On the coronal temperature and its variability

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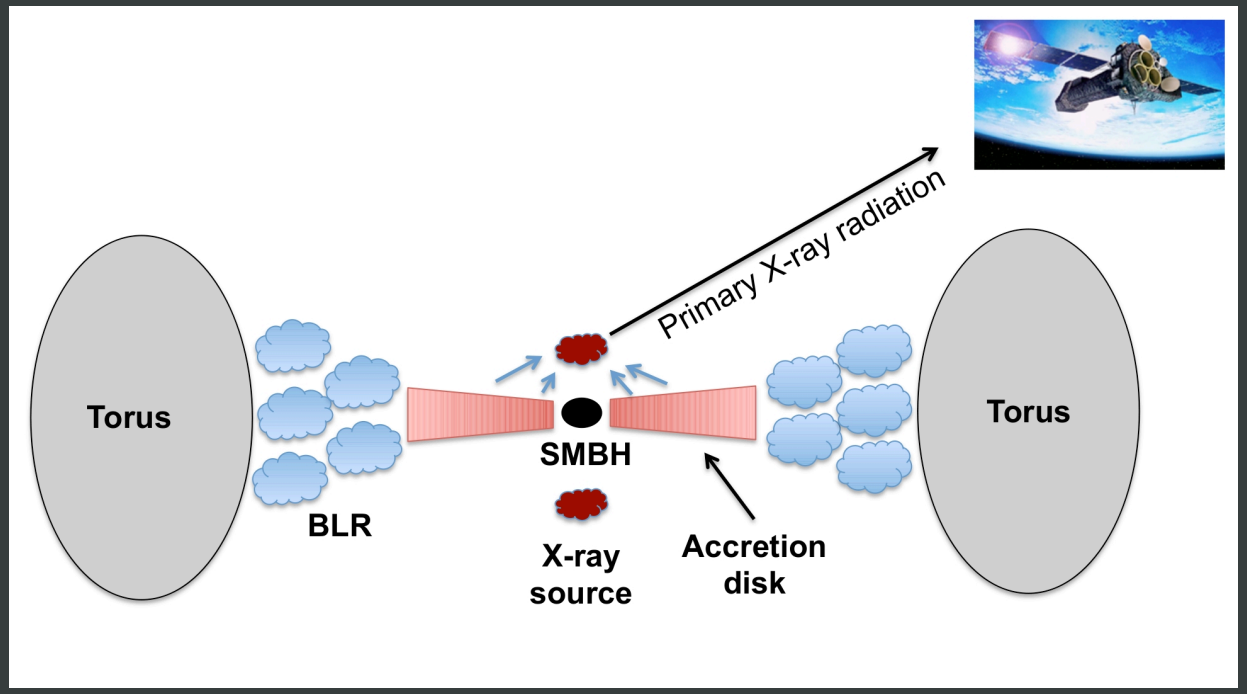
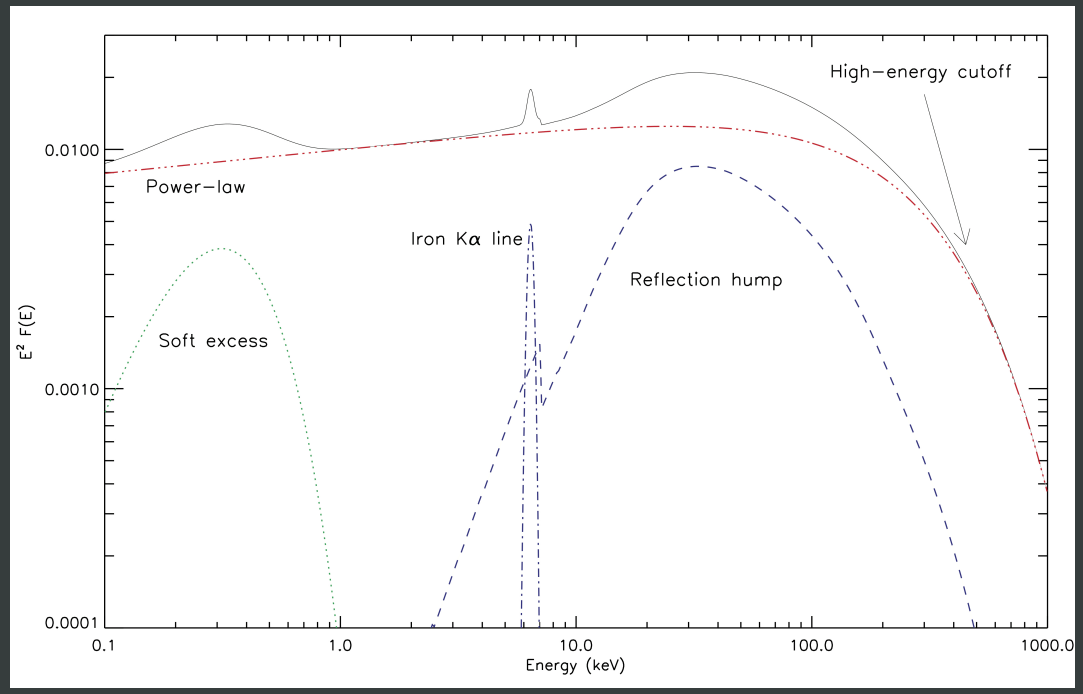
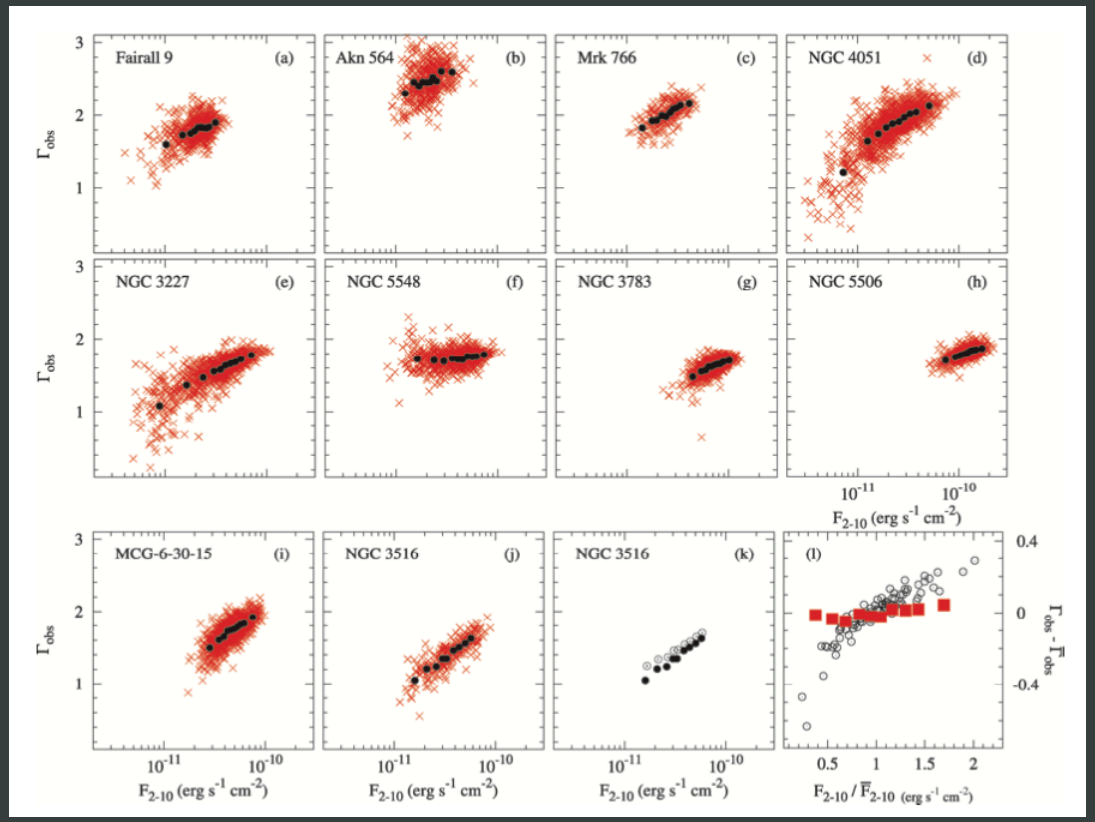


