



Revealing Structure within the Coronae of Seyfert Galaxies

Dan Wilkins

Einstein Fellow, Kavli Institute for Particle Astrophysics & Cosmology, Stanford University

The X-ray Universe 2017 (with Luigi Gallo, Andy Fabian, Ed Cackett, Chris Reynolds, Catia Silva, Elisa Costantini)



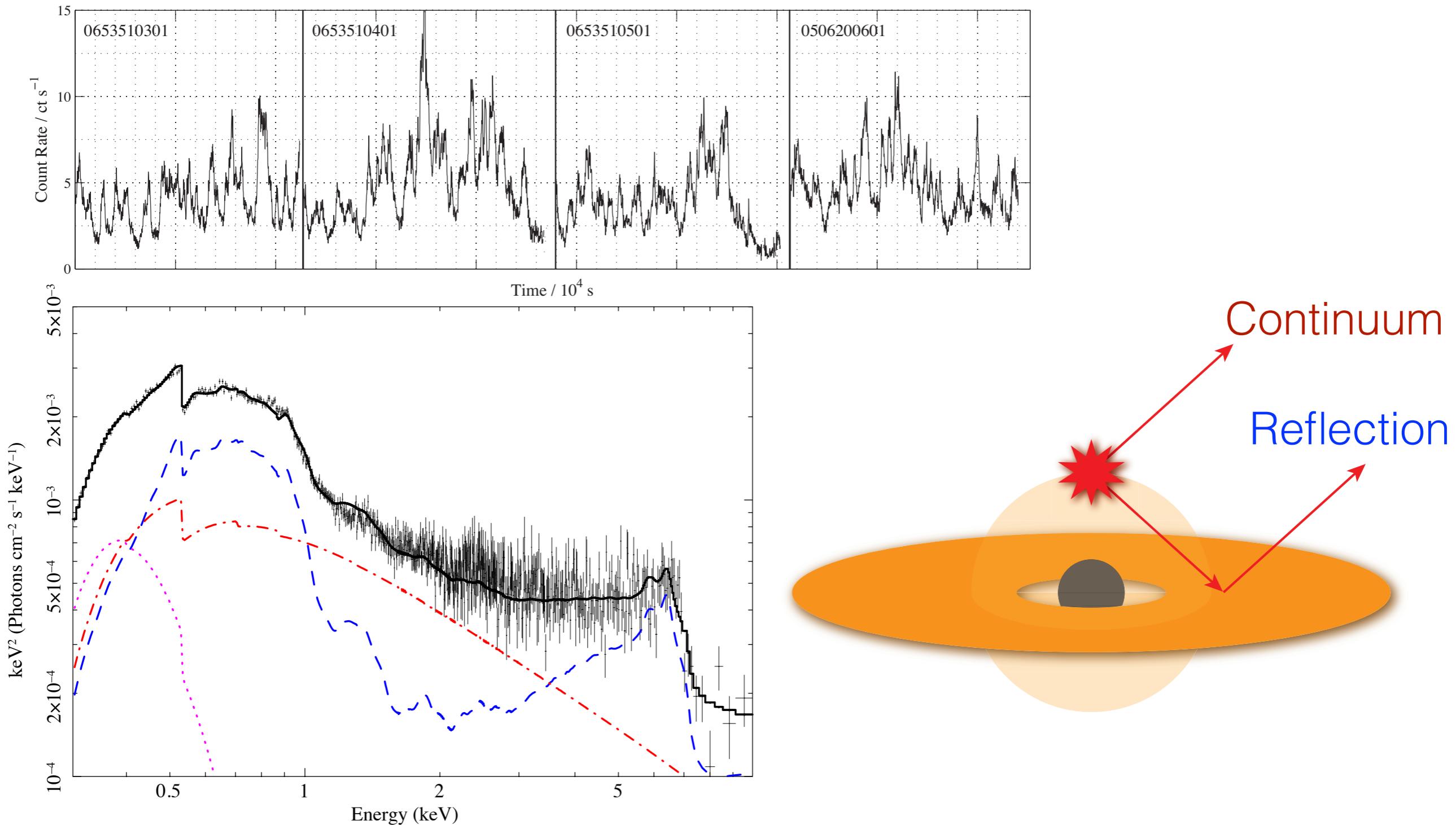
Outline

- Constraining coronal structure through X-ray reverberation
- The corona of I Zw 1
- Evolution of the corona during a flare

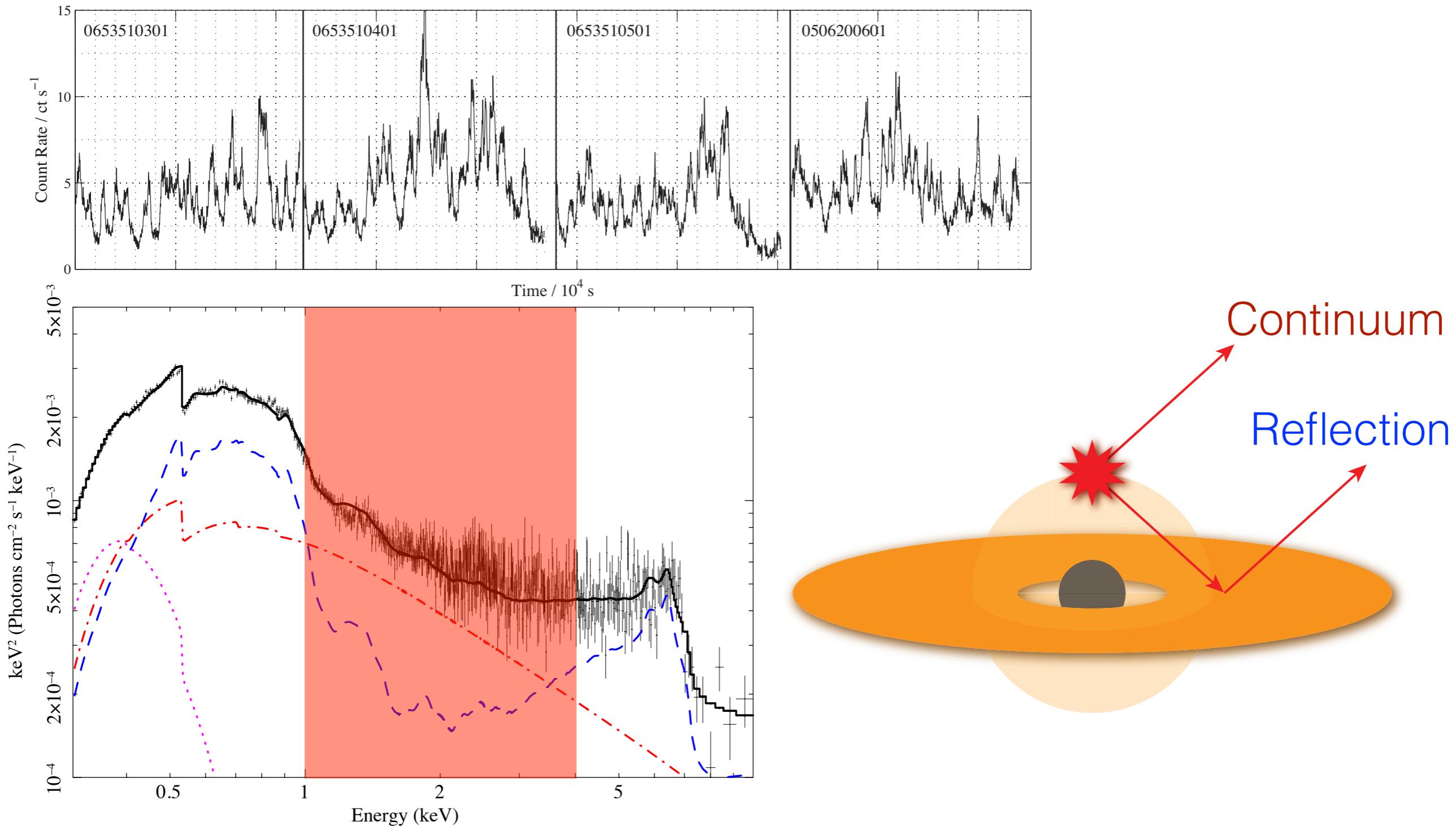
Why do we care?

- How are some of the brightest objects in the Universe powered?
- How is the corona formed and powered by the accretion flow?
- What is the structure of the corona?
- How does the corona evolve in time? What regulates AGN activity?
- How are jets launched and are they related to the corona?

