X-ray Reflection from BHB Accretion Disks: Coronal Geometry & Disk Truncation

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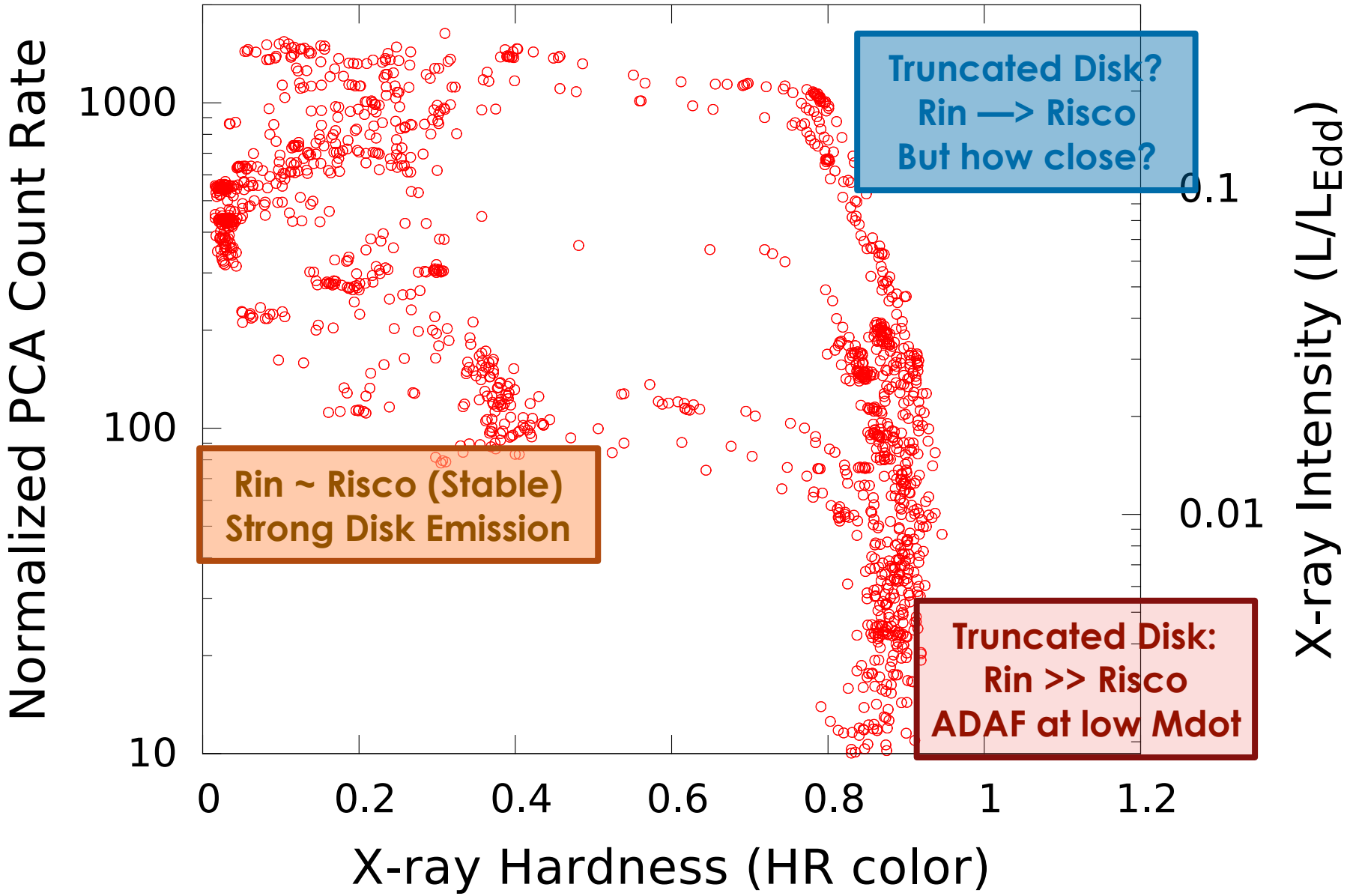
Whirlpool in Lake Onalaska
Photo: Bob King

