The Role of Jets in BHXRBs

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Introduction (1)

- In the BHXRB community, jets are thought to be simply fireworks, that emit radio waves.
- I would like to convince you that jets in BHXRBs play a central role in the observed phenomena.
- I will concentrate on only two of them:
- Power-law X-ray spectra with photon index Γ.
- Time lag of hard X-ray photons w.r.t. softer ones.

Introduction (2)

- Let me start with some **strong beliefs** that our community has.
- Belief #1: The power-law X-ray spectrum in BHXRBs is produced in the corona (the hot inner flow, ADAF) or possibly at the base of the jet (S. Markoff).
- This is fine, but stay tuned.

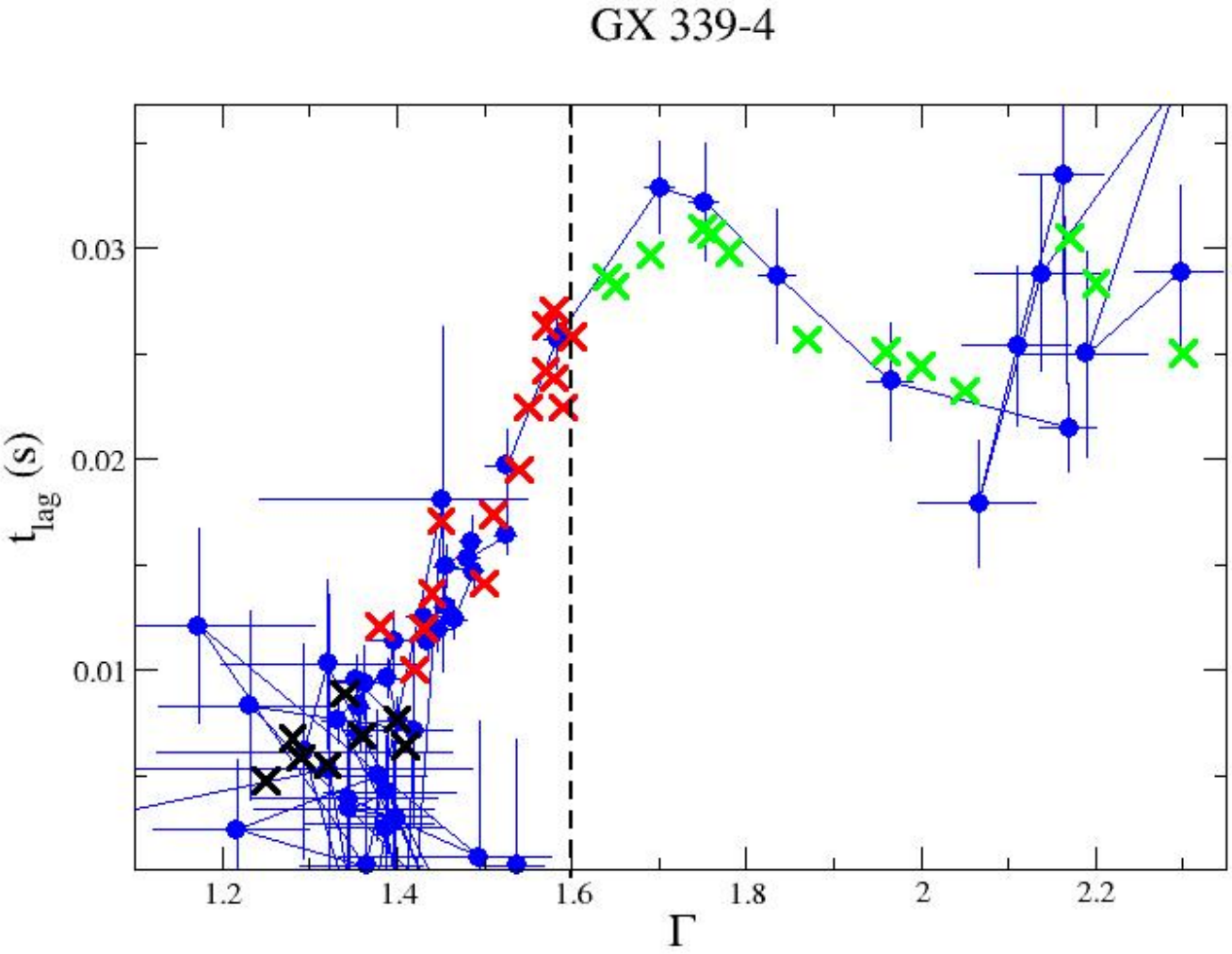
Introduction (3)

- Belief #2: The time lag of the hard X-ray photons w.r.t. the softer ones is caused by propagating fluctuations in the accretion flow (Kotov et al. 2001).
- This is also fine, I like it very much, and it could be happening, but …
- the two mechanisms (inverse Compton and propagating fluctuations) do not "talk" to each other.
- In other words, no correlation is expected between the time lag and the spectral index Γ.