The disk-corona model (Haardt & Maraschi 1991)

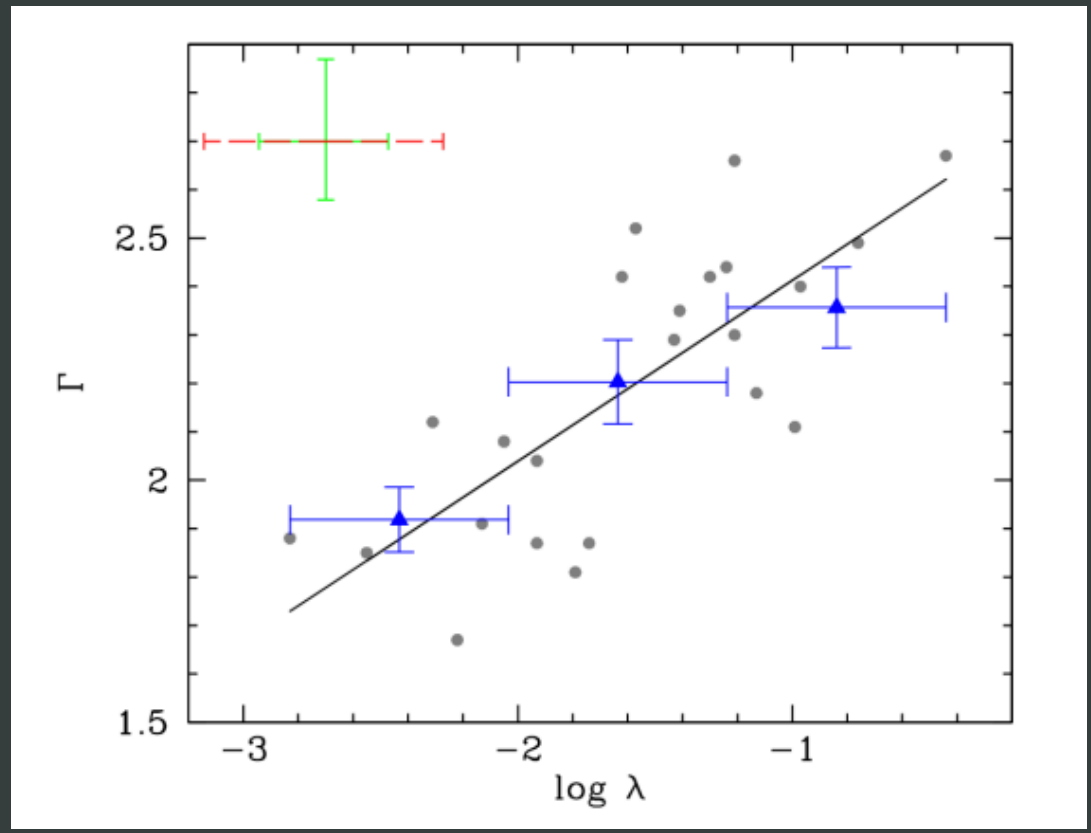


Ecut as an indicator of Tc
Ricci et al. 2011

Credit: https://www.isdc.unige.ch/~ricci/Website/AGN_in_the_X-ray_band.html

