

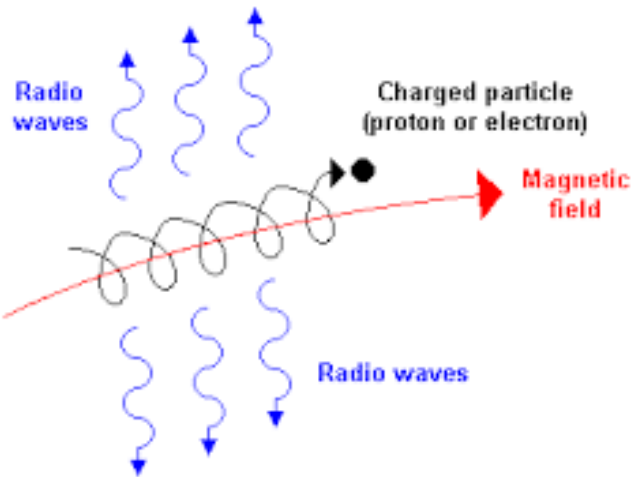
Jet production efficiency in the sample of the youngest radio galaxies

Anna Wójtowicz

in a collaborotio with Łukasz Stawarz & Emily Kosmaczewski

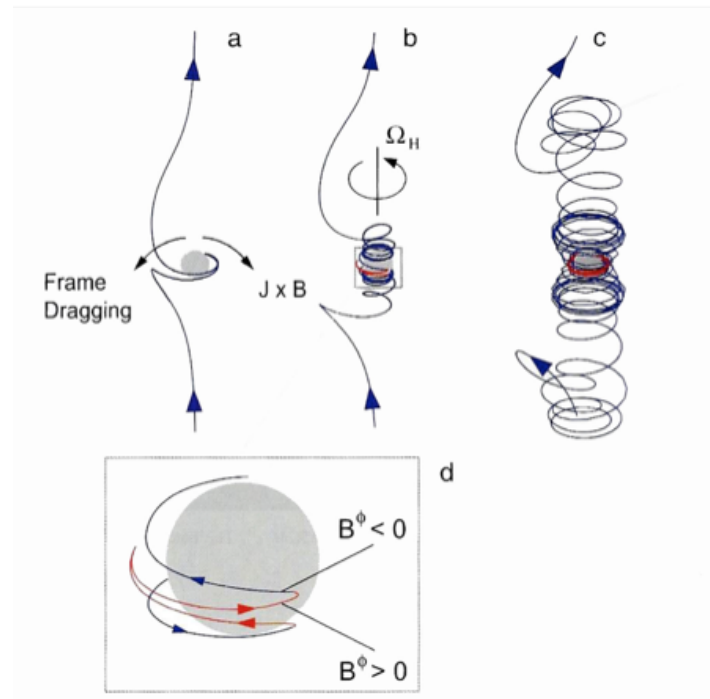
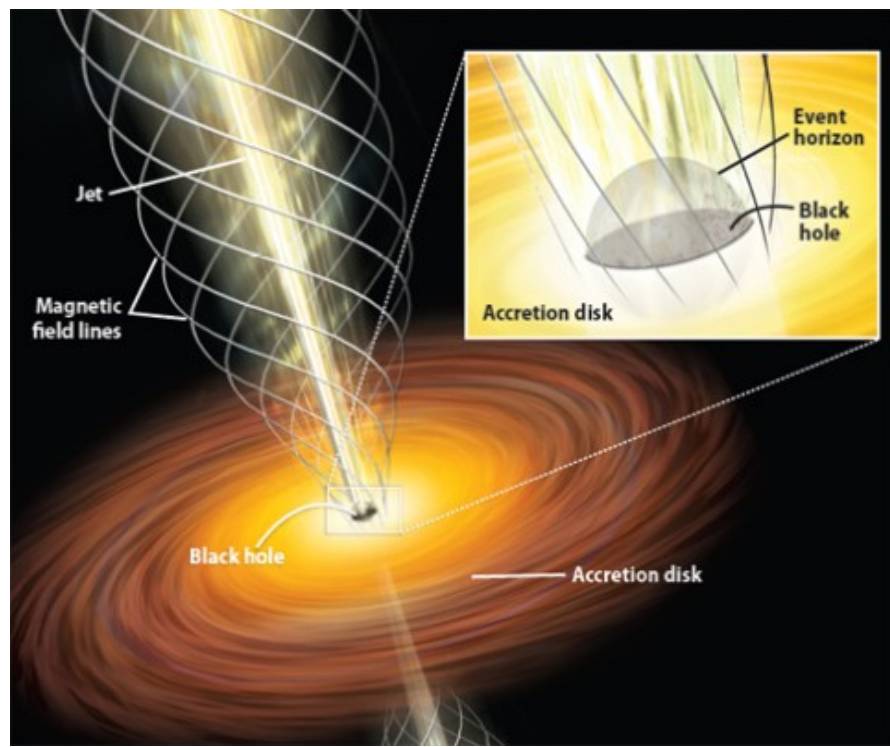
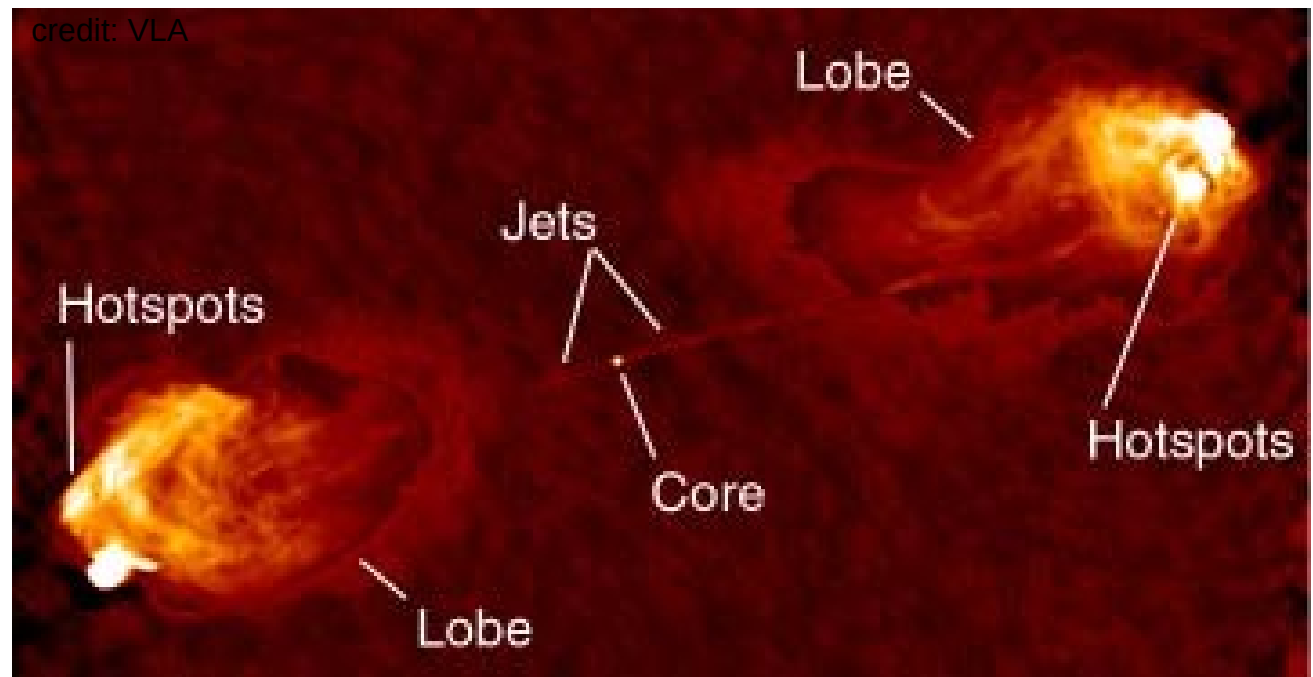
Astronomical Observatory of the Jagiellonian University