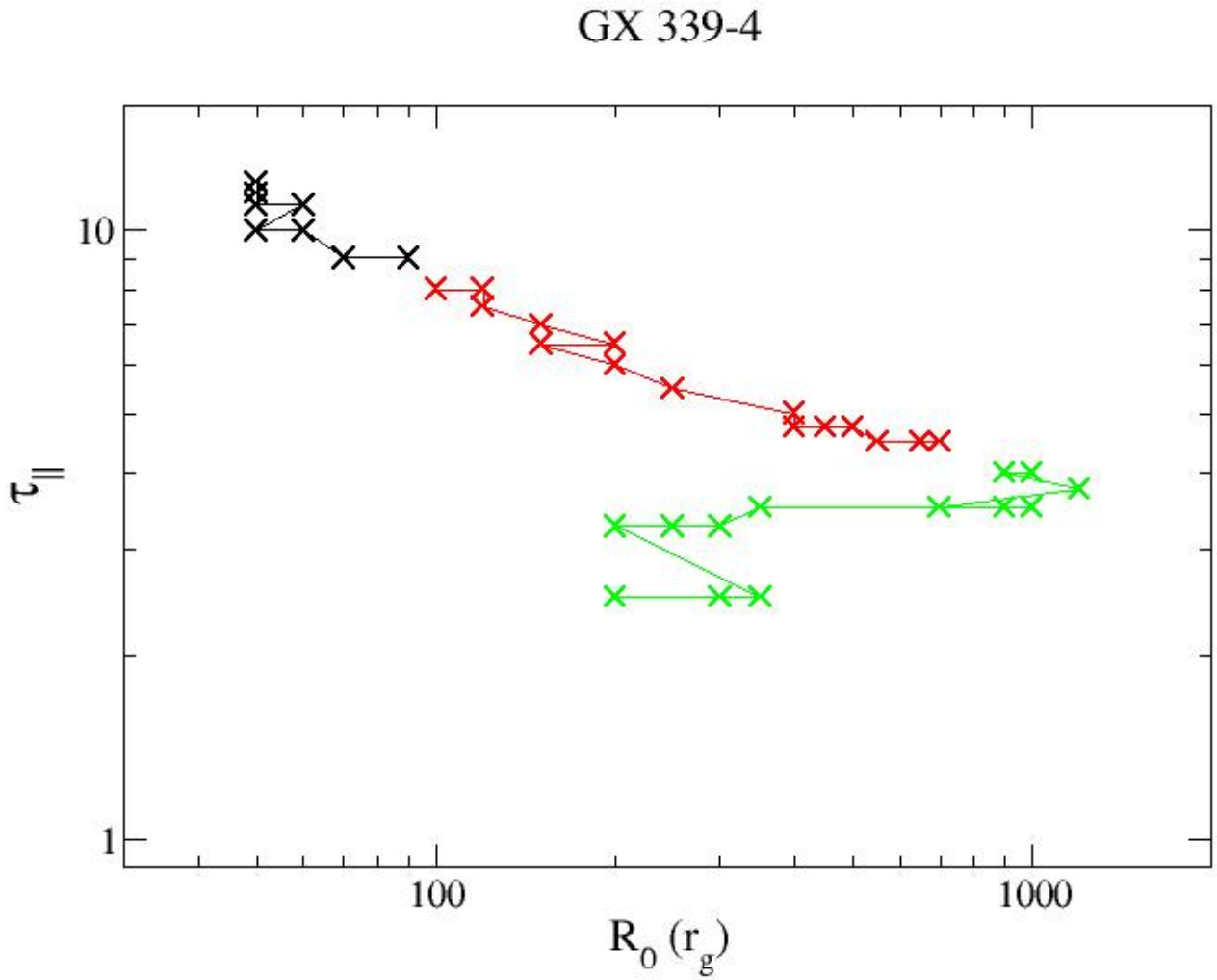
Correlation

- However, the two are correlated!!!
- A nice correlation (next slide) is found in GX 339-4.
- We have explained this correlation by Comptonization in the jet (time lag is due to Comptonization).
- By the way, Comptonization in the jet is **unavoidable**, because the jet is fed by the hot inner flow (ADAF).
- Thus, photons in the hot inner flow cannot escape without travelling through the jet.