The X-ray Universe, Rome, June 6 2017

The Case of GX 339-4



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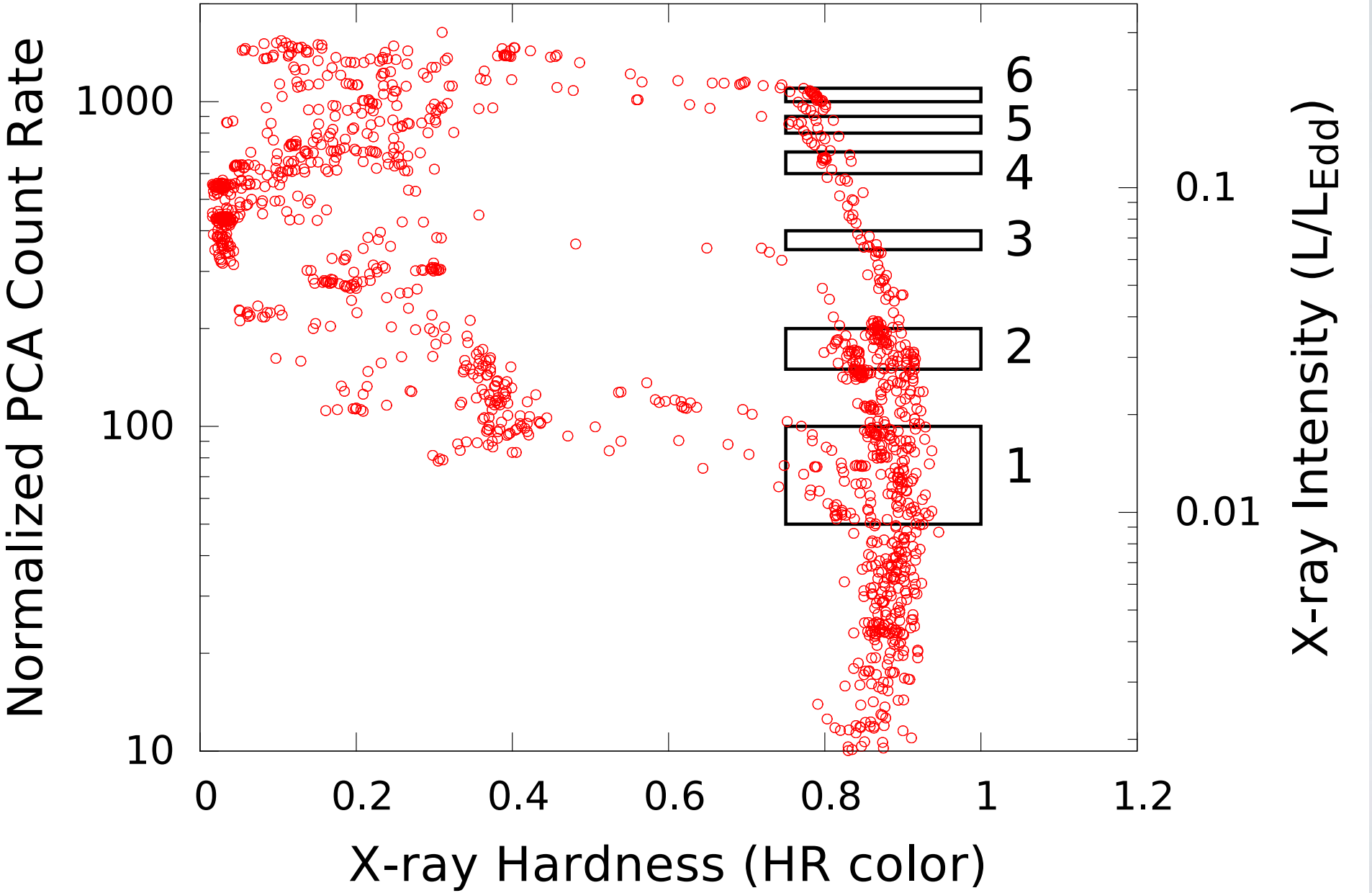
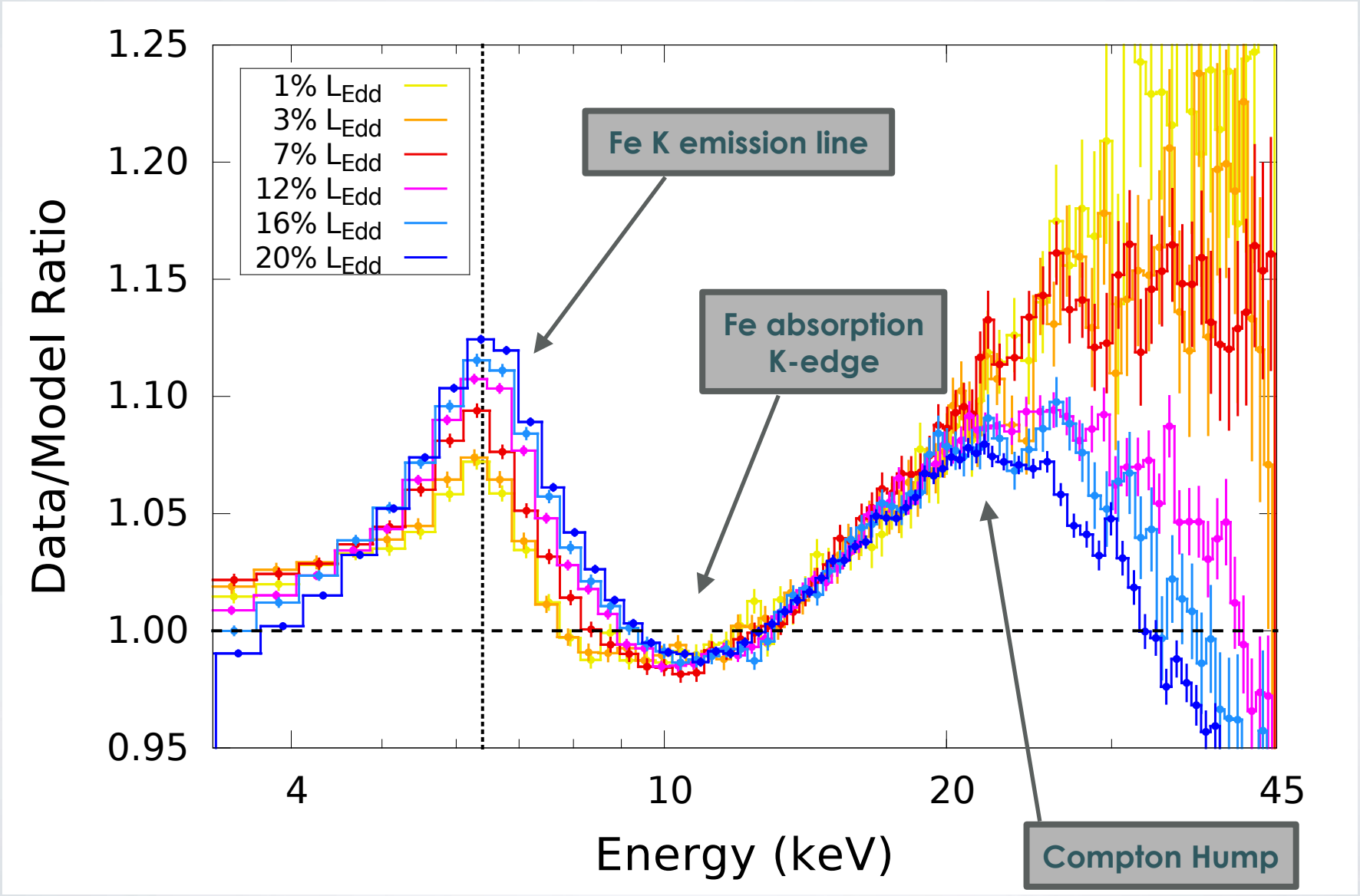