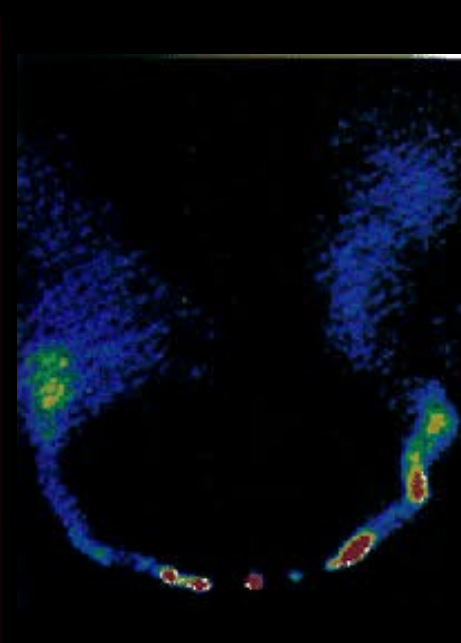
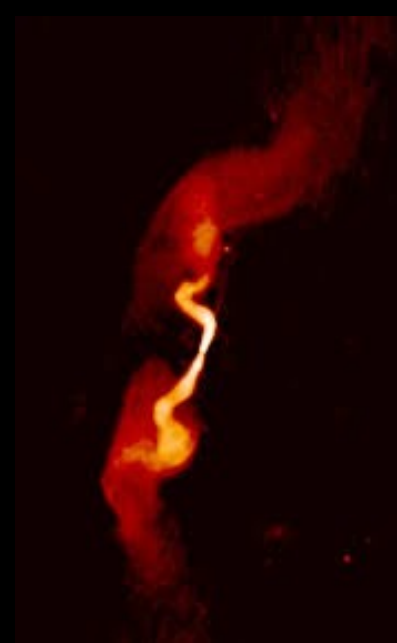
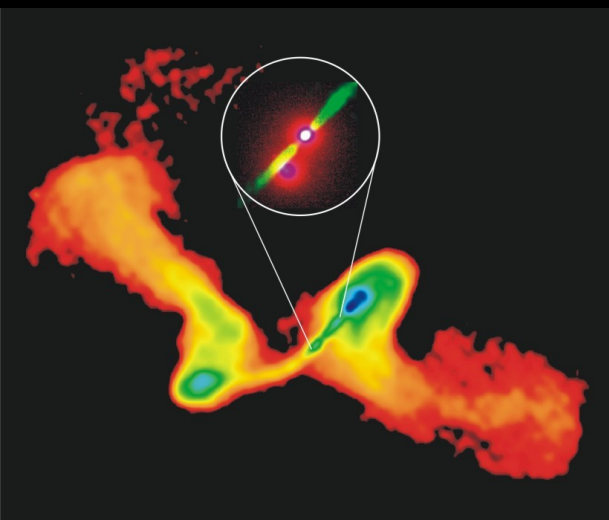




numiano

credit: VLA





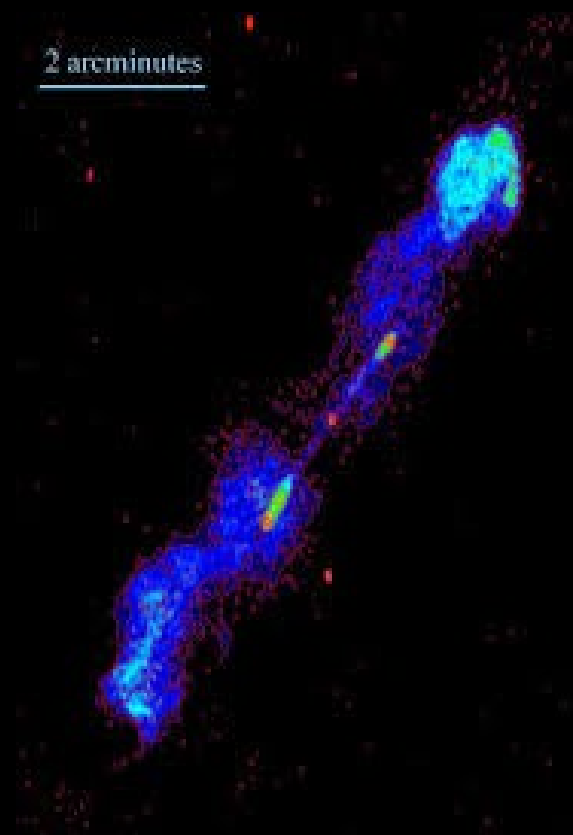
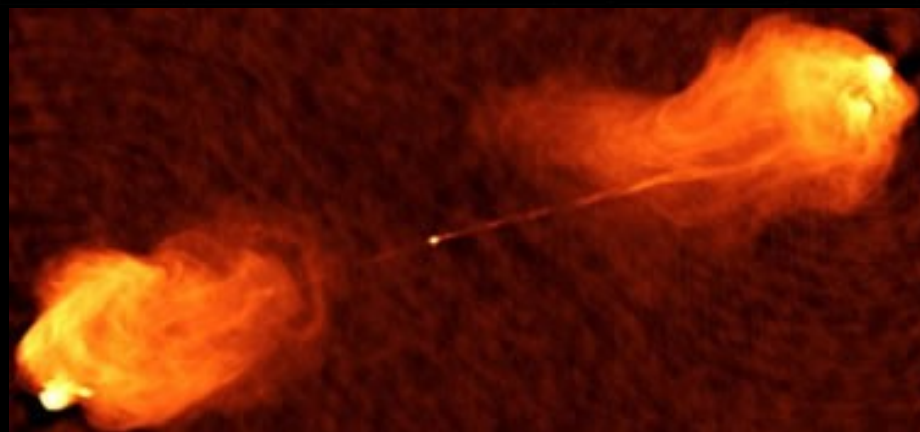
3C 129.1
A
B