Kylafis & Reig (2018)

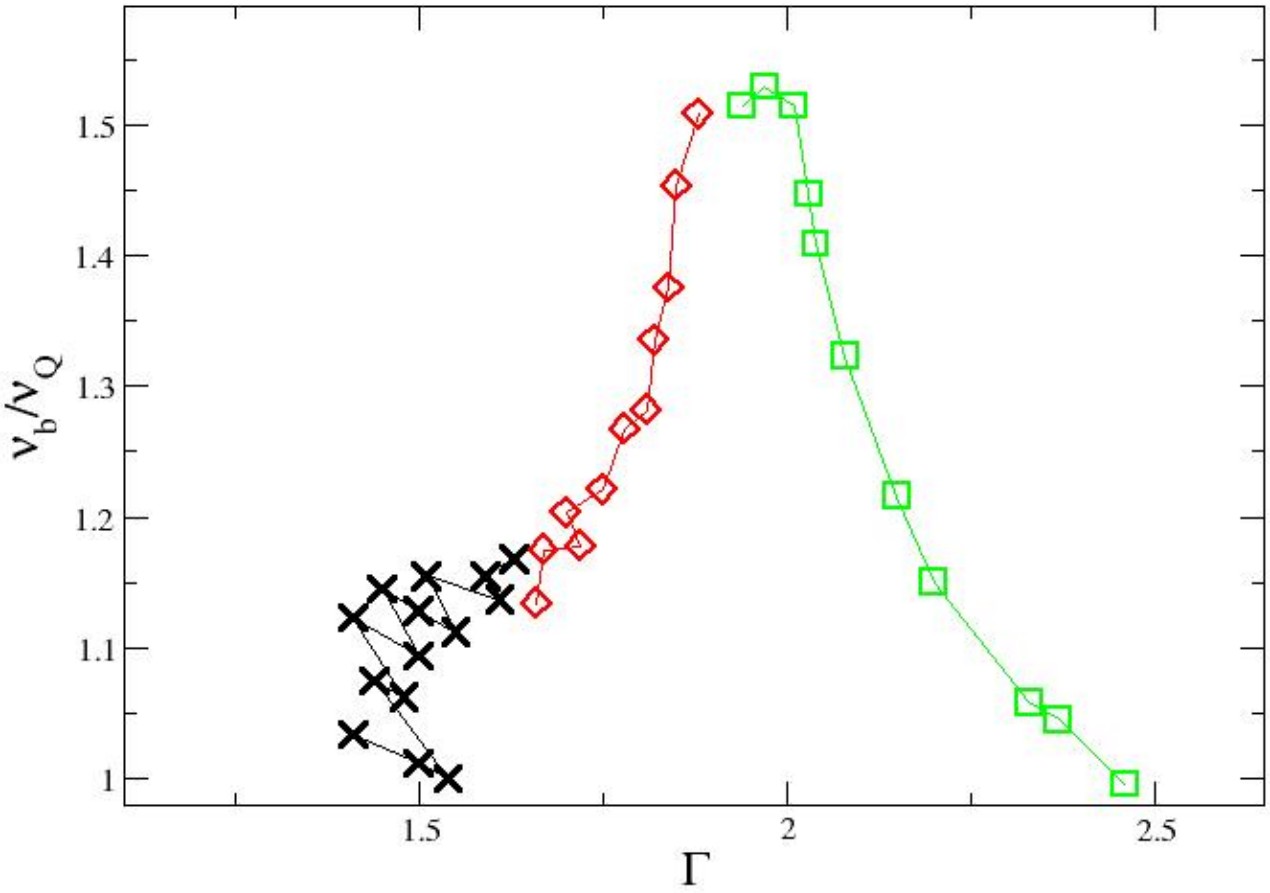


The values of the two model parameters (τ, R0) are correlated



Prediction