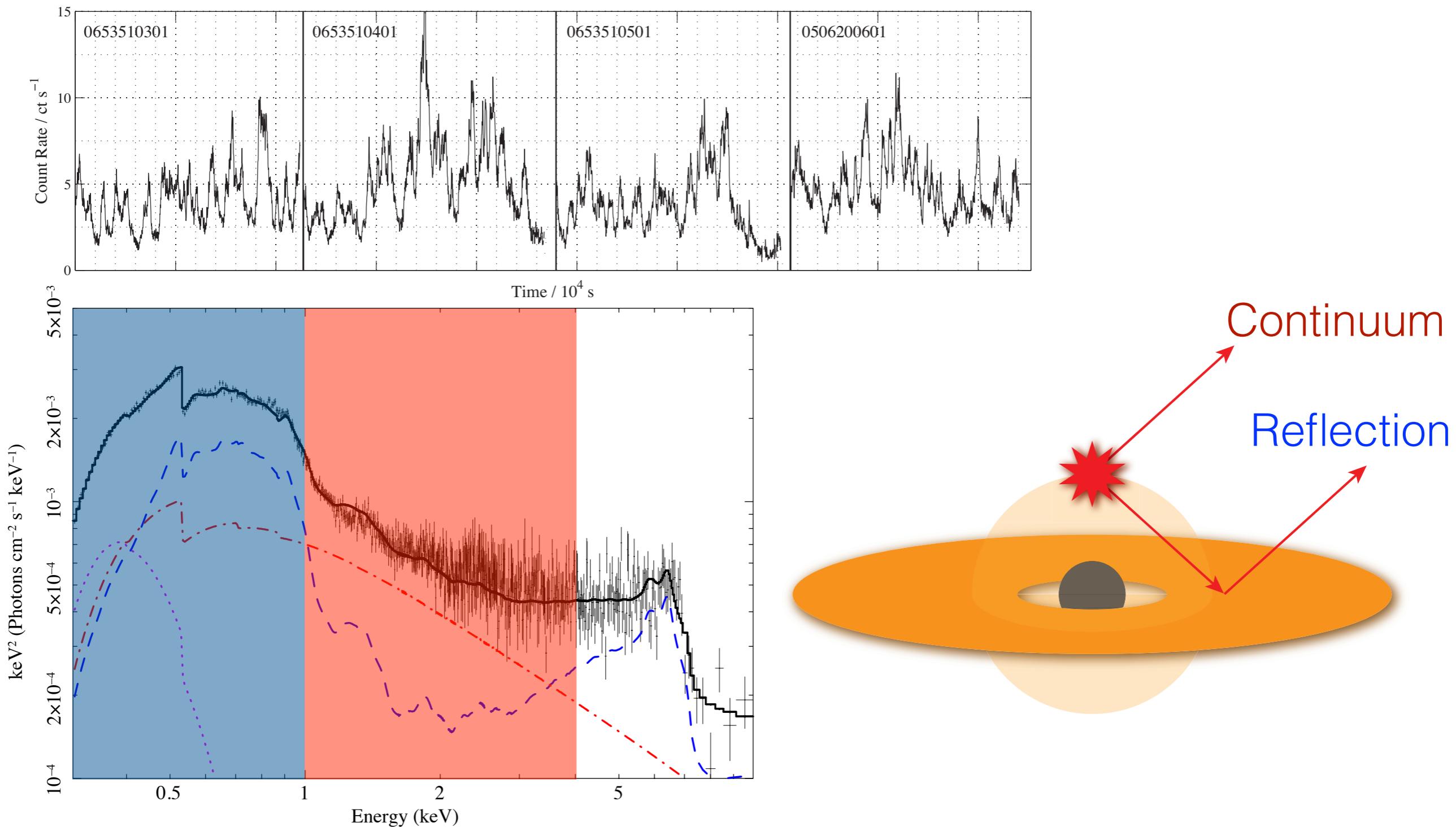
X-ray Reverberation

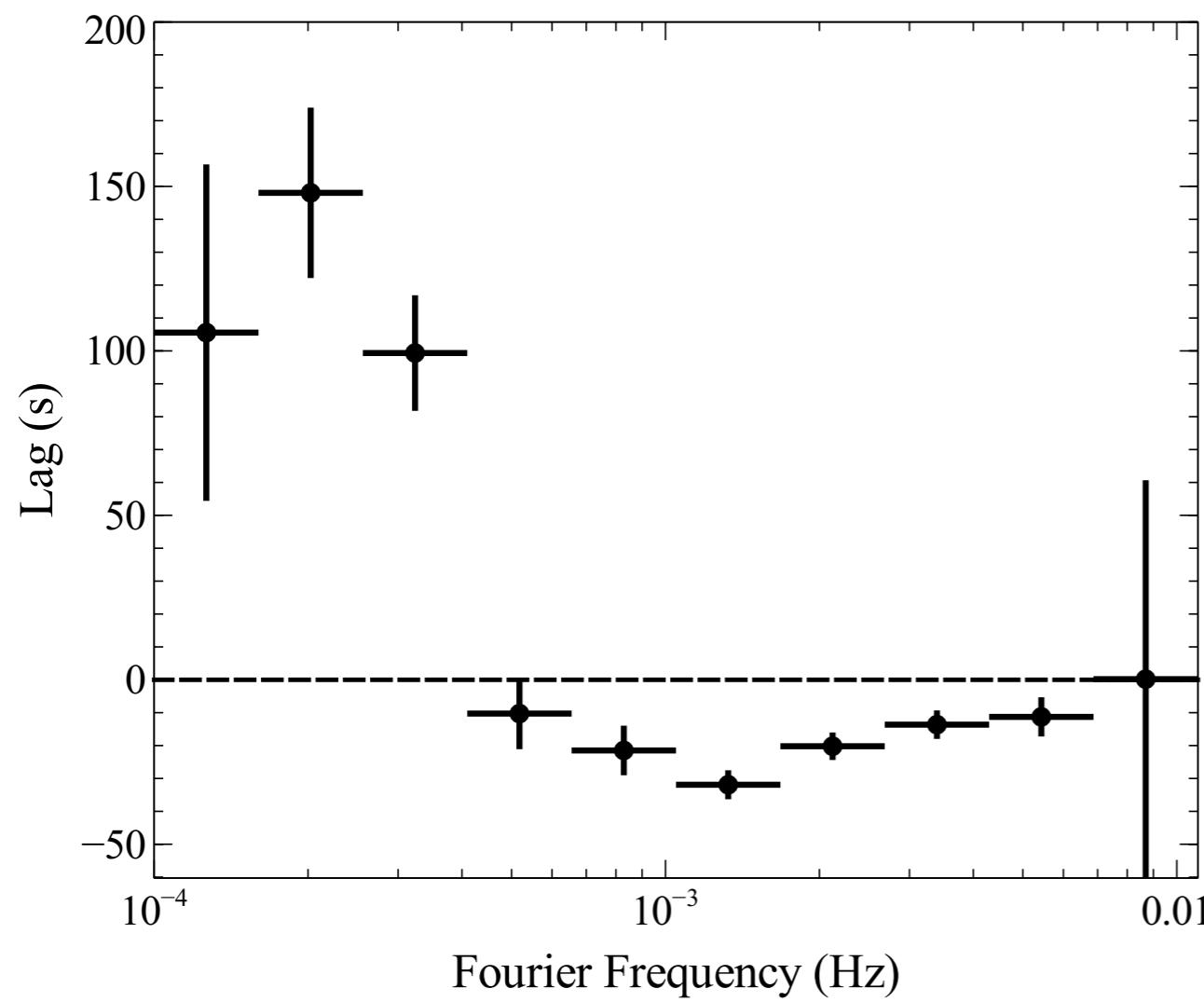


X-ray Reverberation

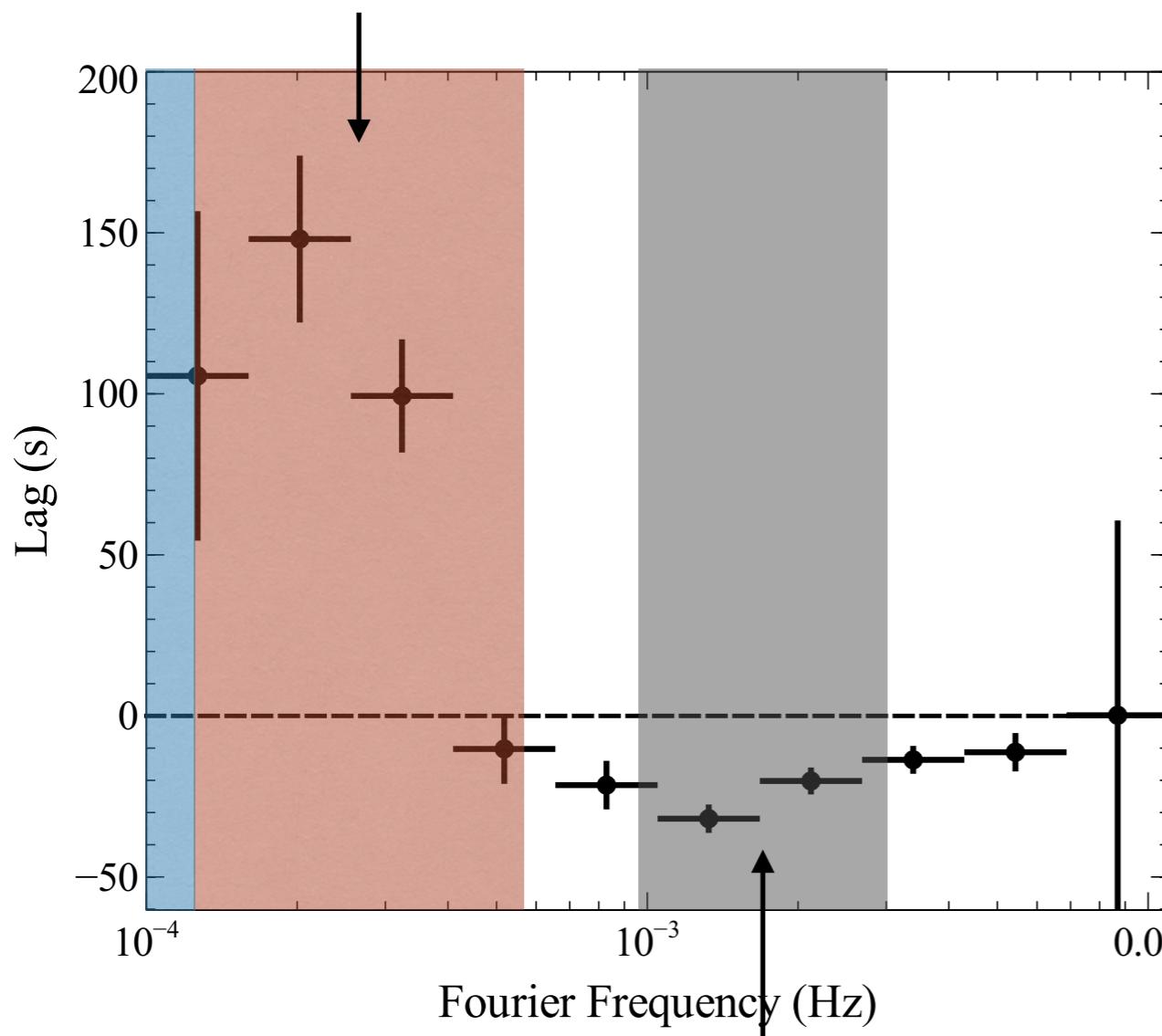


X-ray Reverberation

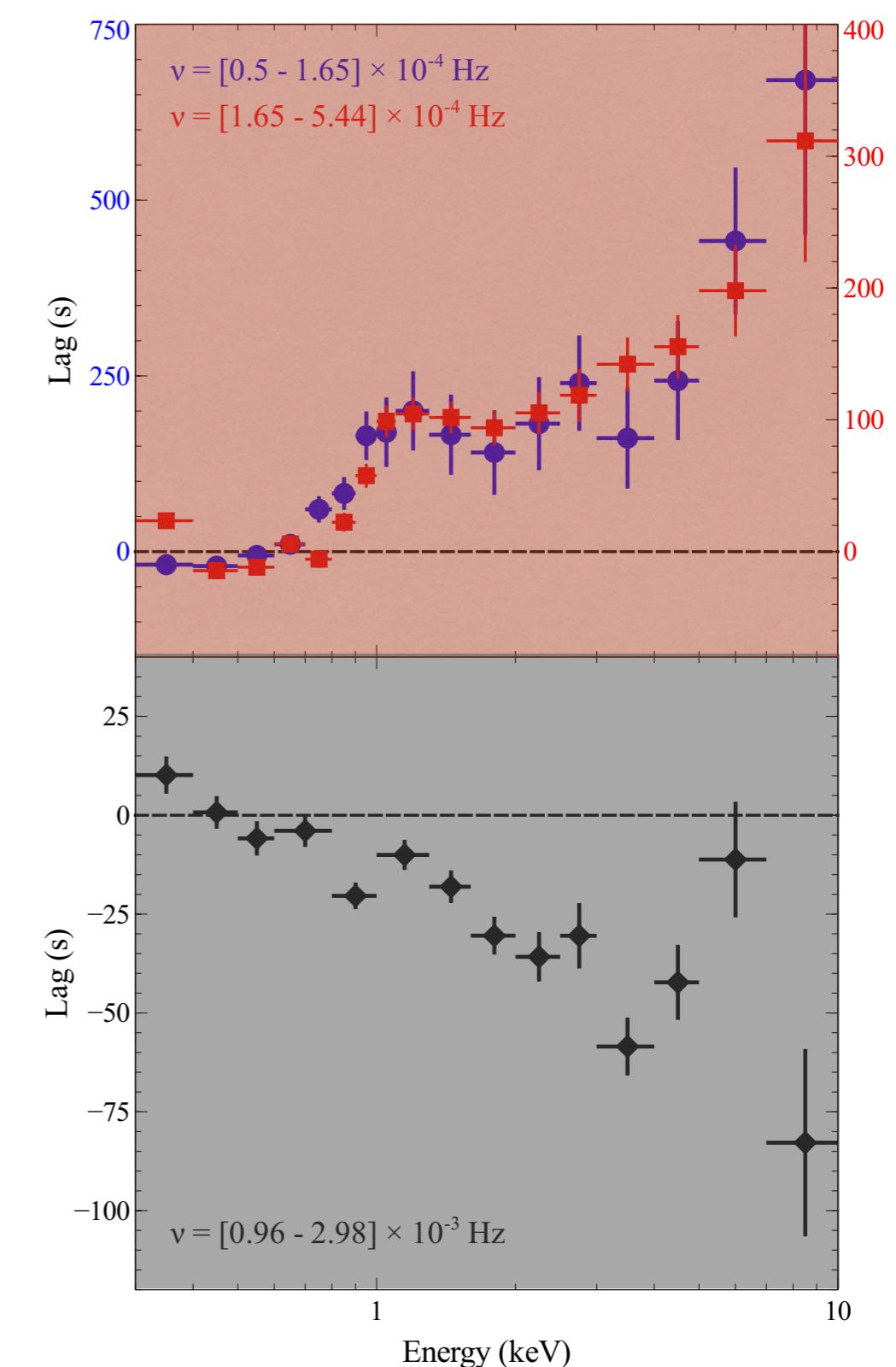




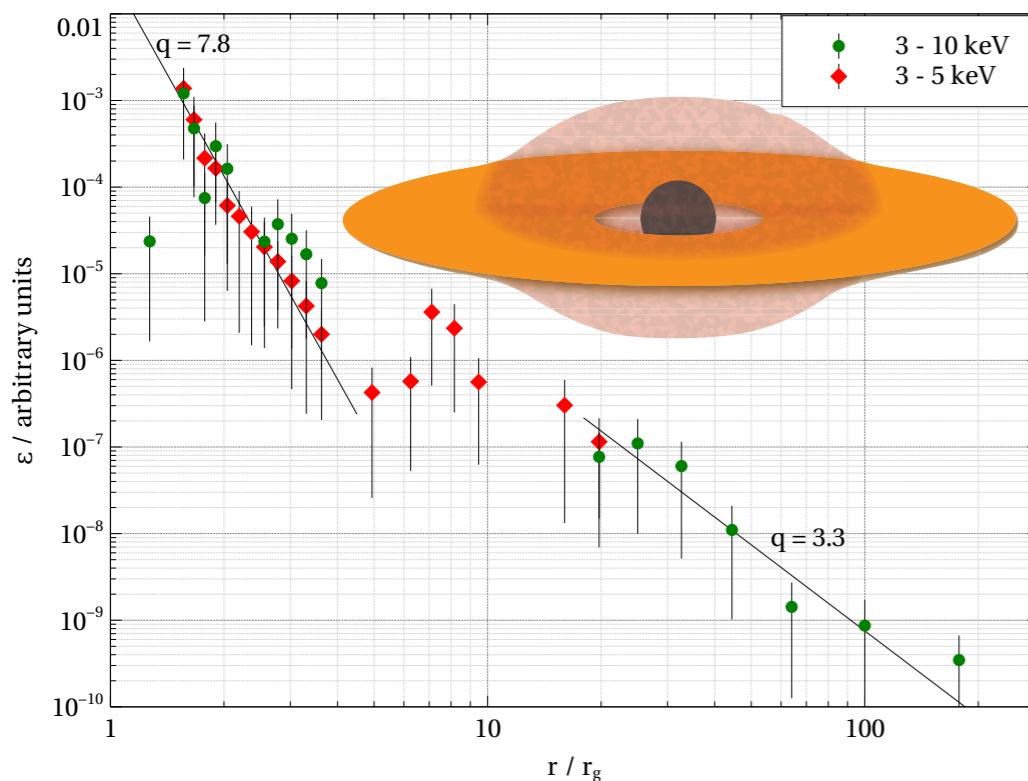
Hard X-rays lag soft (in continuum)



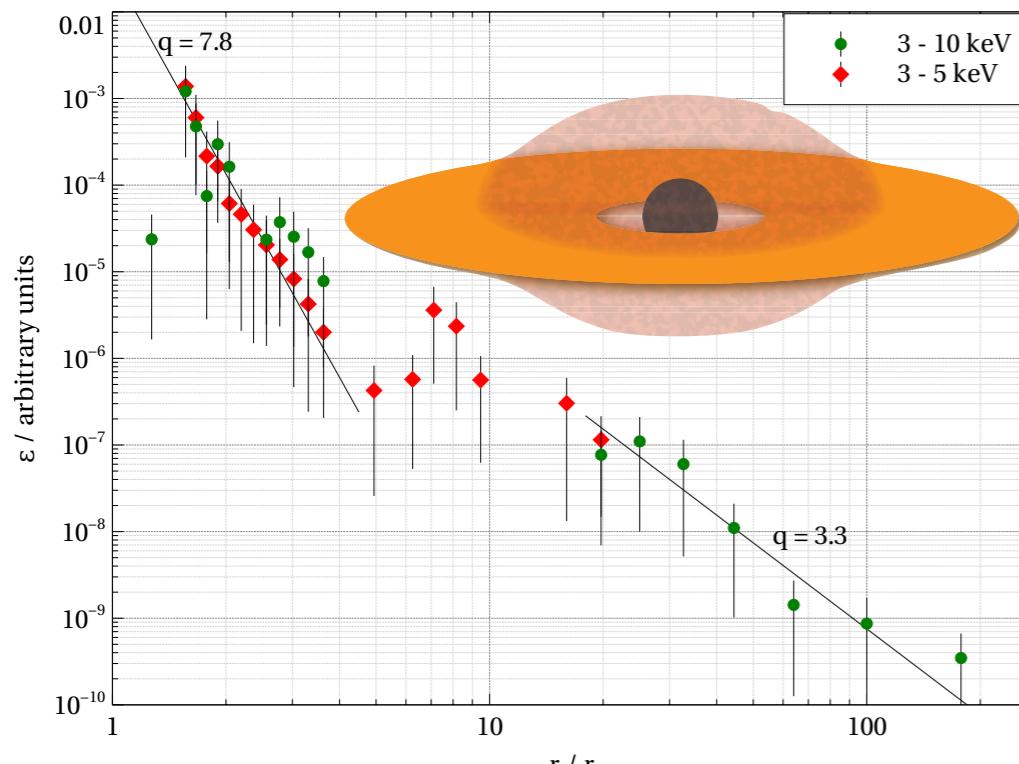