3C 129
C

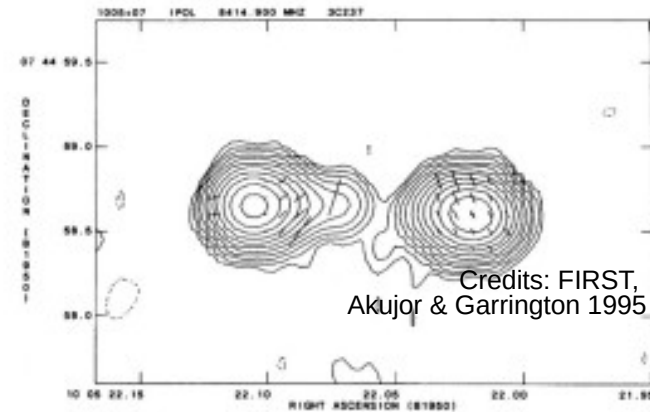
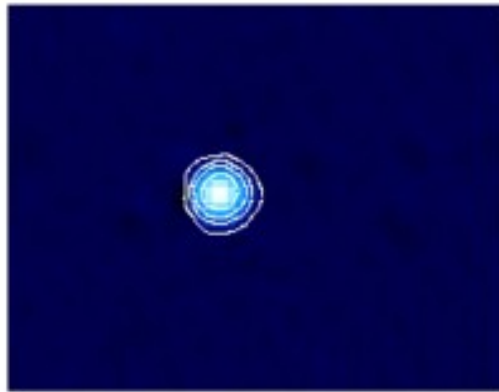
2'

$\lambda \sim 90$ cm

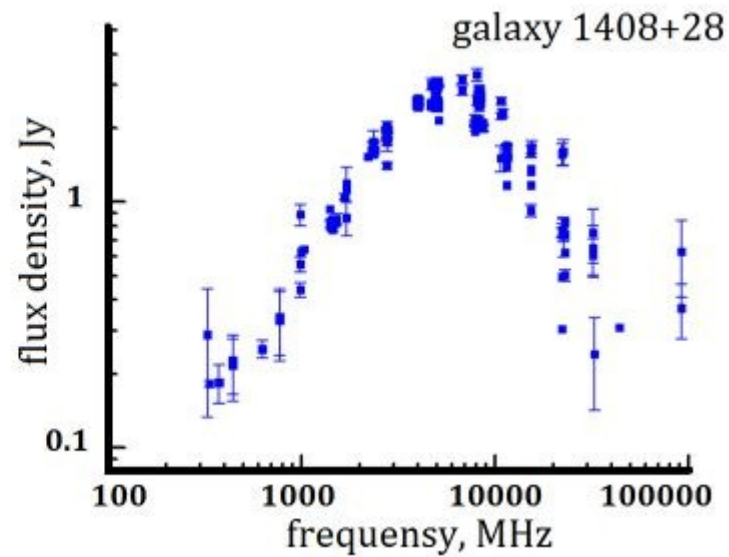
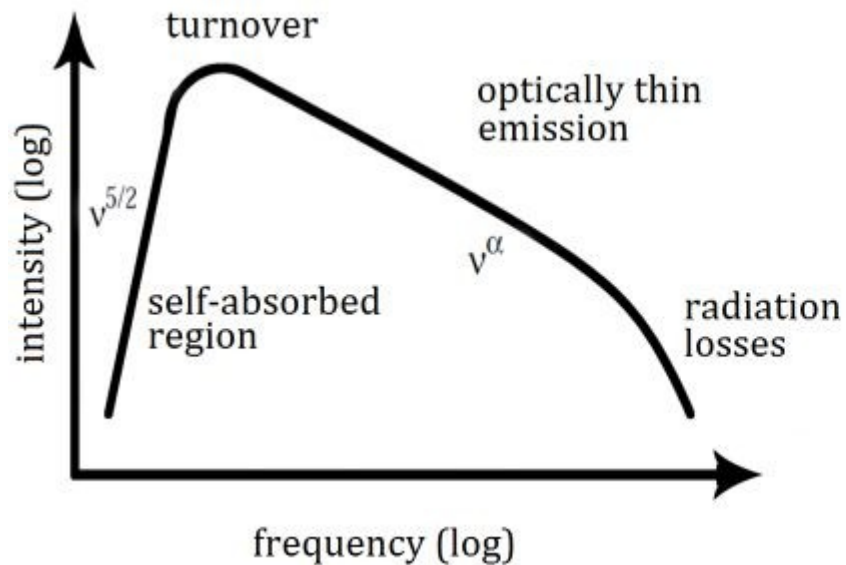
2 arcminutes



Compact Symmetric (CSO)/GHz Peaked (GPS)



Credits: FIRST,
Akujor & Garrington 1995





Why GPS?



Jet-ISM interaction:

- Star formation?
- Galaxy growth
- Why elliptical?
- Why so many of them?



