

The Power Within

Revealing structure, flaring and jet launching in the coronae of Seyfert galaxies

Dan Wilkins, Stanford University/KIPAC
Einstein Fellows' Symposium 2016

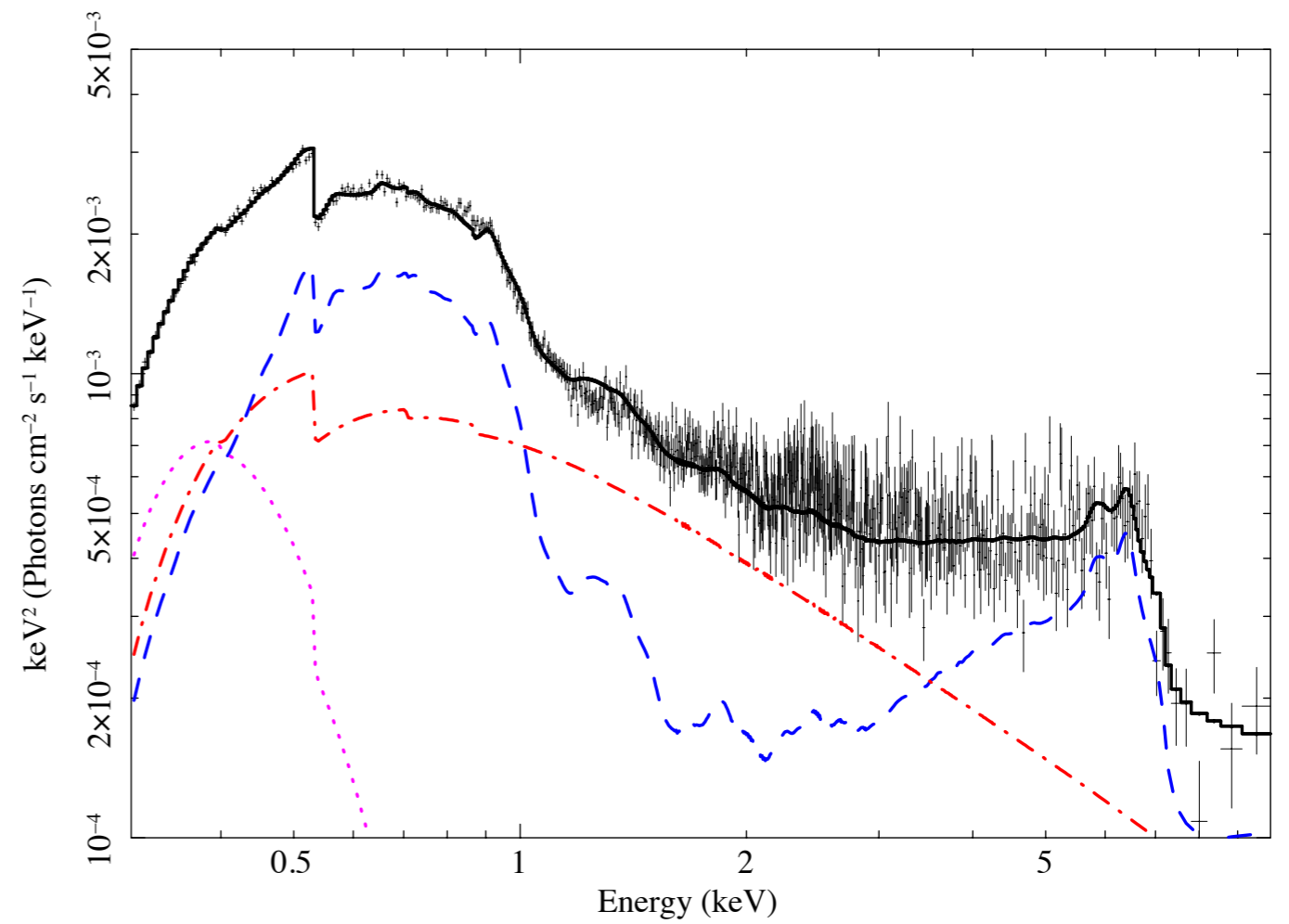
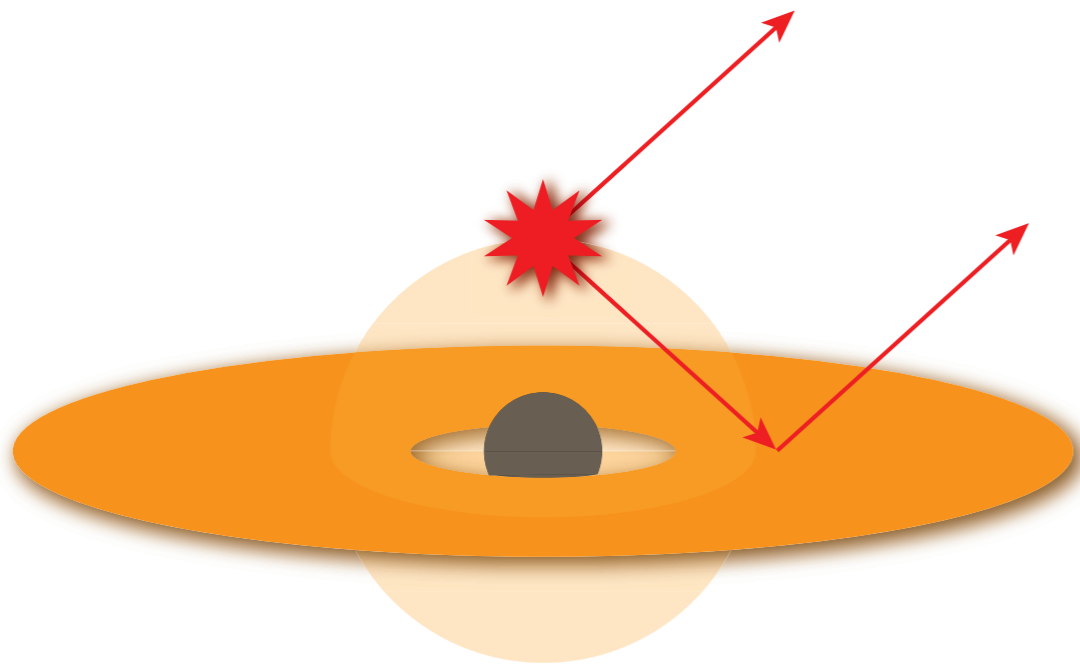


Outline

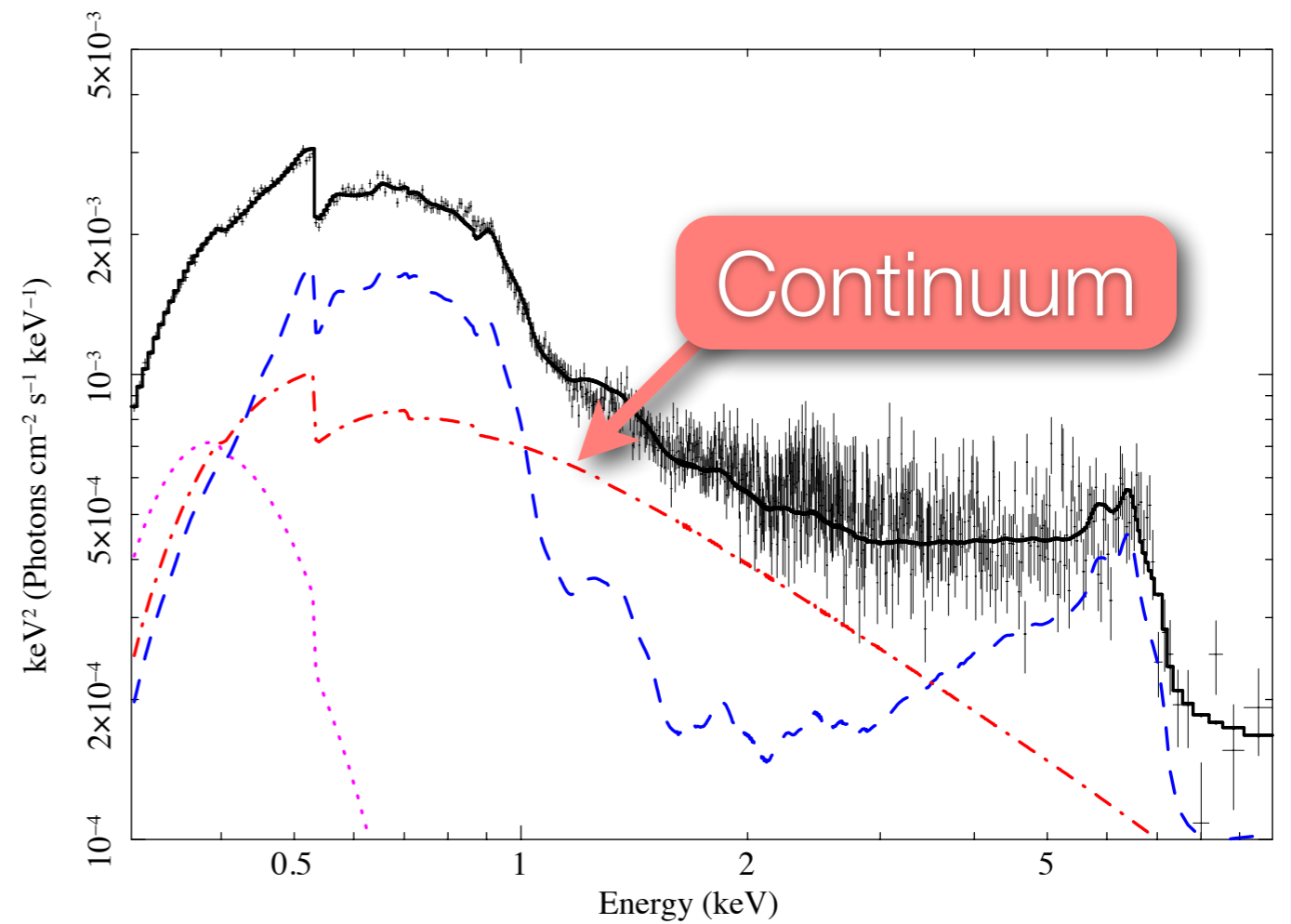
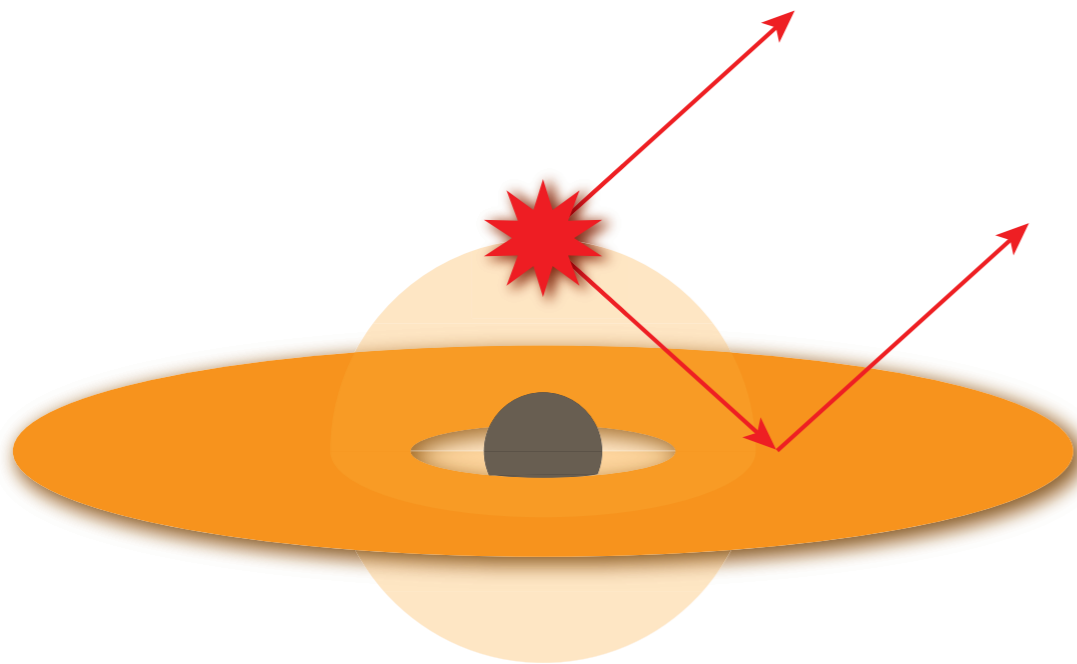
- Measuring the corona with X-ray reflection and reverberation – bringing together theory and observation
- Understanding variability in the corona – clues to the process powering the emission
- Probing structure within the corona