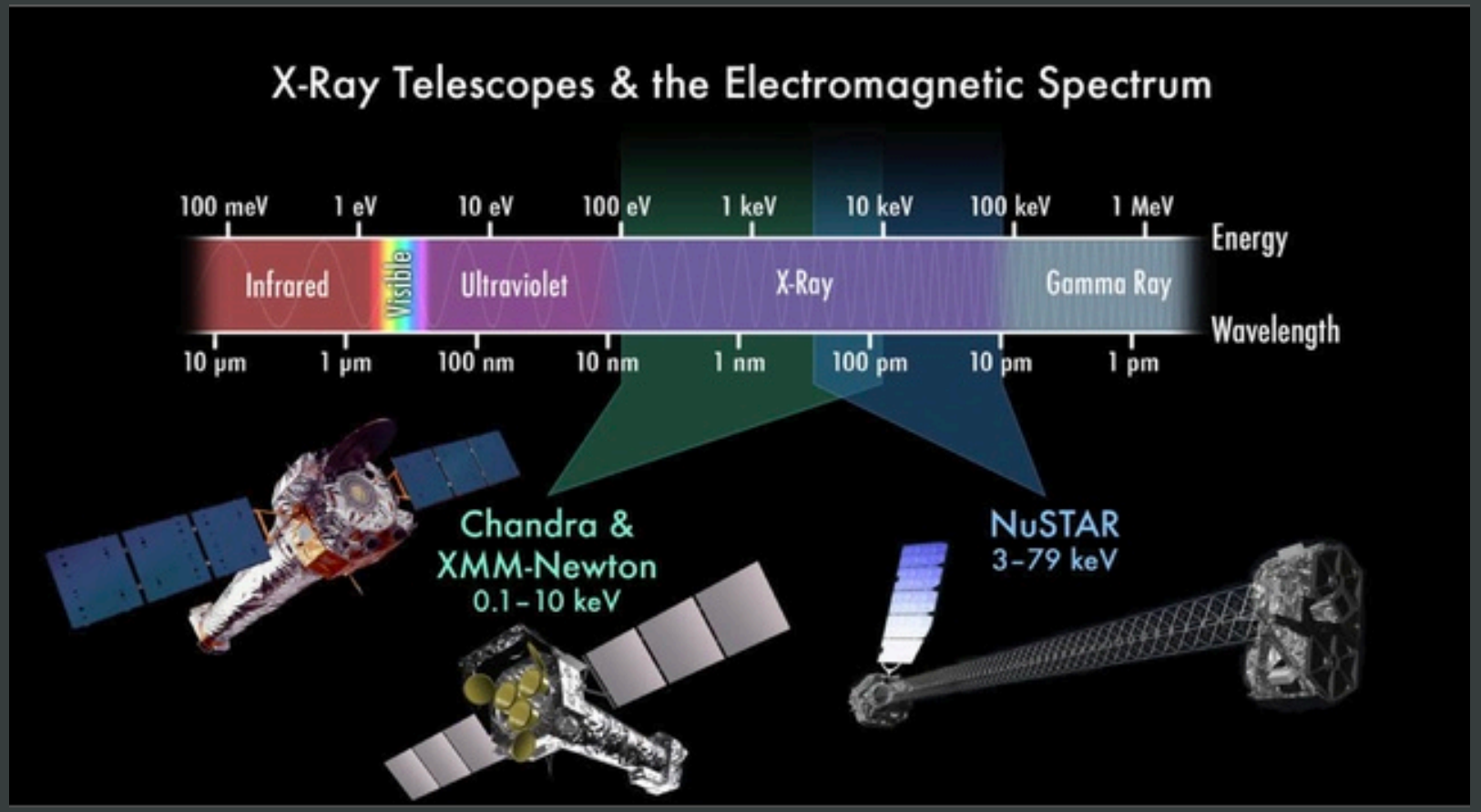


Softer-when-brighter
Sobolewska & Papadakis 2009



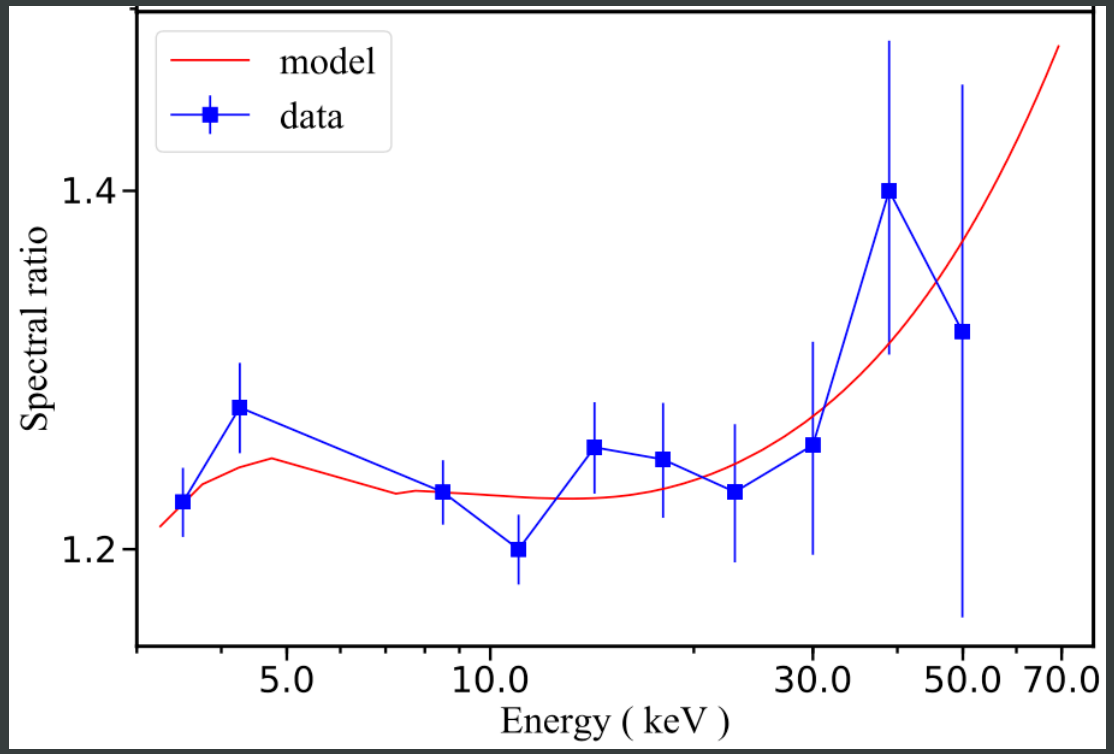
Softer with higher accretion rate
Fanali et al. 2013