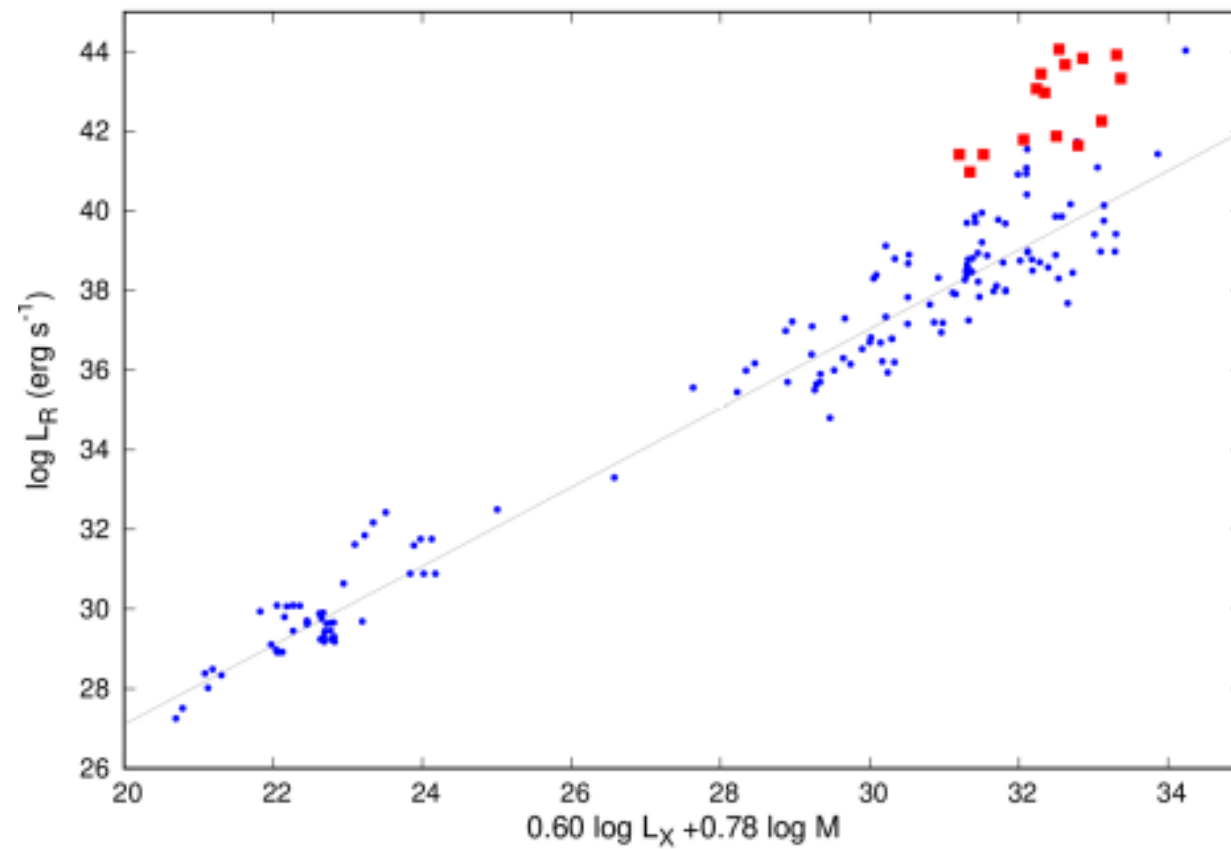
What did we do?

Table 3
Kinematic ages and linear sizes from Siemiginowska et al. (2016)
work.

name	size (pc)	age (yrs)	Refs. (Age)
1718-649	2.0	91	(1)
1843+356	22.3	180	(2)
2021+614	16.1	368	(2)
0035+227	21.8	450	(1)
0116+319	70.1	501	(1)
0710+439	87.7	932	(2)
1946+708	39.4	1261	(1)
1943+546	107.1	1308	(1)
1934-638	85.1	1603	(1)
1607+26	240	2200	(3)
1511+0518	7.3	300	(4)
1245+676	9.6	188	(1)
OQ+208	7.0	219	(5)
0108+388	22.7	404	(1)
1031+567	109.0	1836	(2)
2352+495	117.3	3003	(2)

Fundamental Plane of the Black Hole activity

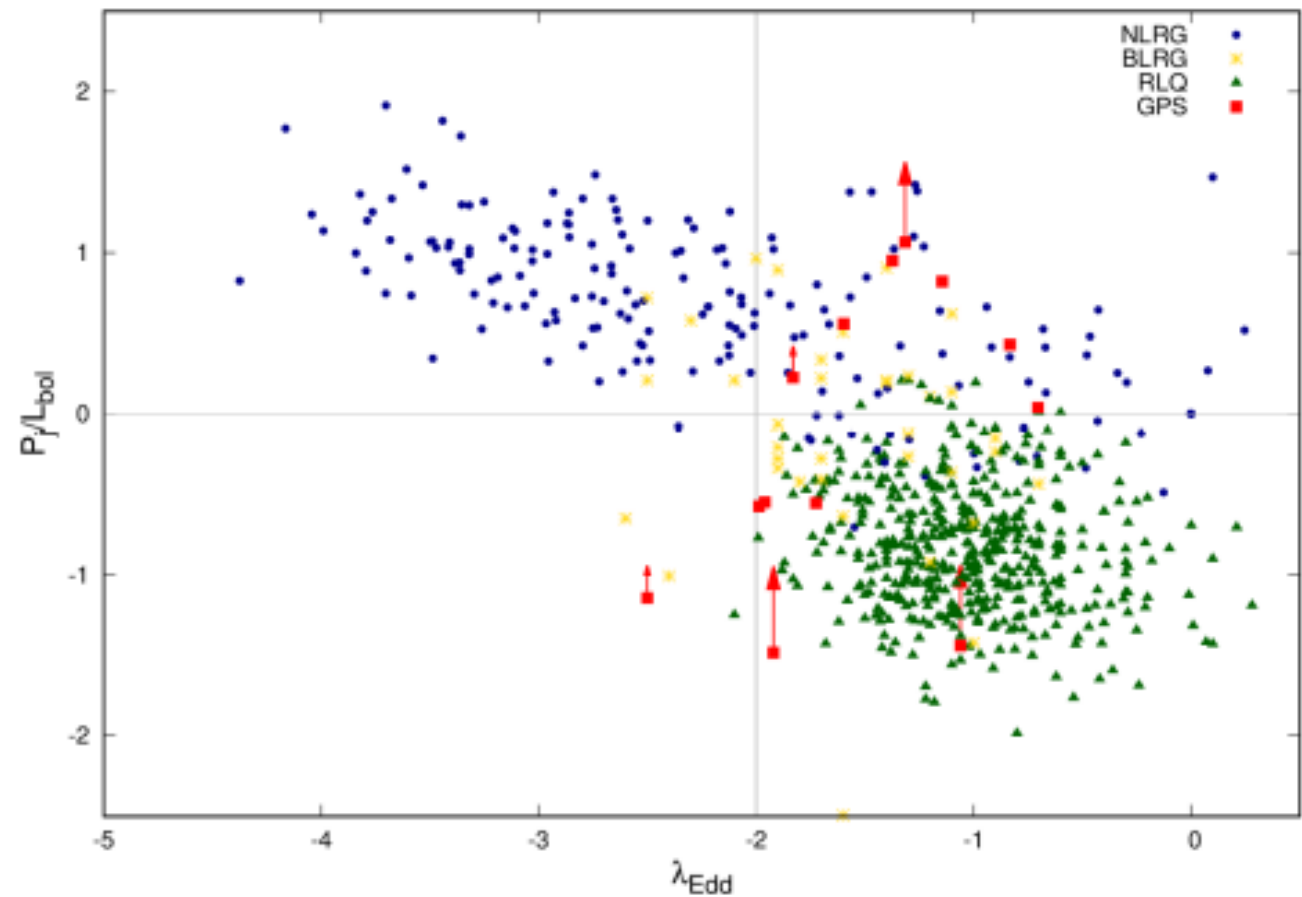
Merloni et al. 2003



How can we calculate the jet power?