Measuring the Corona

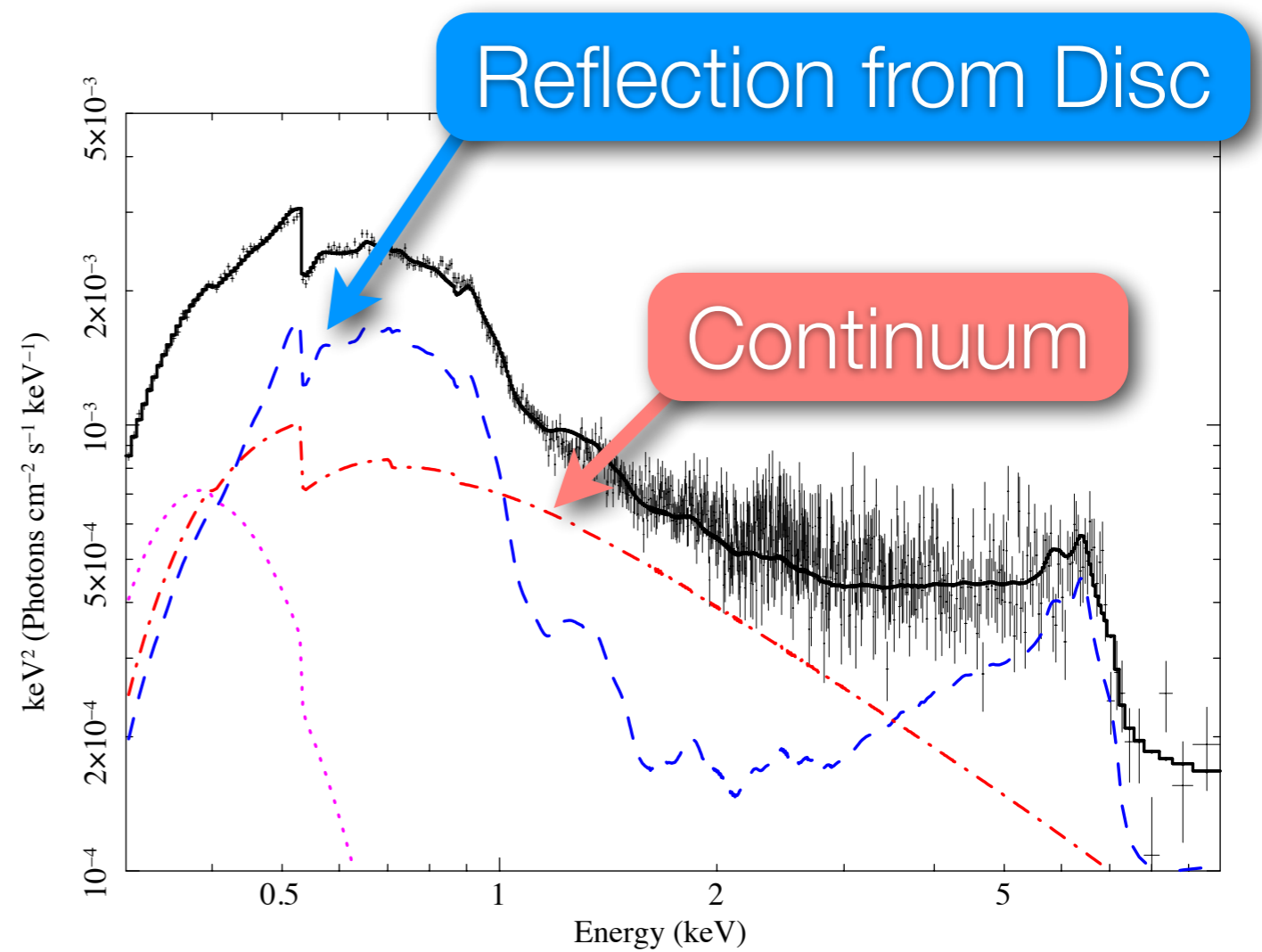
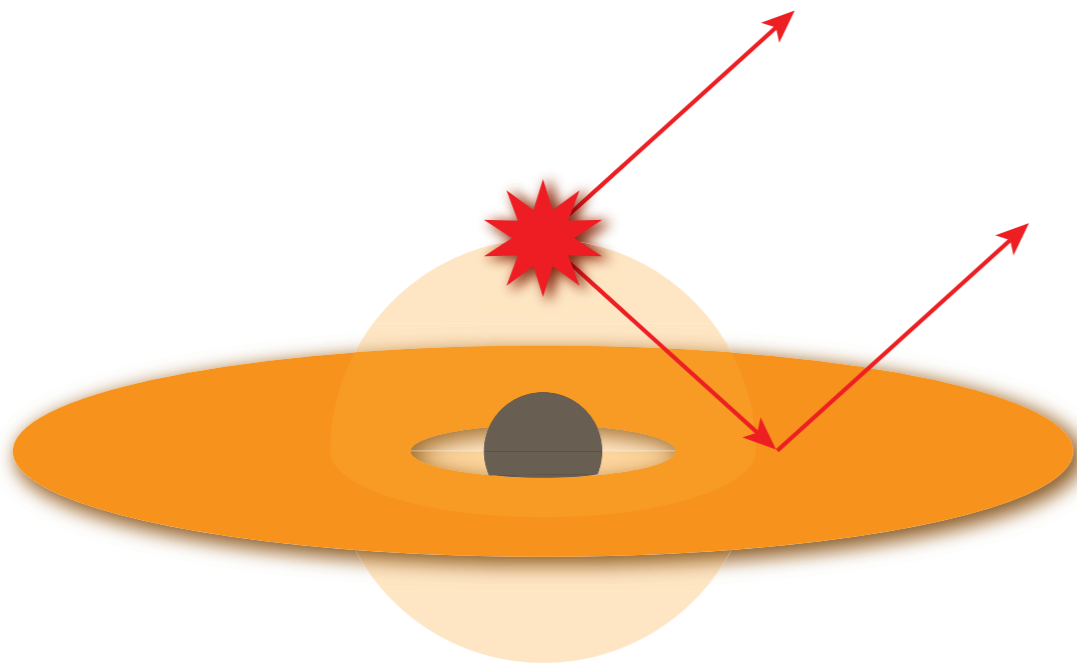
X-ray Reflection



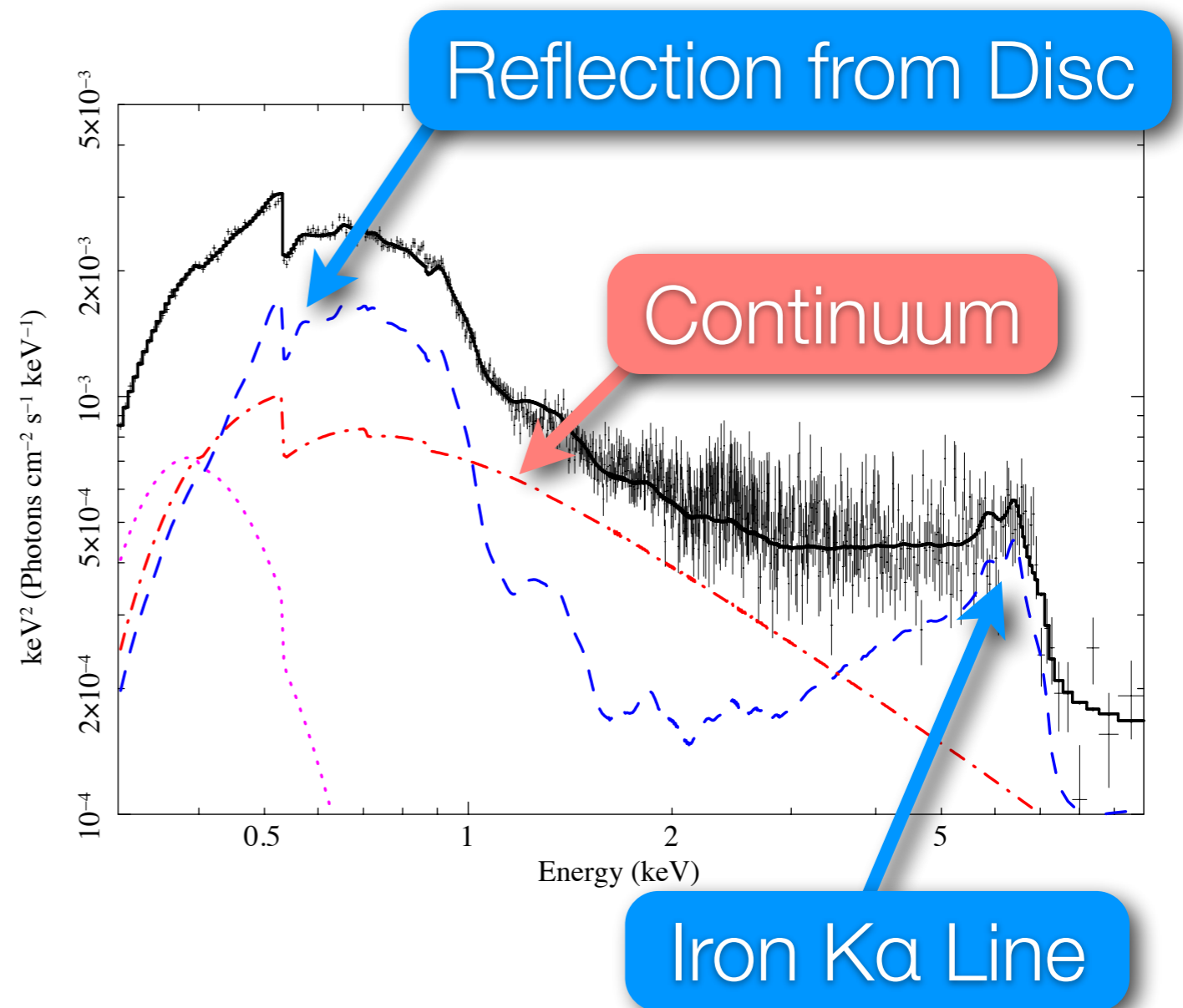
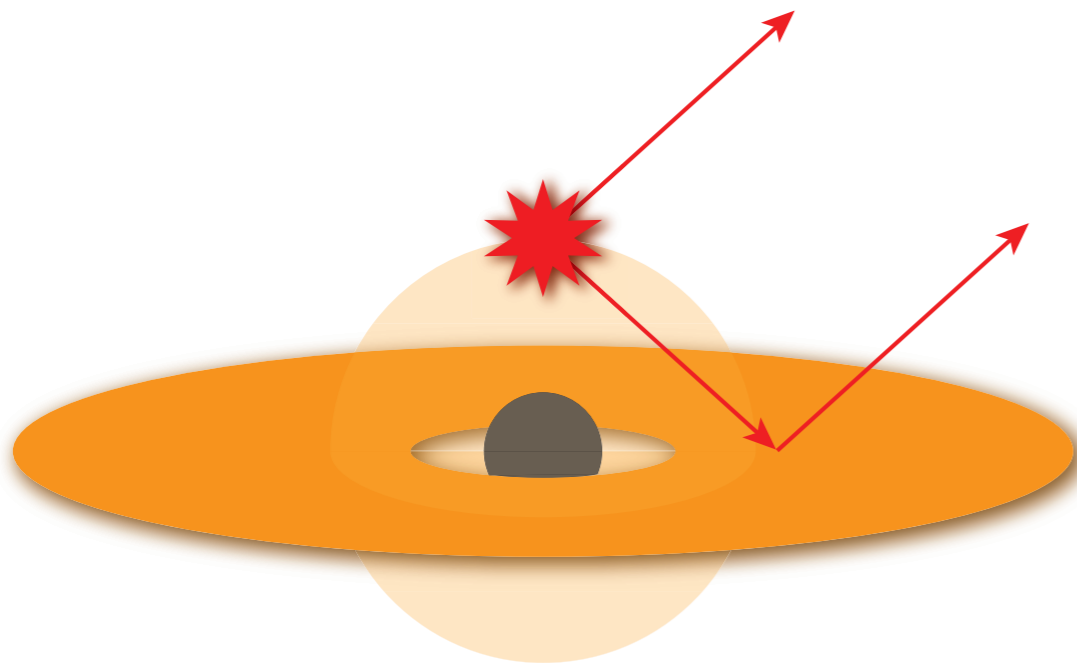
X-ray Reflection

