On the Origin of Radio Emission in Radio Quiet Quasars

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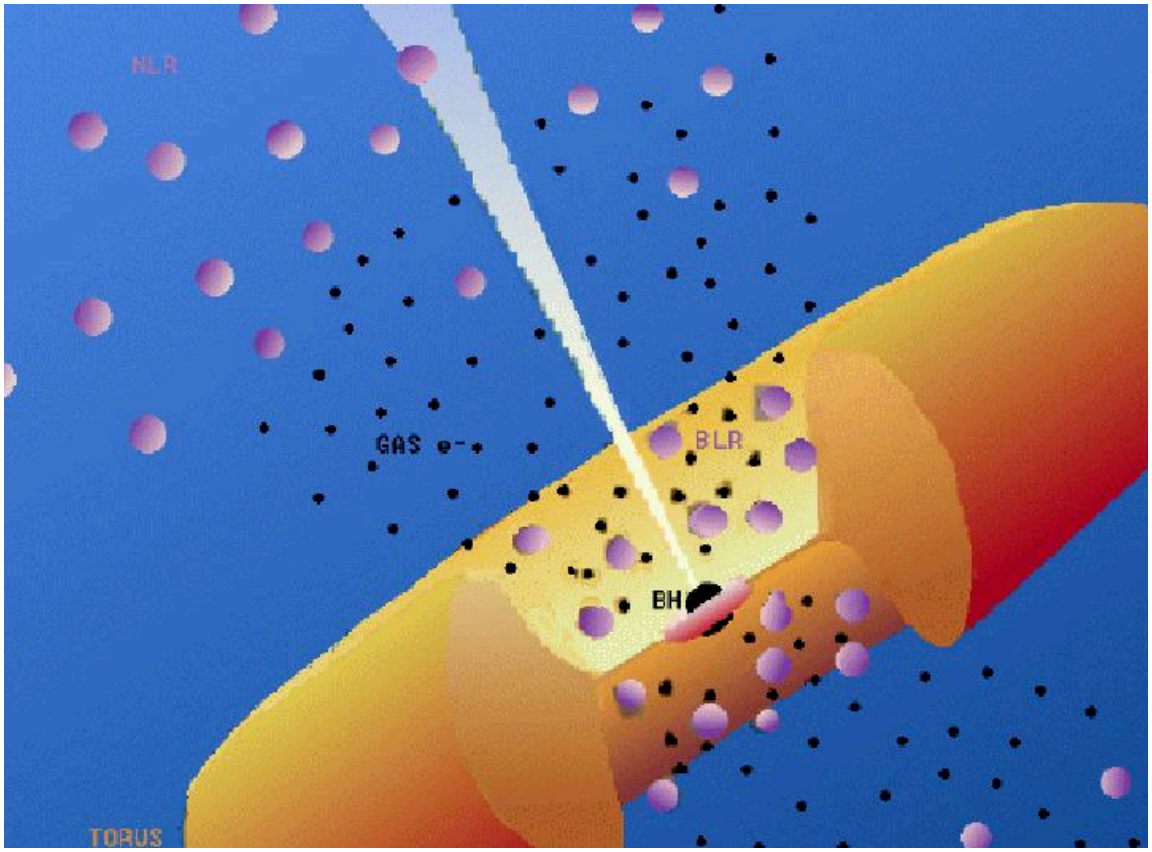