Wilot et al. 1999

$$P_j[\text{ergs}^{-1}] = 5.0 \times 10^{22} (f/10)^{3/2} (L_{1.4\text{GHz}}[\text{WHz}^{-1}])^{6/7}$$



Is there a better way?

$$P_j = H_j / \tau_j$$

For relativistic particle assuming equipartition

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

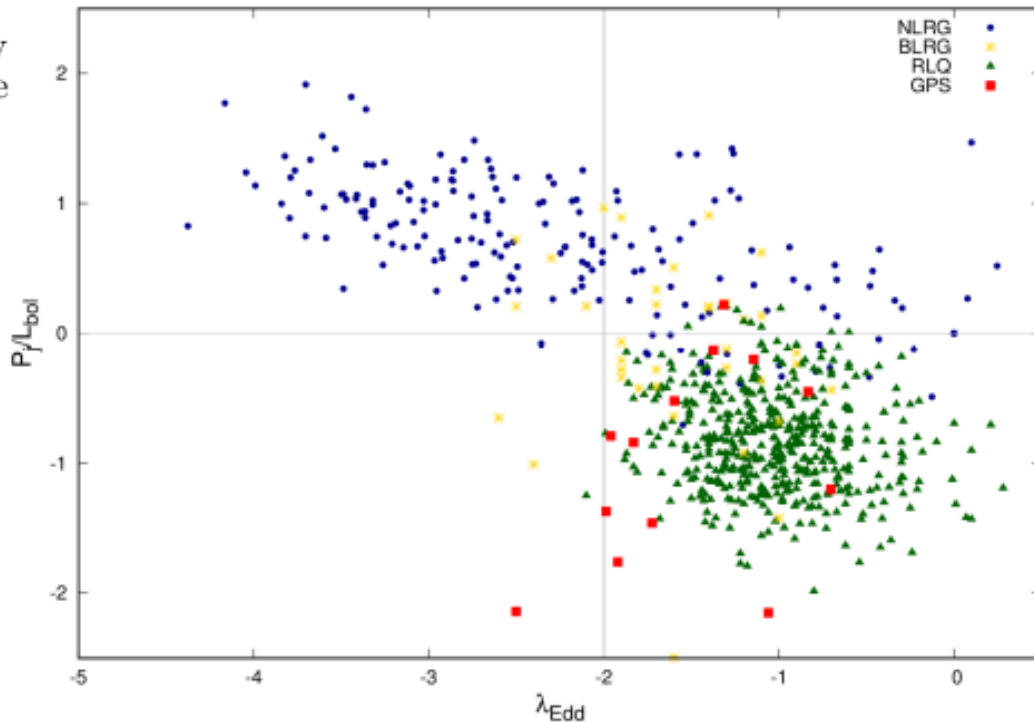
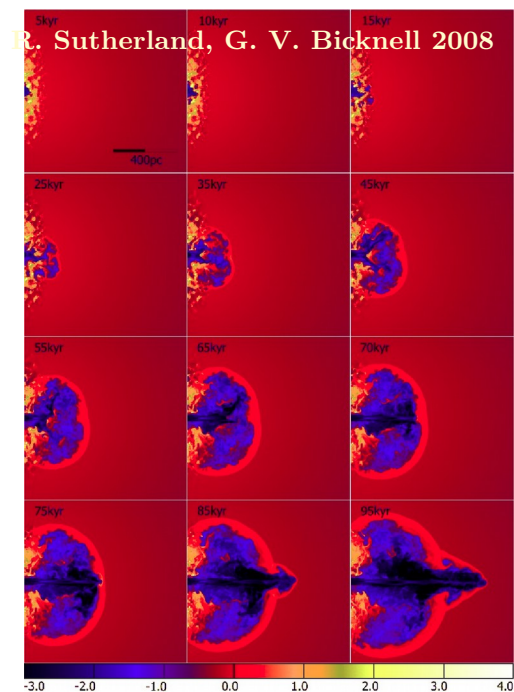
$$B_{eq} = [4.5 L_R c_{12}]^{2/7} R^{-6/7} \quad [G]$$