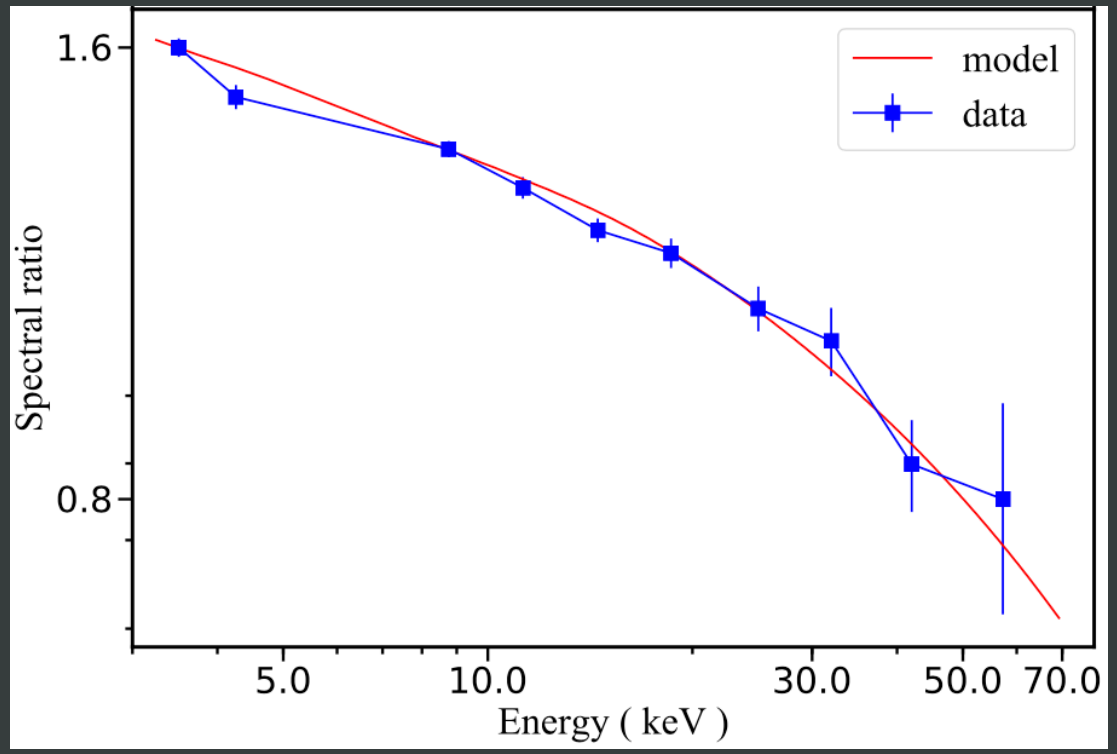
opacity versus temperature



Use the 3-79 keV NuSTAR data to measure Ecut/Tc

Ecut variation in individual sources

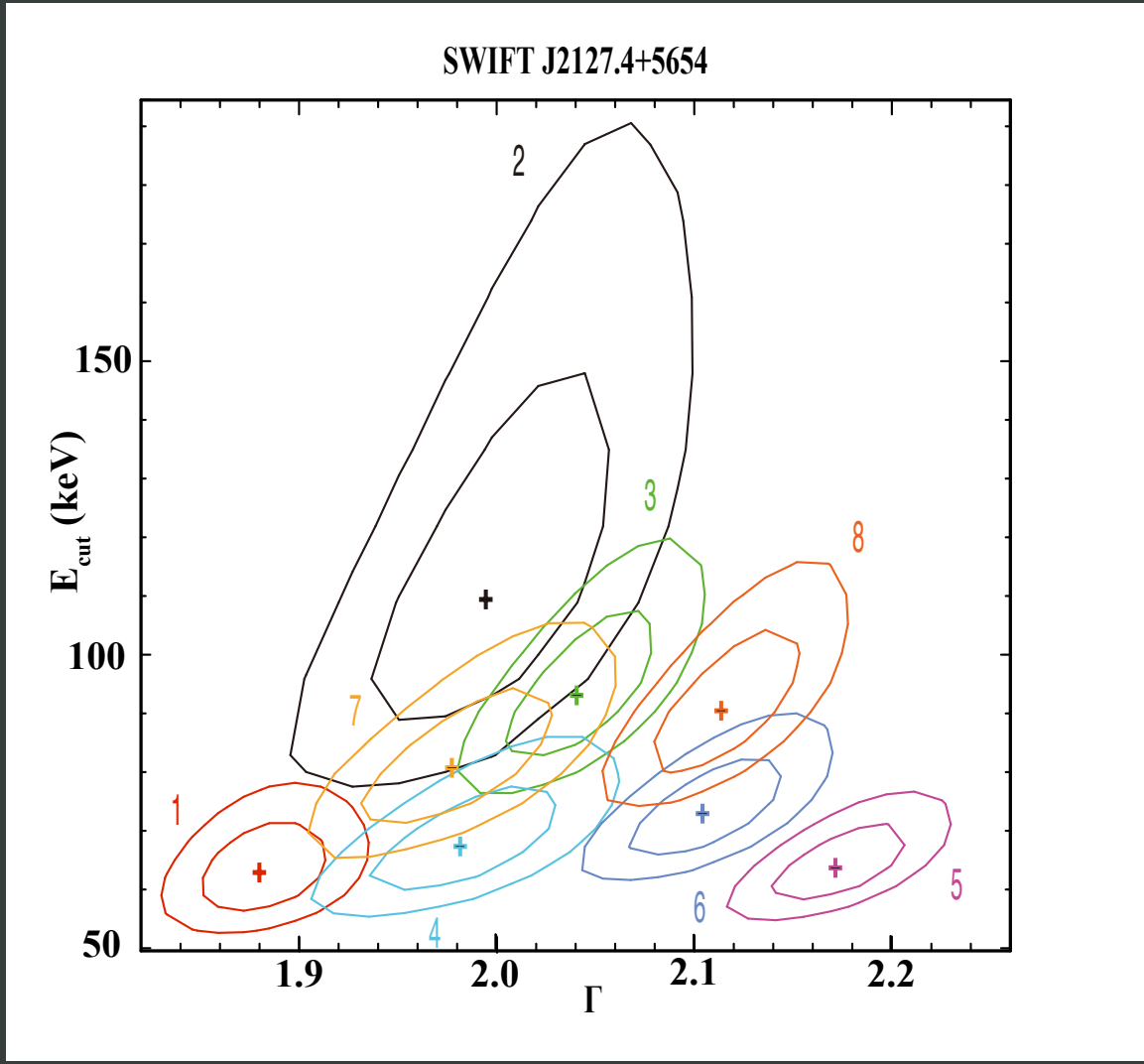




Using spectral ratio to directly show the Ecut variation

Zhang et al. (2018)