Radio Emission in RQQ

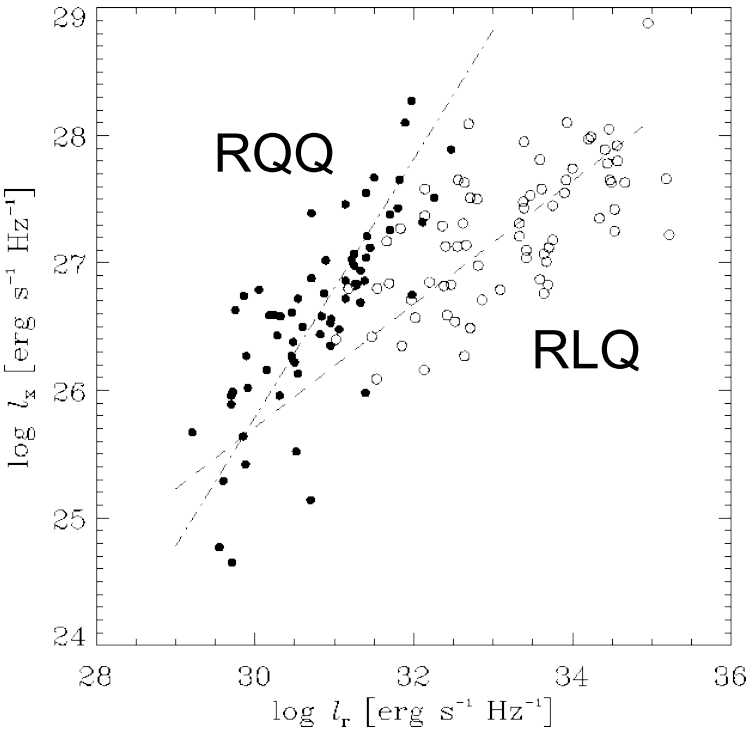
- ~10^3 weaker than in RLQ
- Unresolved with VLA ⟶ Smaller than ~1 kpc.
- Unresolved with VLBI ⟶ Smaller than ~1 pc
- Variable on months timescale ⟶ Smaller than ~0.1pc

Galactic scale origin is clearly excluded.