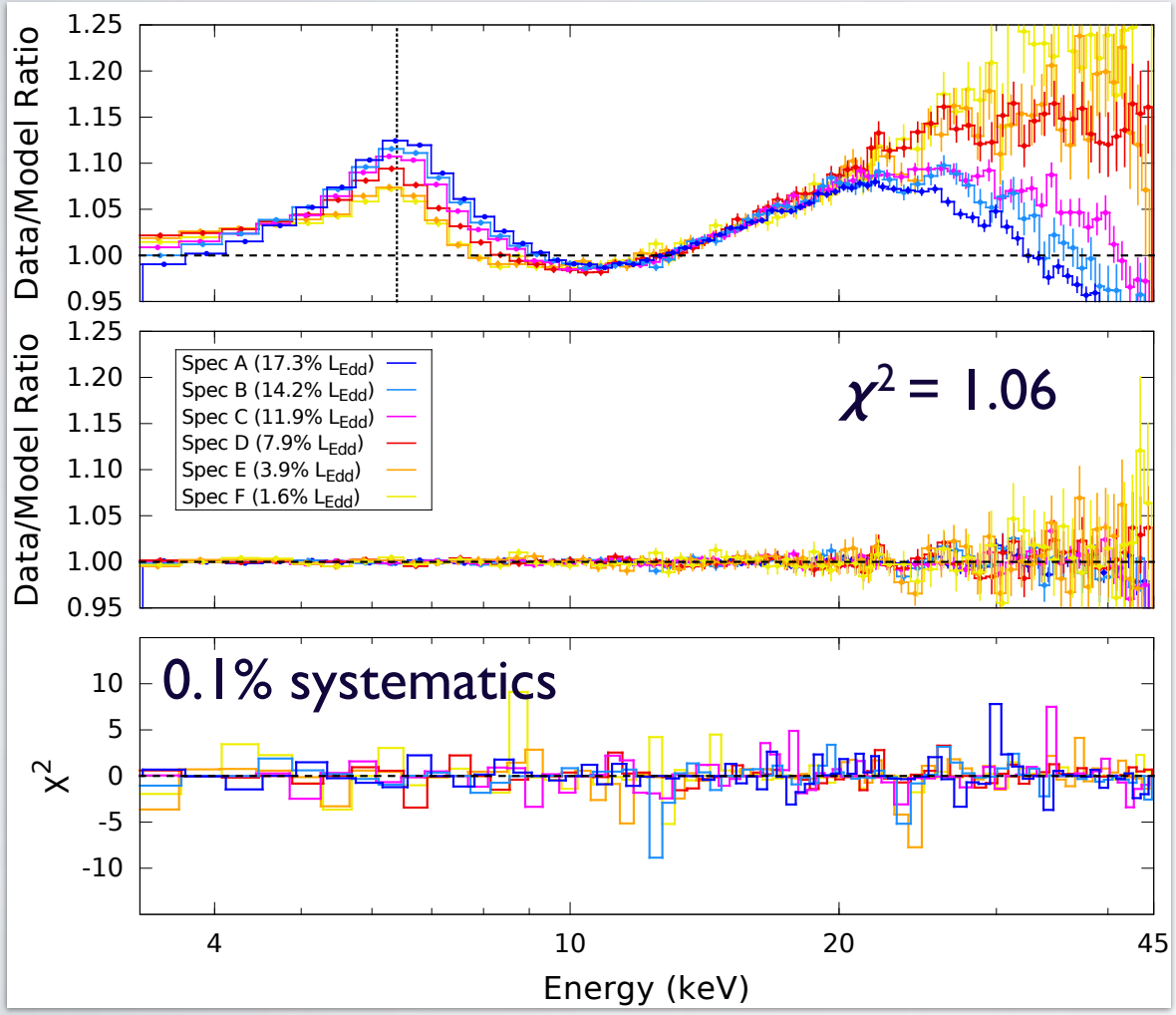
Reflection Signatures

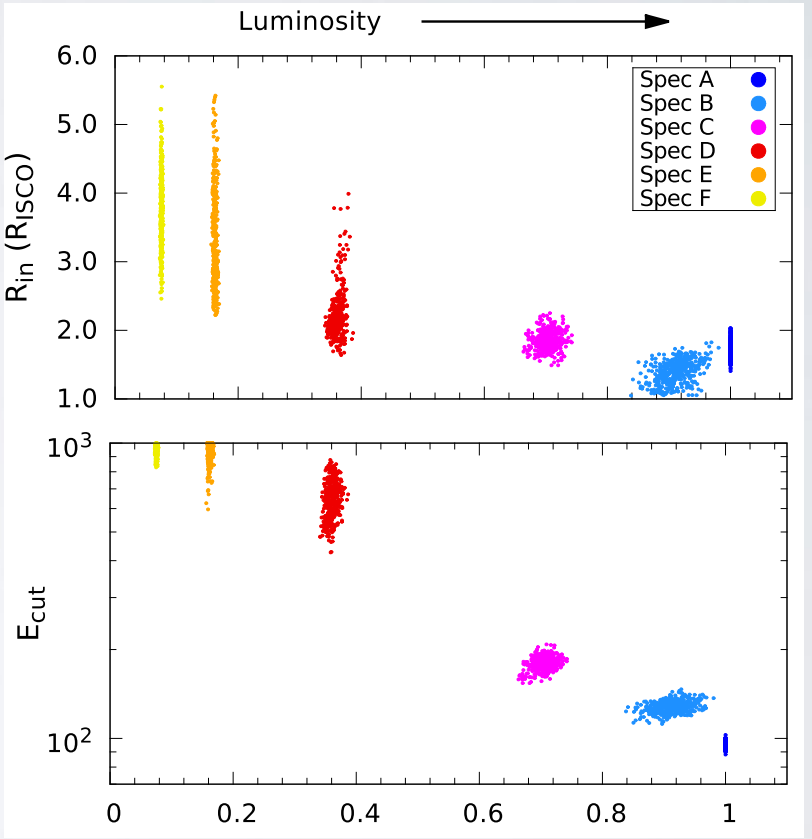
Ratio to a power-law model shows the signatures of reflection



Disk and Corona Evolution

Simultaneous fit of the RELXILL model to a 77 million count RXTE spectra revealed changes in disk and corona.