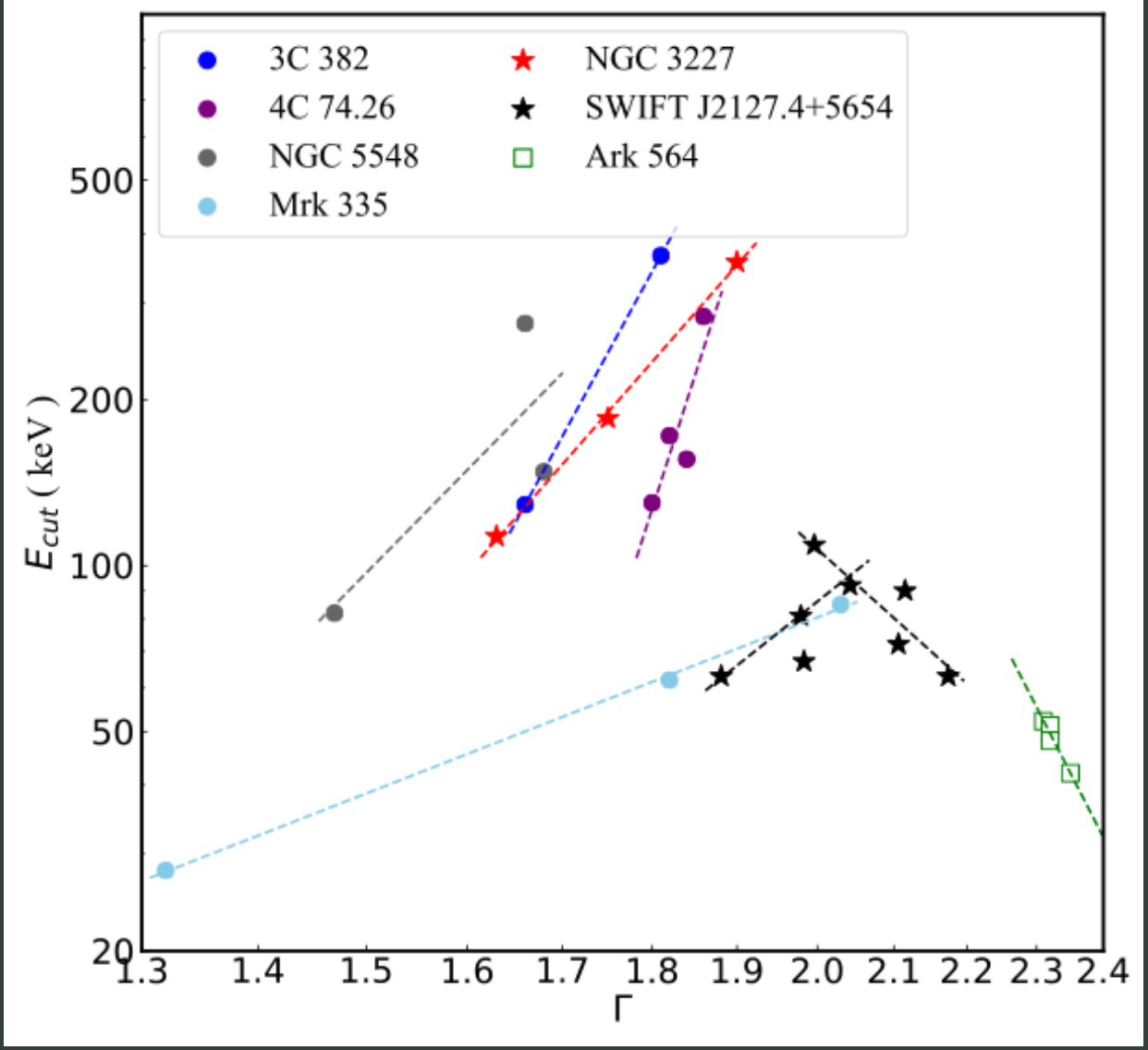
Ecut variation in individual sources： Λ pattern?



SWIFT J2127.4+5654 exhibits a distinct Λ shape

Kang J.-L., Wang J.-X., Kang W.-Y., 2021, MNRAS, 502, 80

Ecut variation in individual sources： Λ pattern?



The global Λ pattern

“hotter-softer-brighter”

⇕

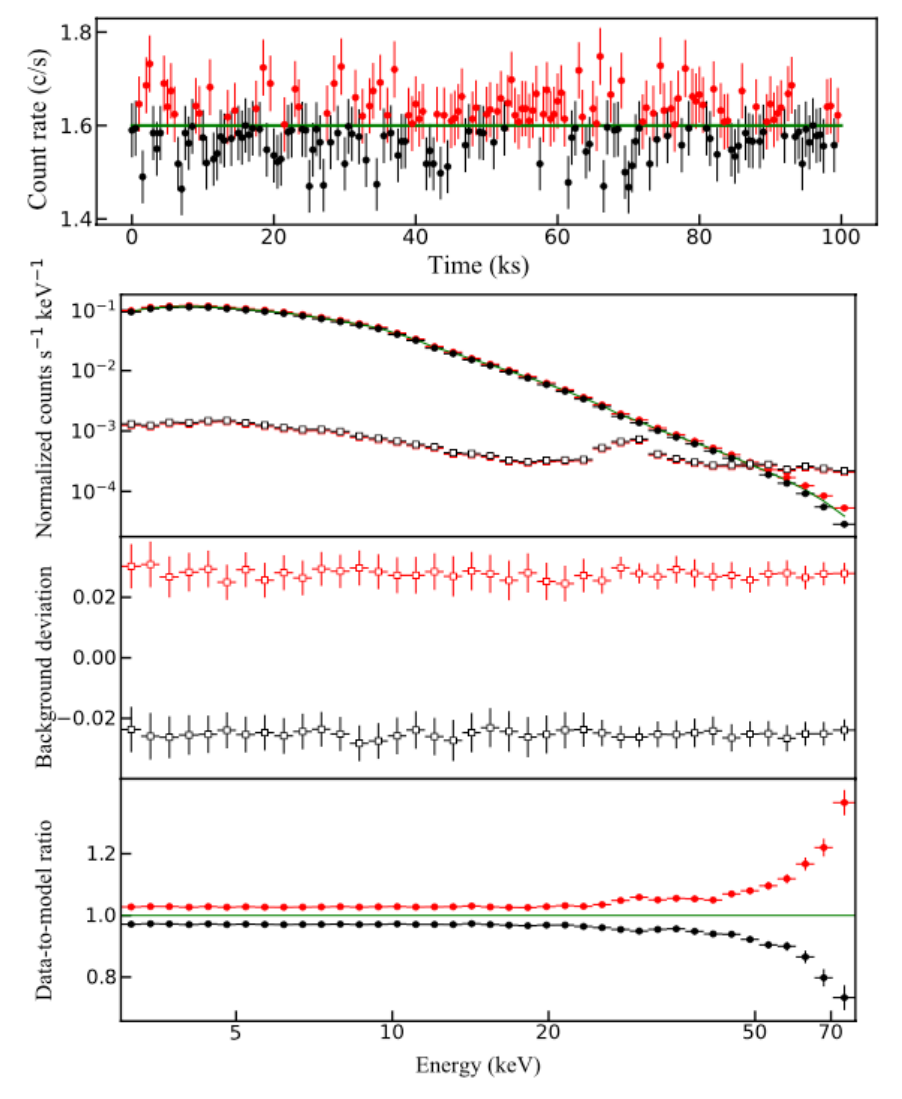
“cooler-softer-brighter”

