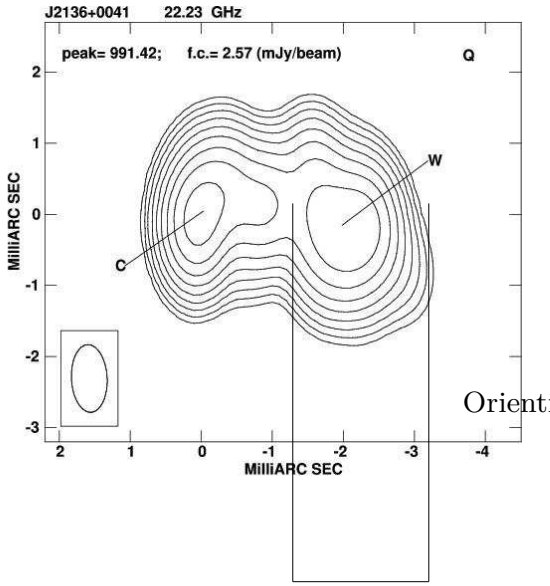


Jet power estimate

- Classical Willott et al. 1999 scaling relation

$$P_j[erg\,s^{-1}] = 5.0\times10^{22}(f/10)^{3/2}\left(L_{1.4\,GHz[W\,Hz^{-1}]}\right)^{6/7}$$