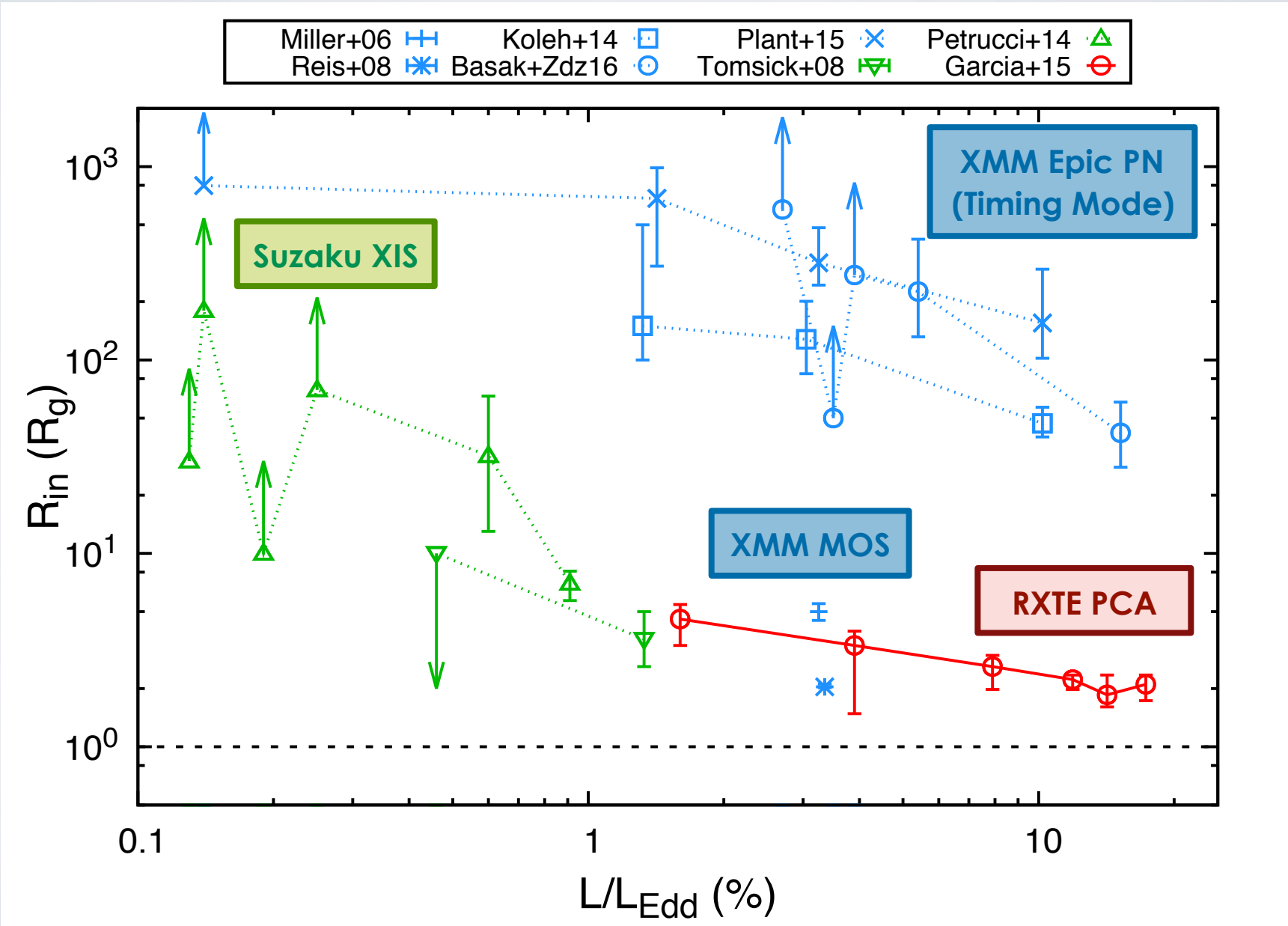


a = 0.95 +/- 0.04 (90% conf)
i = 48 +/- 1 deg
Fe abundance 5x Solar

García et al. (2015)