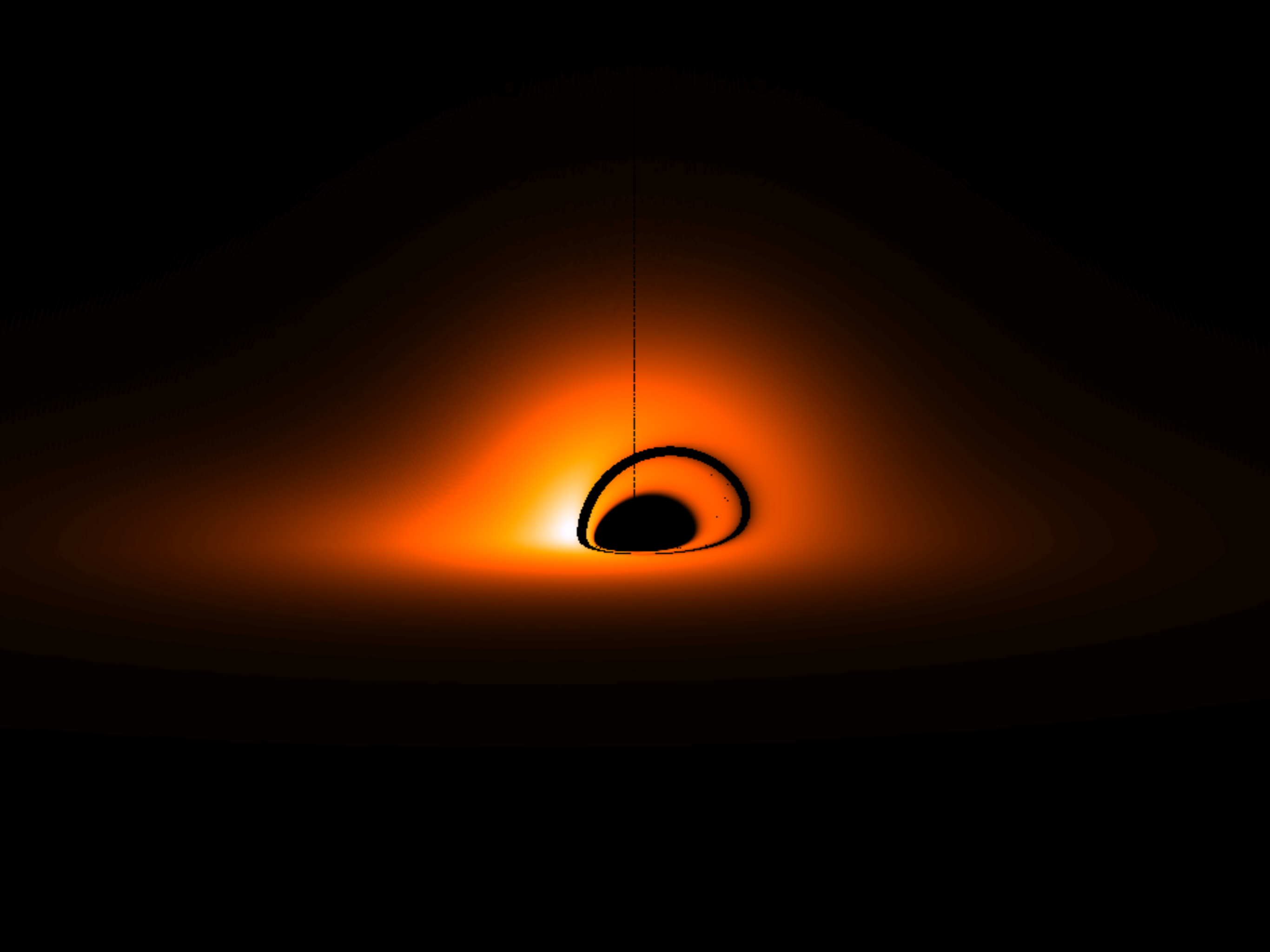


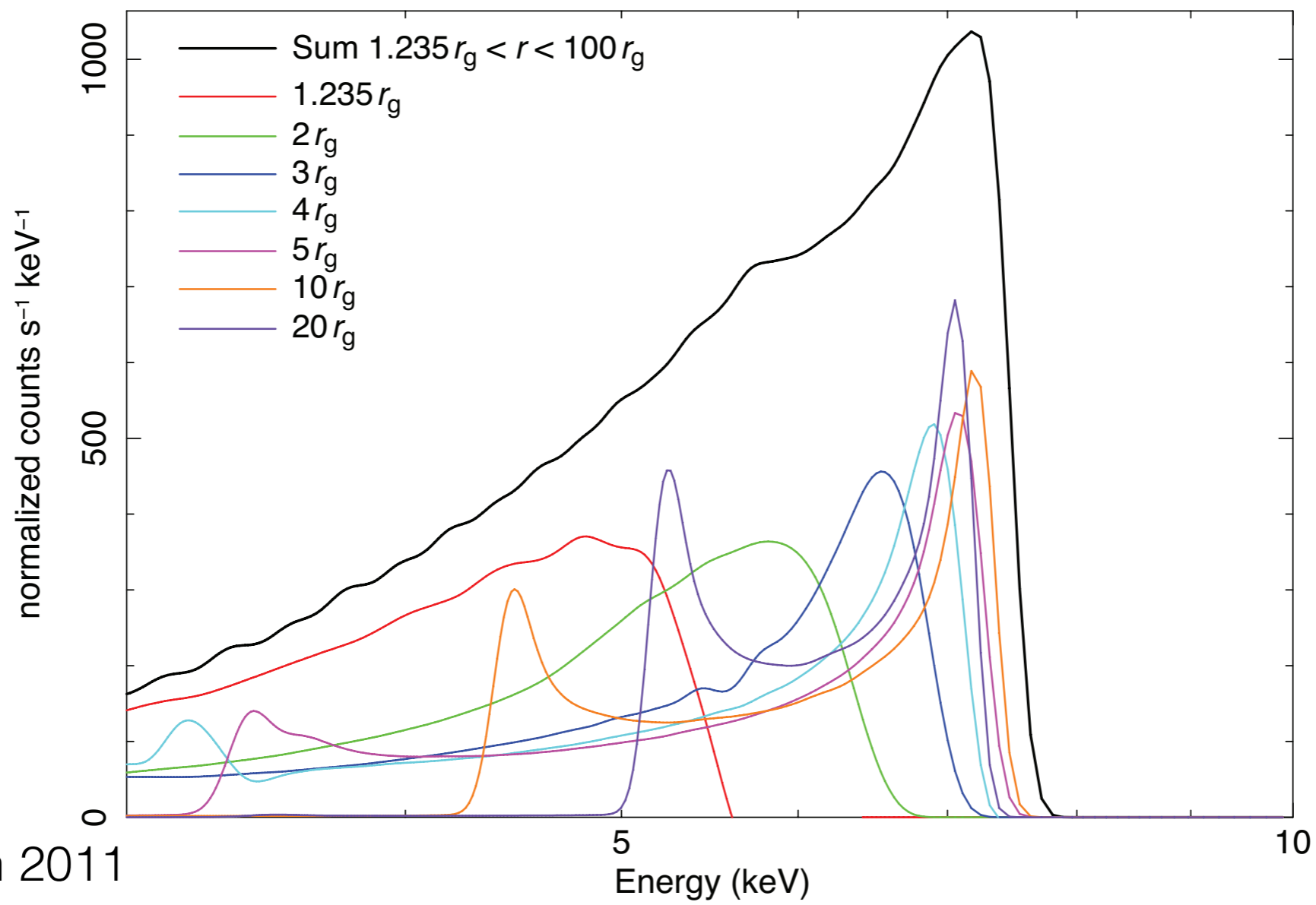
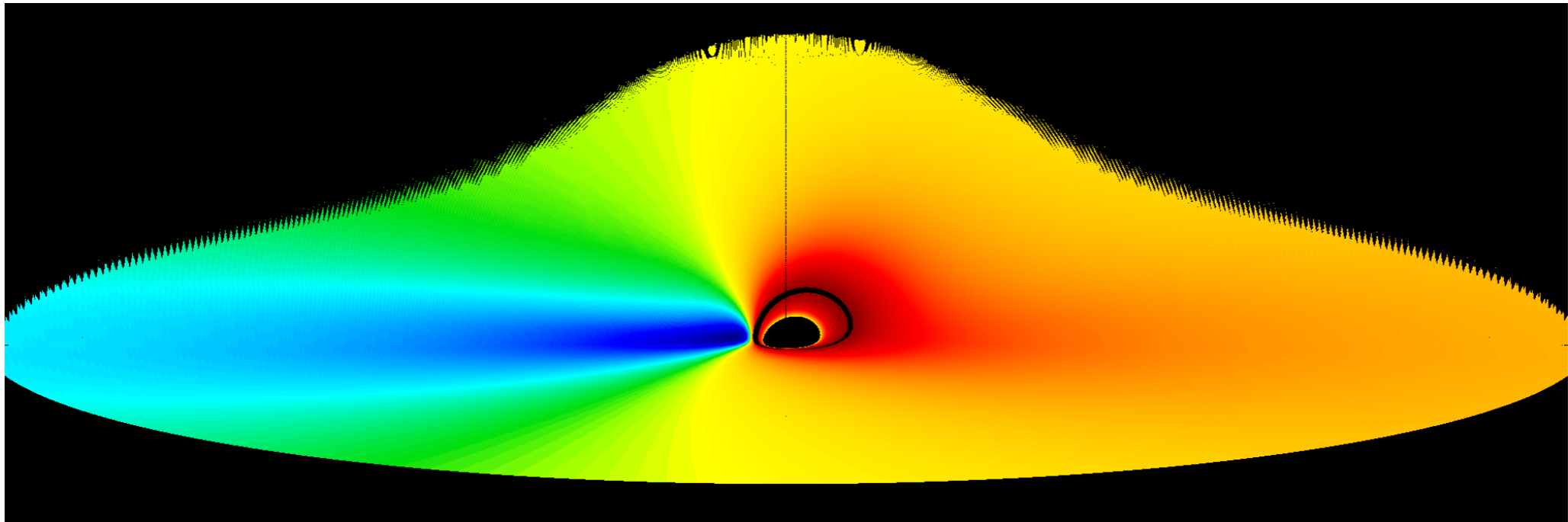
X-ray Reflection