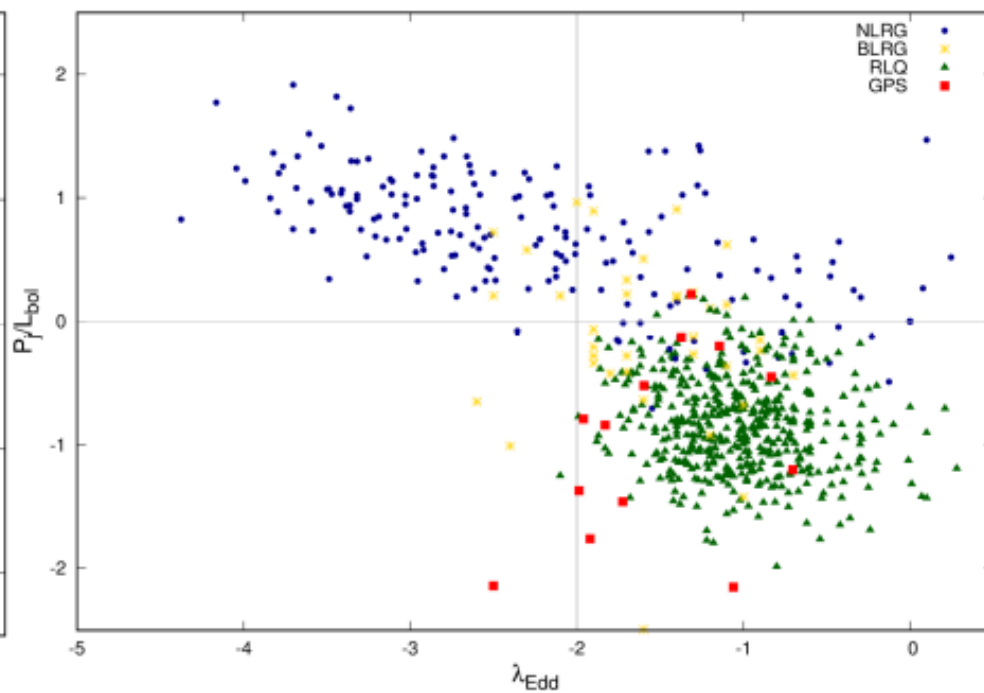
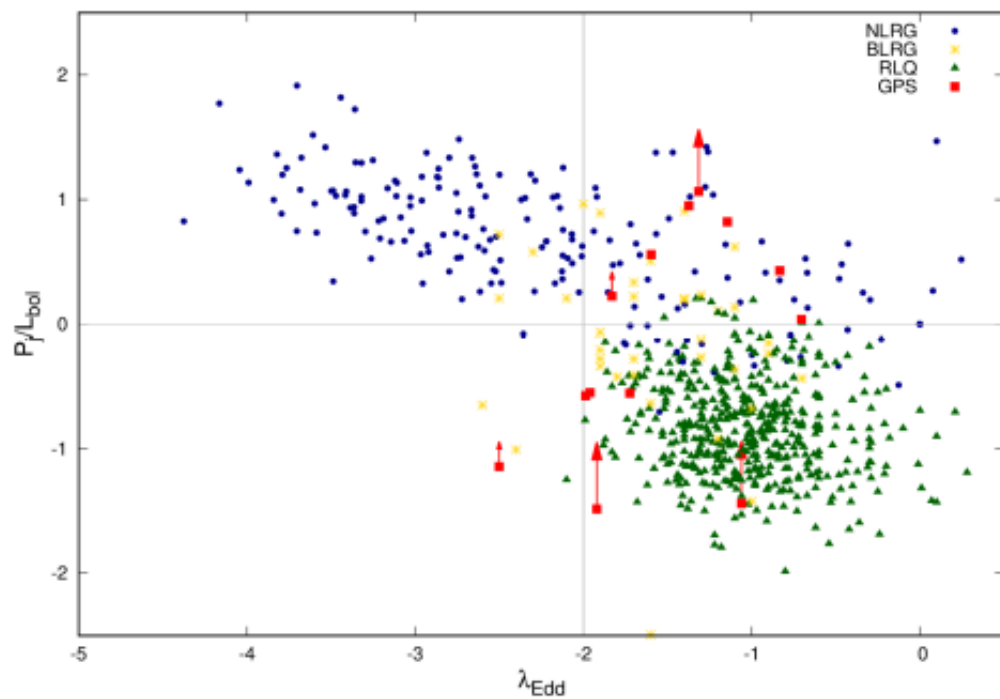
We assume constant spectra index in energy range $\gamma \in \{0.01 \text{ GHz}-100 \text{ GHz}\}$ to be equal $\alpha = 0.73$ (de Virios et al. 1997*).

$$L_R = L_{5GHz} \int_{0.01/5}^{100/5} x^{-\alpha} dx = 7.62 \times L_{5GHz}$$

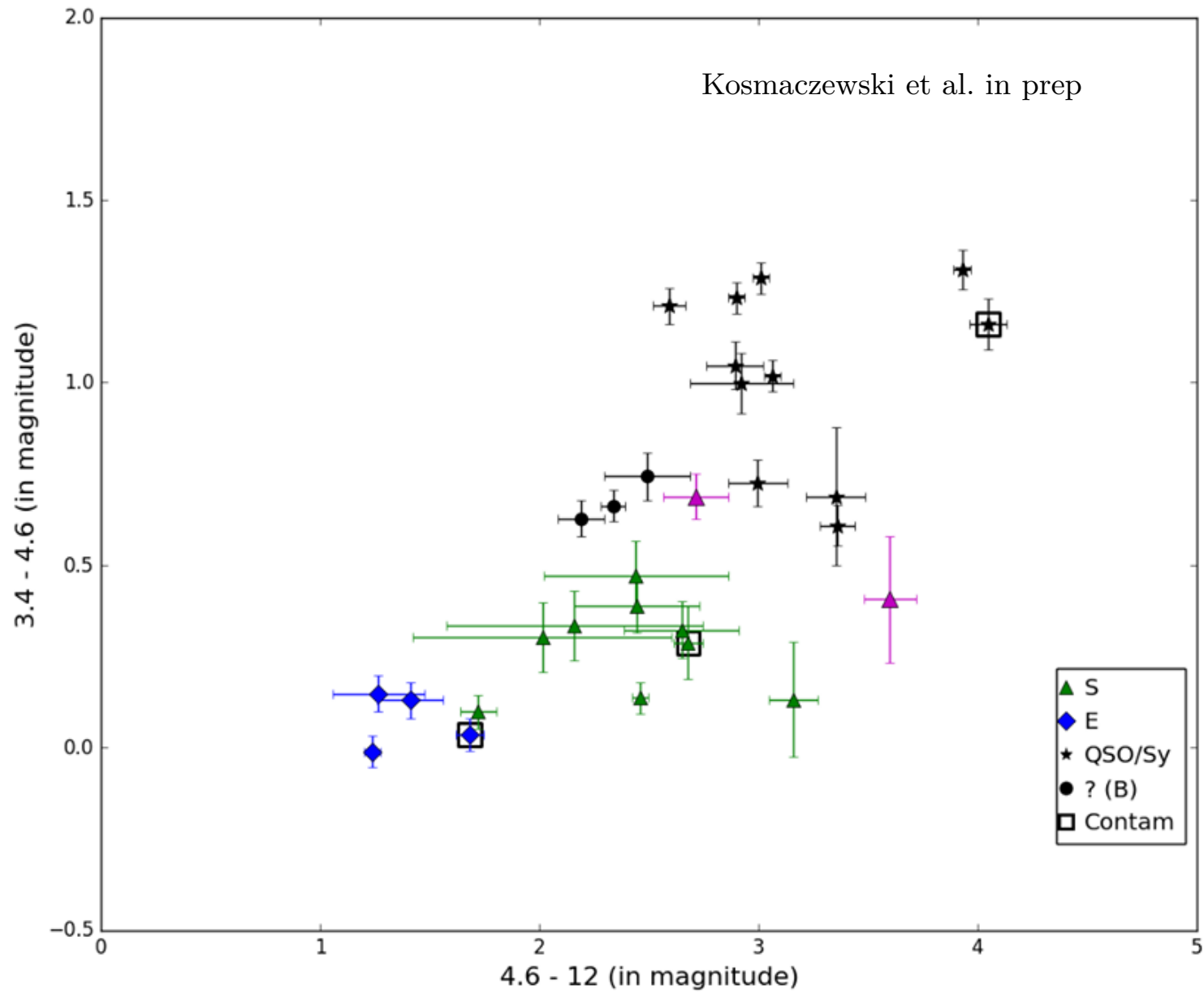
$$\frac{4}{3} \pi R^3 = \pi a b^2$$

$$R = 0.18 \text{ LS}$$





These disks are MAD!!!