Orienti et al. 2006

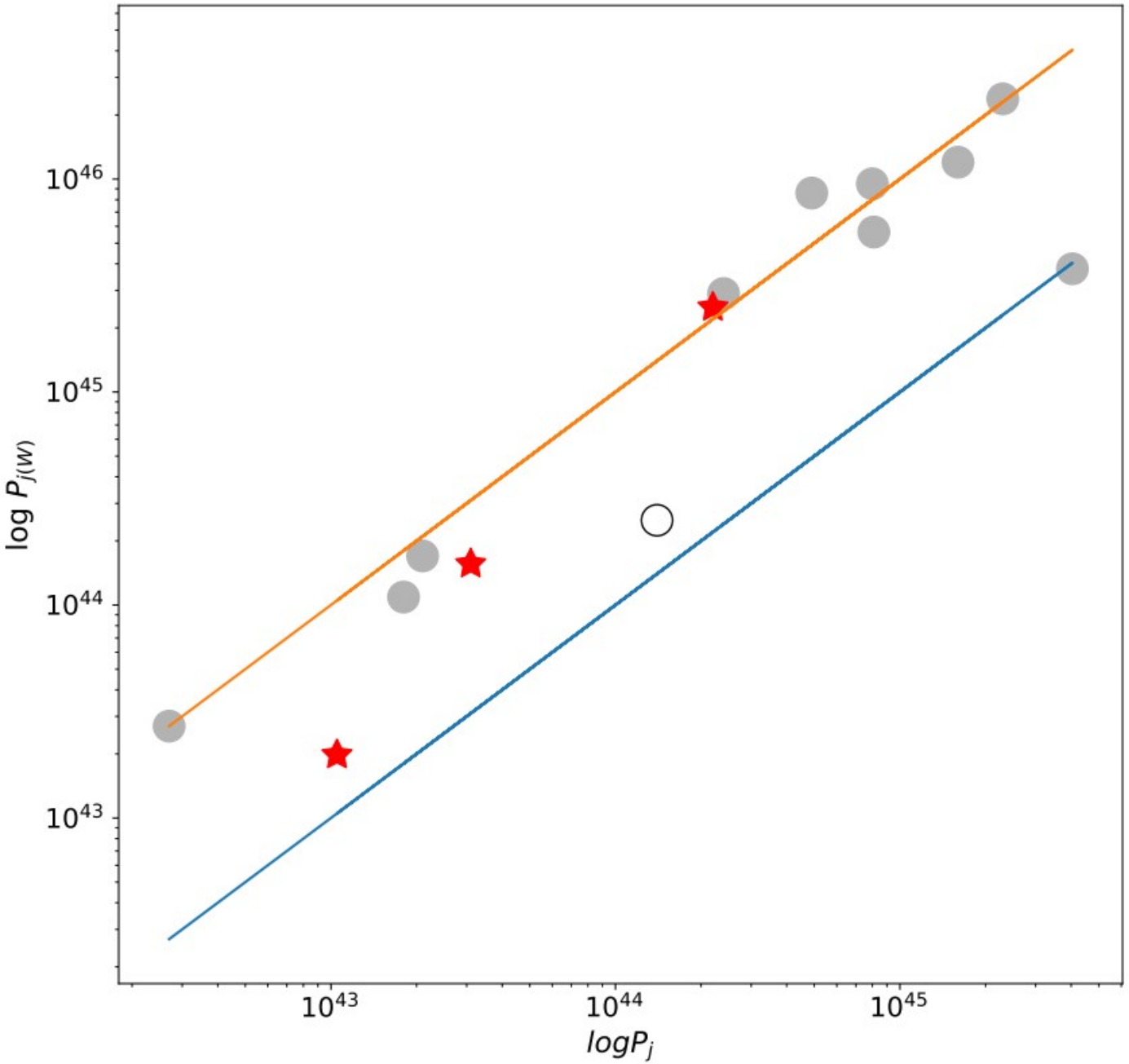
- Kinetic jet power

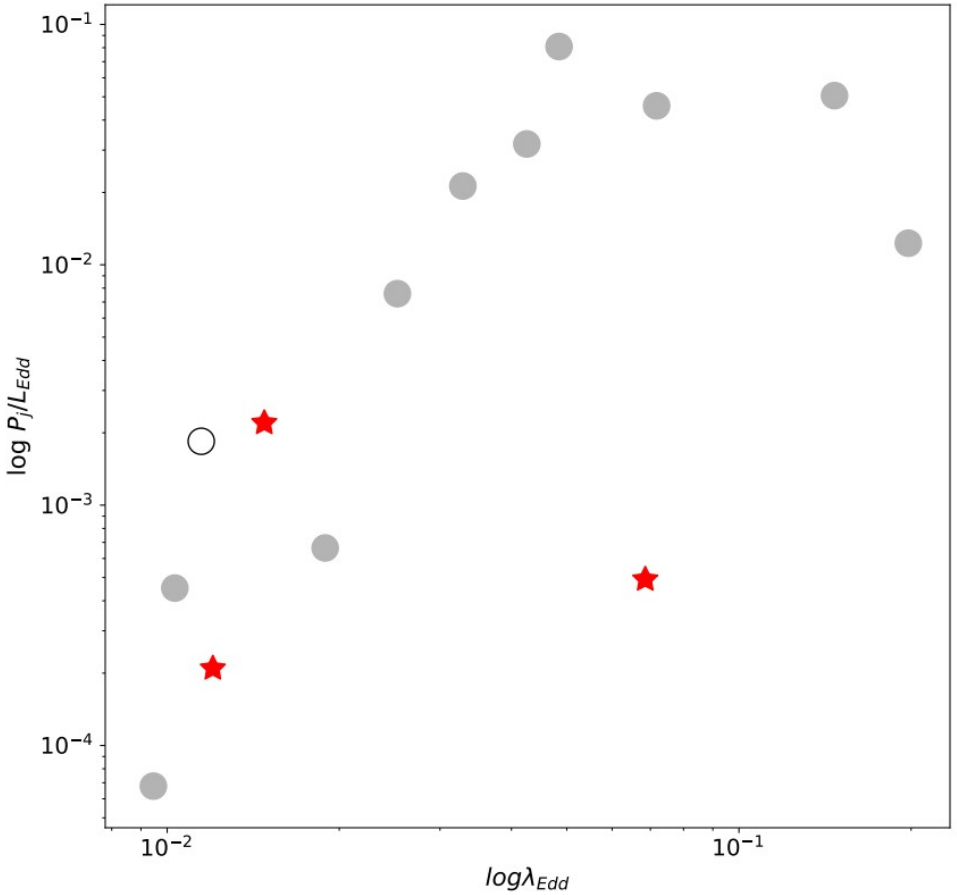
$$P_j = \frac{4\,pV}{\tau_j} = \frac{16\,\pi R^3}{3}\left(u_B + u_e\right)/\,\tau_j = \frac{32}{3}\,\pi R^3\,\frac{B_{eq}^2}{8\,\pi\,\tau_j}$$