⟶ *A 10^3 weaker jet?*

But, there is a clue for a different origin

The radio vs. X-ray relation in Quasars



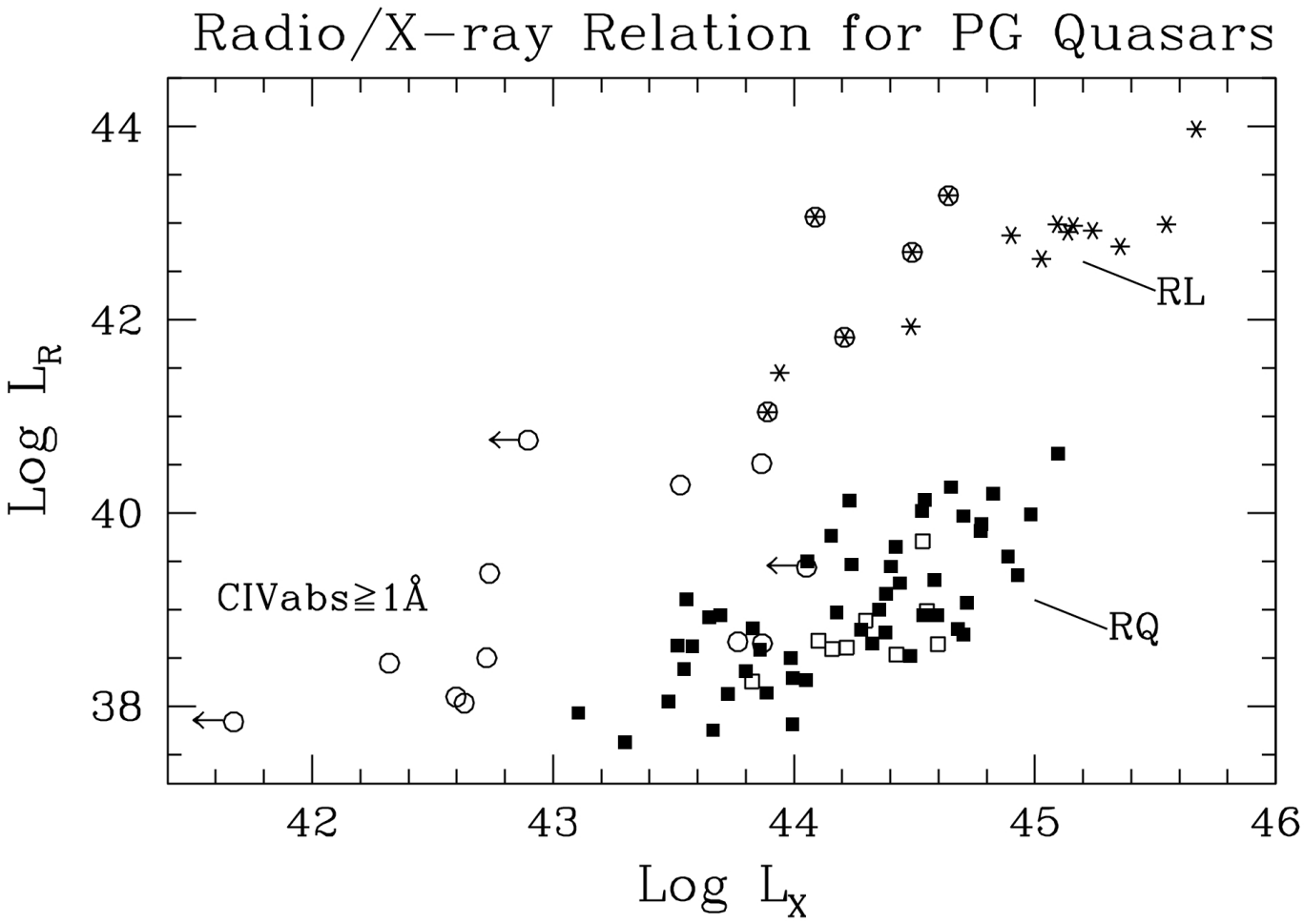
Brinkmann et al. 2000

Cross correlation of the RASS and the FIRST surveys.

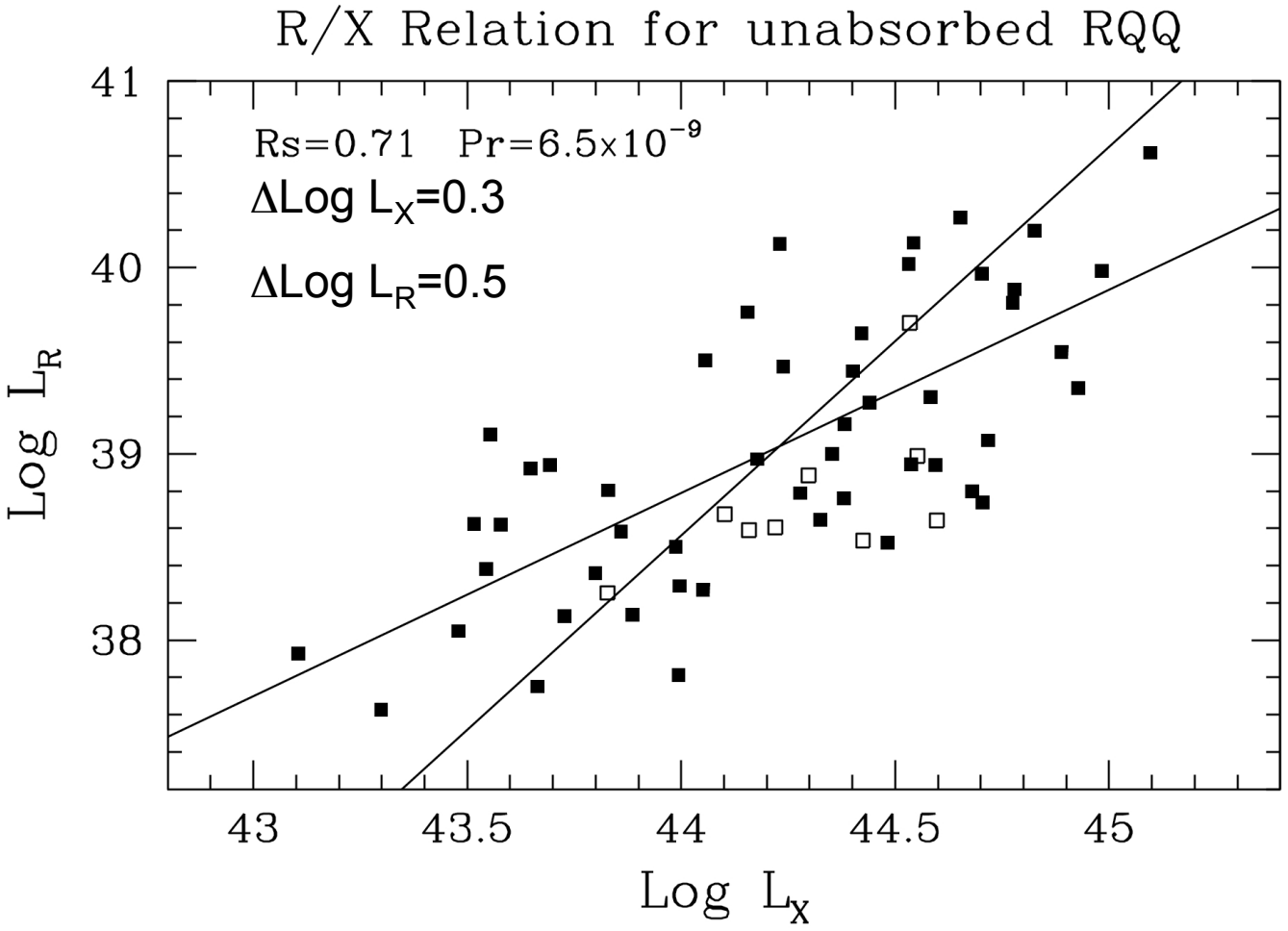
→ A linear relation between L_x and L_R in RQQ.

