

The Spintronics of Black Holes

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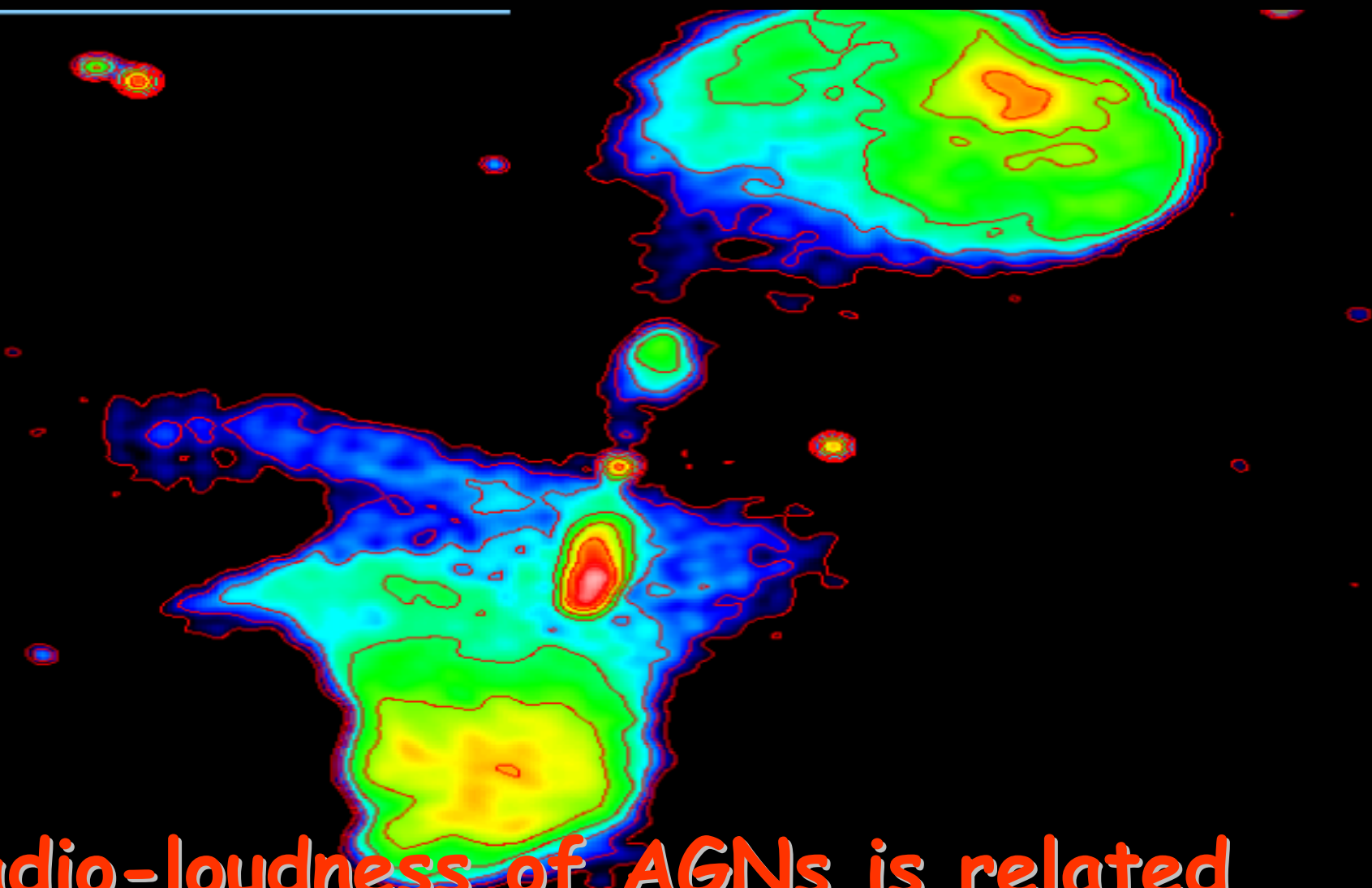
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Jean-Alain MARCK

KITP, June 1, 2006

Motivation: the SPIN "PARADIGM"



Radio-loudness of AGNs is related to the (high) value of the BH spin.