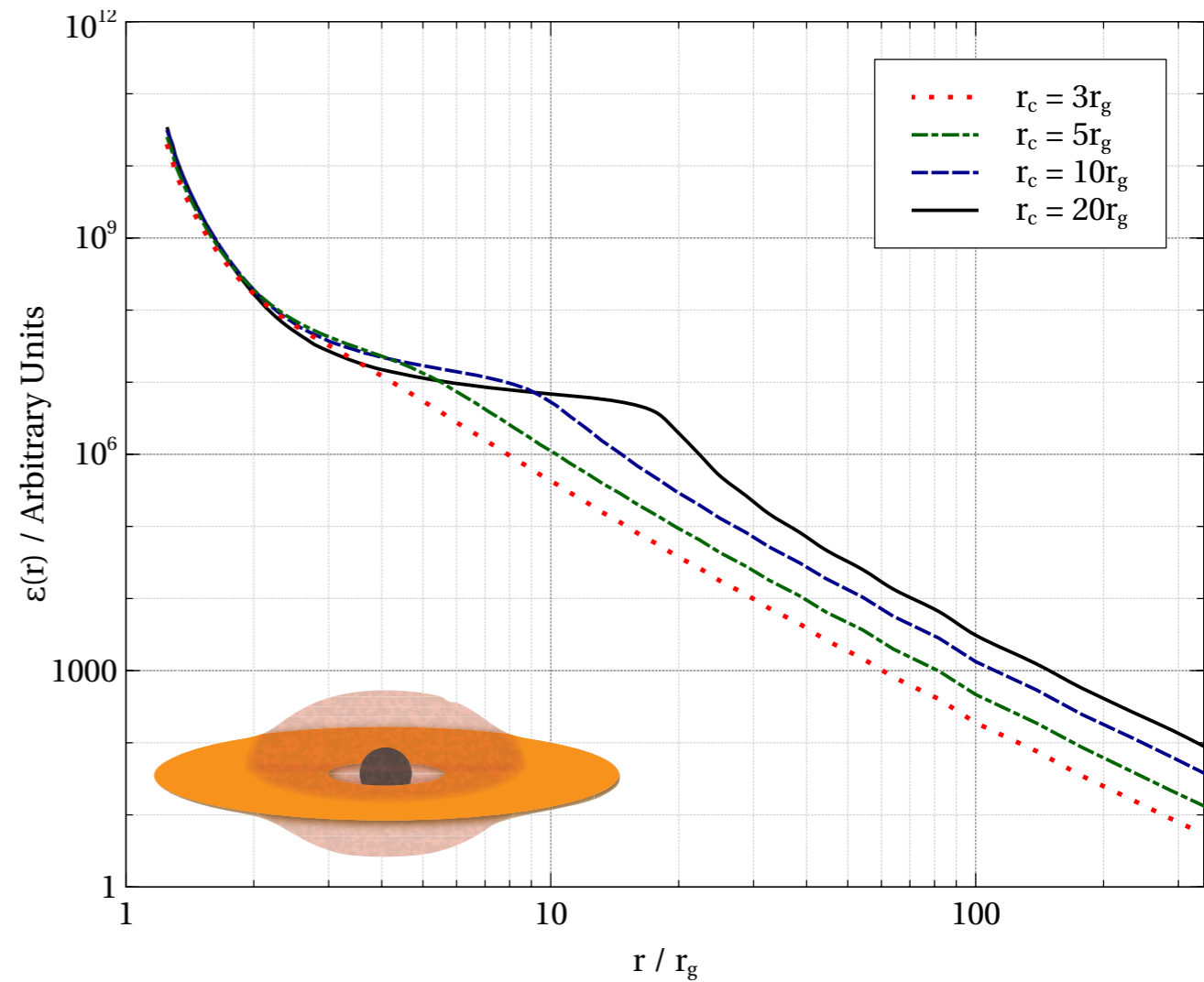
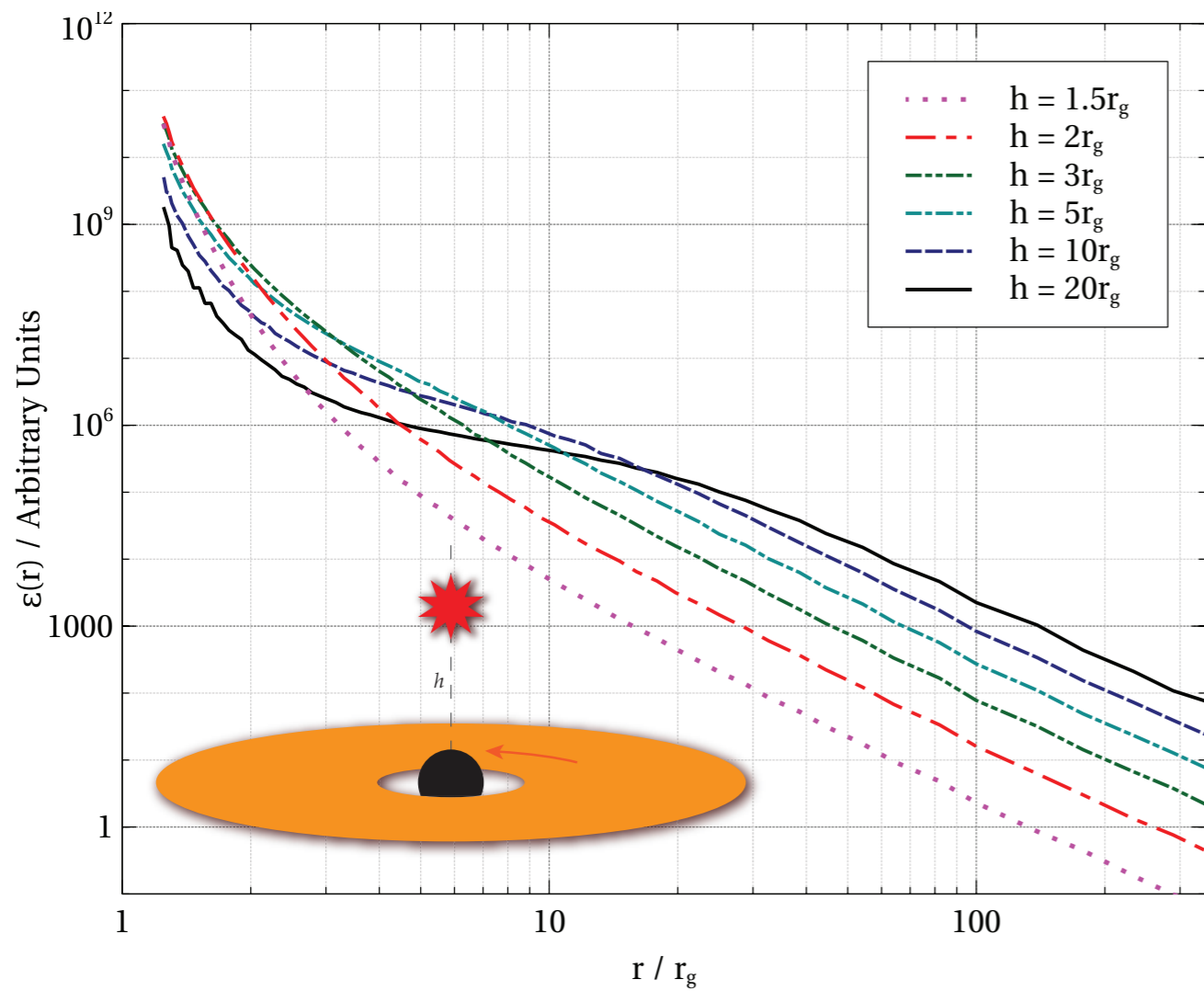
X-ray Reflection



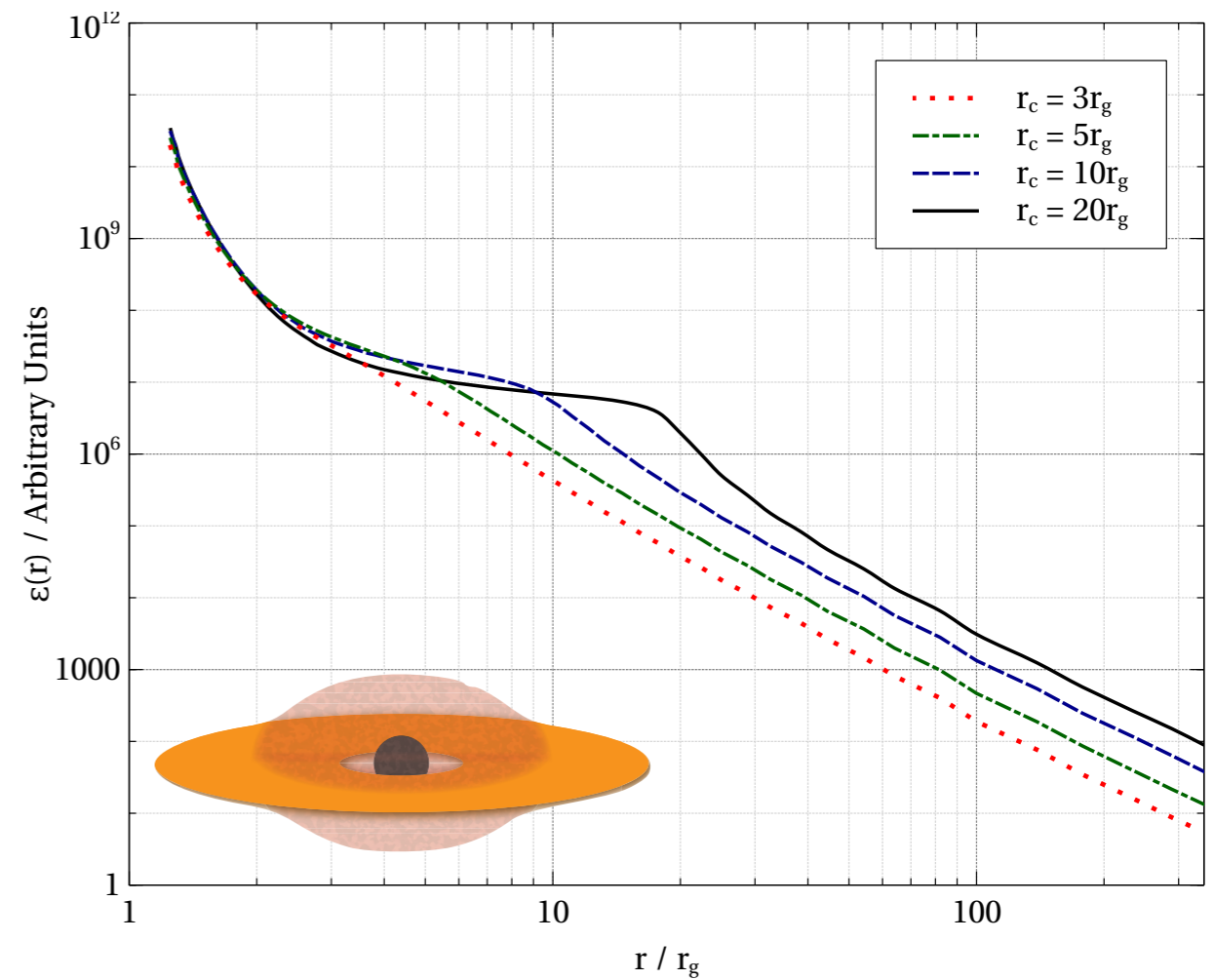
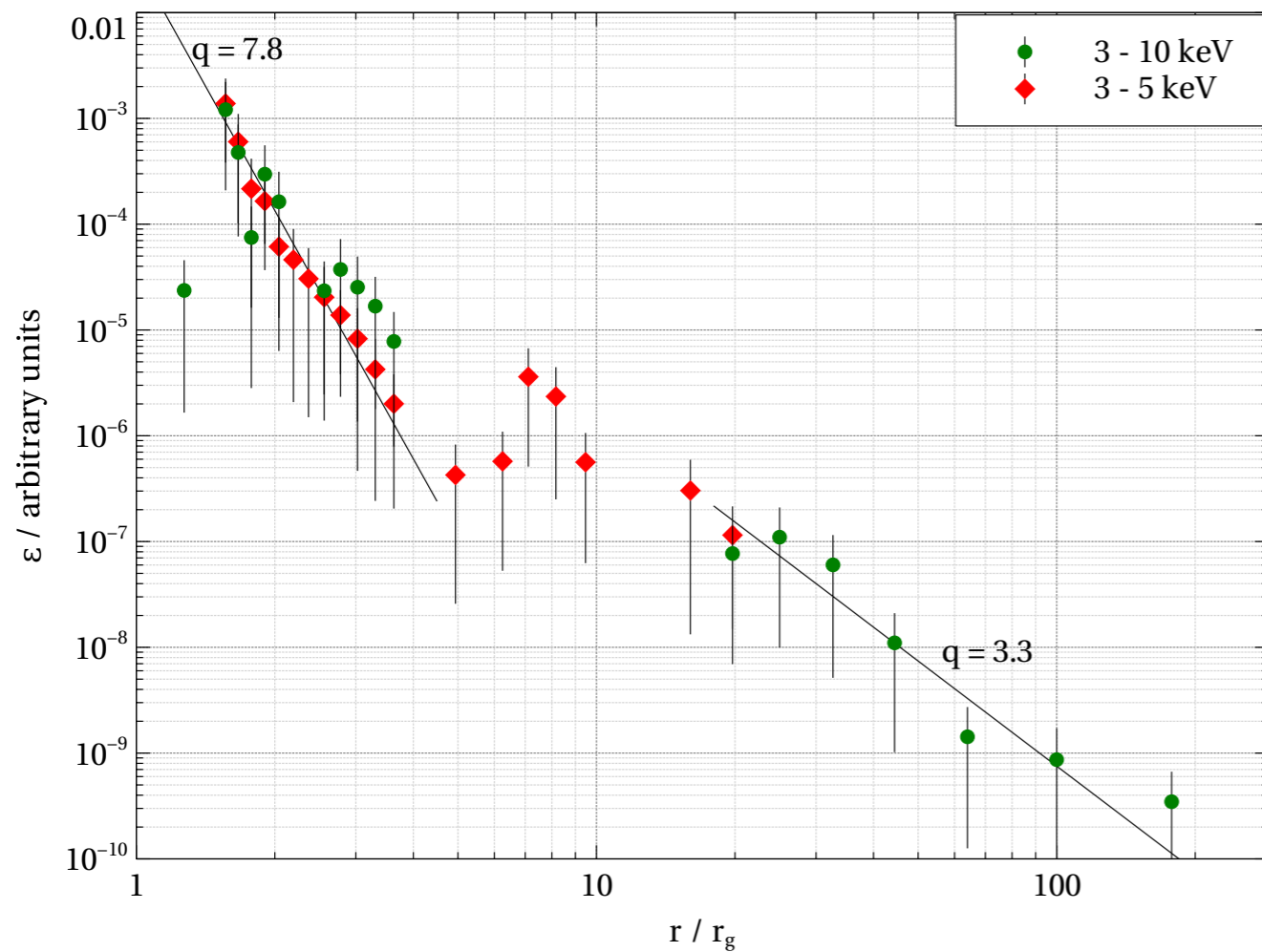