Or, is it just a selection effect?

Need a sample selected independently of the X-ray and Radio properties with complete detections.



PG Quasars: selection of blue, point like, AGN.
Independent of Radio and X-ray properties.
Of the 87 z<0.5 B&G quasars, *3 X-ray UL* (Brandt et al. 2000), *9 Radio UL* (Kellerman et al. 1989).



Remarkable correlation strength given:

1. Factor of ~3×10^7 in photon energy.
2. Time difference (early 80s vs. 90s)

What is it telling us?

Some implications

•X-rays are not relativistically beamed

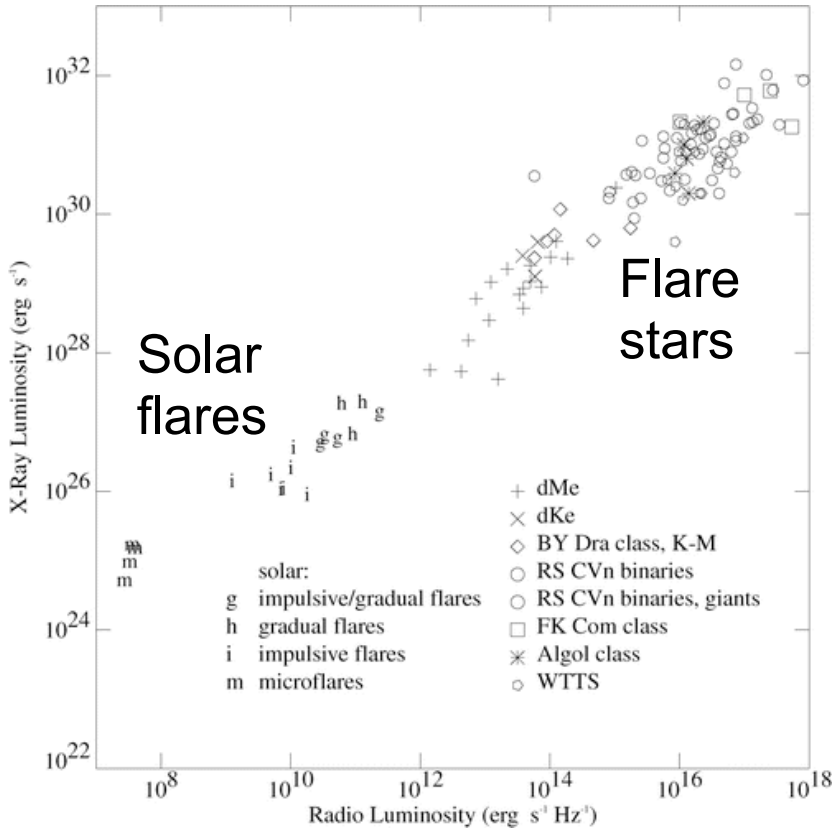
⟶ Radio emission in RQQ is also unbeamed.
If radio is from a jet, the jet must be slow.