Soft (reflection-dominated)
lags hard (continuum)



The Corona – A Summary

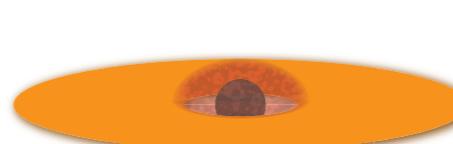
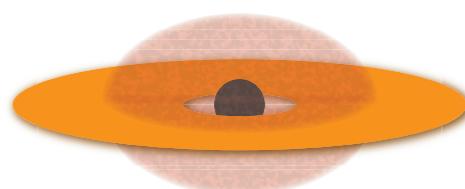
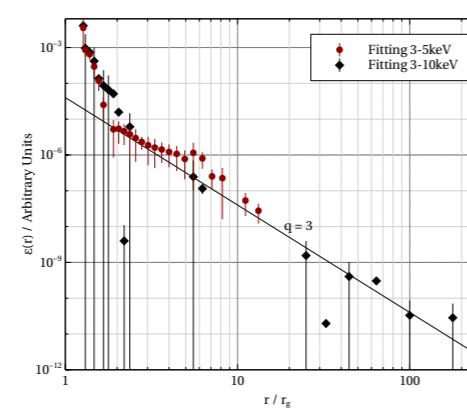
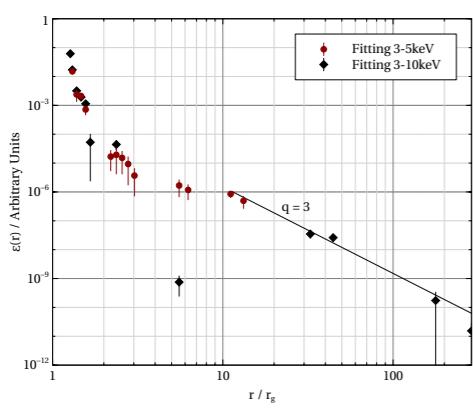


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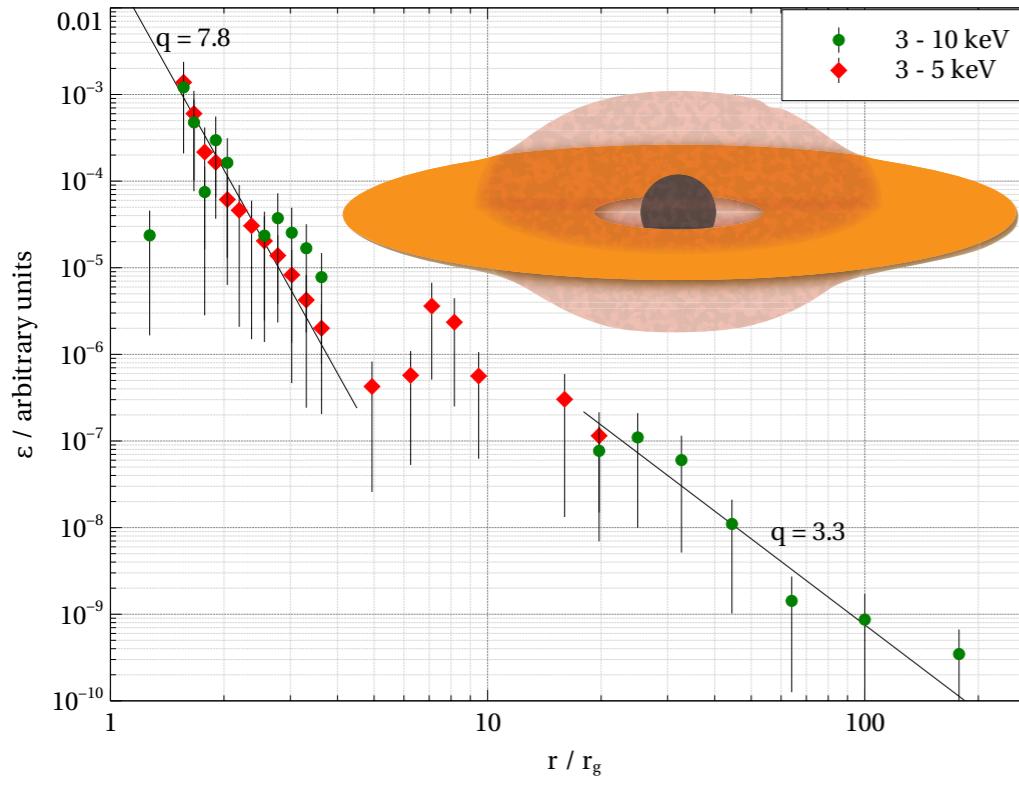