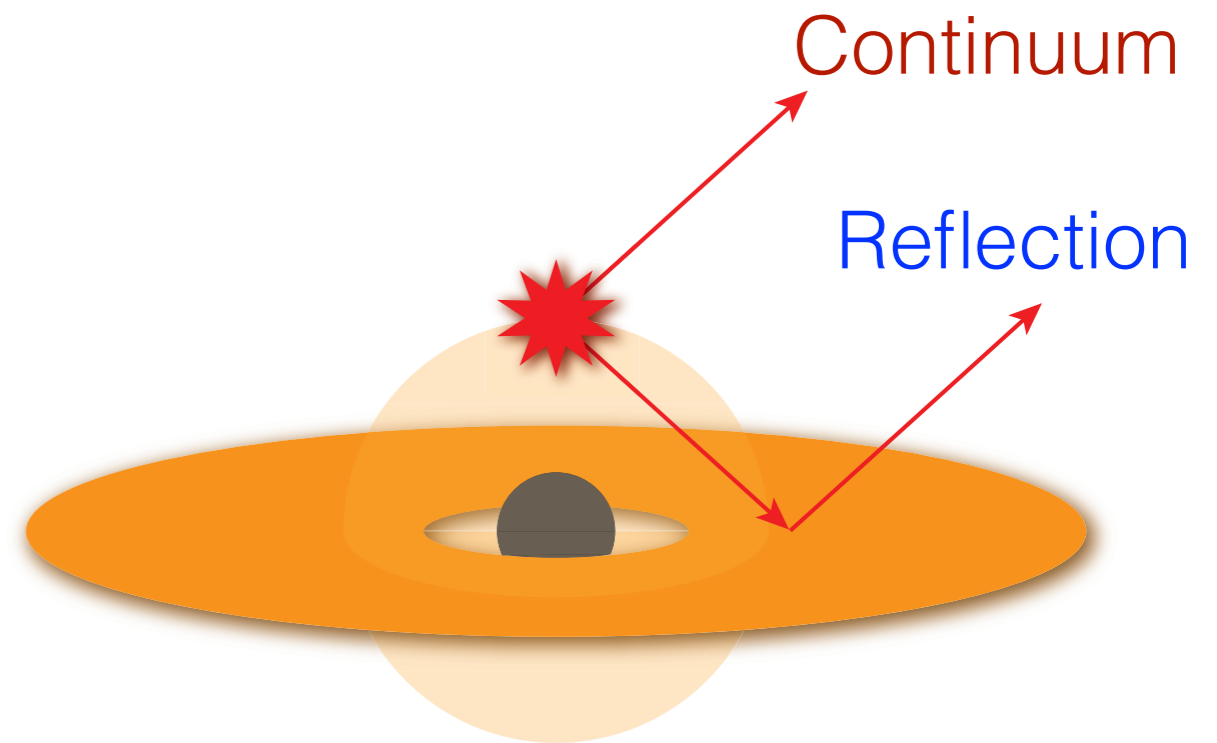
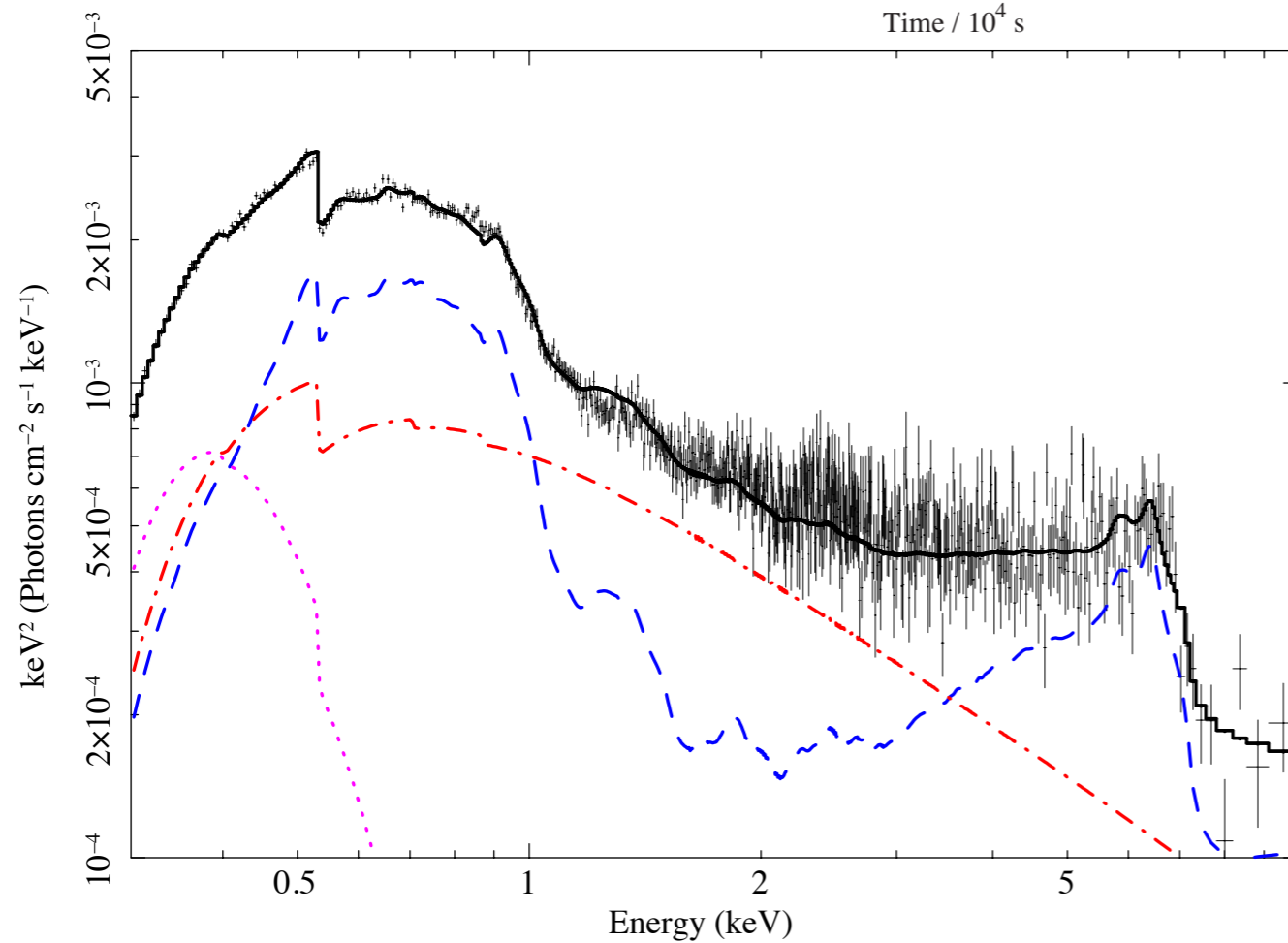
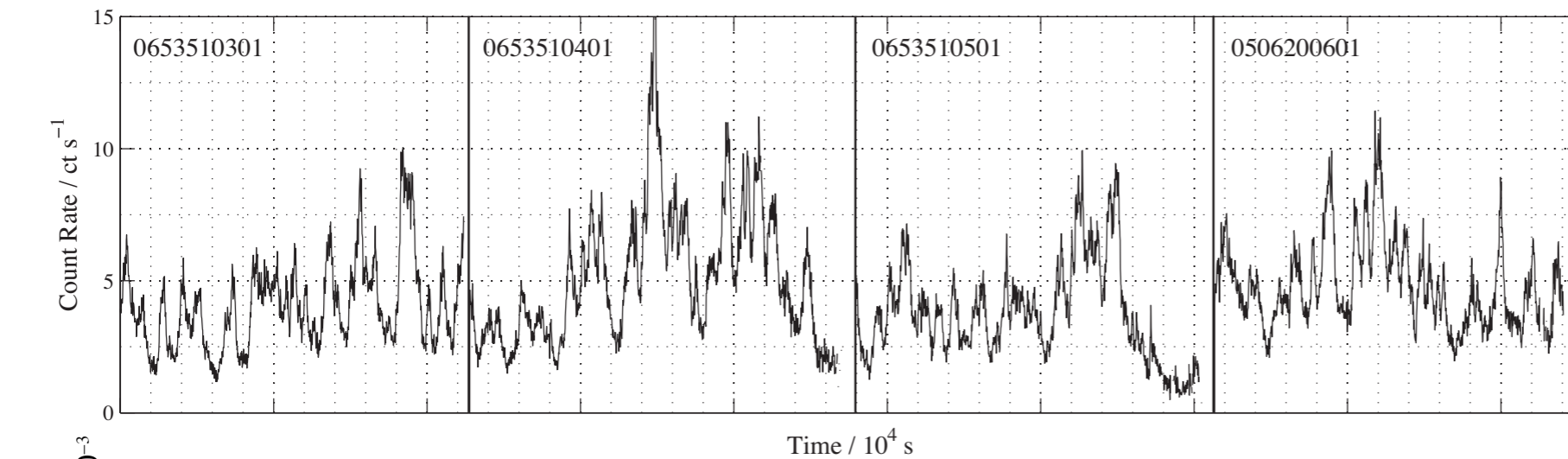
The Emissivity Profile