Luminosities:

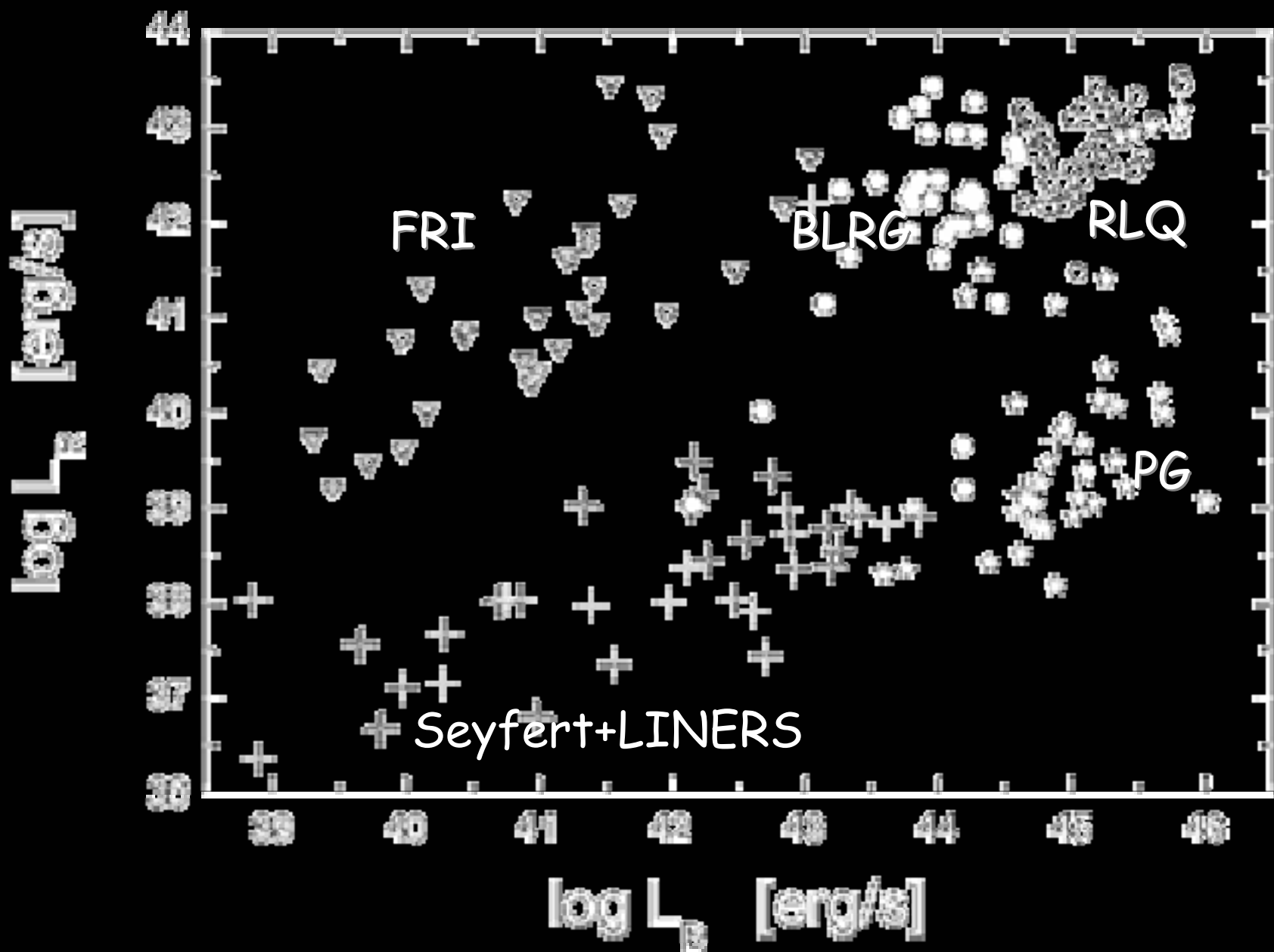
$$\lambda_B \equiv 4400\text{\AA}, \quad L_B \equiv \nu_B L_{\nu_B}$$