High Flux

Low Flux

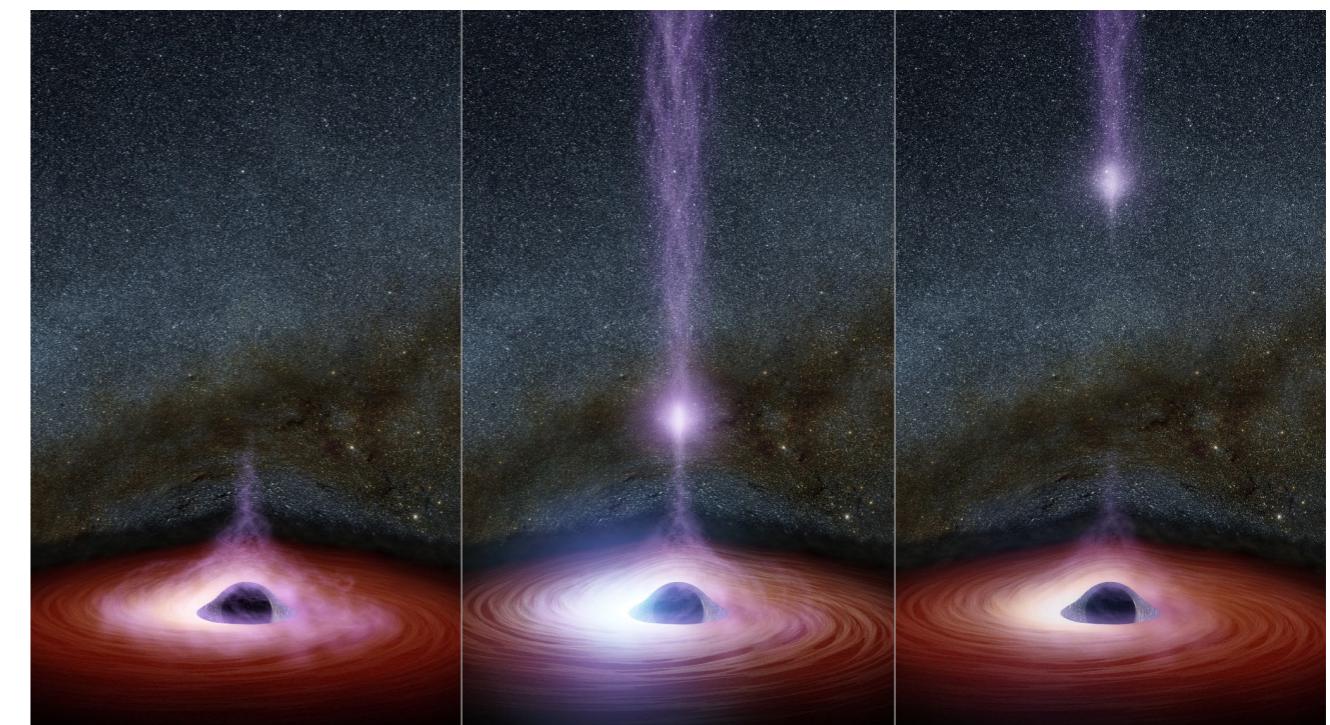
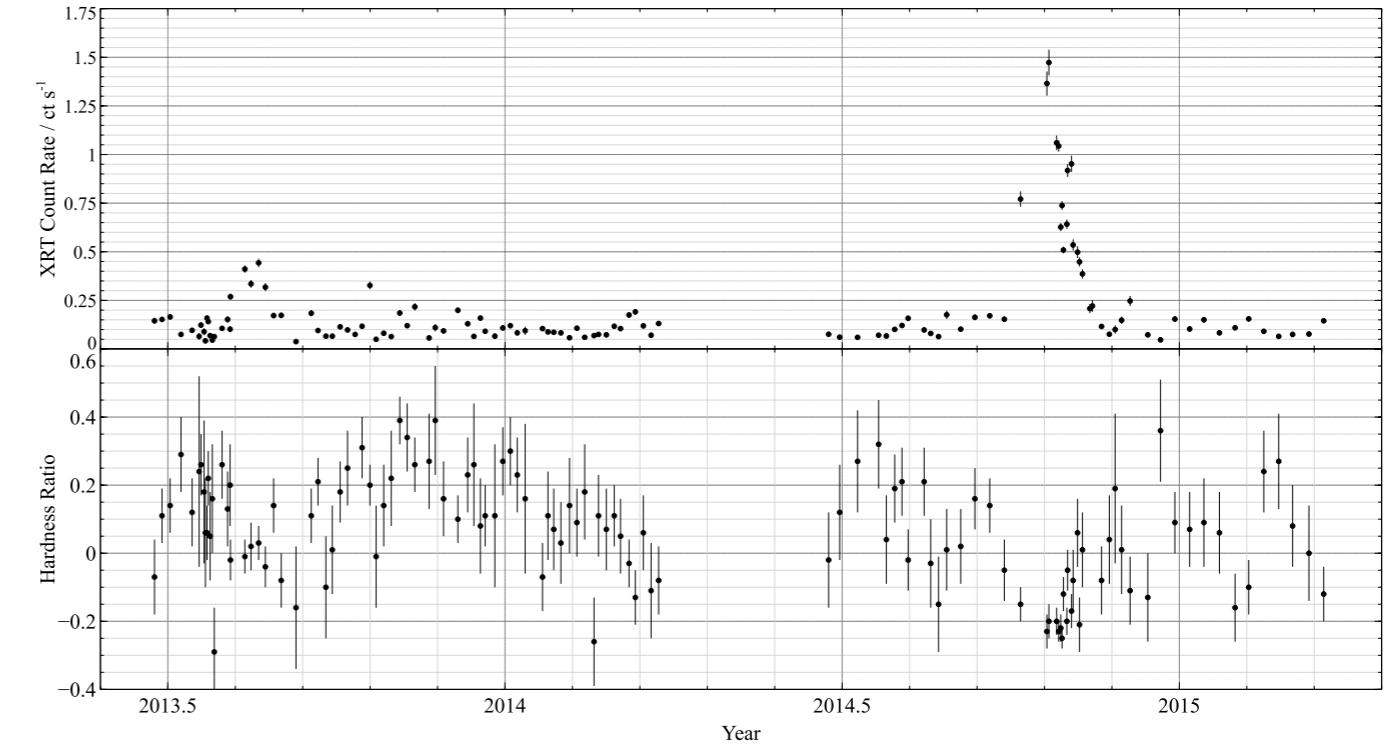
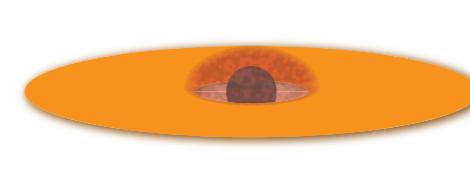
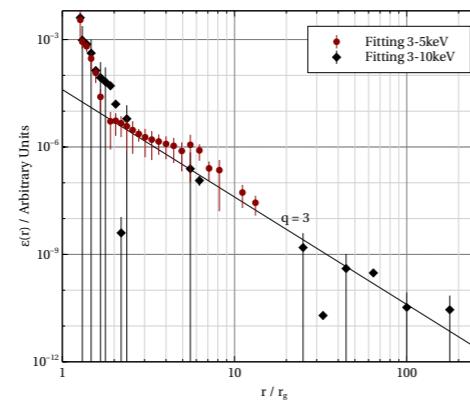
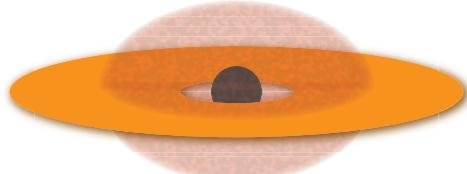
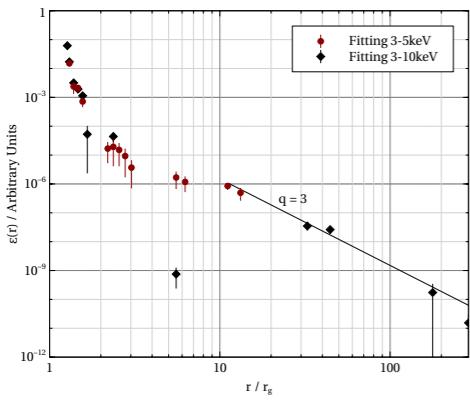


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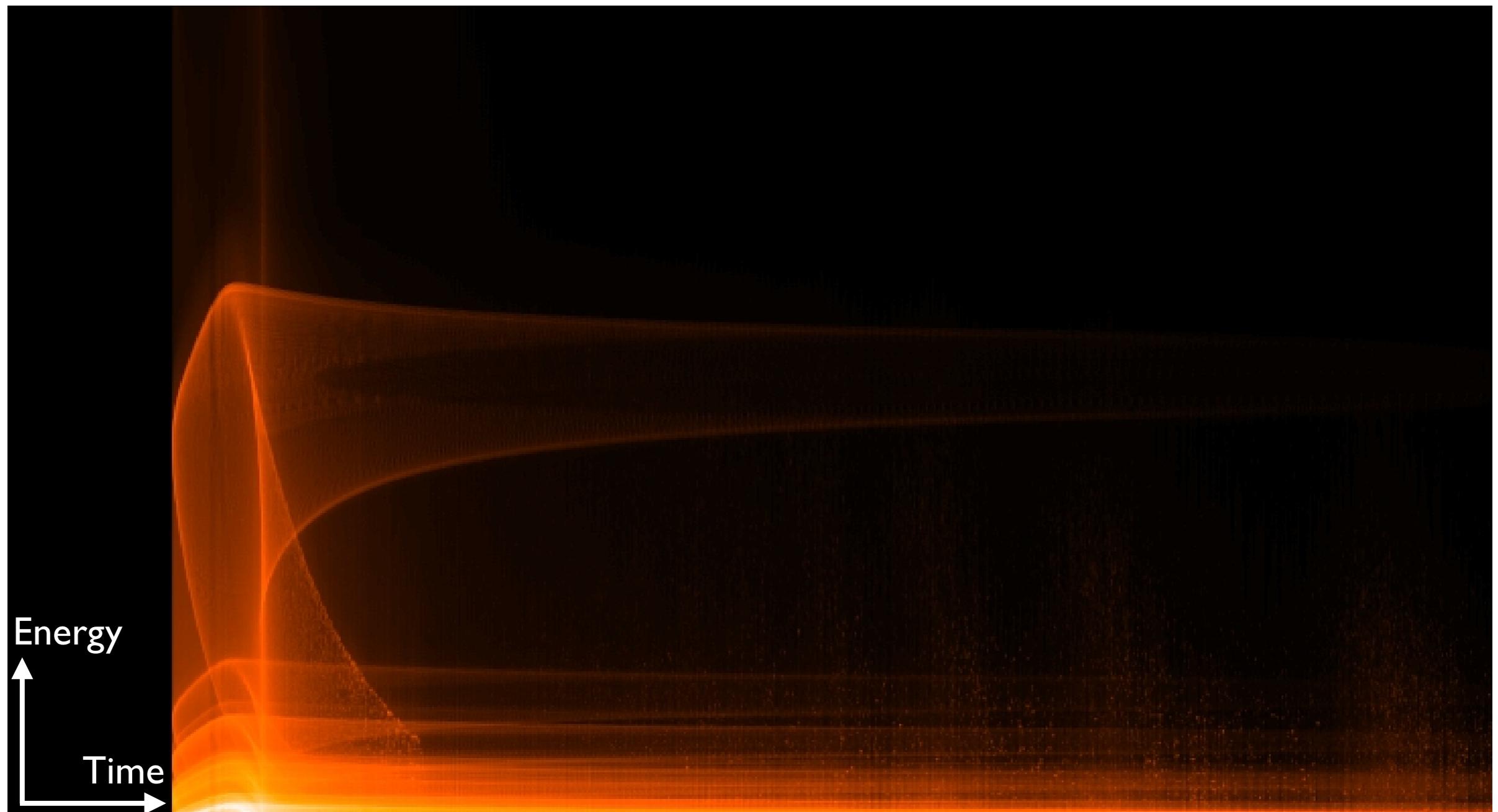