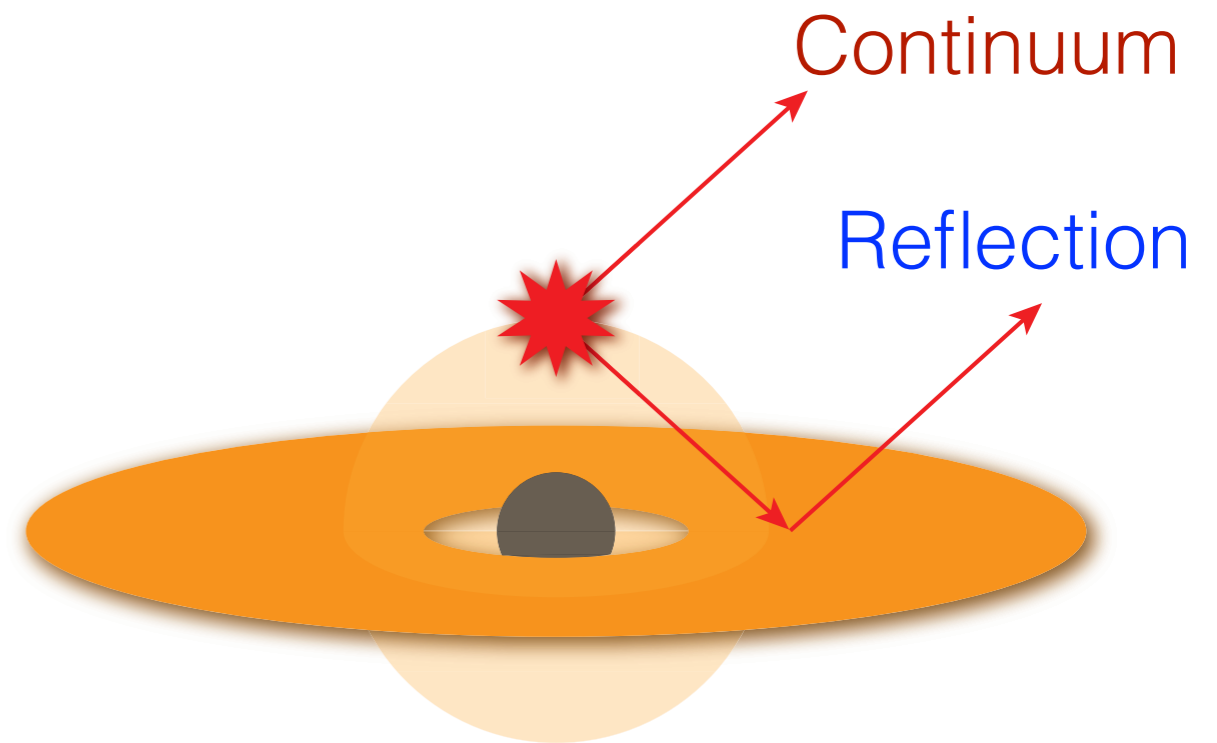
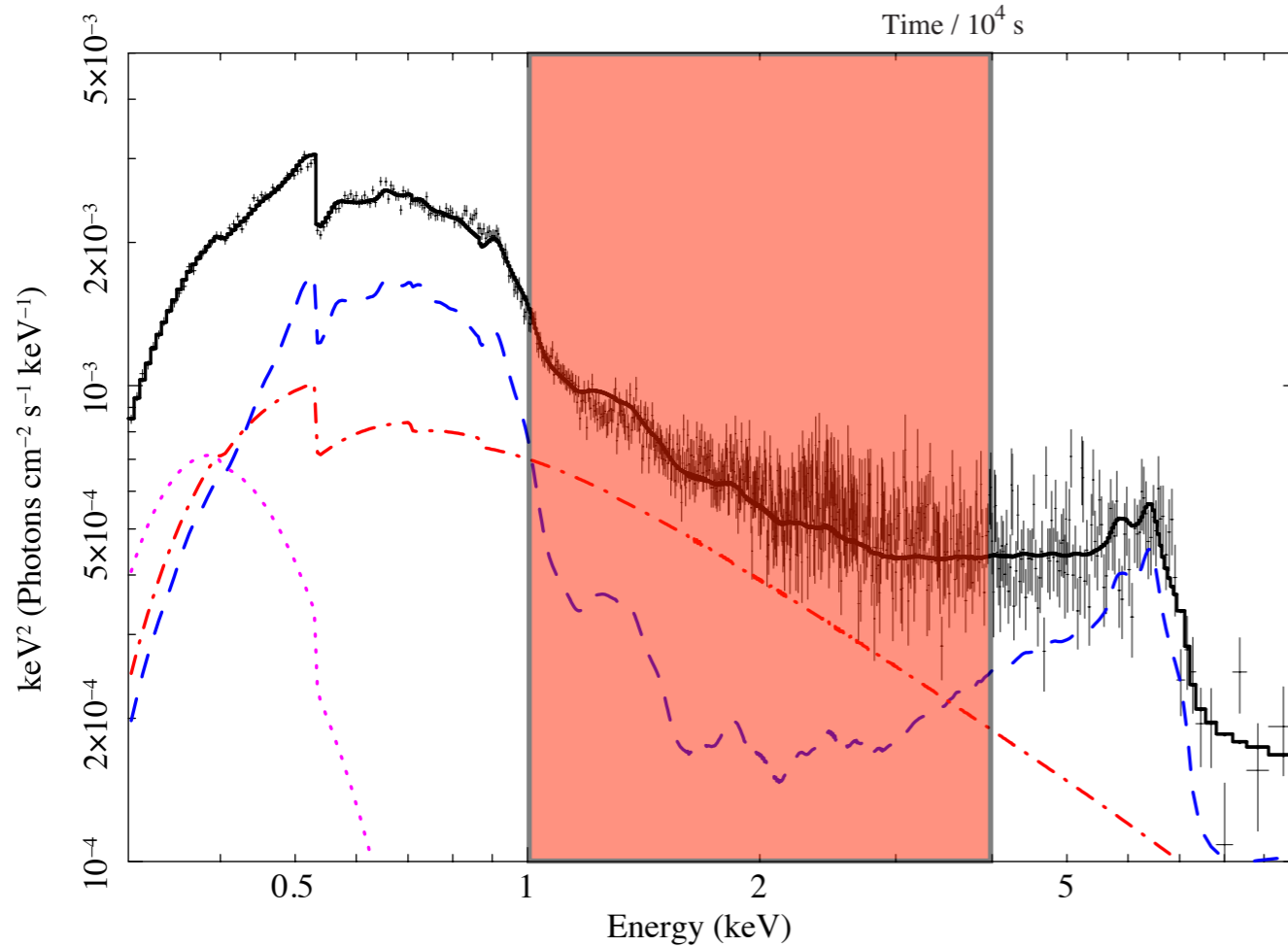
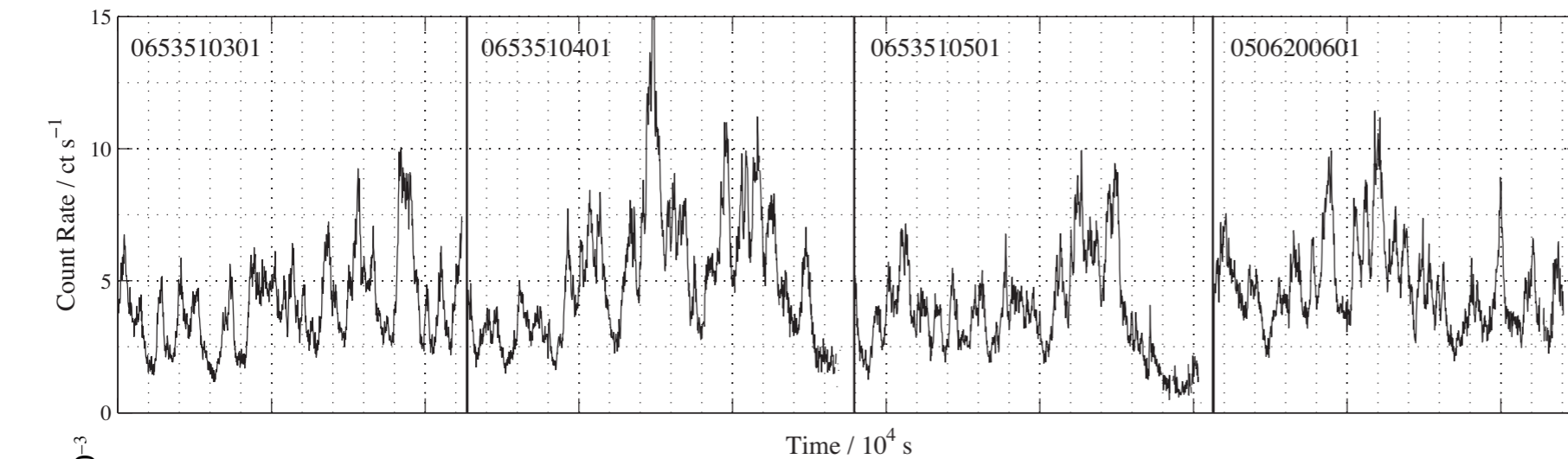
Finding the Corona



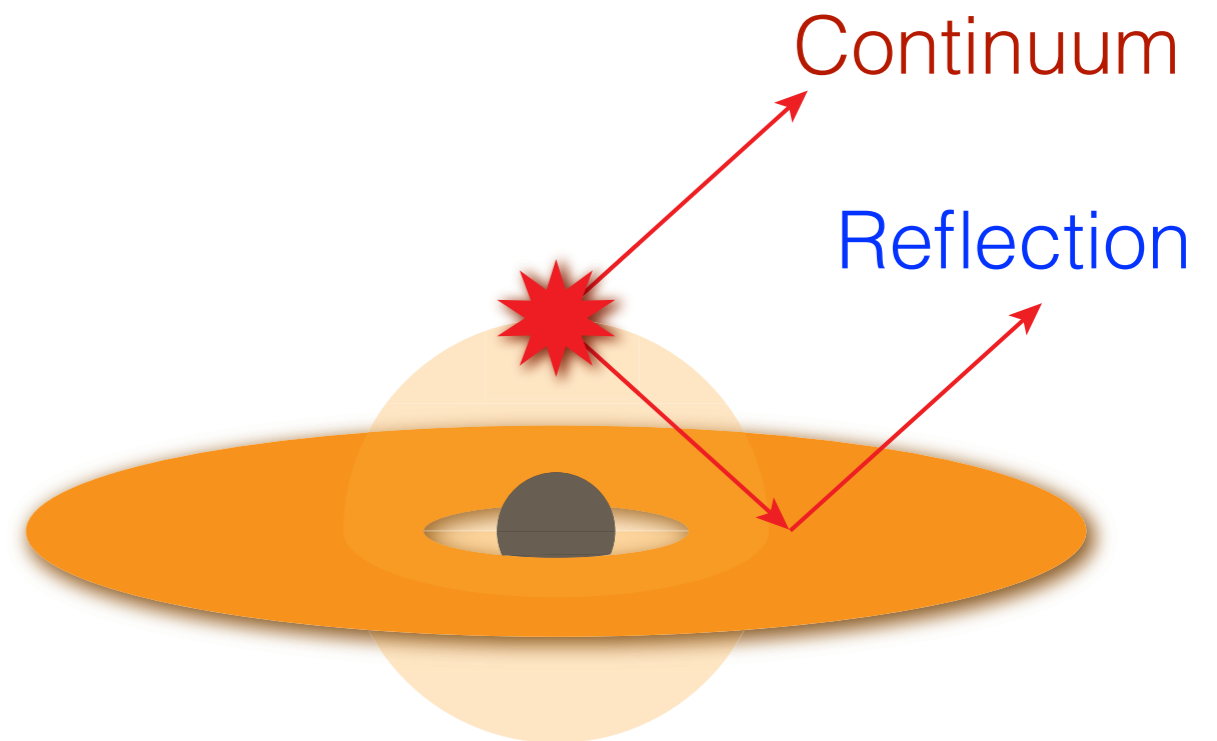
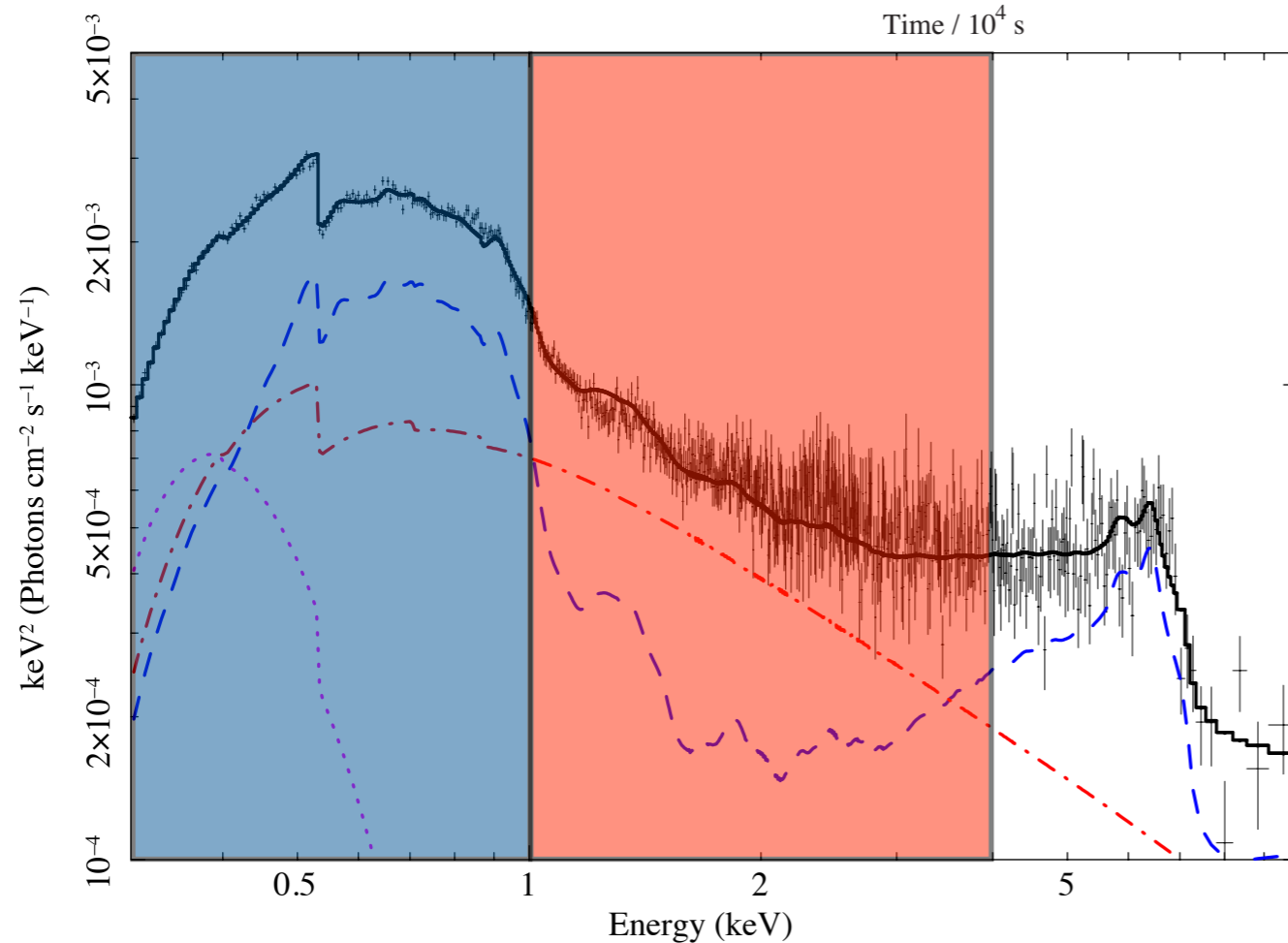
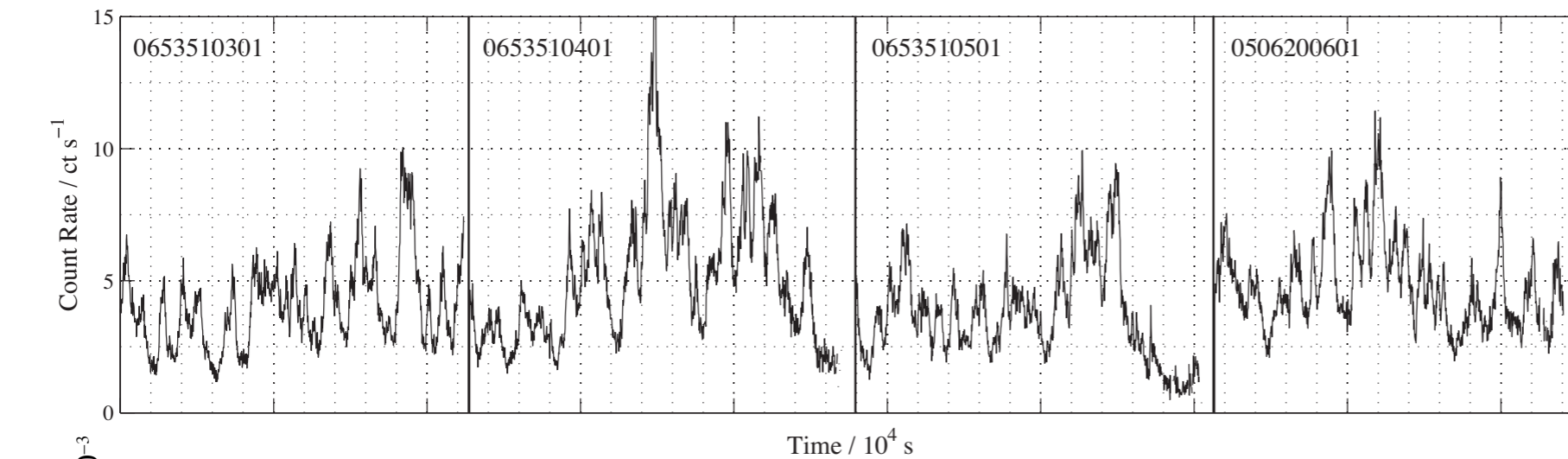
X-ray Reverberation