Multiple mechanisms are contributing:

changes of the cooling efficiency
inflation/contraction of the corona

Kang J.-L., Wang J.-X., Kang W.-Y., 2021, MNRAS, 502, 80

Hidden biases in flux-resolved spectroscopy

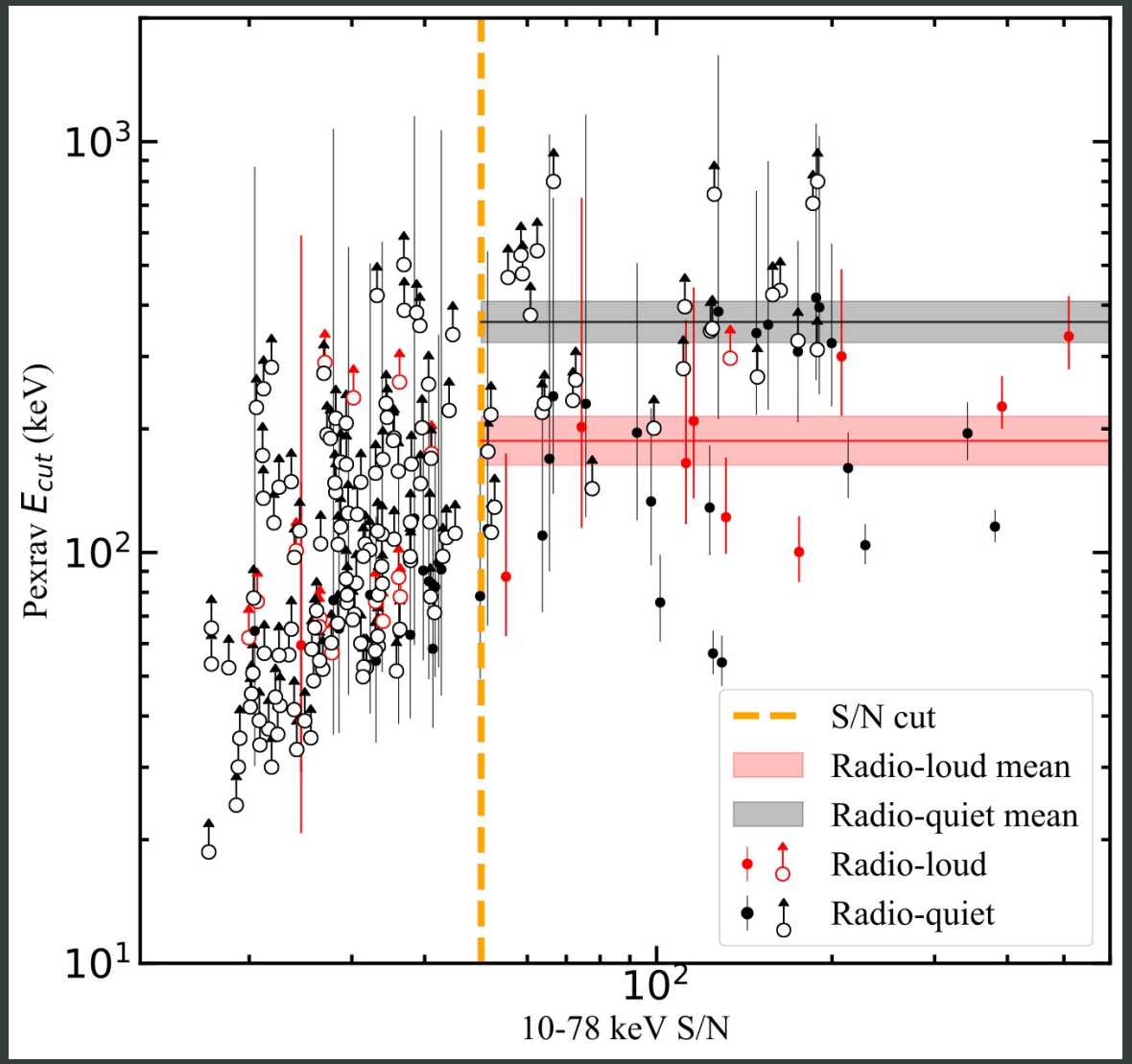


the background of the high (low) state is under-estimated (over-estimated)