High Flux

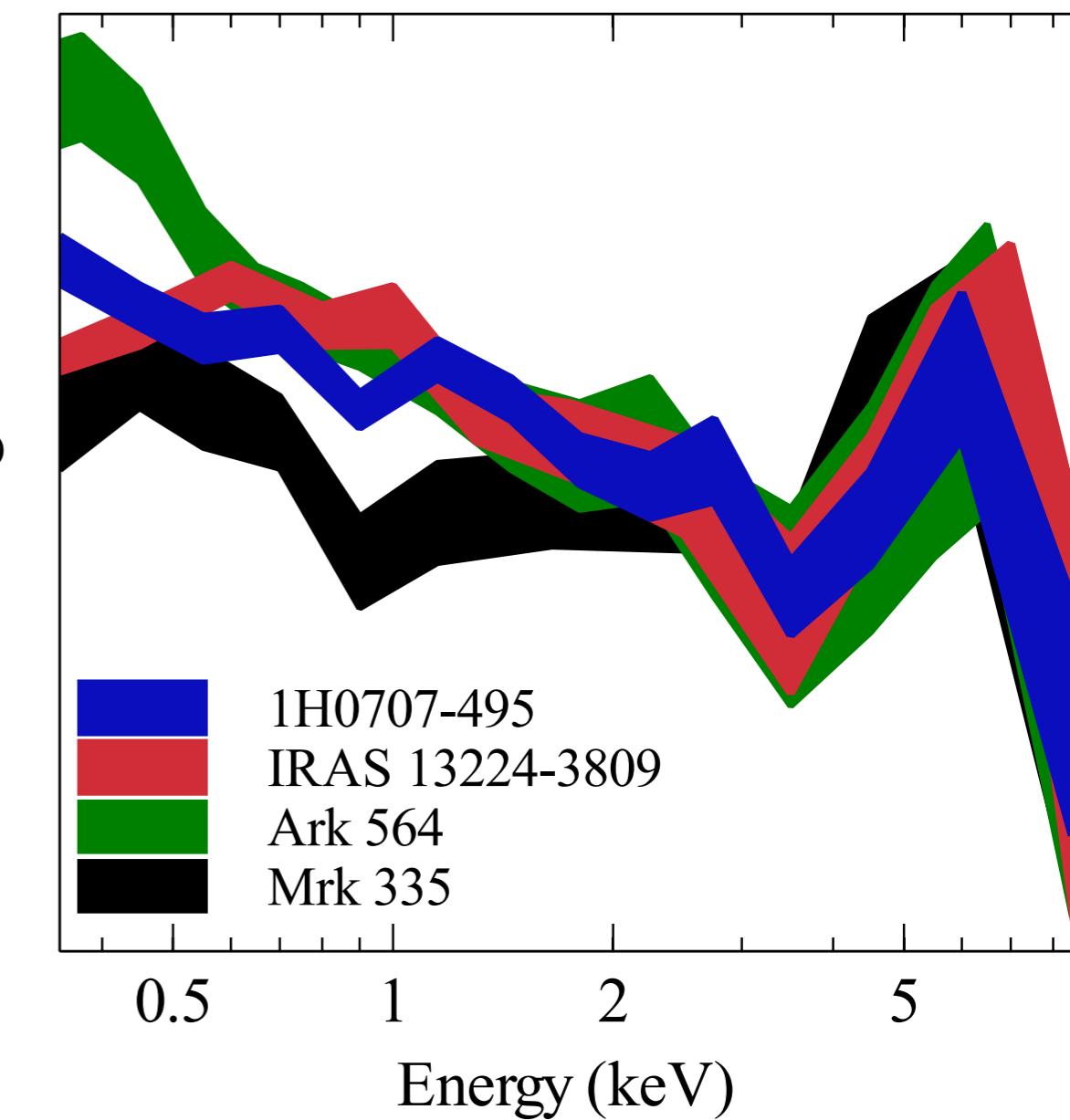
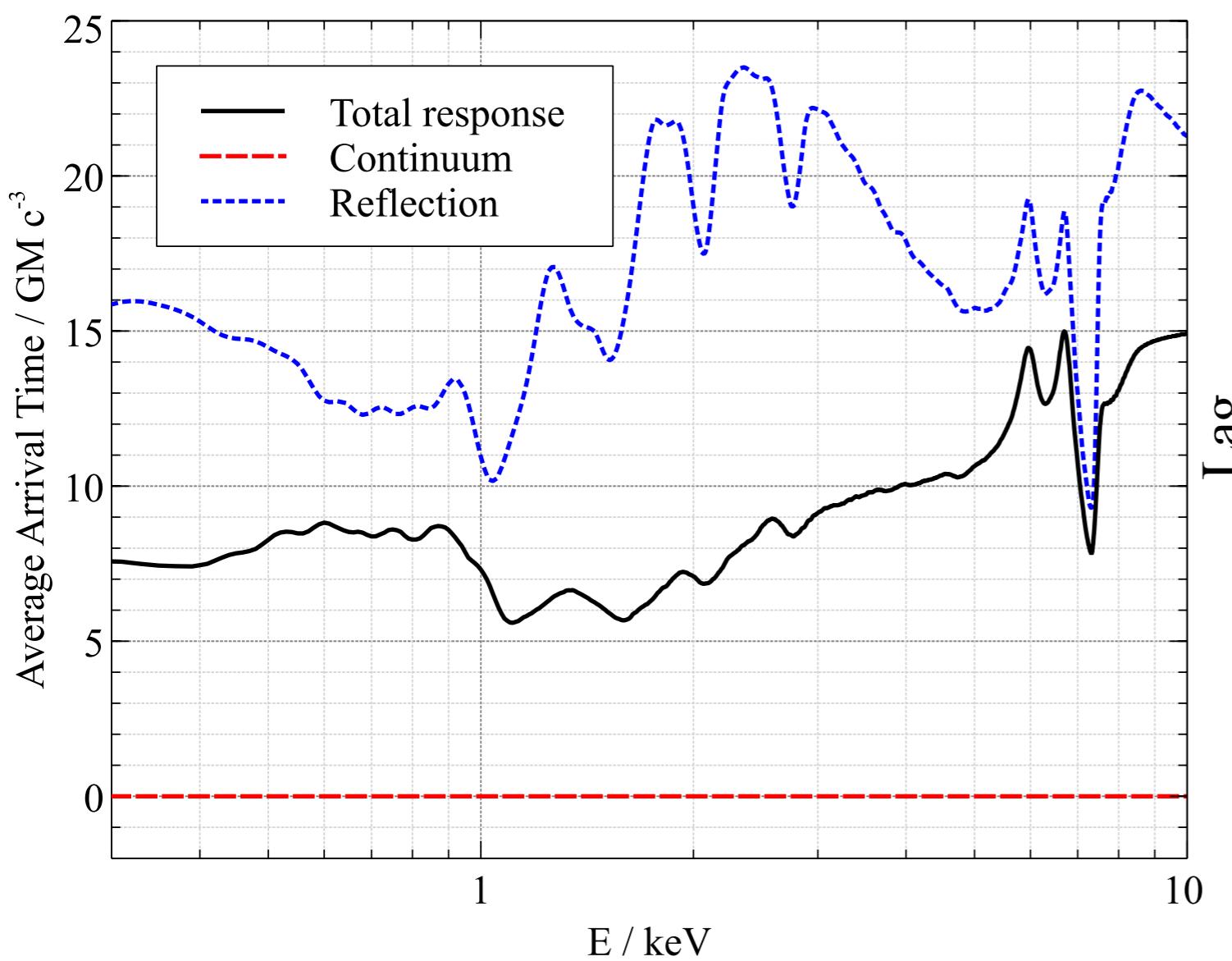
Low Flux



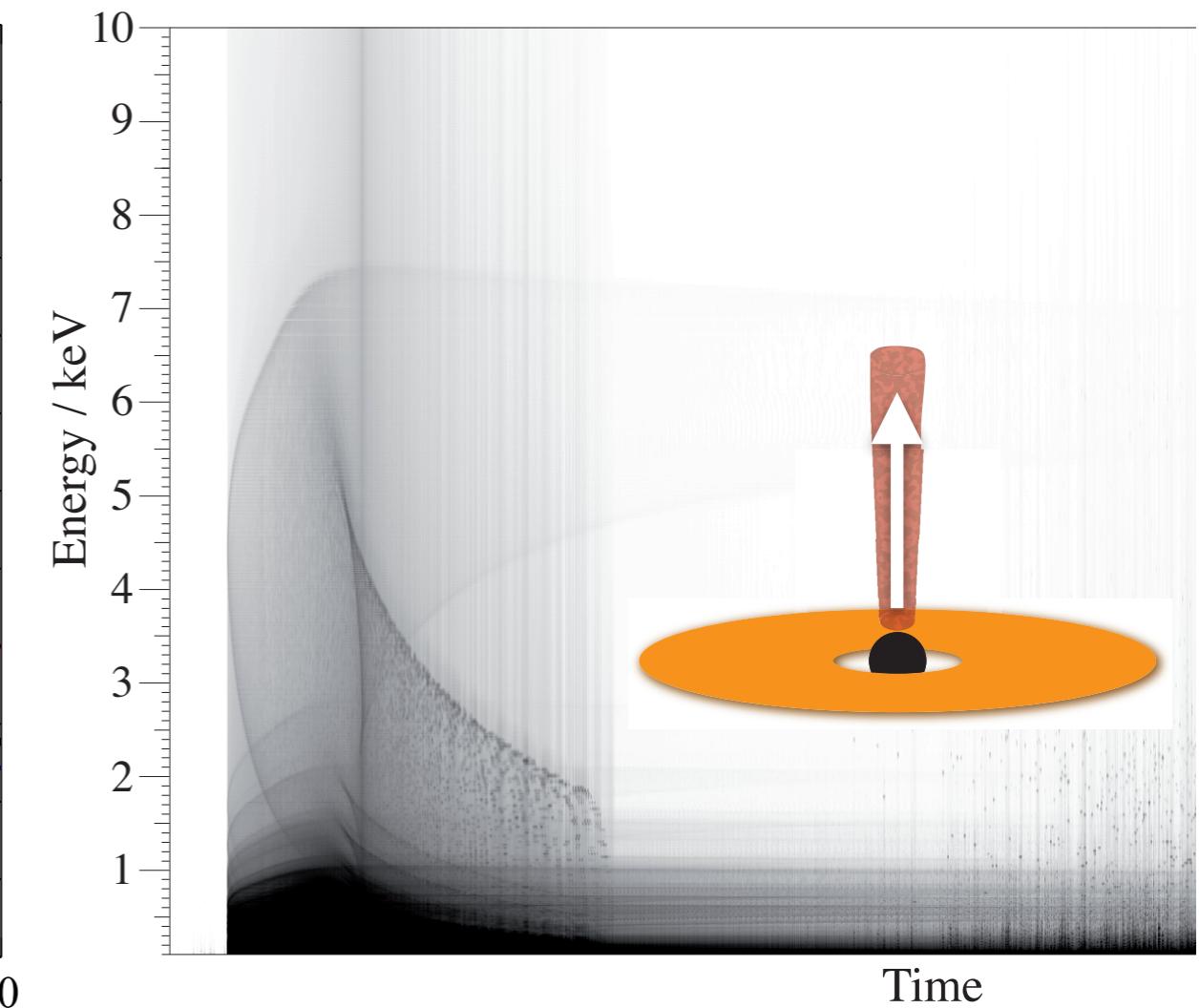
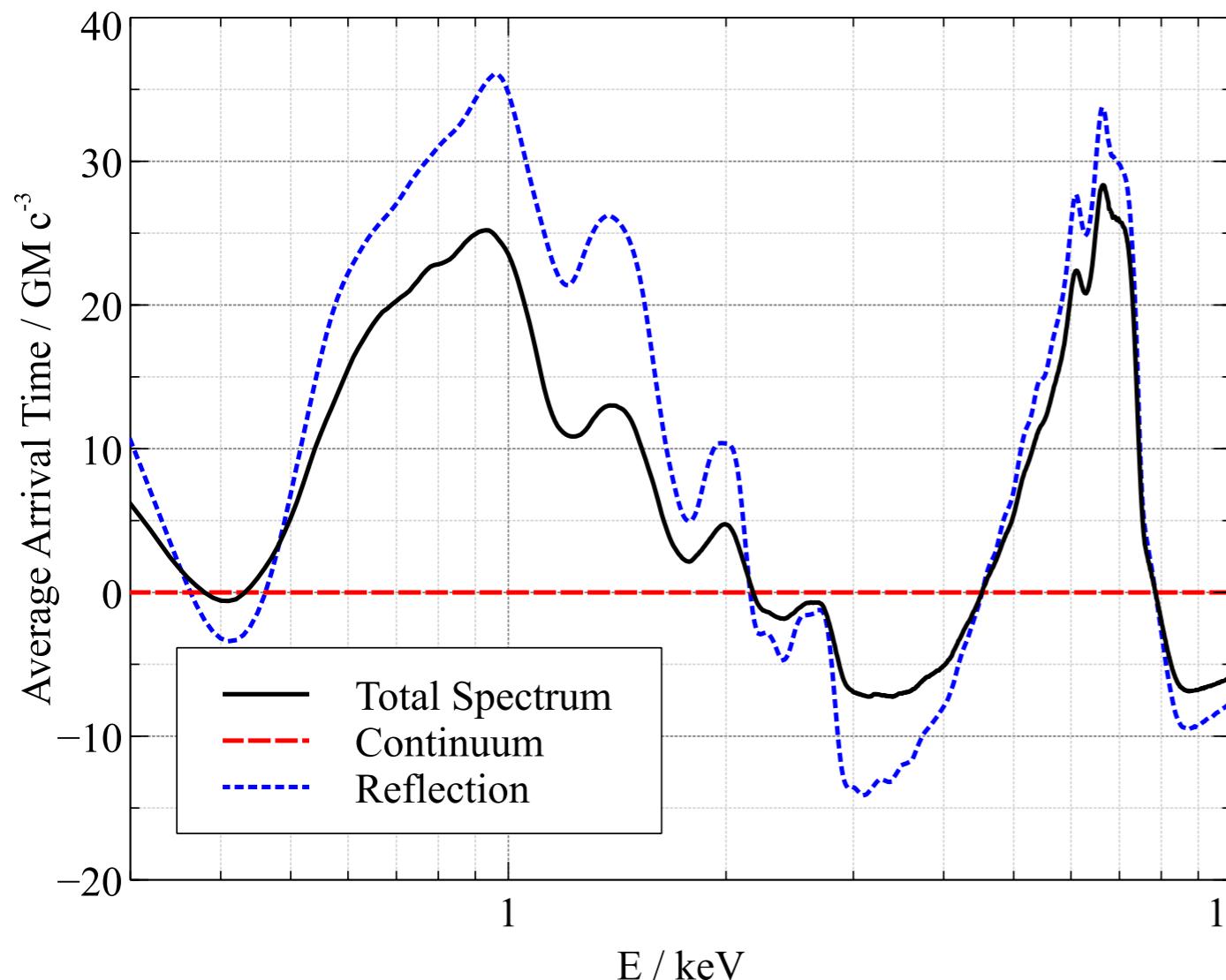
Reverberation Response