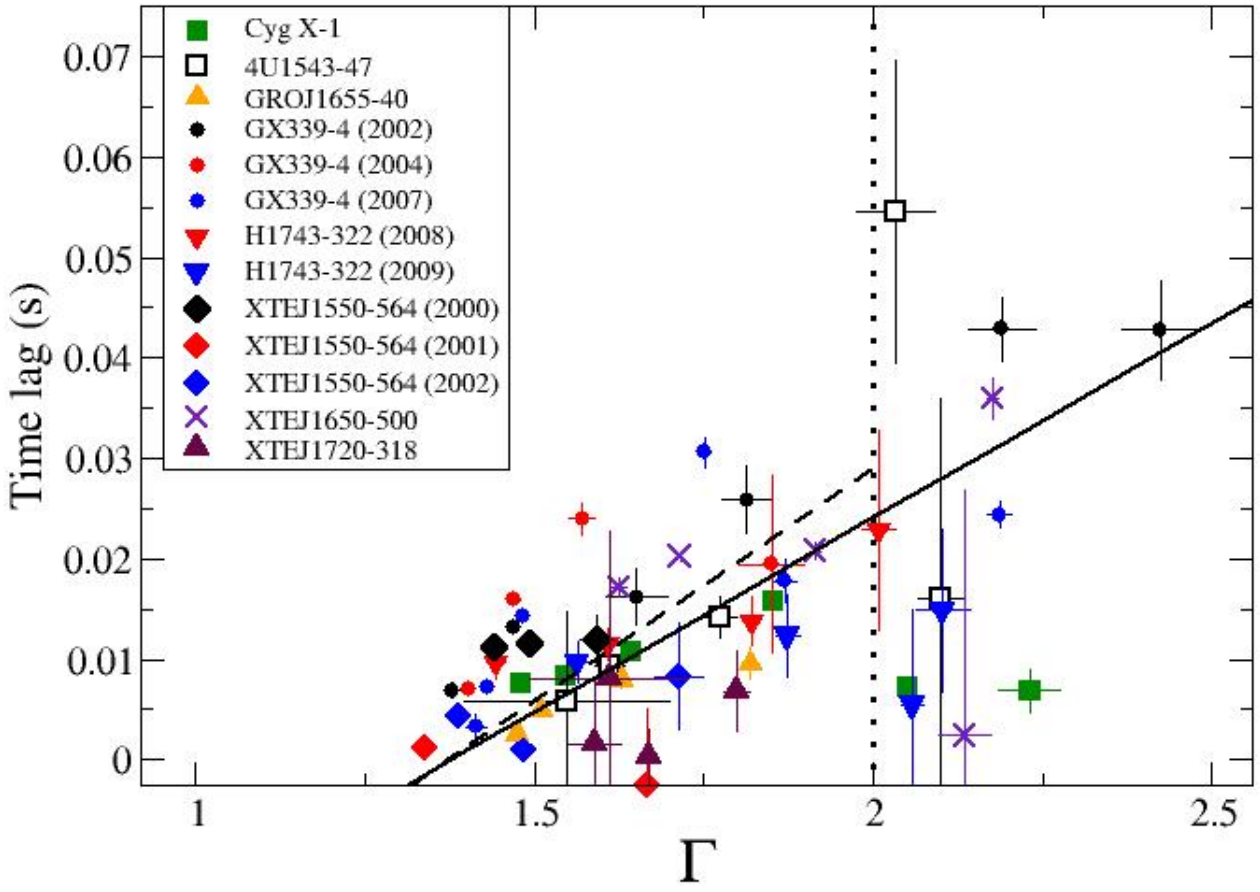
Break frequency in radio spectrum vs. Γ



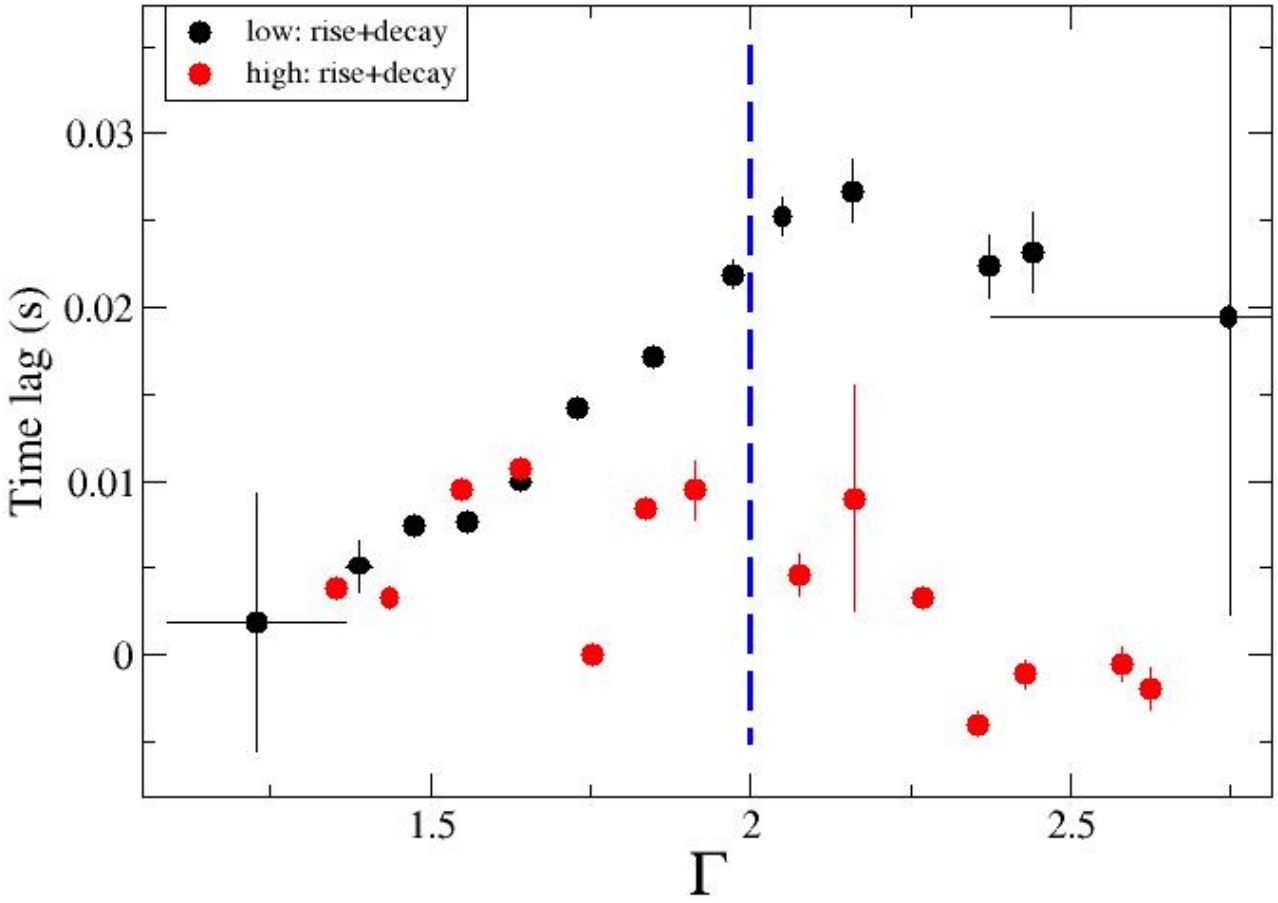
Generalization to all sources

- Could the above be just a