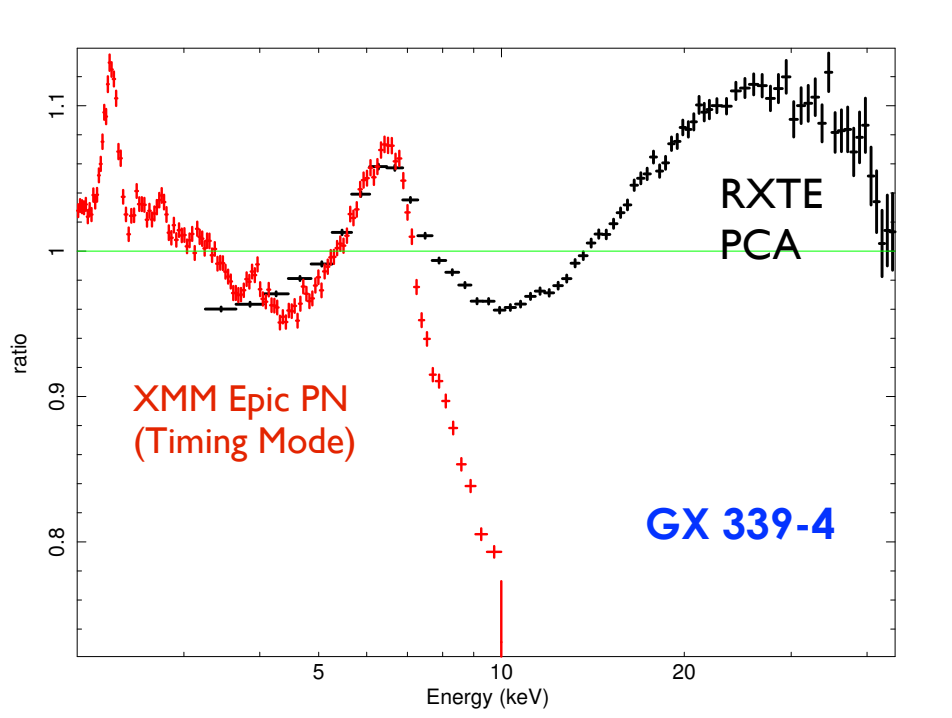
Controversy on the Disk Truncation

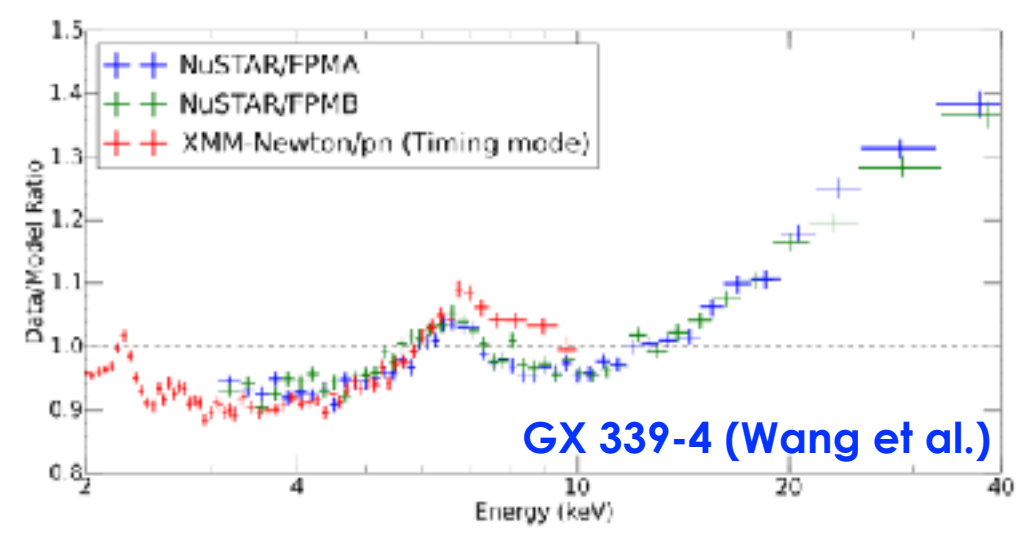
Large disagreement with other reflection spectroscpy results!



Controversy on the Disk Truncation

Reflection spectroscopy results: Calibration issues?





XMM (TM) vs. RXTE

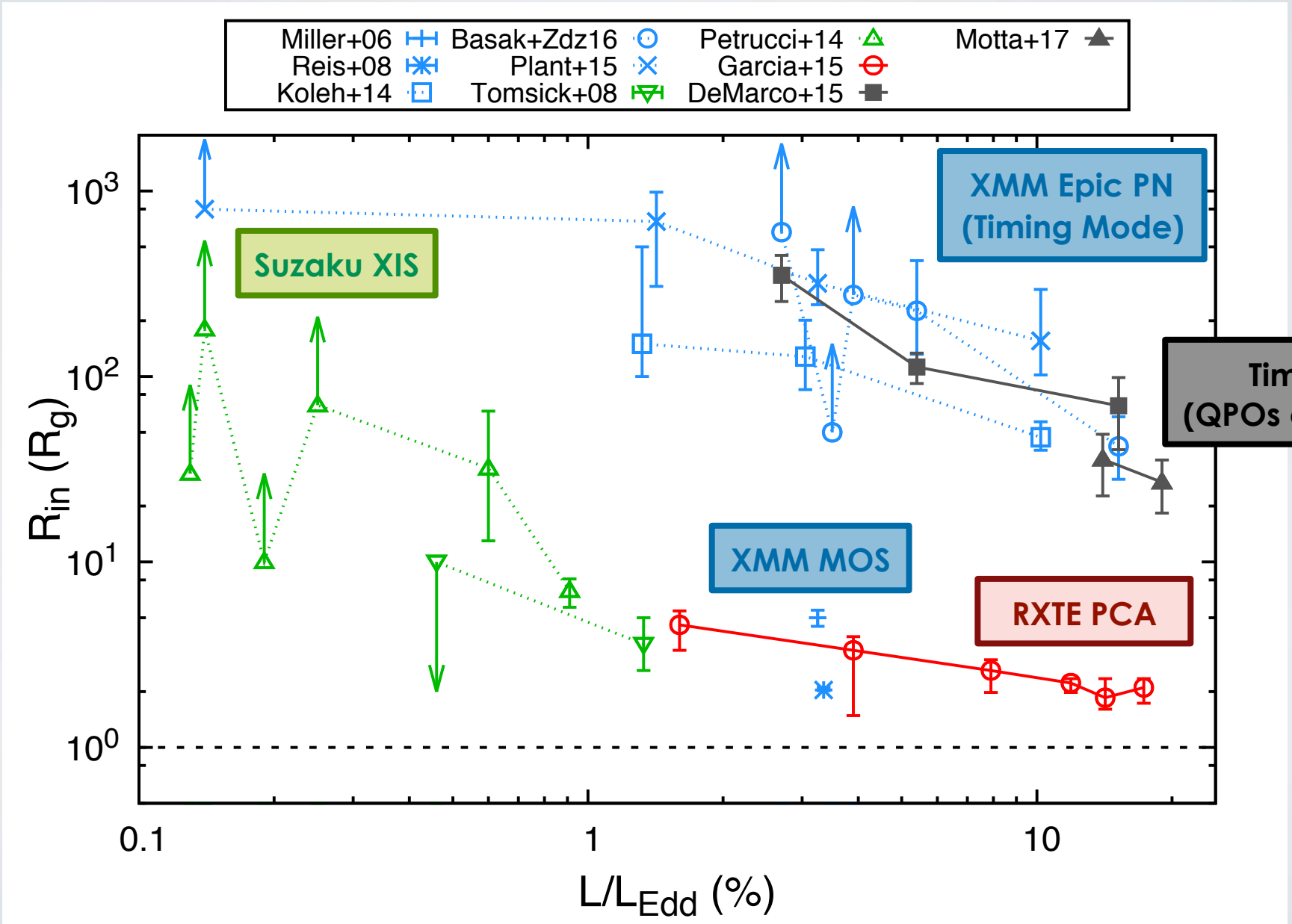
- 2009 Outburst: High count rate
- Very different Fe K line profile: XMM looks narrower