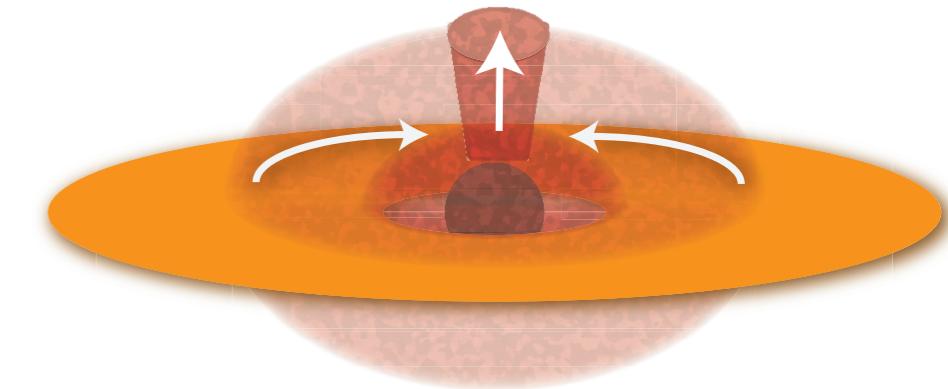
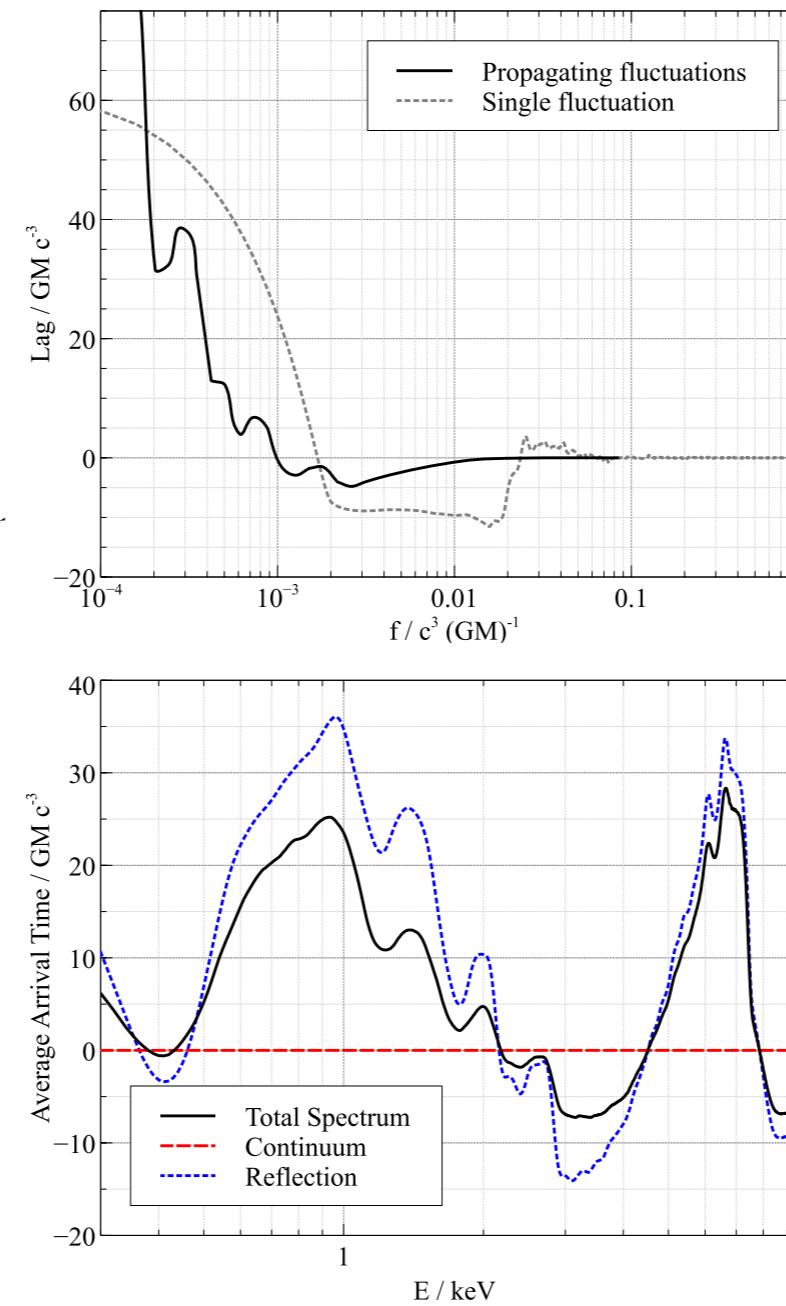
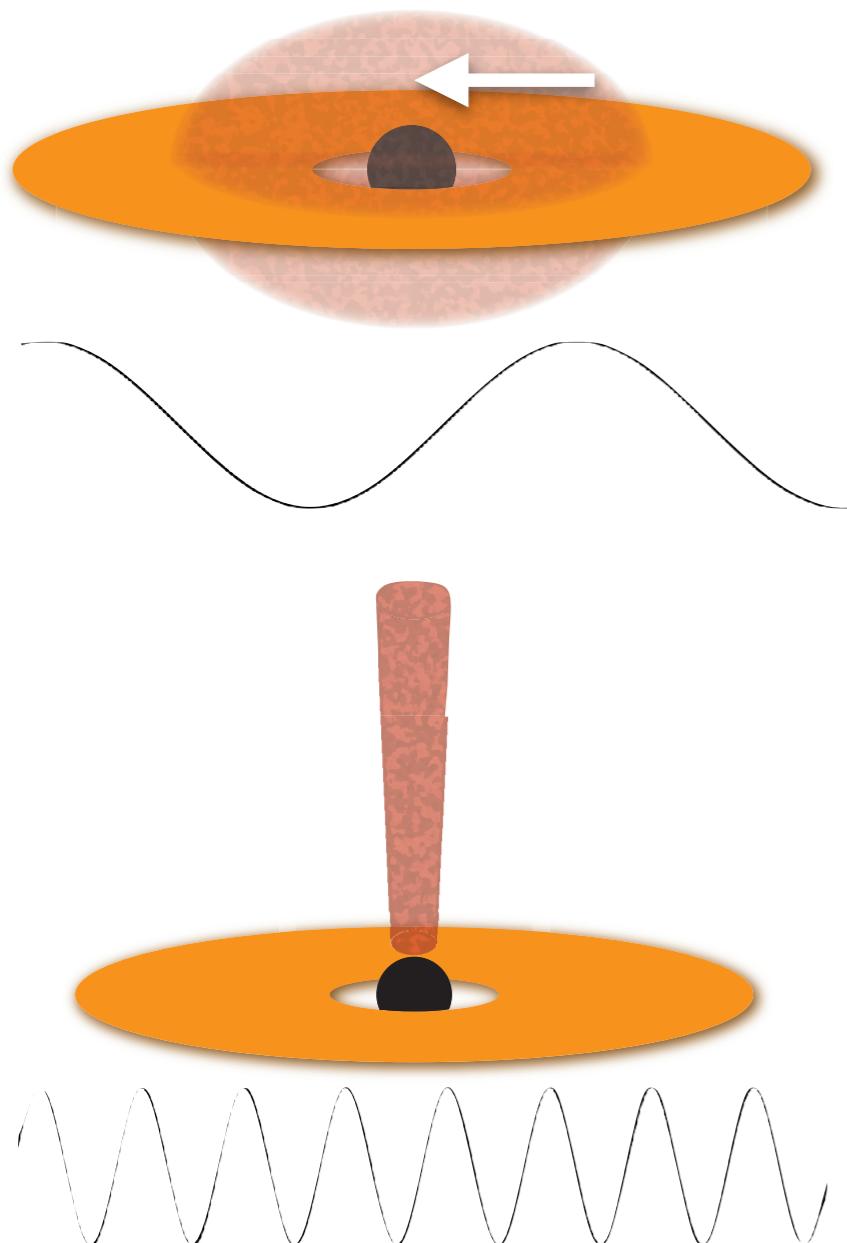
The Lag-Energy Problem



What is the dip at 3keV?