5 GHz

$$L_R \equiv \nu_5 L_{\nu_5}$$

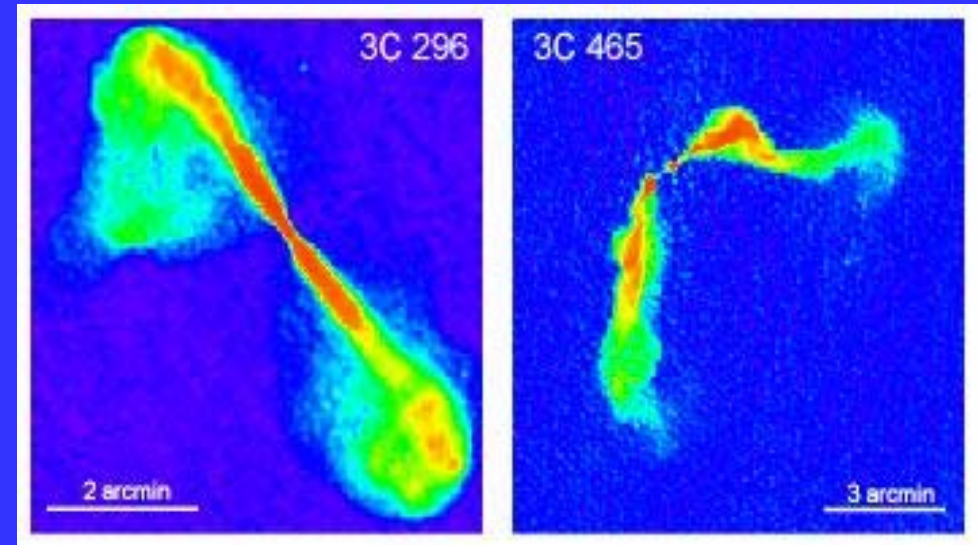
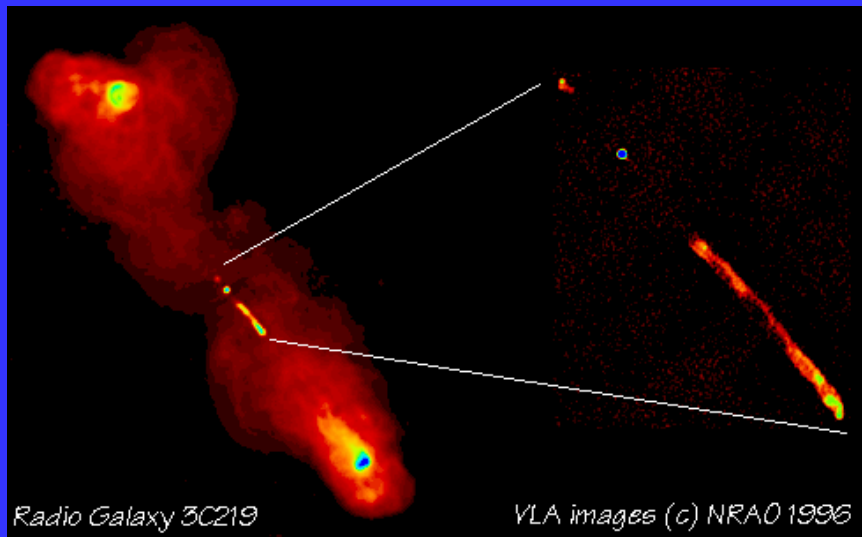
Radio-loudness:

$$\mathcal{R} \equiv L_{\nu_5} / L_{\nu_B} = 1.36 \times 10^5 (L_R / L_B)$$



FRII

FRI



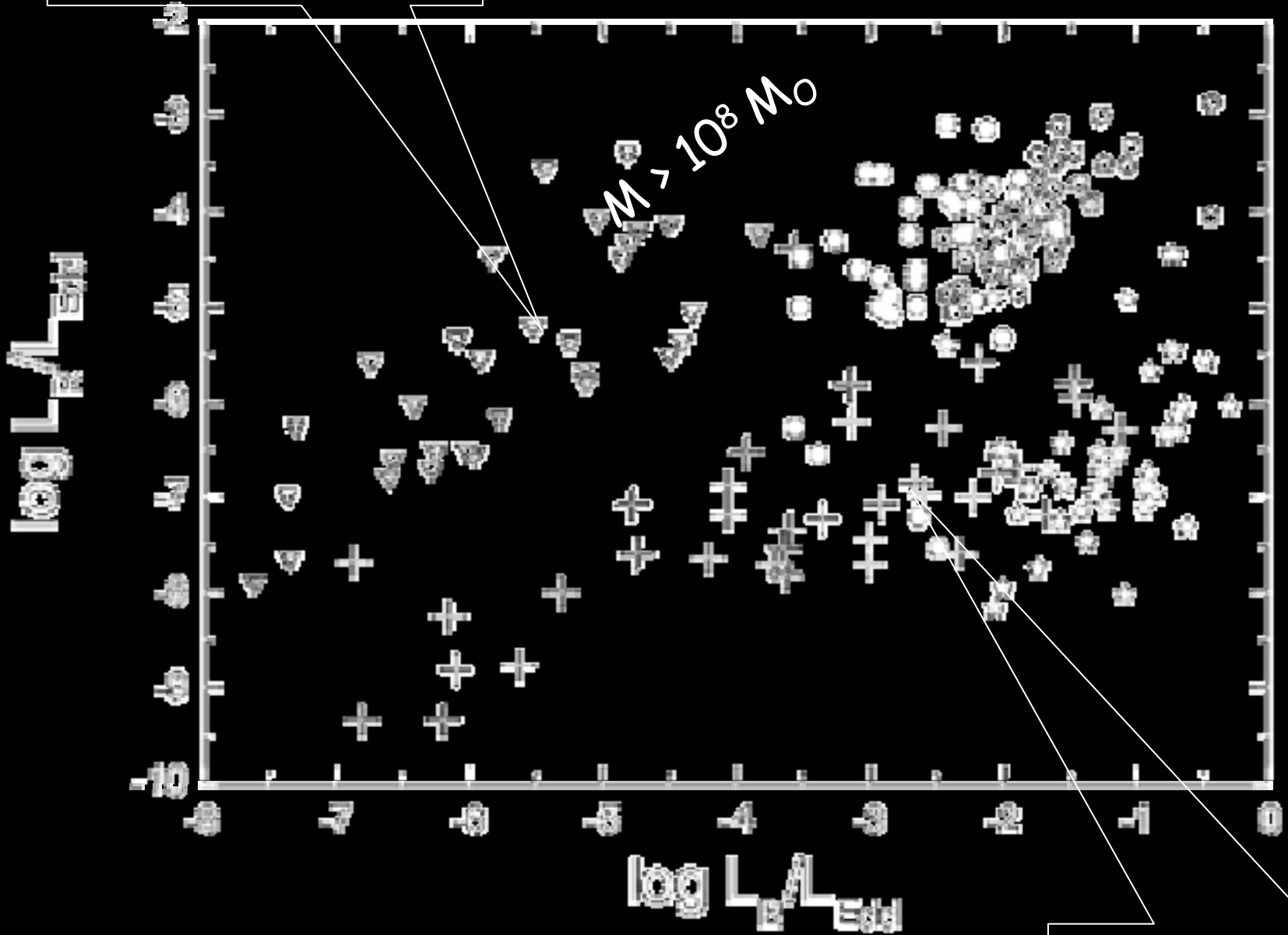
Seyfert



LINER



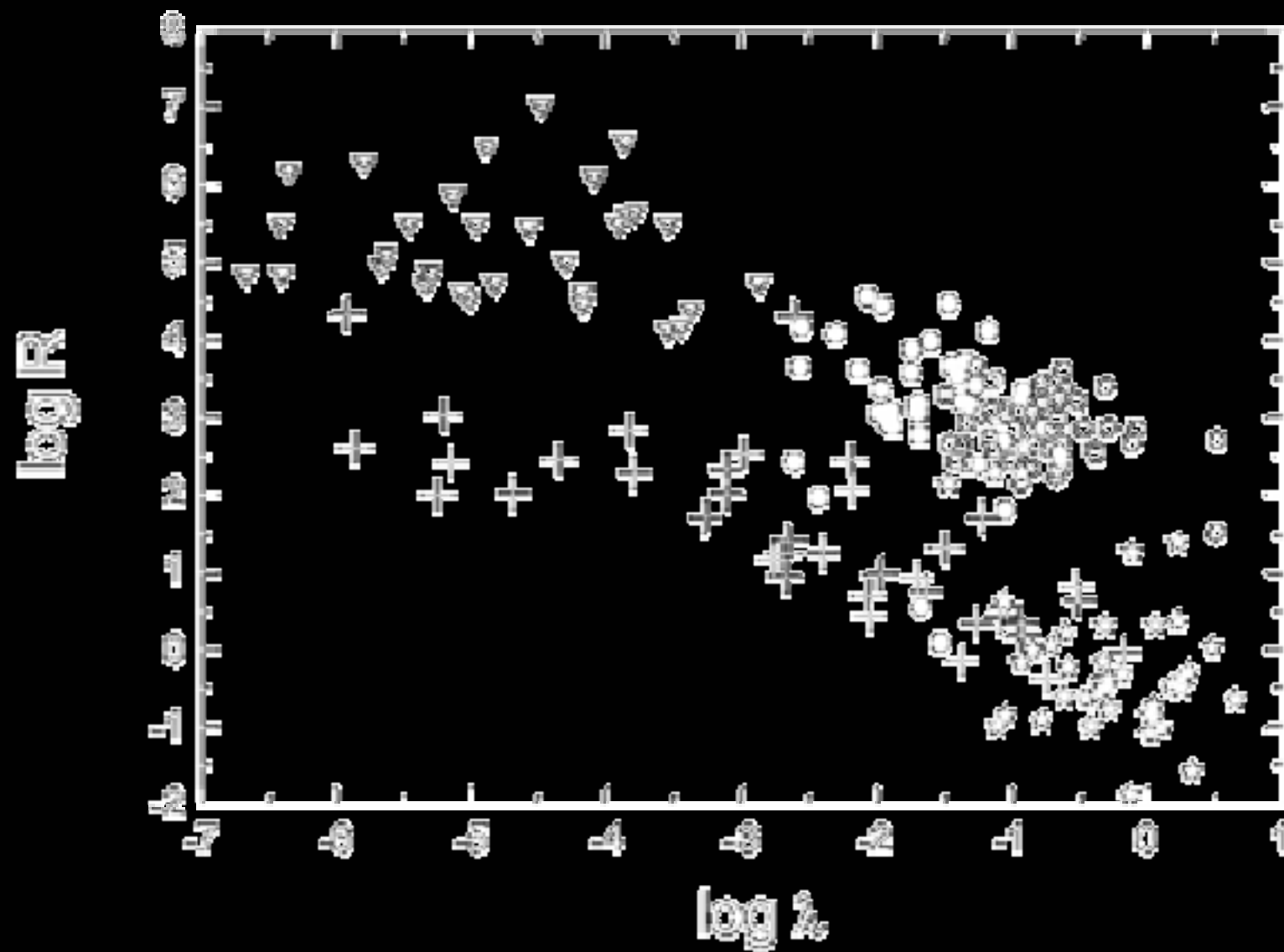
Ellipticals only



Disc and Ell

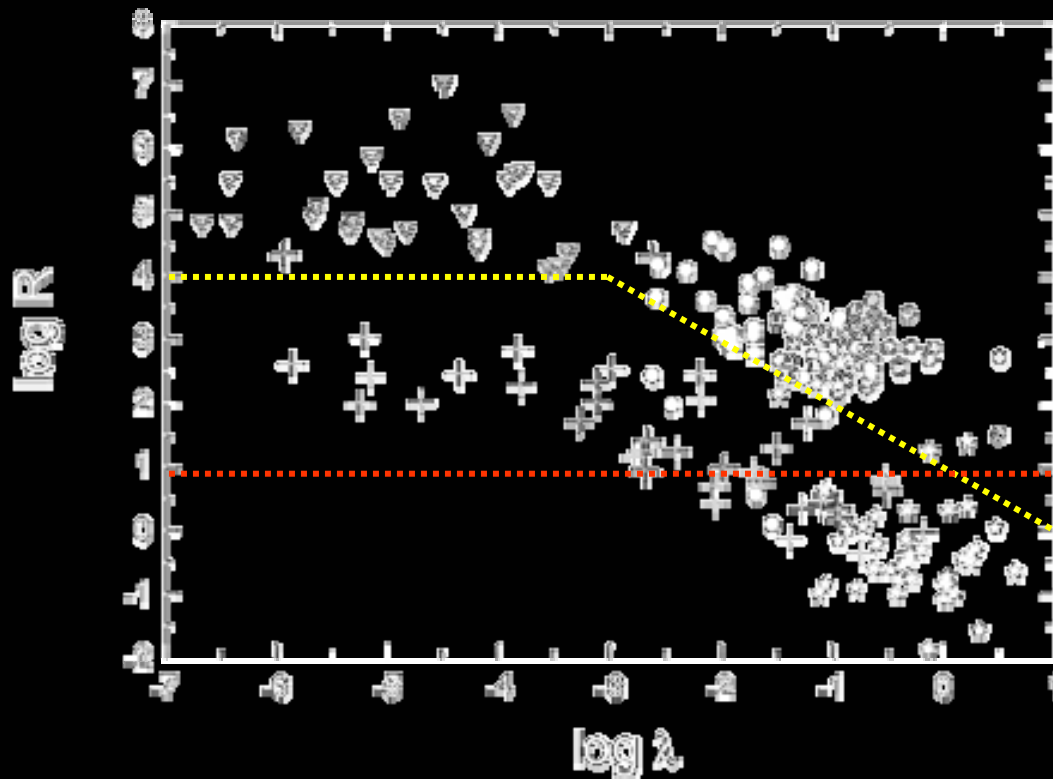
- No disc-galaxy hosted AGN on the higher “radio-loud” sequence
- At high accretion luminosities AGN hosted by giant elliptical galaxies are found on both sequences (majority on the lower, “radio-quiet” one)
- At intermediate accretion luminosities, AGNs hosted by giant elliptical galaxies and located in the lower sequence are represented in our sample only by 4 objects. But recently: many radio-quiet galaxies with very massive BH.