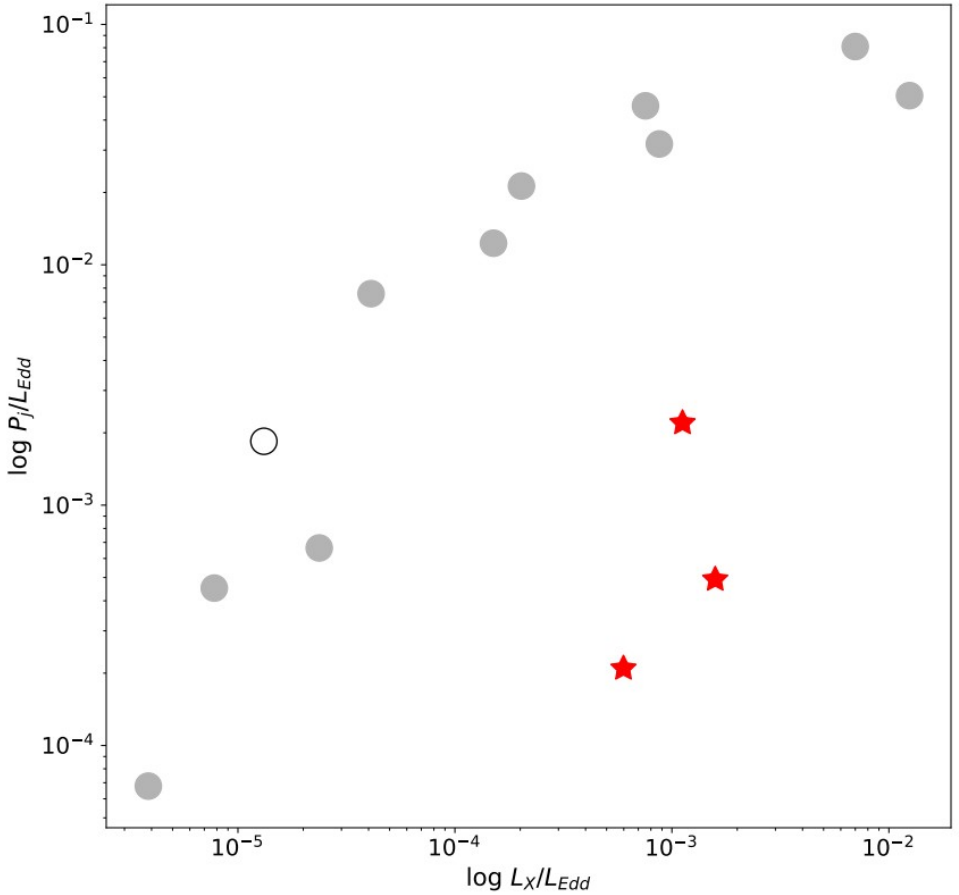
LS

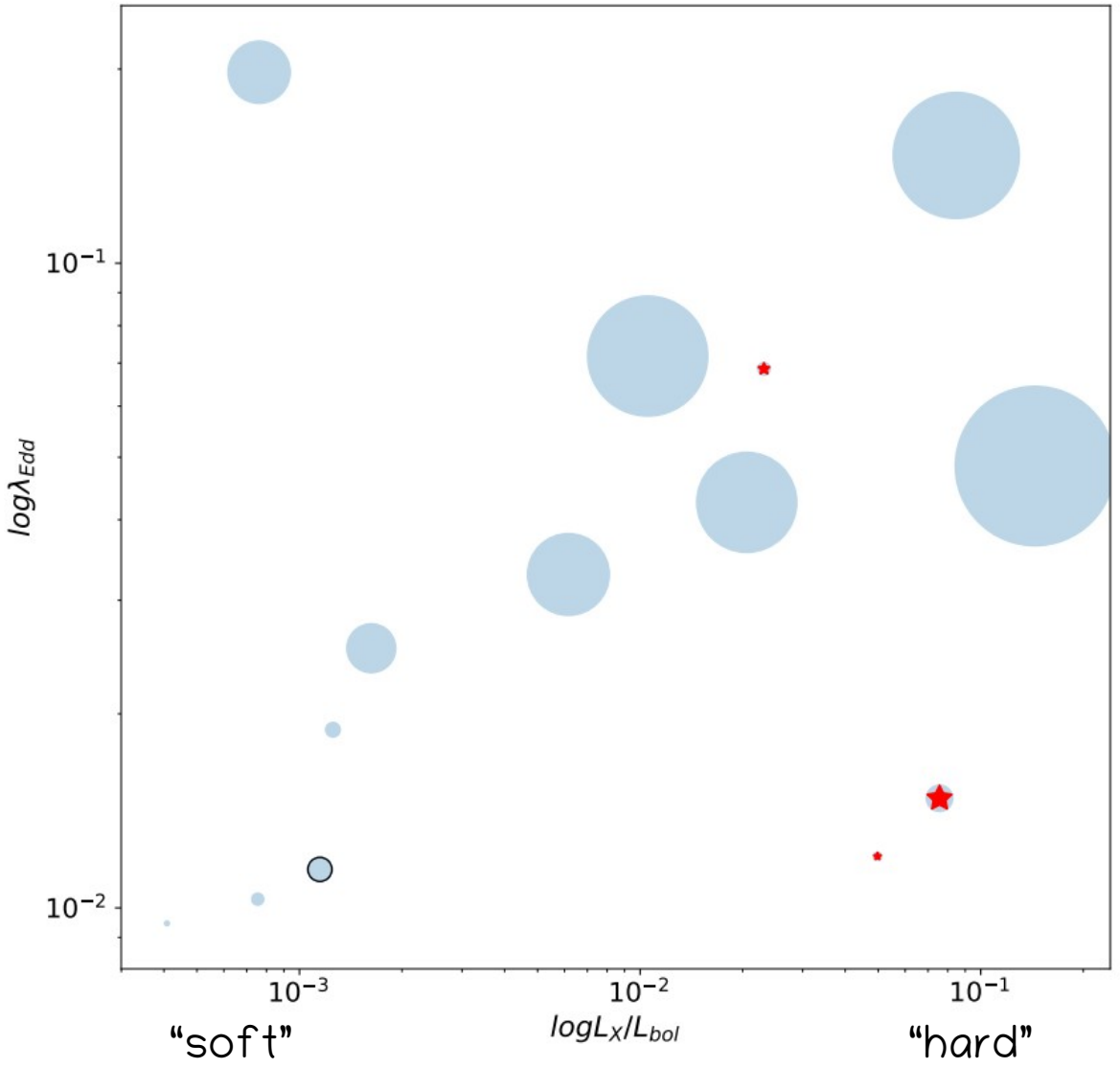
$$\frac{4}{3}\,\pi R^3 = \pi a b^2$$

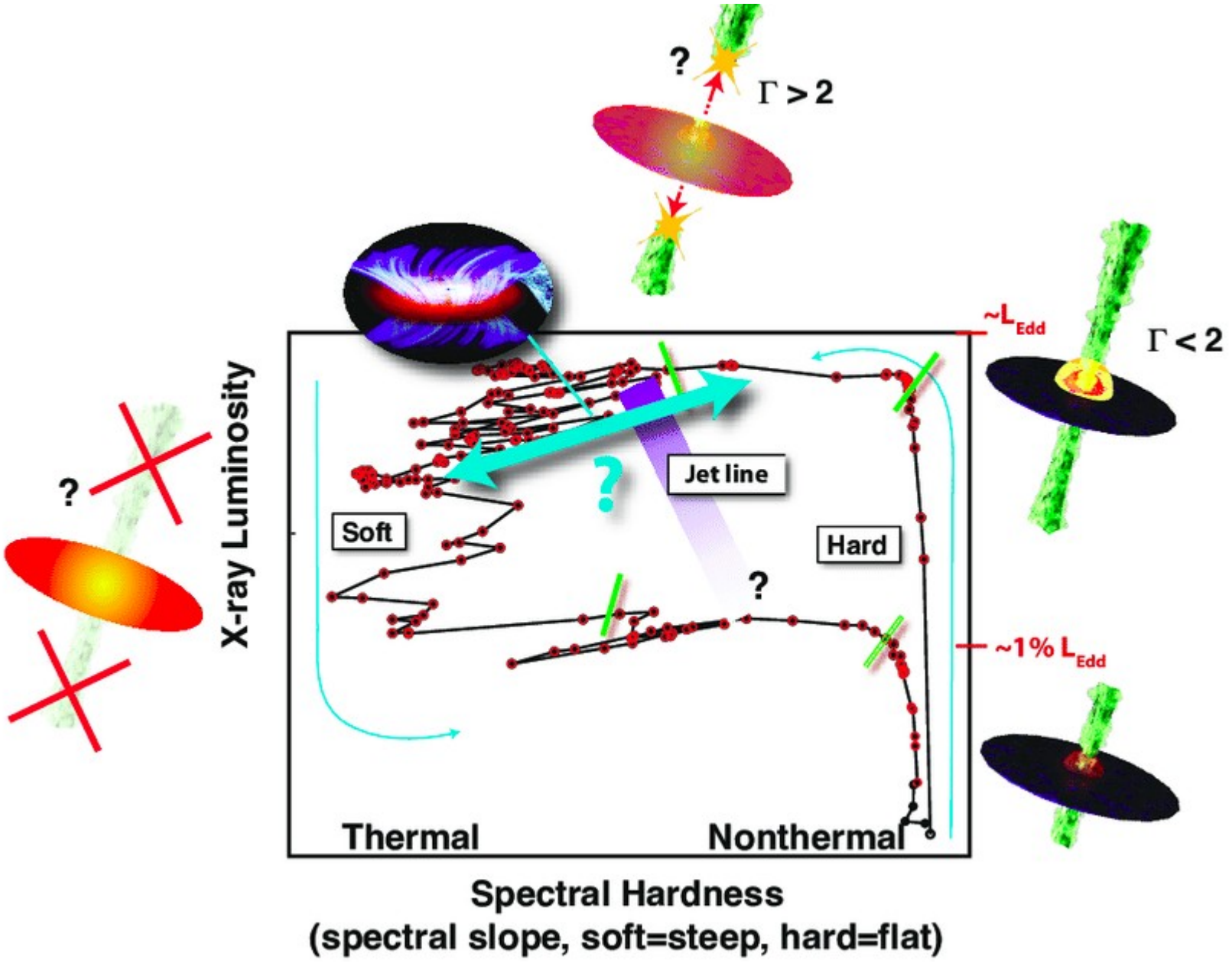
$$R = 0.18\,LS$$

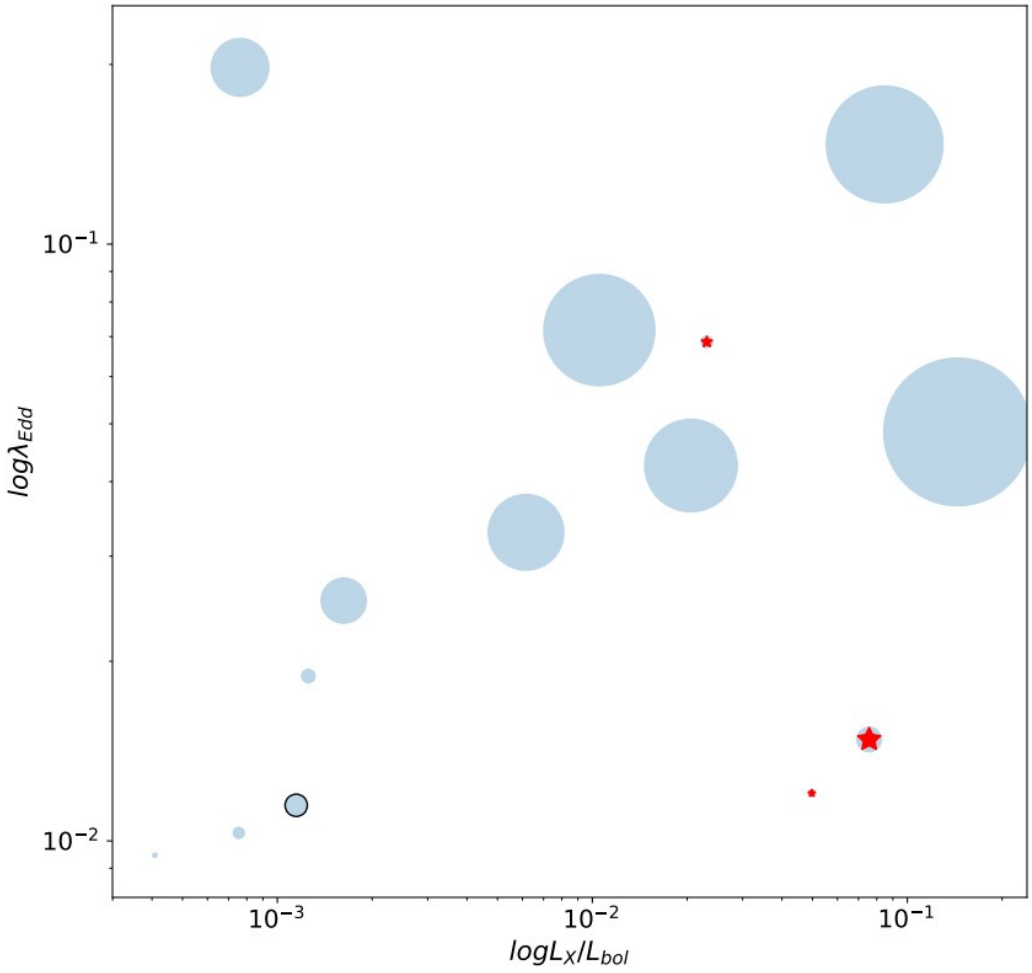

10^{46}
10^{45}
10^{44}
10^{43}
log $P_{j(W)}$
10^{43}
10^{44}
10^{45}
$logP_j$


10^{-1}