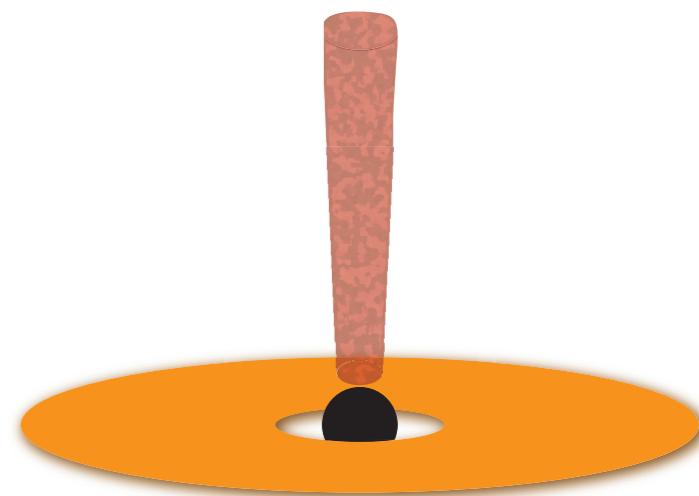
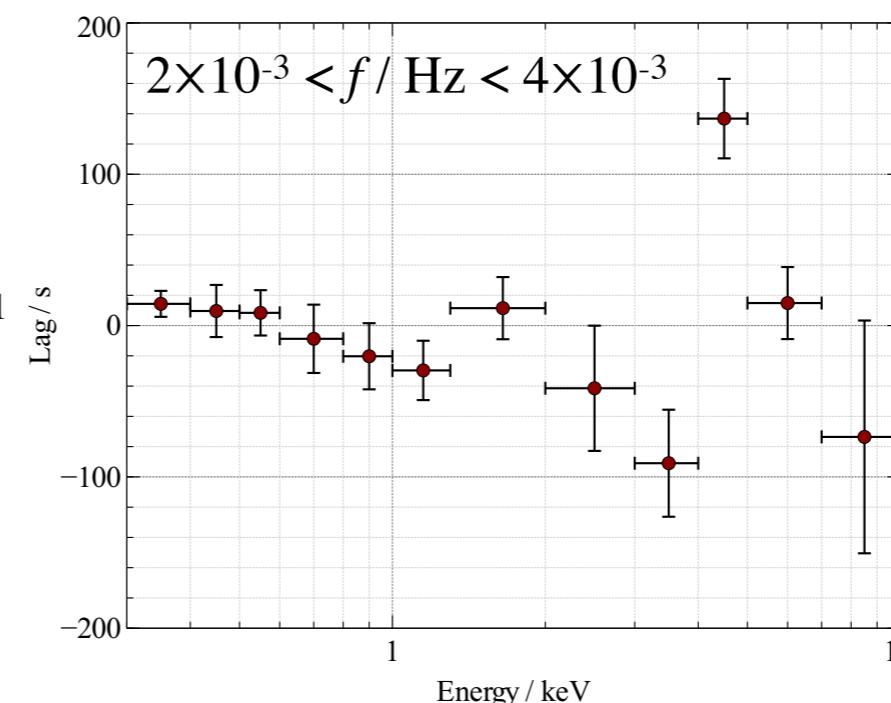
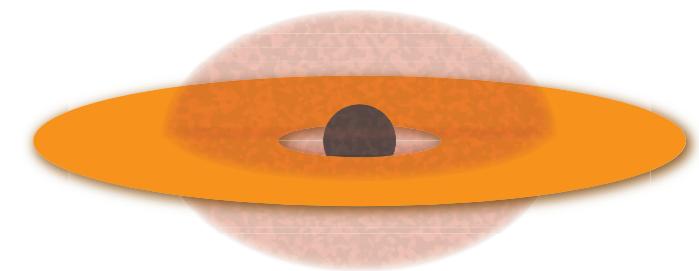
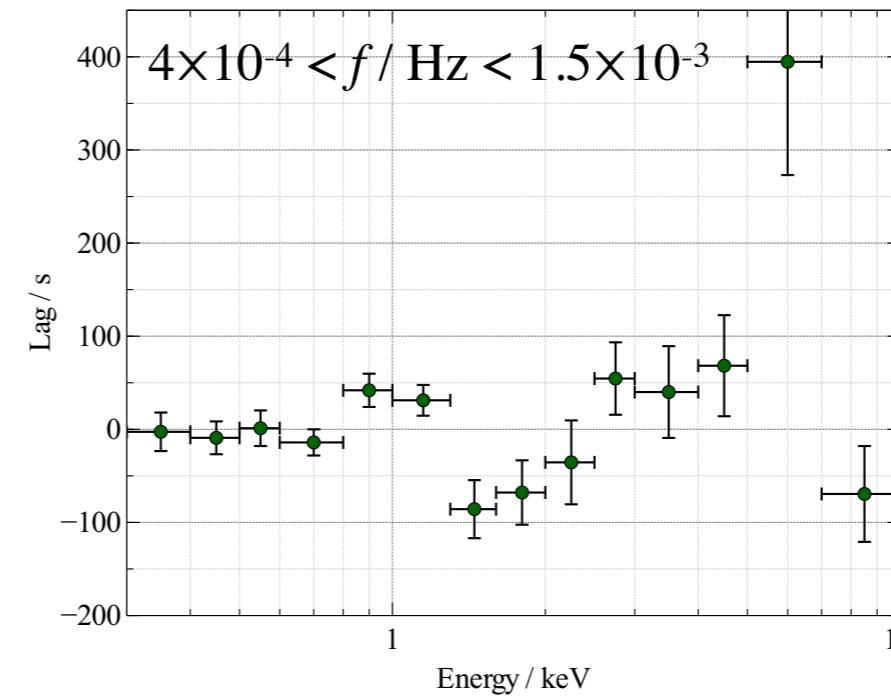
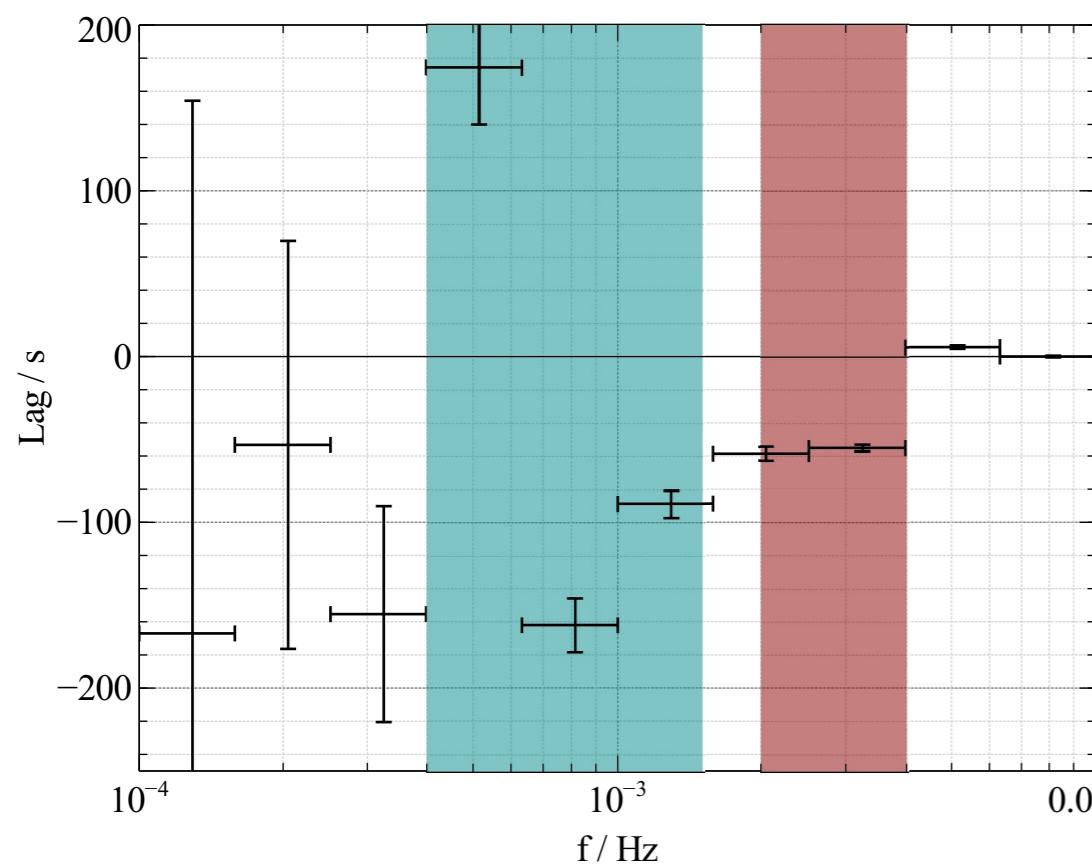


A tale of two coronae?



Seeing the structure in 1 Zw 1

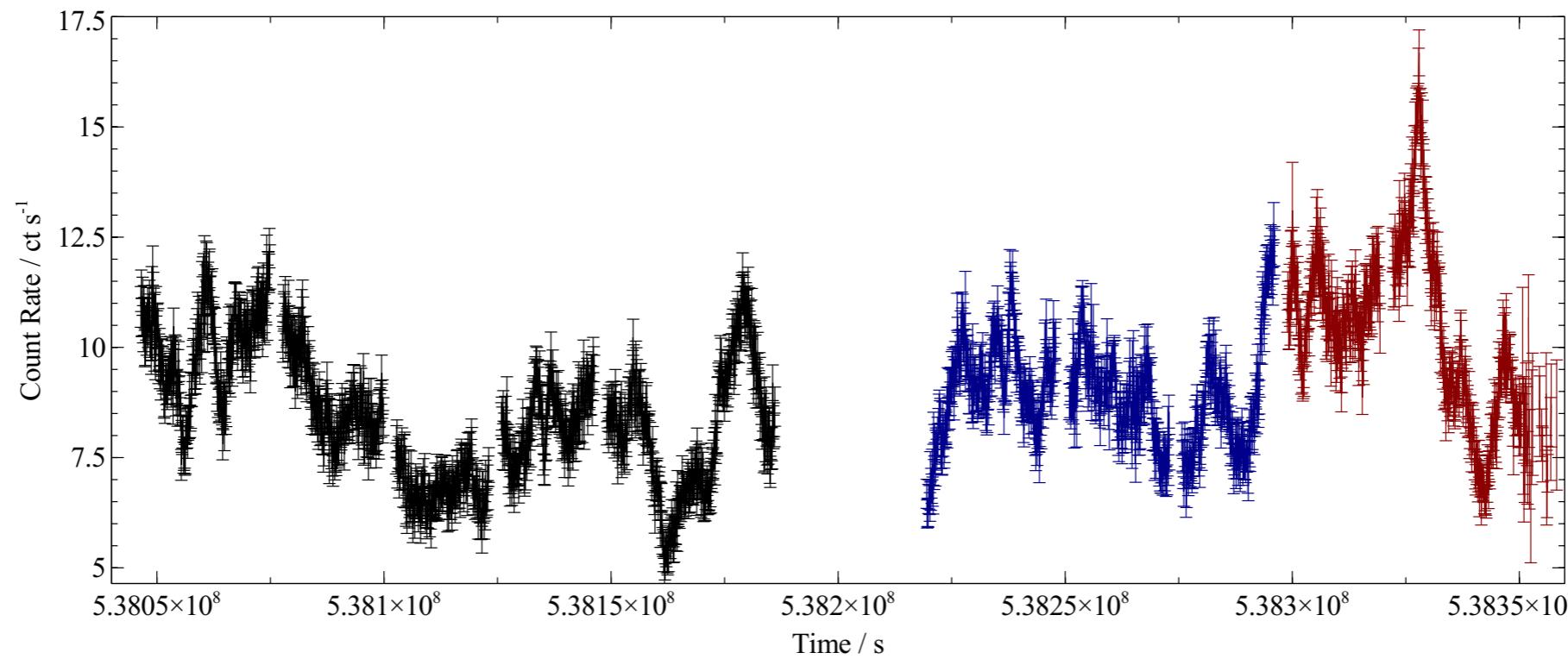
XMM Newton, January 2015
2 orbits (275ks)



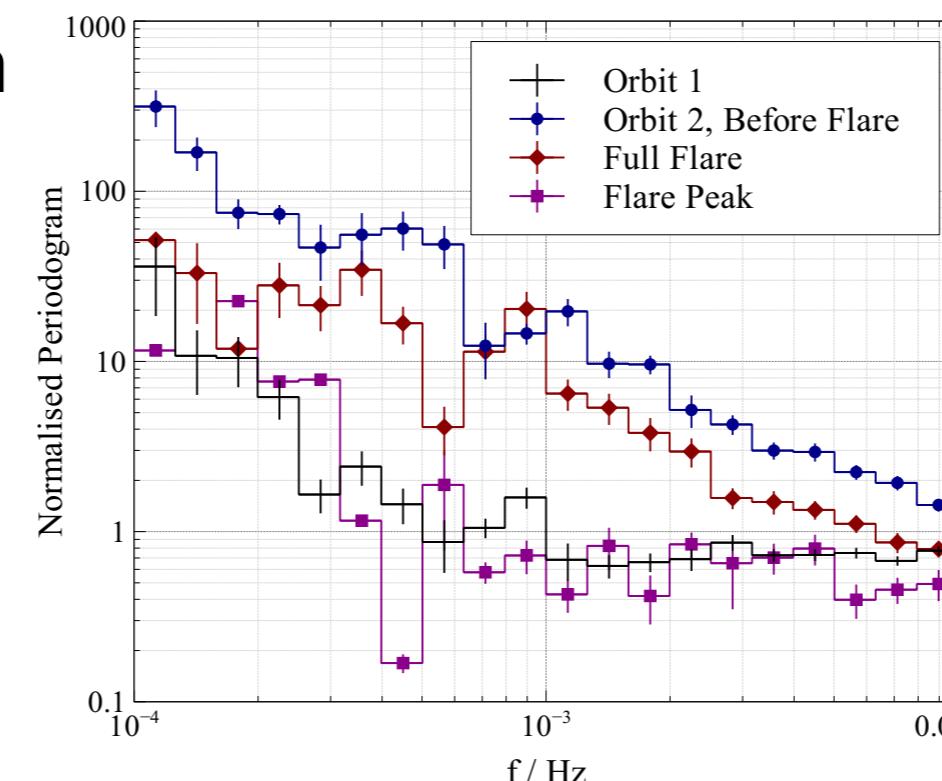
See also C. Silva talk (Fri)