Summary

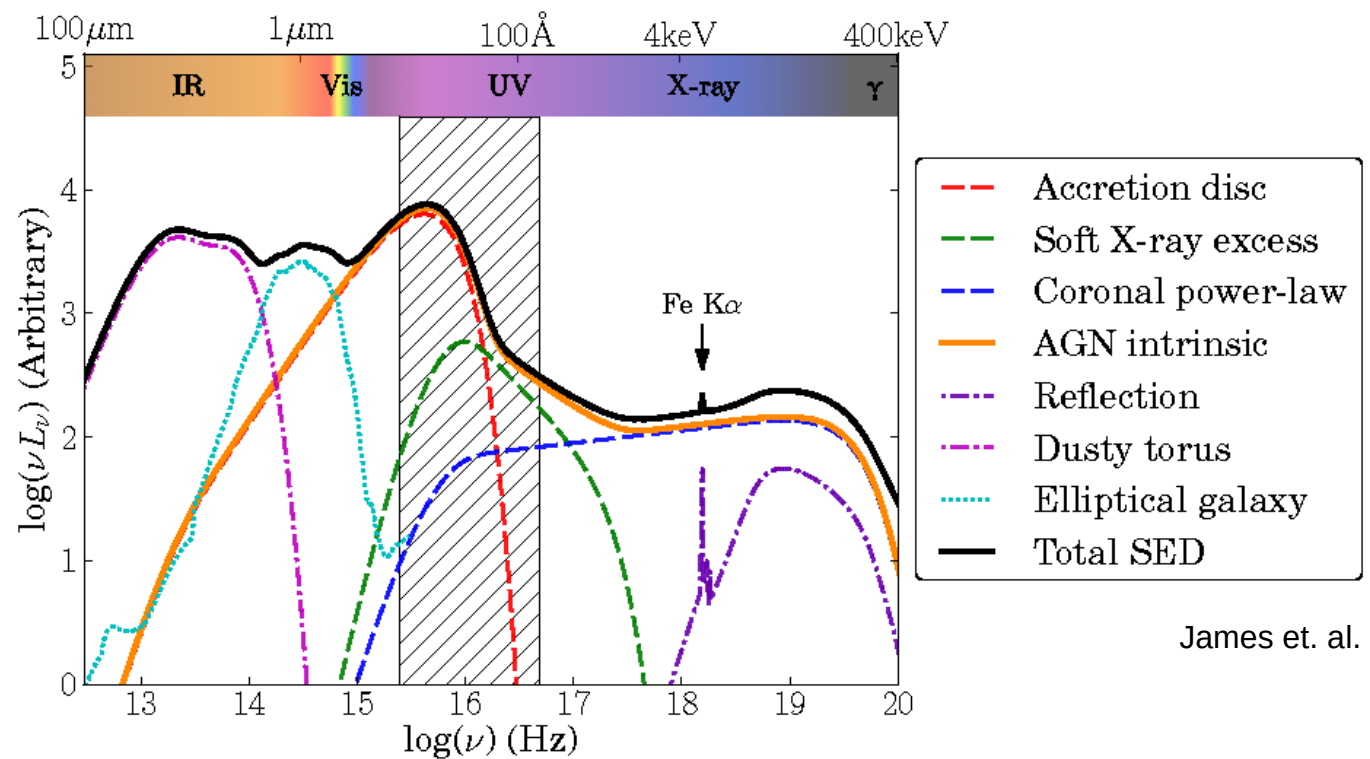
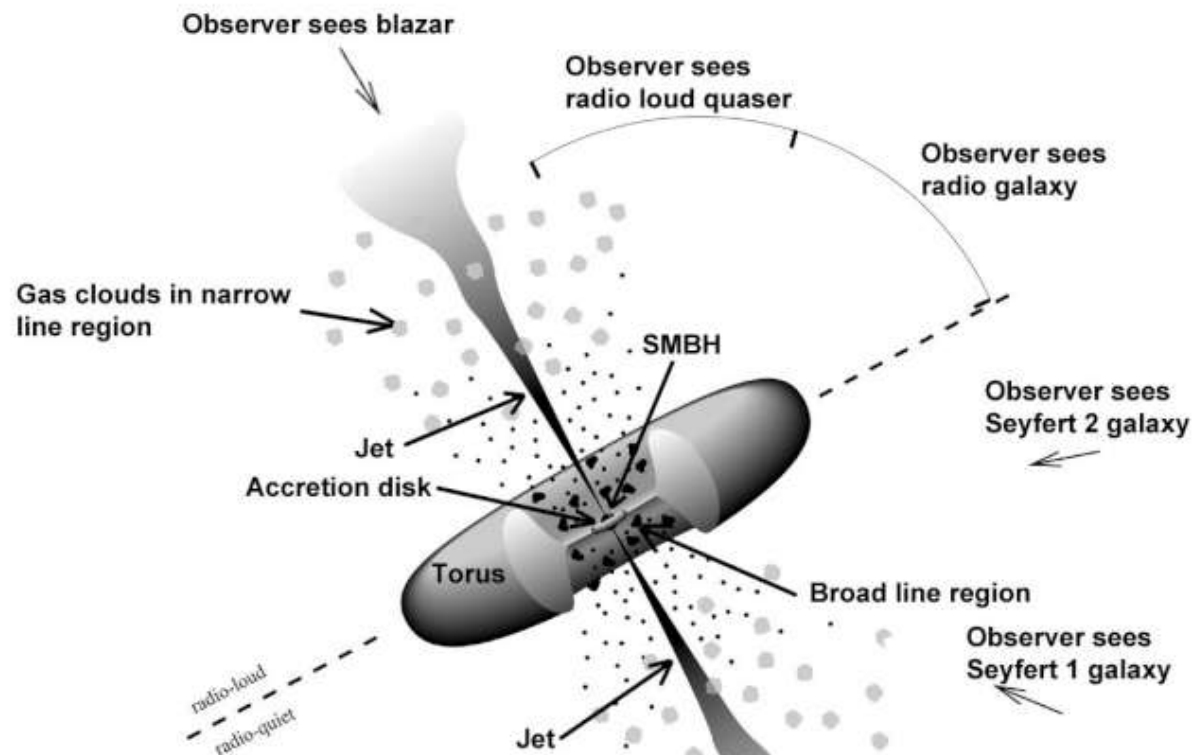
- GPS are found in all kind of host galaxies
- Jet-efficiency consistent with MAD disk scenario
- Overluminous in radio→ higher radiative efficiency



Thank you for your attention!