•X-rays most likely from a hot corona. Coronal luminosity related to accretion luminosity.

⟶ If radio is from a jet, the jet luminosity is related to the accretion luminosity.

But, there may be a more direct Radio/X-ray relation

The Radio/X-ray relation in Stellar Coronae



Gudel 2002

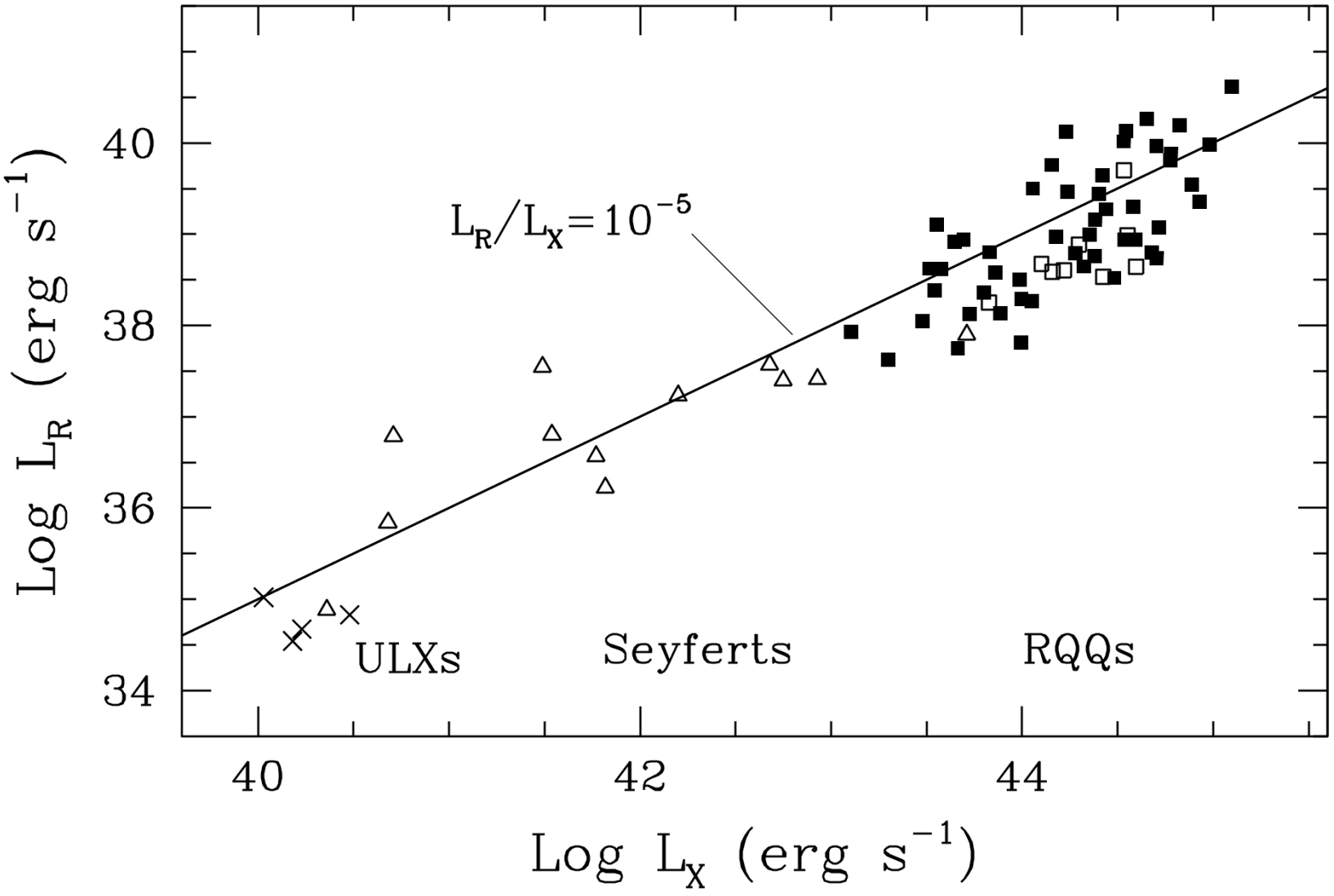
Common interpretation:
Coronae are *magnetically* heated.