Wilkins et al. submitted

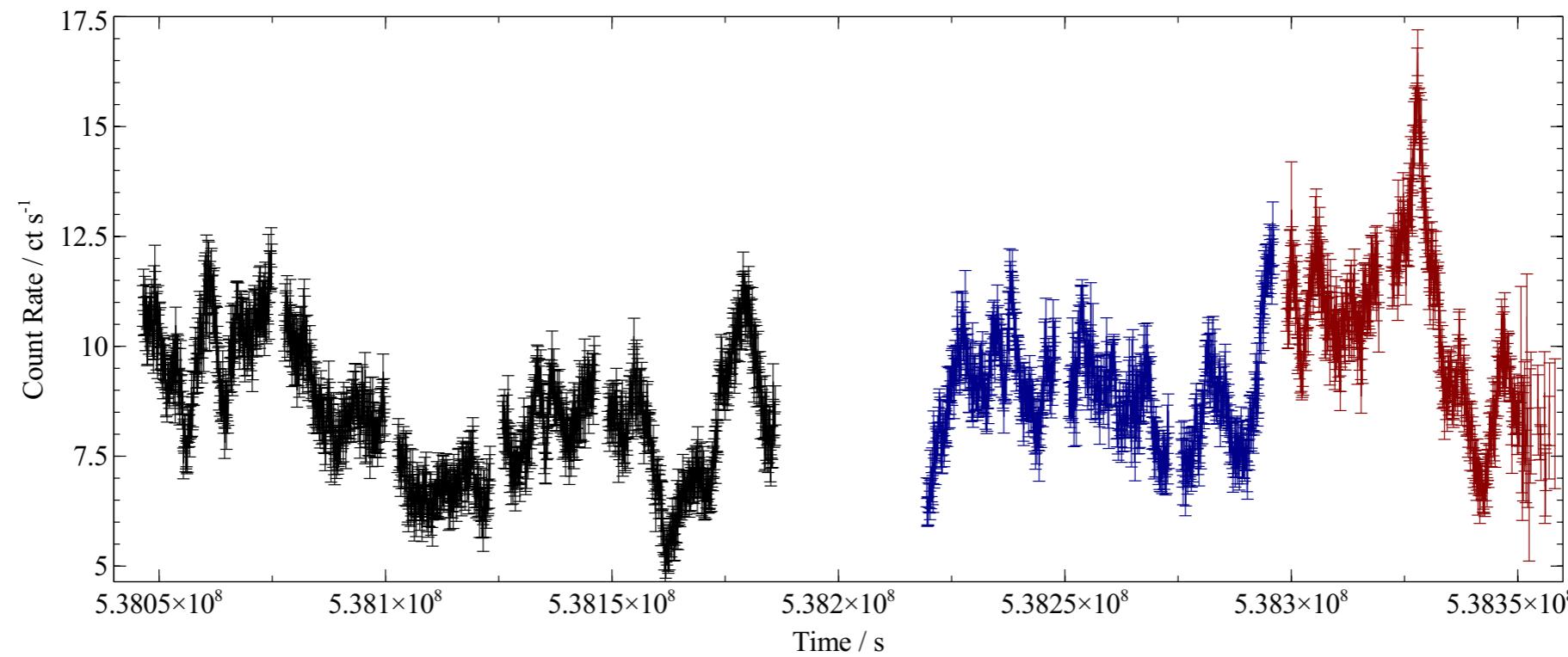
Evolution of the Corona in I Zw 1



Periodogram

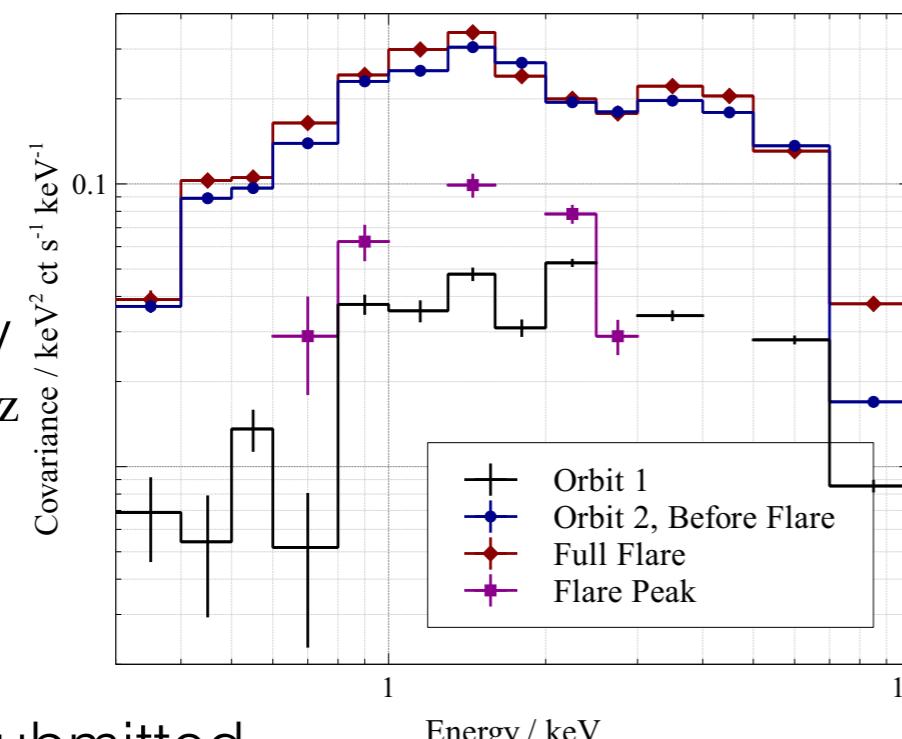


Evolution of the Corona in I Zw 1

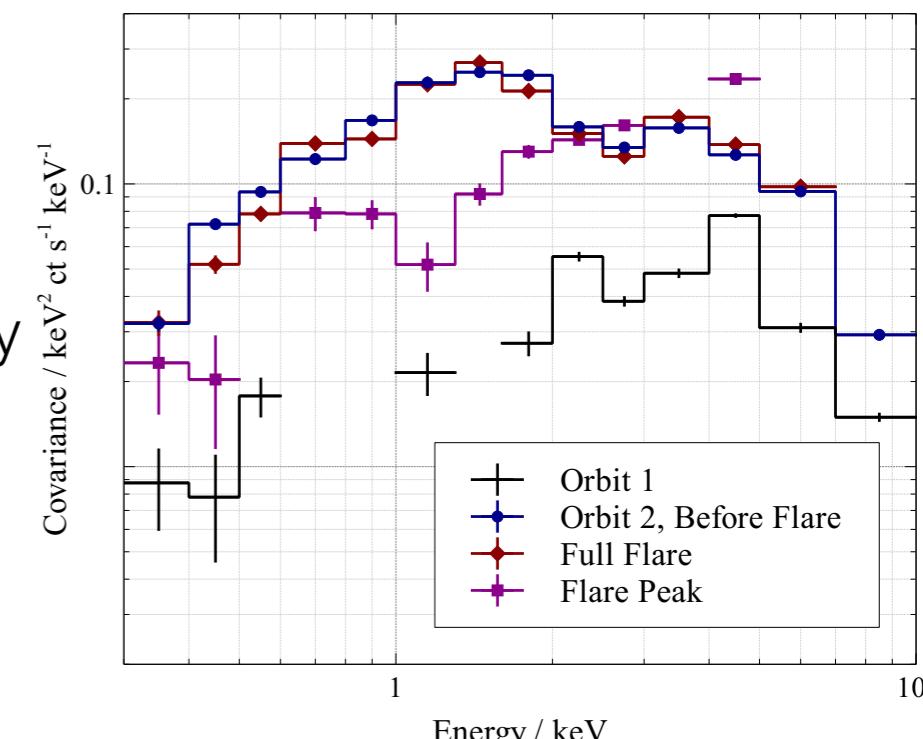


Covariance Spectrum

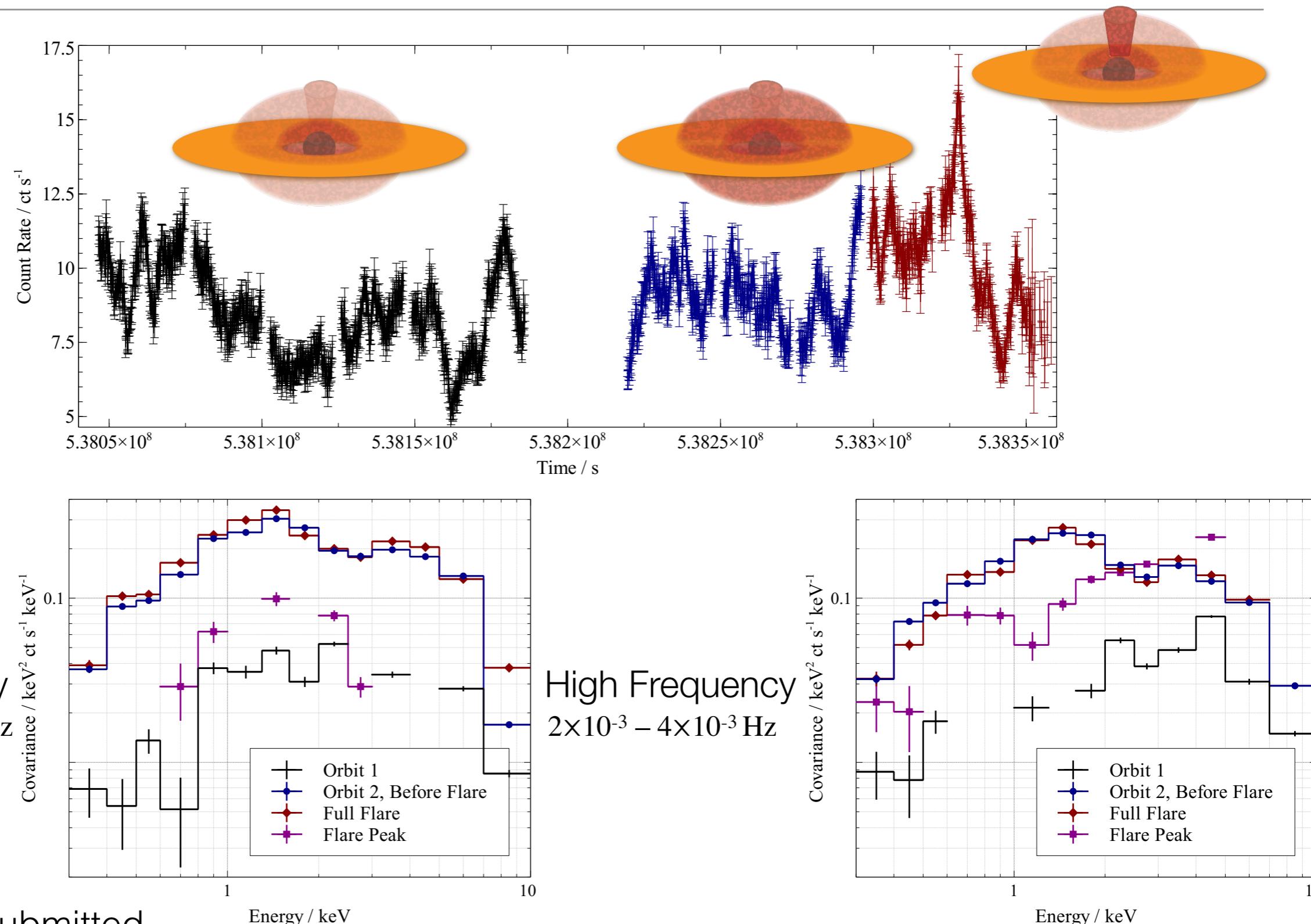
Low Frequency
 $4 \times 10^{-4} - 1.5 \times 10^{-3} \text{ Hz}$



High Frequency
 $2 \times 10^{-3} - 4 \times 10^{-3} \text{ Hz}$



Evolution of the Corona in I Zw 1



Summary

dan.wilkins@stanford.edu

- X-ray reflection and reverberation reveals structure right down to the innermost stable orbit and even the event horizon
- Starting to see evidence of a persistent collimated core within an extended corona – the base of a (failed) jet?
- Flare begins as an increase in variability of the accretion disc corona before the X-ray count rate increases, then propagates inwards from the disc corona to the core. Core causes a second, more sudden, increase in count rate
- Understand the physics of the corona, how it is powered by the accretion flow and how jets are launched