10^{-2}
10^{-3}
10^{-4}
log P_j/L_{Edd}
10^{-2}
10^{-1}
$log\lambda_{Edd}$

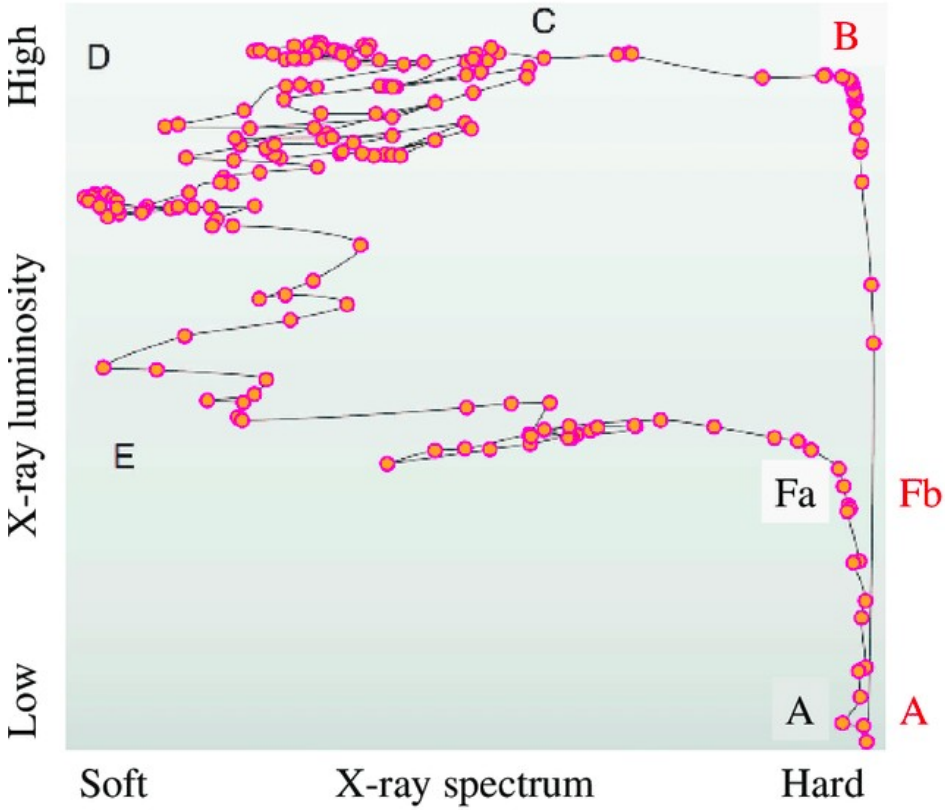

10^{-1}
10^{-2}
10^{-3}
10^{-4}
log P_j/L_{Edd}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
log L_X/L_{Edd}


10^{-1}
10^{-2}
$log\lambda_{Edd}$
10^{-3}
10^{-2}
10^{-1}
$logL_X/L_{bol}$
“soft”
“hard”


?
Γ > 2
~L_Edd
Γ < 2
?
X-ray Luminosity
Jet line
?
Soft
Hard
?
~1% L_Edd
Thermal
Nonthermal
Spectral Hardness
(spectral slope, soft=steep, hard=flat)



ns in the HID are very important during the system's evolution (see H



Summary:

- Sample of 17 confirmed GPS were studied and accretion properties have been derived
- Accretion properties characteristic for quasars- standard, radiatively efficient disk in the early stages of jet formation
- Normalized jet power seems to correlate with accretion rate
- Jet production efficiency doesn't reach maximum level (no-MAD disk)
- Broad lines→ clumpy torus?

Thank you!