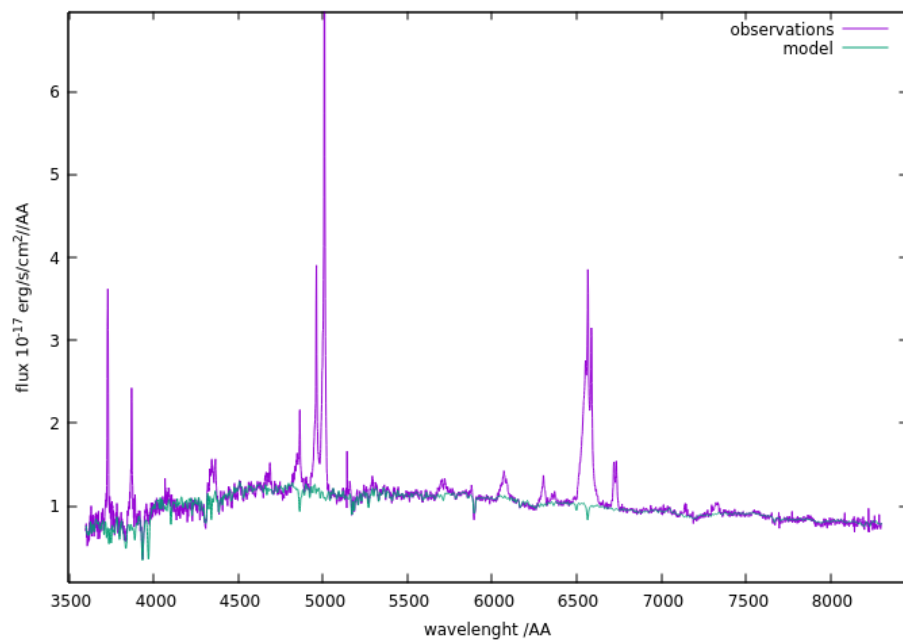






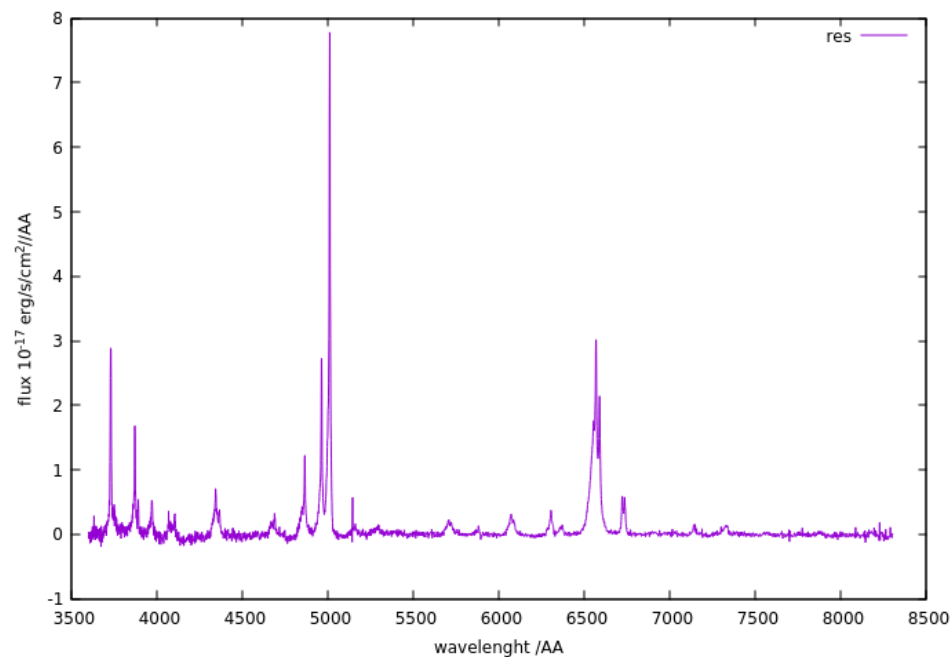
STARLIGHT

Spectral Synthesis Code



name	Ref.	σ_* [$km s^{-1}$]	$F_{H\beta}$ [$\frac{erg}{cm^2}$]	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

Mini , Mcor , σ , AV



$$\log\left(\frac{M_{BH}}{M_{\odot}}\right) = \alpha + \beta \log\left(\frac{\sigma_*}{200 km s^{-1}}\right)$$

Jedno wystarczy

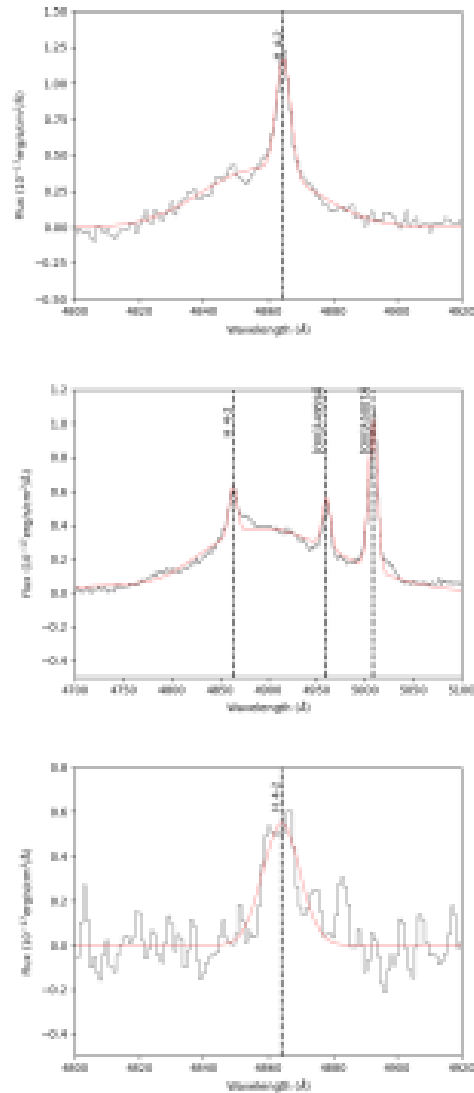


Figure 1. Fitted $H\beta$ profiles for (starting from the top) 1607+26, 1511+0518, OQ+208 and 1031+567 respectively.

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