producing pseudo Ecut variation

Kang J.-L., Wang J.-X., 2023, MNRAS, 519, 3635

Ecut variation between sources in a NuSTAR bright sample



BAT-selected, 10-78 keV S/N > 50

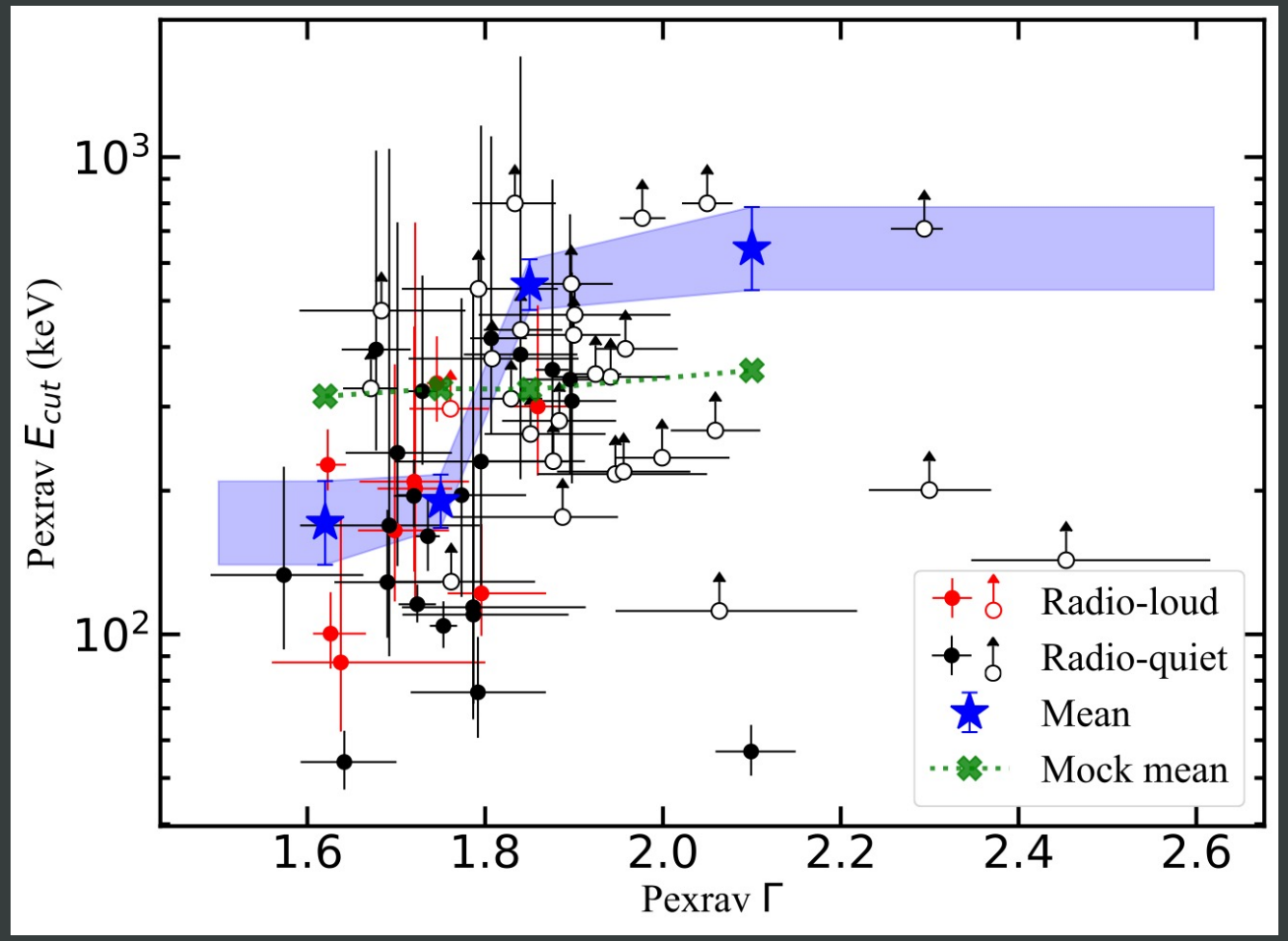
50 radio-quiet, 10 radio-loud

10 radio-quiet sources have Ecut > 400 keV

Radio-quiet sources have higher Ecut/Tc

Kang J.-L., Wang J.-X., 2022, ApJ, 929, 141

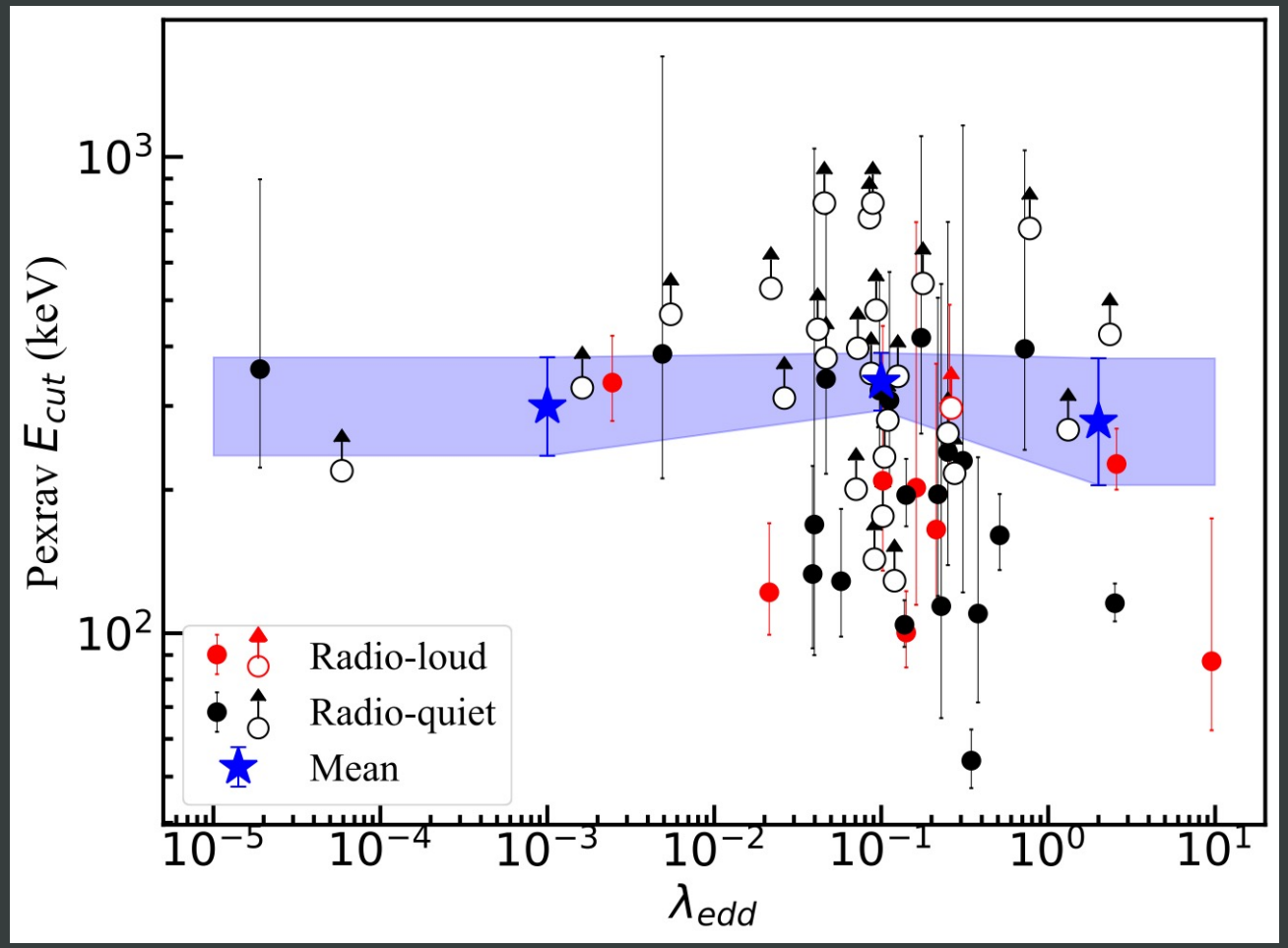
A strong positive correlation between Ecut and photon index