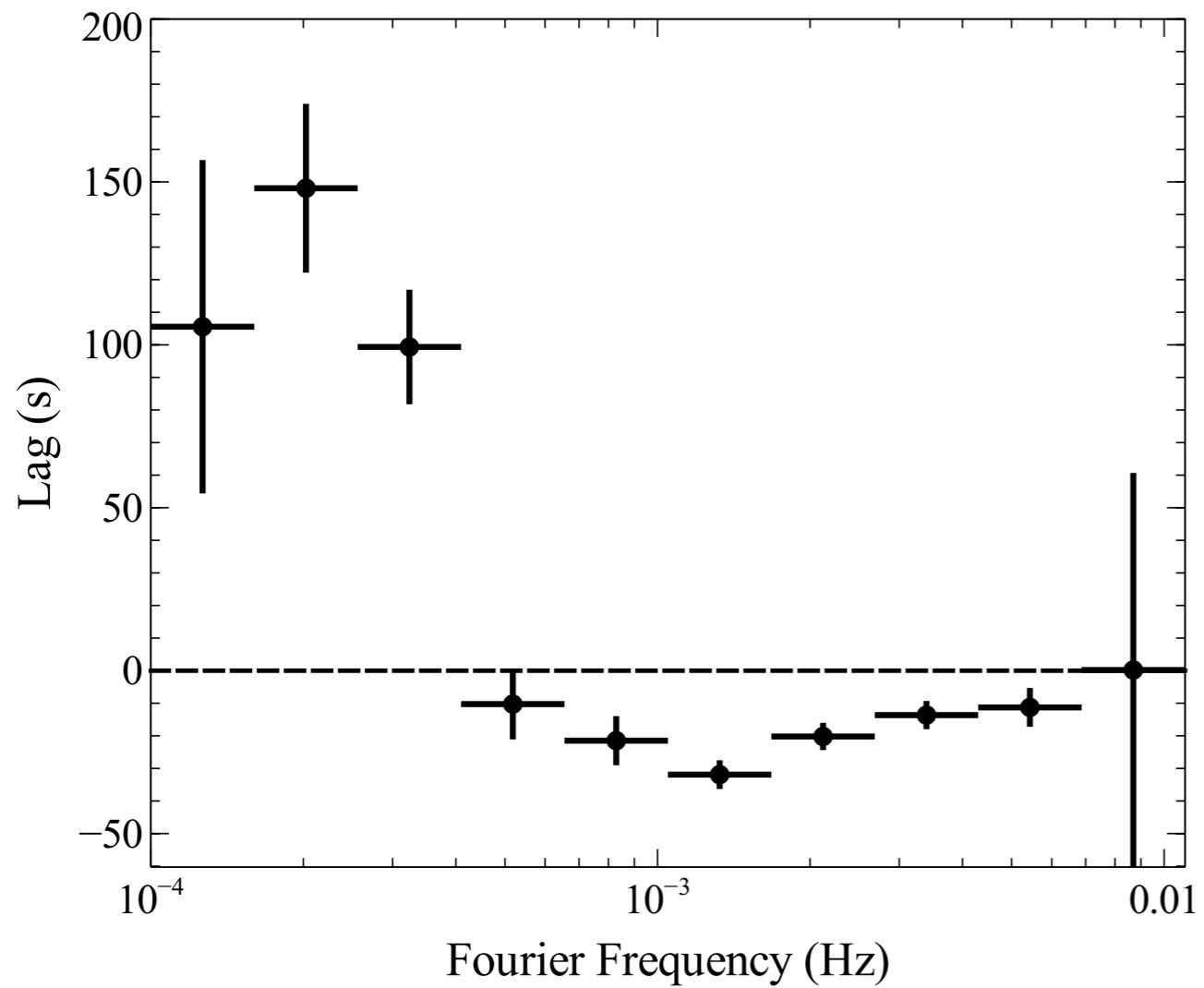


X-ray Reverberation

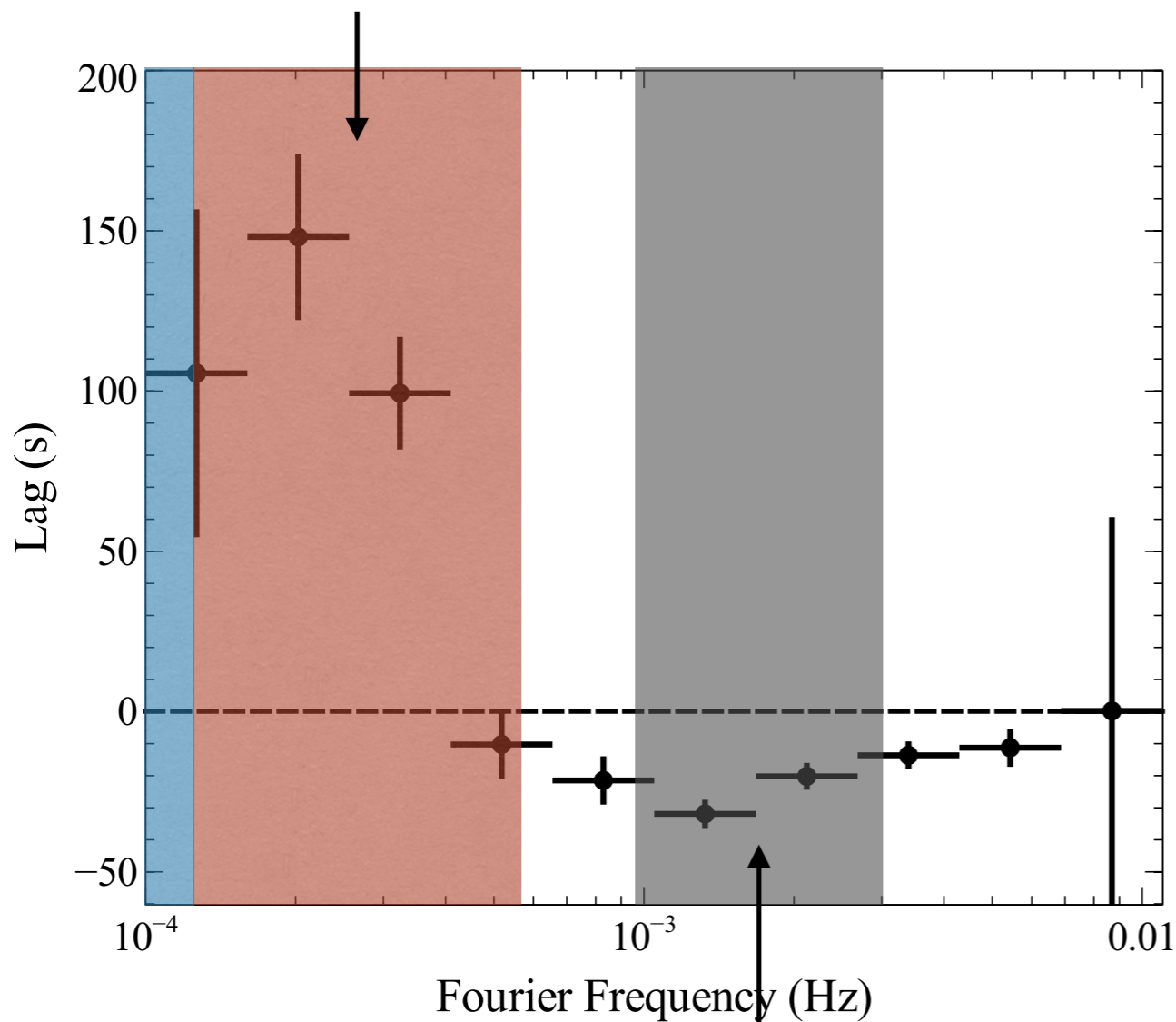


X-ray Reverberation

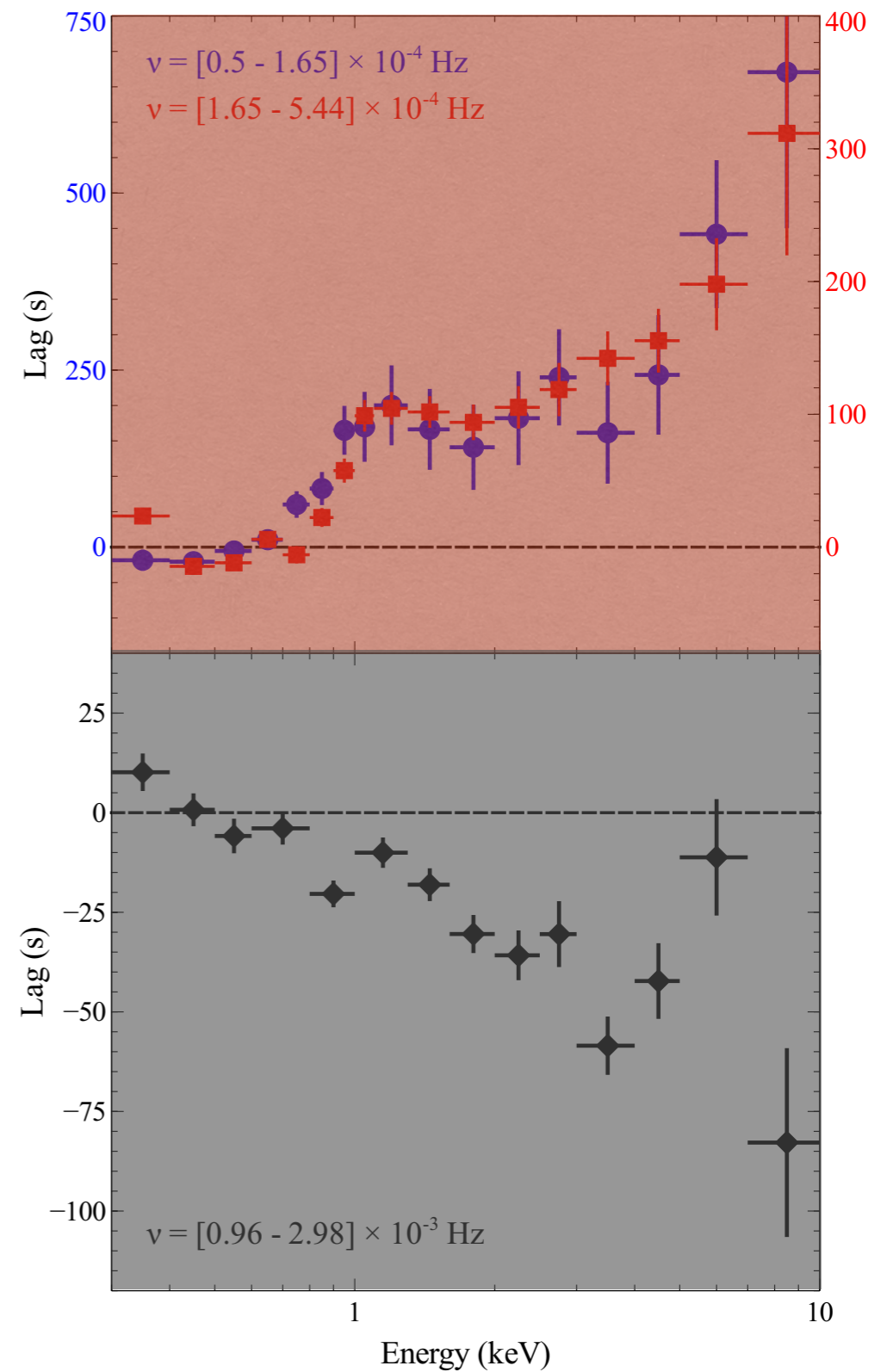




Hard X-rays lag soft (in continuum)