B^2 is converted to accelerated particles (reconnection)
$\rightarrow$ synchrotron emission.

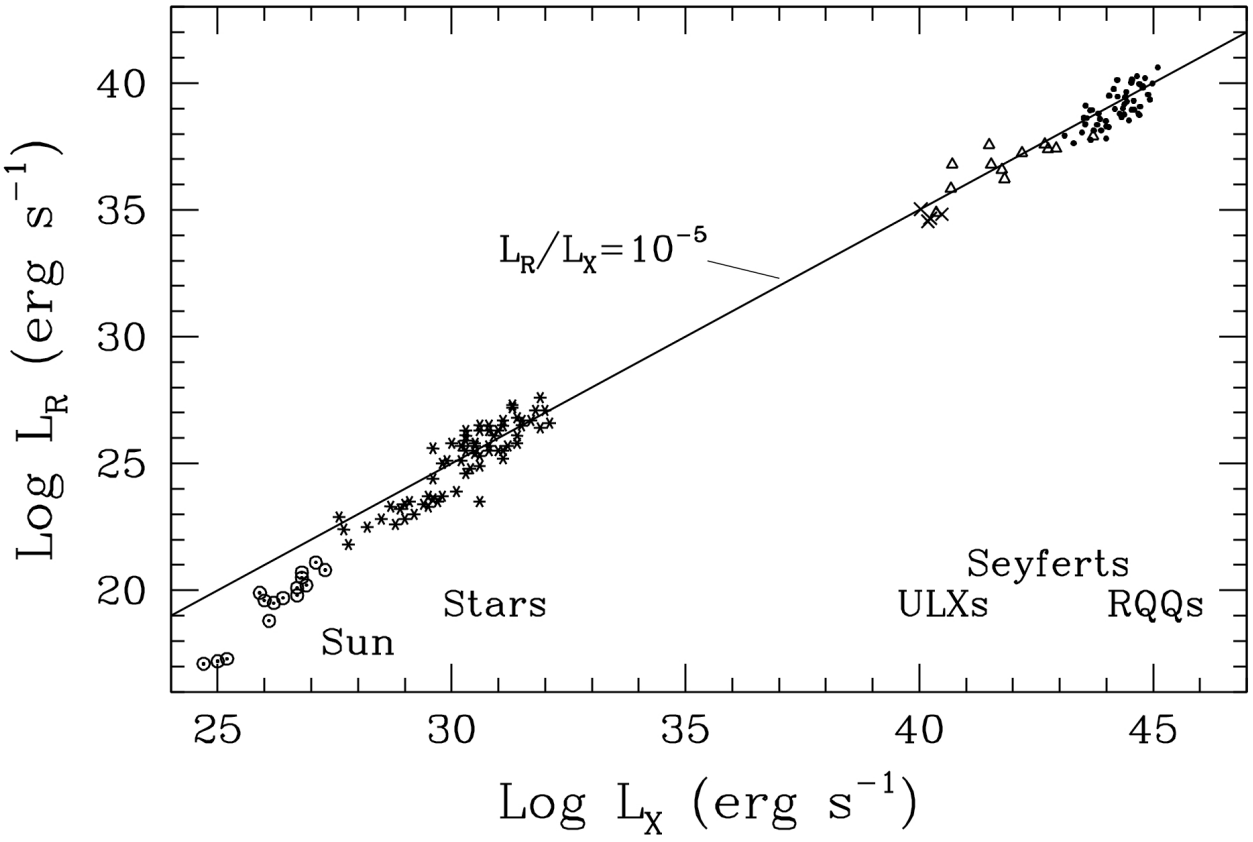
Particles deposit their energy, heating the corona, and releasing new hot coronal gas
$\rightarrow$ X-ray emission