peculiarity of GX 339-4?
- No, all the sources do more or less the same.

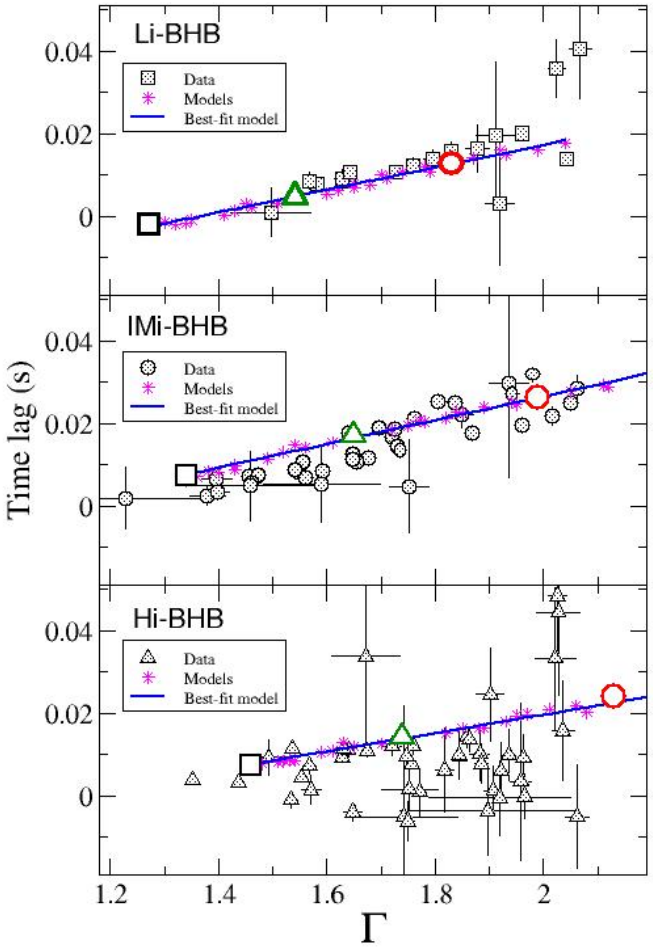
Time lag vs. Γ (all data) (Reig et al. 2018)