XMM (TM) vs. NuSTAR

- 2015 Outburst: lower count rate
- Significantly different continuum slope
- But good agreement between NuSTAR and Swift XRT

Controversy on the Disk Truncation

Large disagreement with both spectral (reflection) and timing results!



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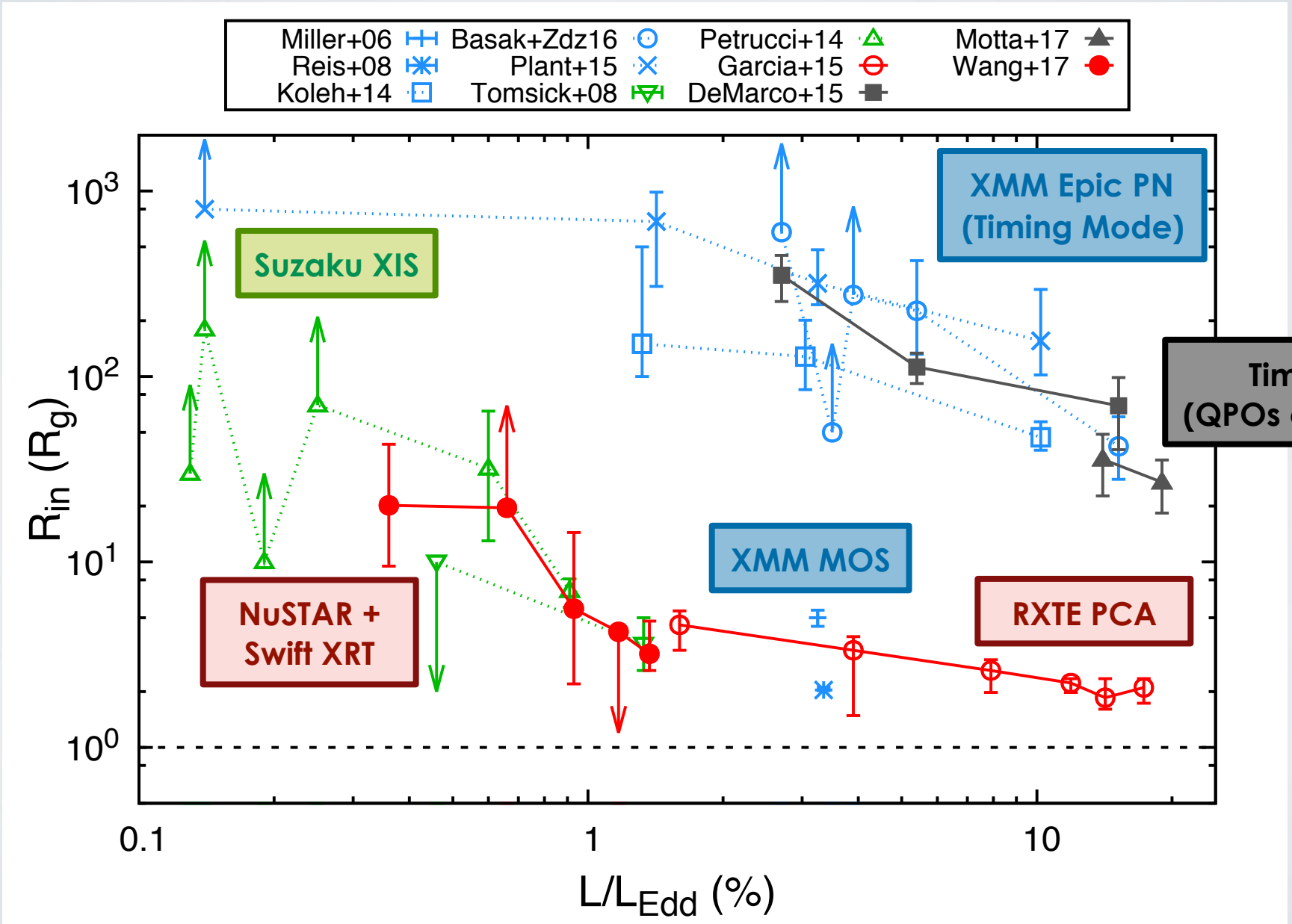
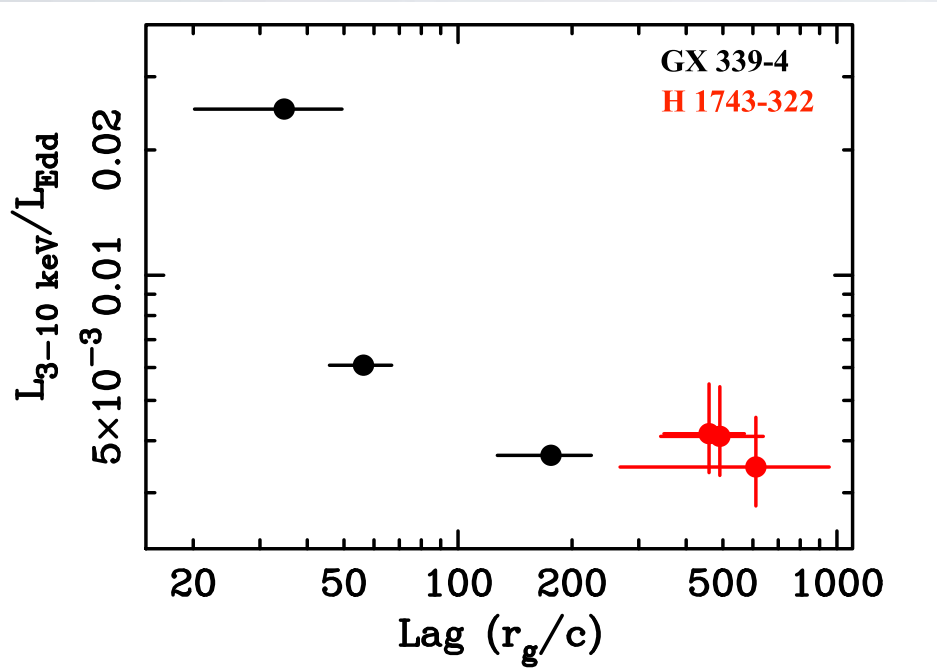
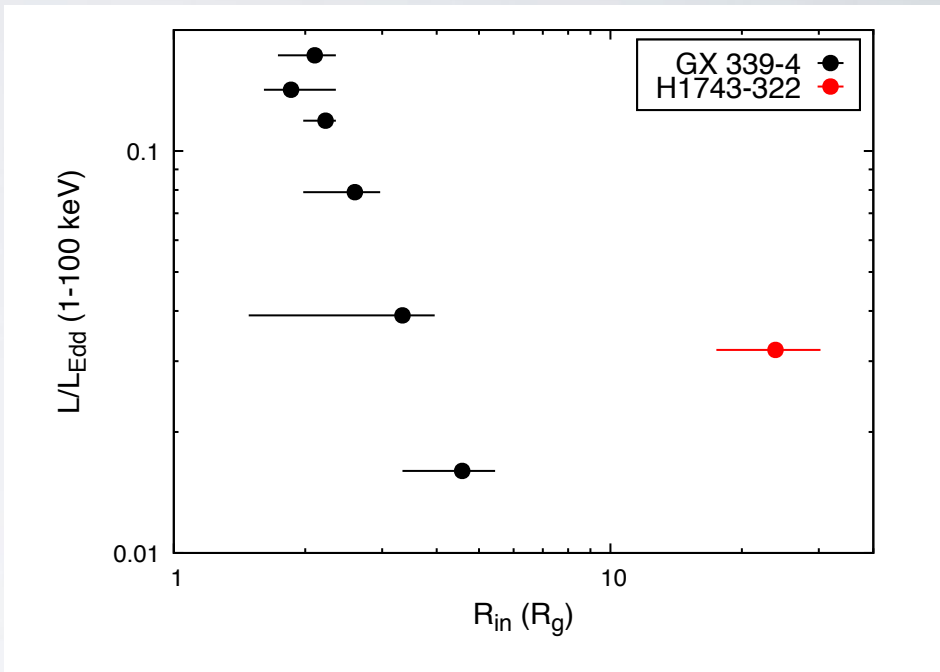