$L_R \propto L_X \rightarrow$ Heating $\propto$ Cooling

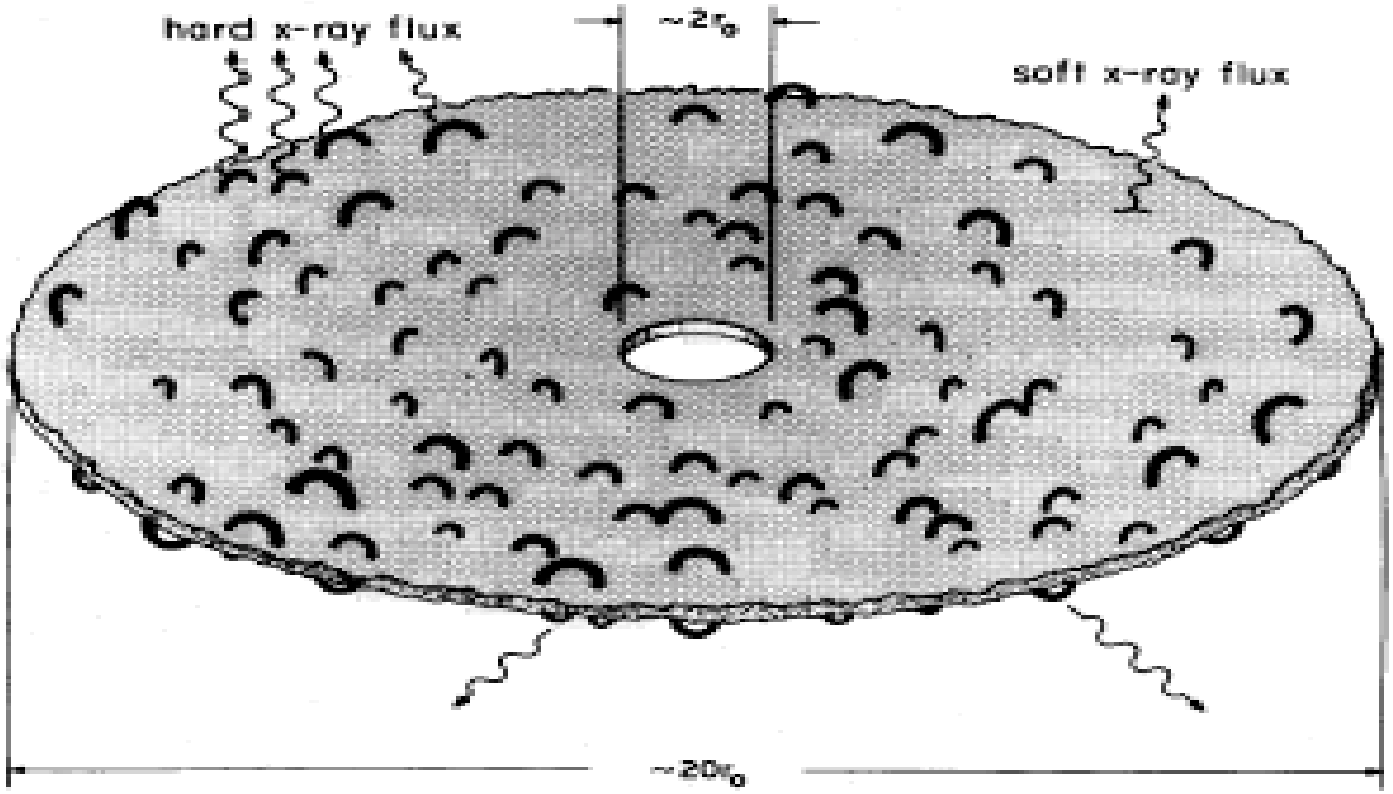
Extending the Luminosity Range of the R/X relation