$$\lambda = L_{\text{bol}}/L_{\text{Edd}} = 10(L_B/L_{\text{Edd}})$$



Radio-loudness

$R > 10$ - Kellerman (1989), for quasars



$$\log R > \log R^* = \begin{cases} -\log \lambda + 1 & \text{for } \log \lambda > -8 \\ 4 & \text{for } \log \lambda < -8 \end{cases} .$$

Spin-accretion scenario

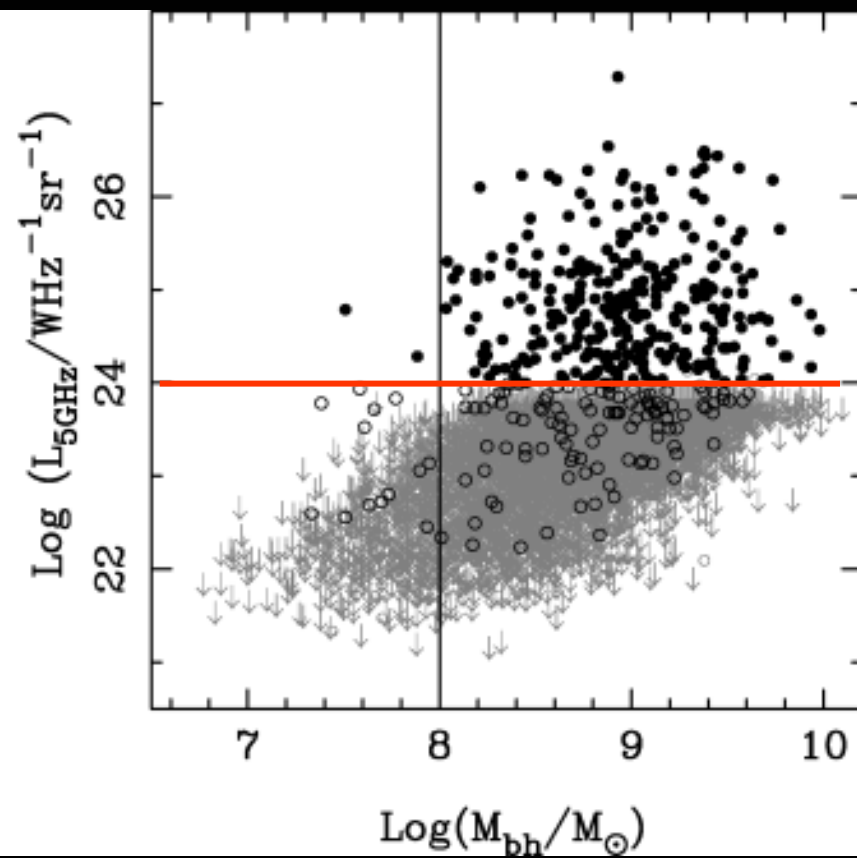
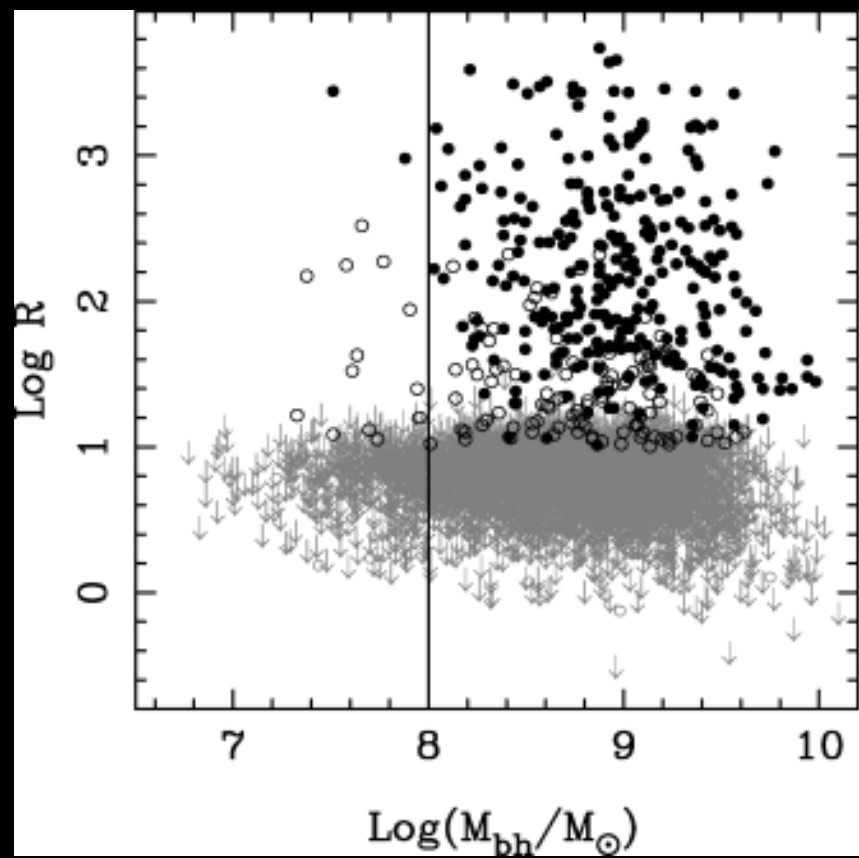
Slope of the radio-loudness (λ) sequence:
accretion rate