Comparison with Timing Analysis

Reverberation Lags (De Marco et al. 2016)



Reflection Spectroscopy (Garcia et al. 2017)



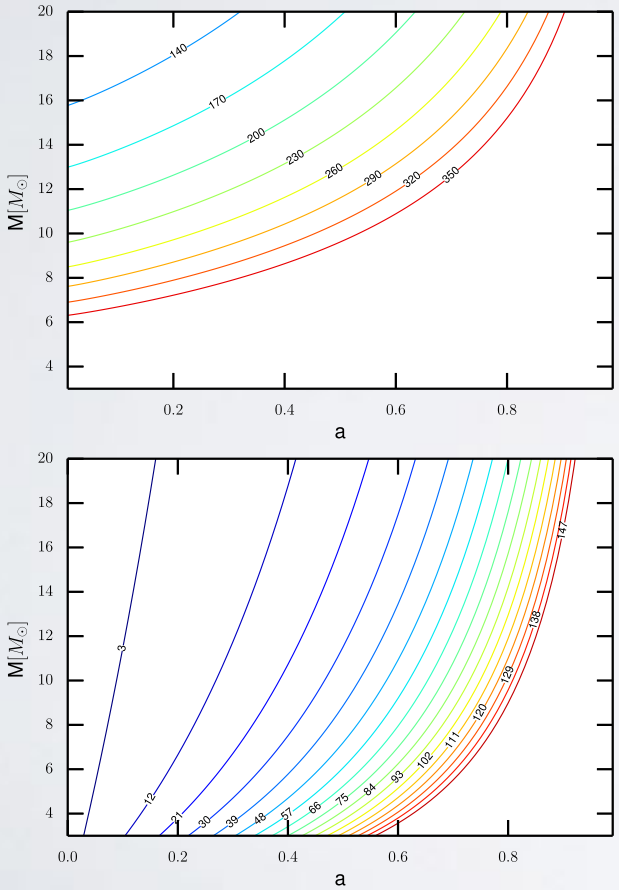
Are we measuring the same Physical Quantity?

- Simple "back of the envelope" estimates
- More rigorous estimate requires detailed modeling of the lag-energy spectra with the proper transfer function

Comparison with Timing Analysis

Are we measuring the same Physical Quantity?