Hotter coronae produce softer spectra, thus having a smaller opacity

Kang J.-L., Wang J.-X., 2022, ApJ, 929, 141

No significant correlation between Ecut and Eddington ratio

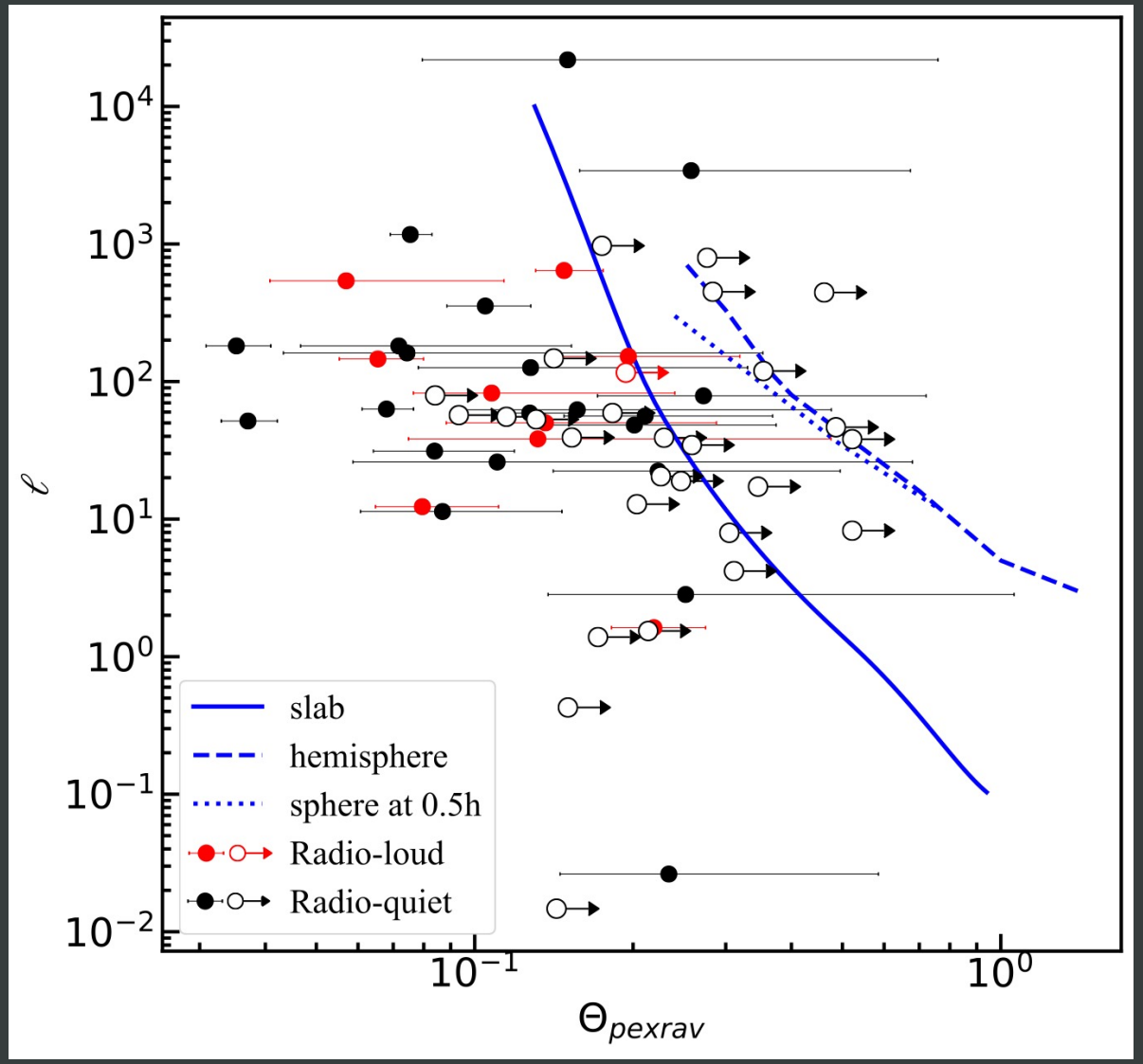


The large uncertainty of Ecut and λ_{edd}?

A balance of the cooling and heating?

Kang J.-L., Wang J.-X., 2022, ApJ, 929, 141

Distribution in the temperature-compactness diagram



hybrid corona? (Fabian et al. 2017)

Kang J.-L., Wang J.-X., 2022, ApJ, 929, 141

Summary

- In individual sources, the variation of Tc with Γ/flux is non-monotonic (**Λ pattern**)

- In a NuSTAR bright sample, some radio-quiet sources are found to have extraordinarily large Ecut/Te. A strong positive correlation between Tc and Γ is detected.

Thanks for your attention!

Appendix: the calibration issue between XMM-Newton and NuSTAR biases the Ecut measurement