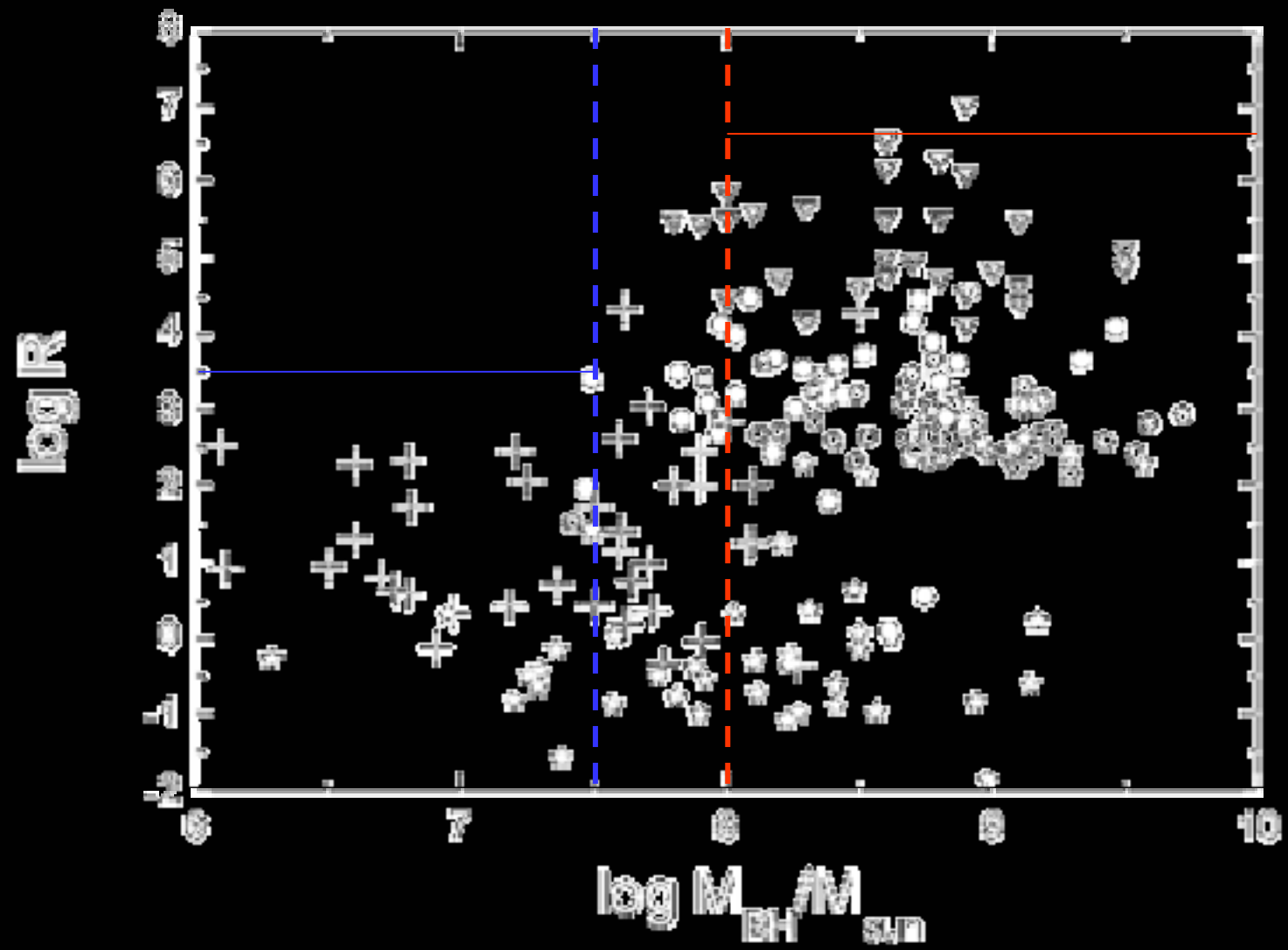
Normalisation: spin

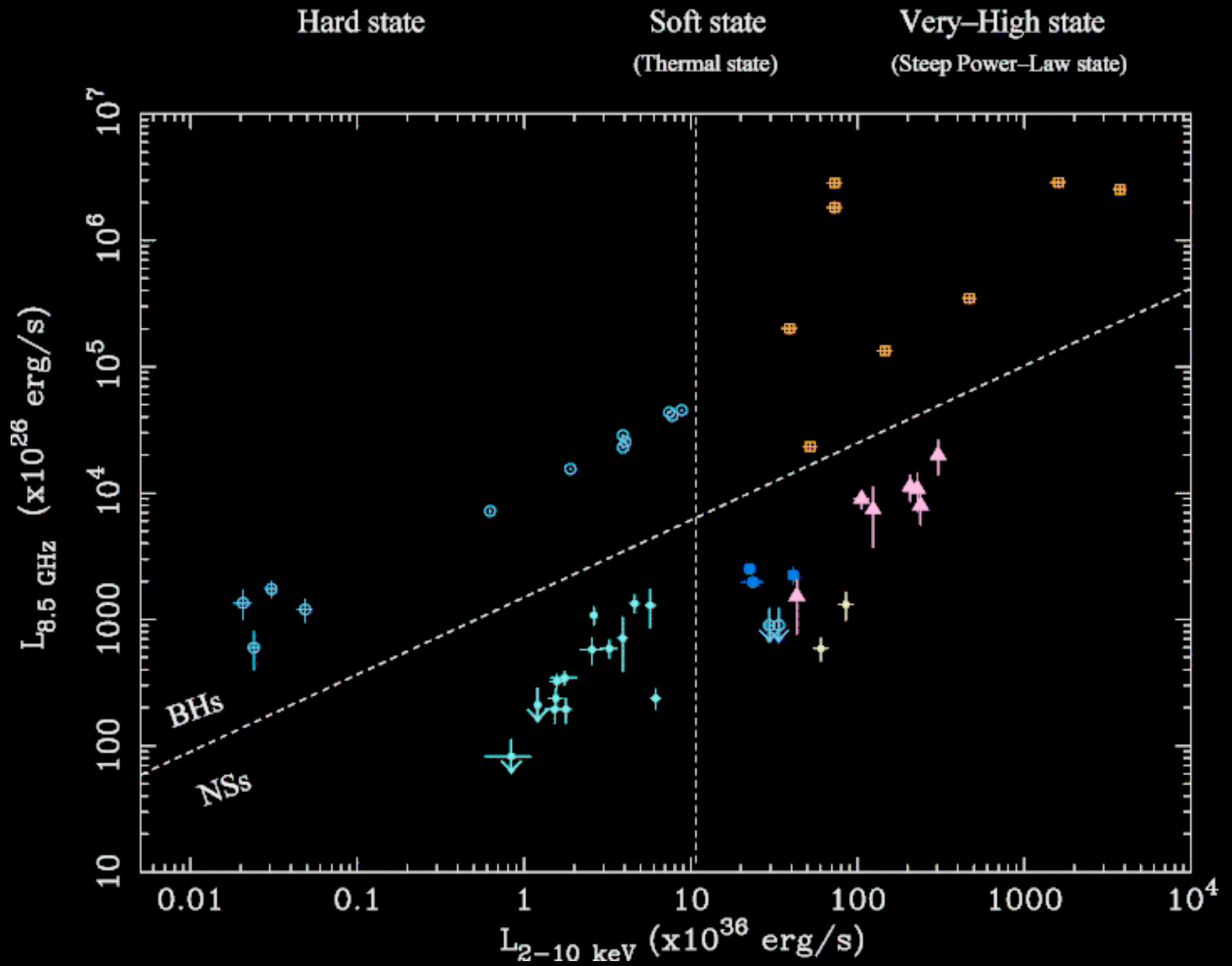
$$\lambda_c \sim 10^{-3}$$

Two types of RQ/RL "bimodality":

- $\lambda > \lambda_c$ - intermittency of narrow jet production (two accretion modes)
- $\lambda < \lambda_c$ - spin (low for disc galaxies, high for elliptical galaxies)









How to keep a low value of
BH spin in disc galaxies ?