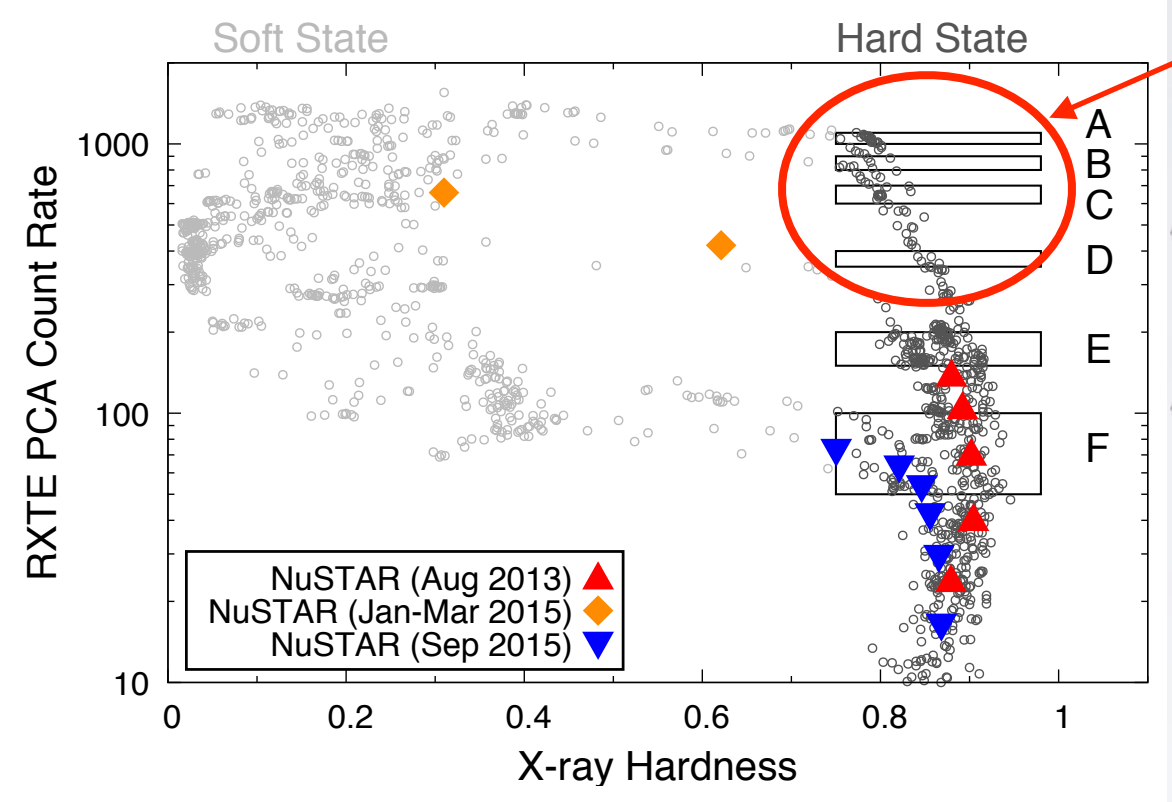
QPO's and Lense-Thirring Precession



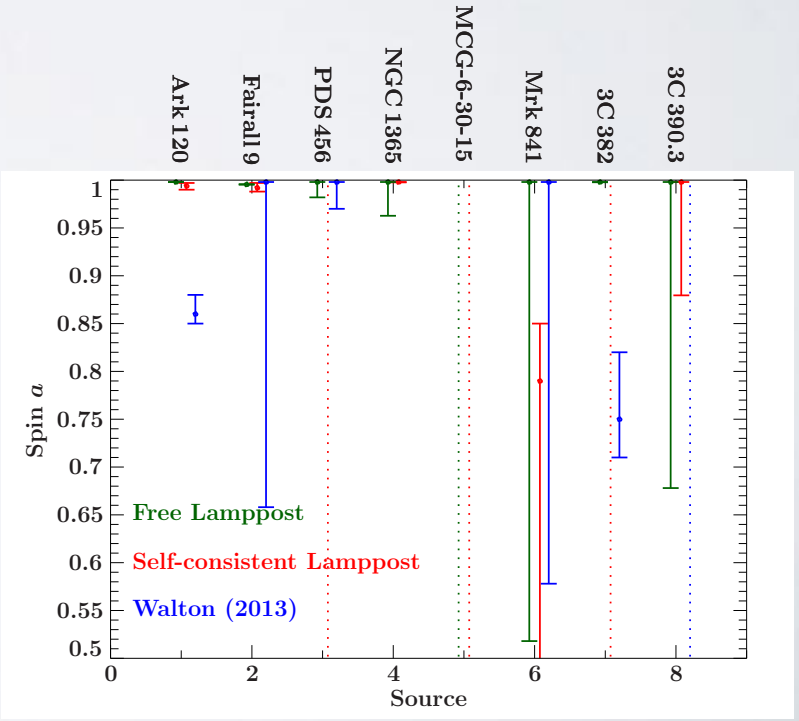
Franchini et al. (2016)

- Mass and distance are unknown for GX 339-4
- Is LT precession the correct interpretation of QPO's?
- Are there observational limitations?
- Can we detect the highest frequency QPOs?
- Do the amplitude and intensity of the QPO depend on the frequency?

Future developments



- ToO for bright HS of GX 339-4 during NuSTAR's Cycle 3
- Systematic exploration of all bright BHB in the RXTE archive
- New faster and more accurate reflection models (see T. Dauser's talk on Thursday)



- Self-consistent modeling of the continuum emission via the lamppost geometry (see M. Fink's Poster J10)

Summary

- The problem of disk truncation in the bright hard-state of BHBs is still an open problem
- Reflection Spectroscopy results are in strong disagreement only with XMM-Newton data in Timing Mode
- Thus, data calibration is likely the source of the discrepancy
- Timing studies also predict large disk truncation, in disagreement with the reflection spectra.
- Yet, the physical interpretation of time lags or QPOs is less clear and might require careful revision