Low vs. High inclination



Dependence of the correlation on observing direction

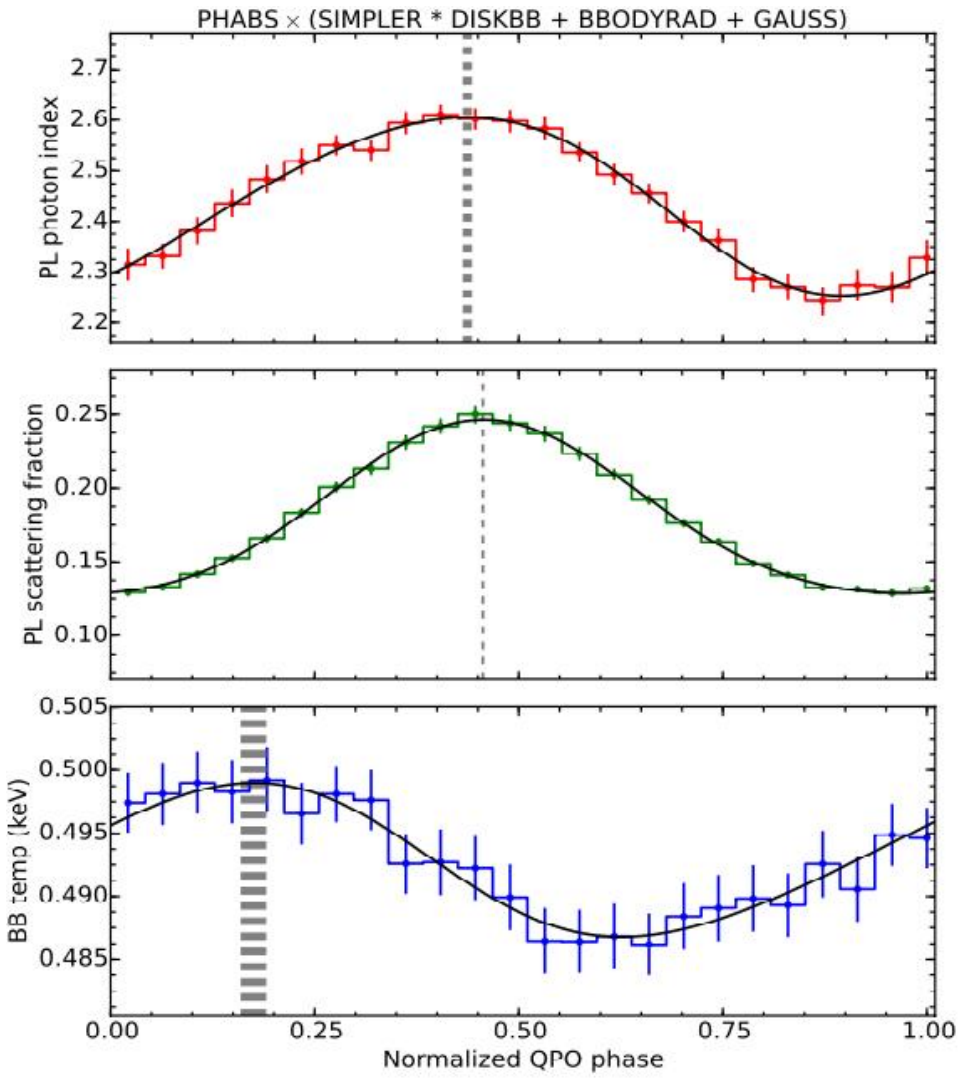


Type-B QPOs

- Stevens & Uttley (2016) did phase-resolved spectroscopy of the type-B QPOs in GX 339-4 and found a sinusoidal variation of Γ with phase.

- They interpreted it as a precessing jet.

Stevens & Uttley (2016)



Kylafis & Reig (in preparation)

- As we have seen, inverse Compton scattering in the jet **predicts** a variation of Γ with viewing angle.
- Stevens & Uttley found an amplitude of variation of Γ of ~6%.
- We have explained this variation **quantitatively** with our jet model.
- In conclusion, jets in BHXRBs are NOT at all fireworks. They play a central role!

THANKS