Coronally active stars vs. RQ AGN

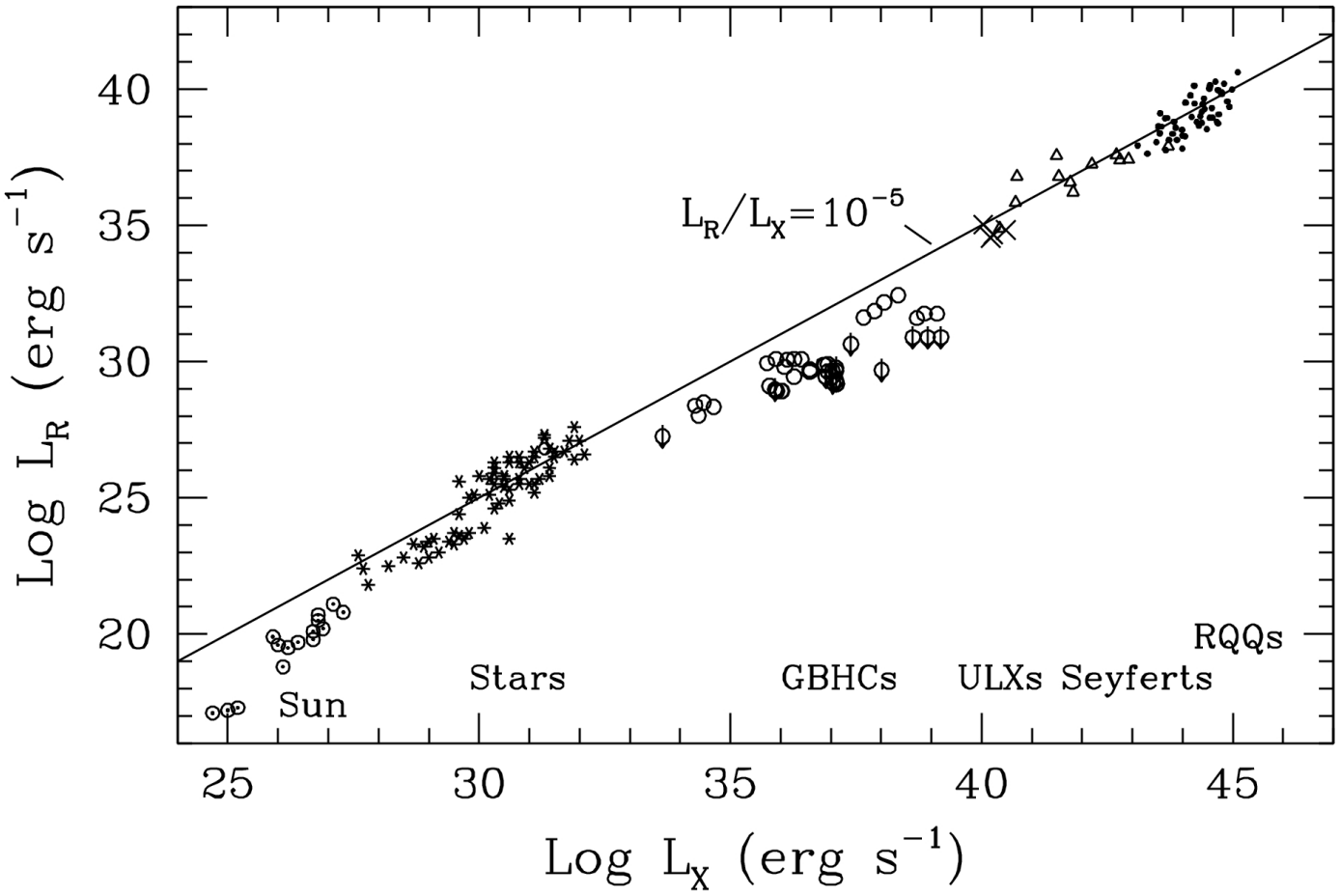


Does radio emission in radio quiet AGN also originates in a magnetically heated corona?



Magnetically heated coronae in accretion disks already suggested by Galeev et al. 1979
(but no mention of observable radio emission)

Do GBHC & ULX fit in as well?



GBHC from Merloni et al. 2003

Summary

- X-ray in AGN produced in the accretion disk corona
- L_R/L_X (stellar coronae) ~ 10^{-5} ~ L_R/L_X (RQ AGN(

→ Radio emission in RQ AGN may also originate in the accretion disk corona

- Coronal cooling ∝ Coronal heating

→ produces rather tight L_R vs. L_X correlation

Simultaneous X-ray/Radio monitoring of RQ AGN may provide some insight to coronal physics