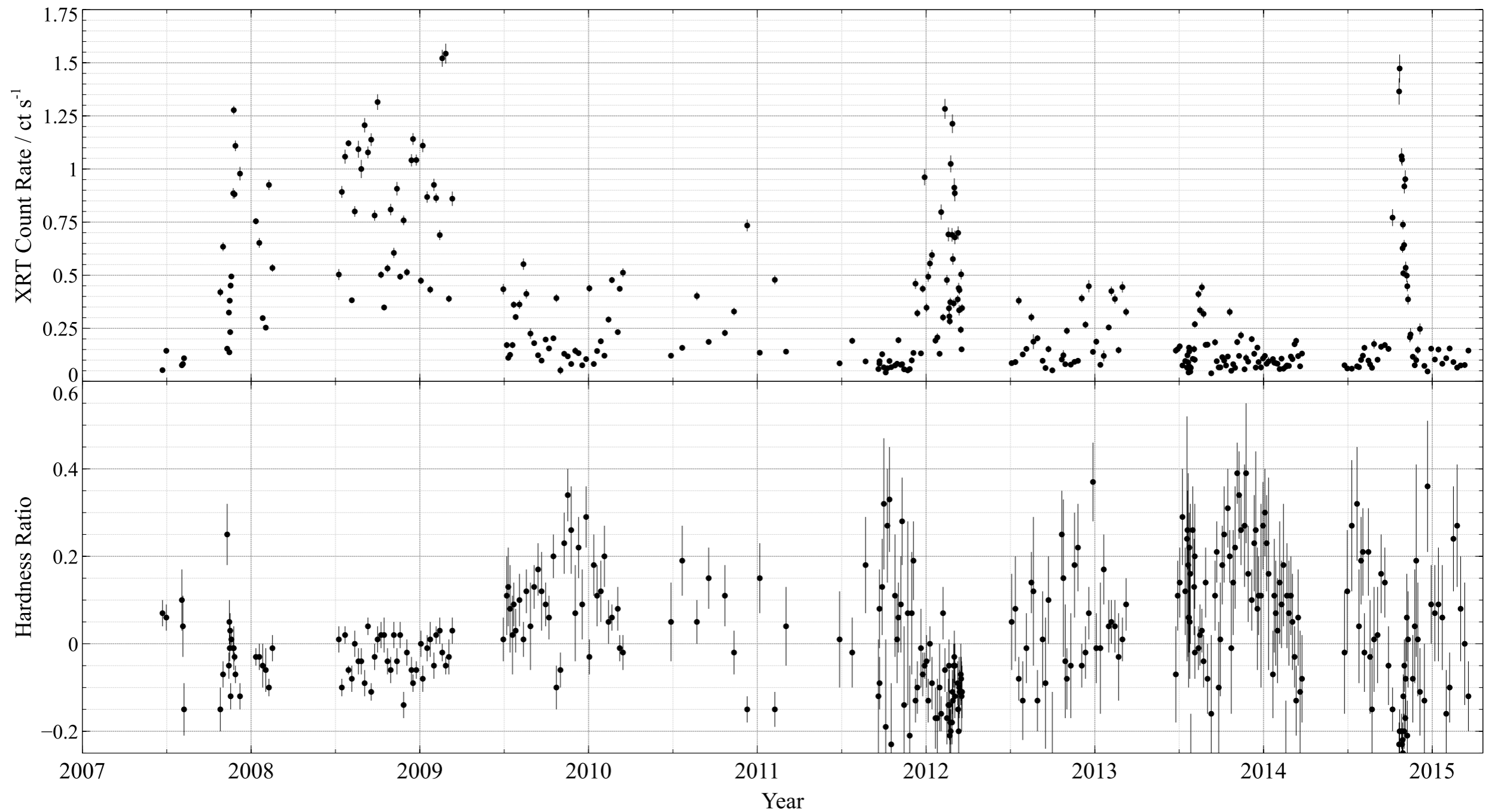


Soft (reflection-dominated)
lags hard (continuum)

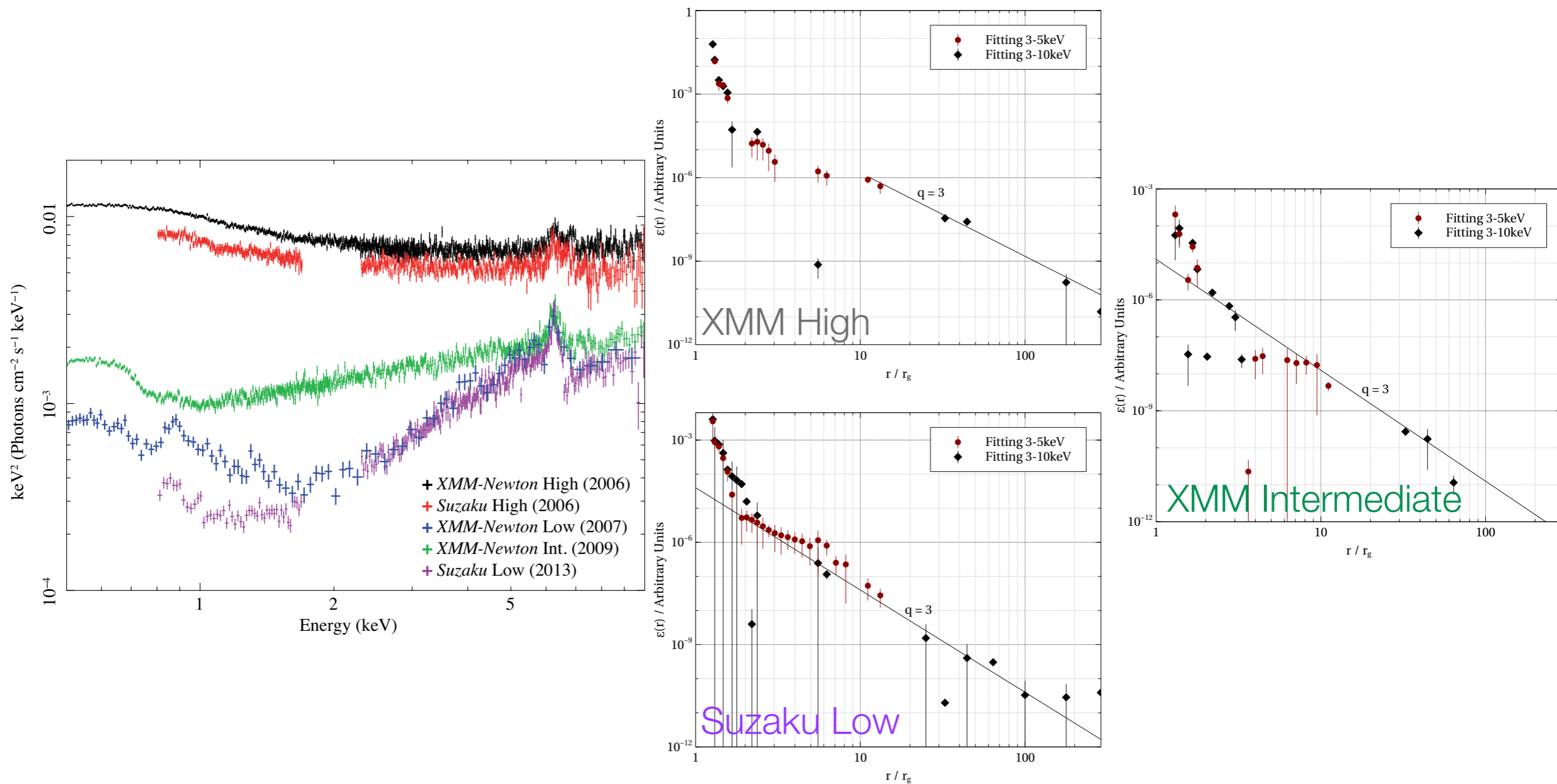


Understanding the Variability

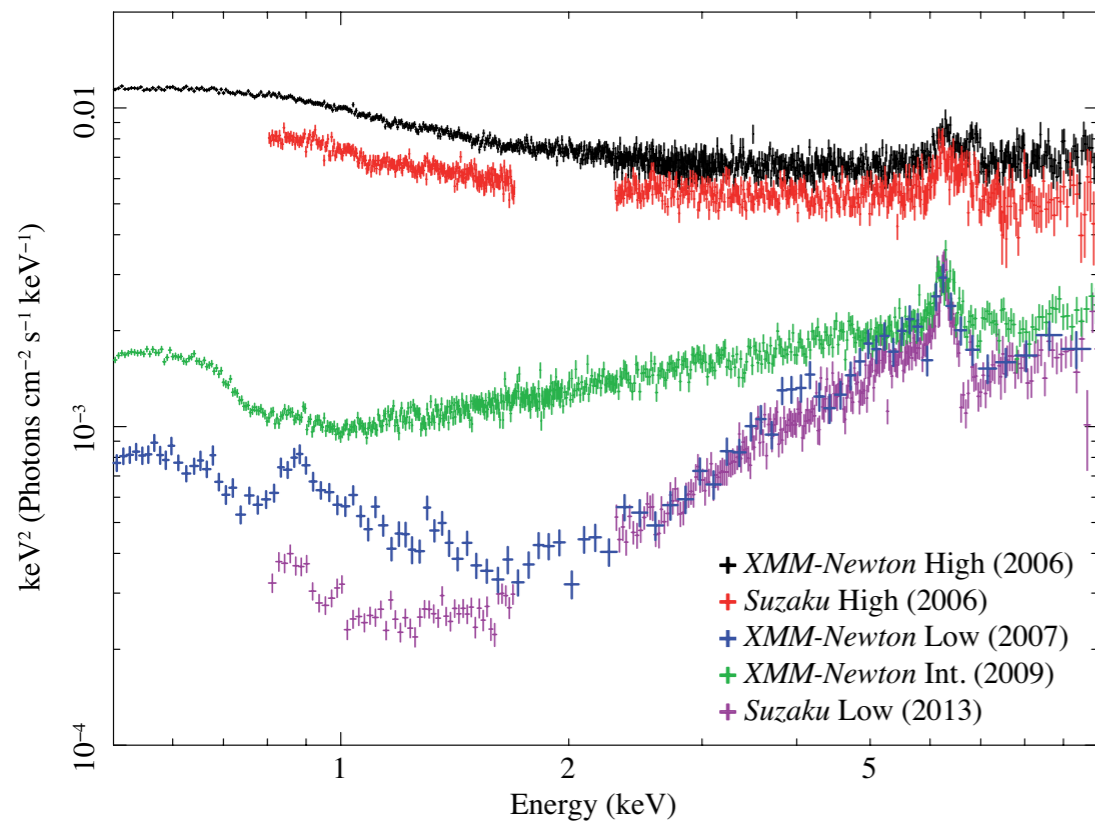
Markarian 335 is a variable source!



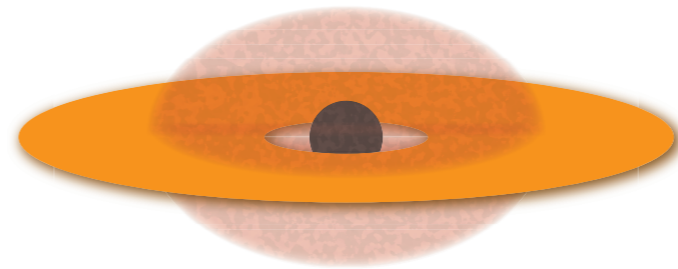
Variability in the Corona



Variability in the Corona

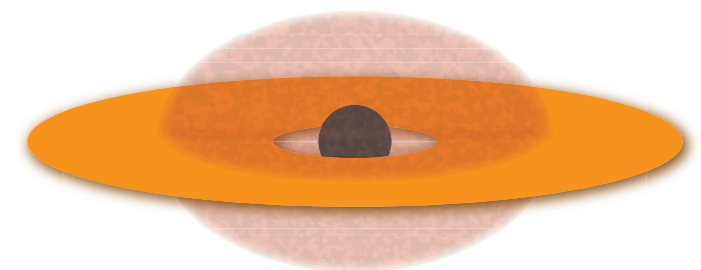


$$r_b = 26^{+10}_{-7} r_g$$



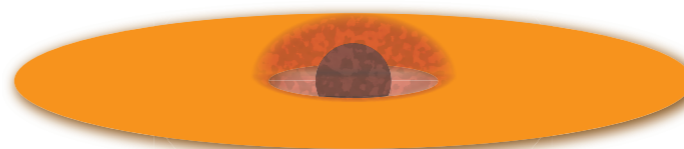
XMM High

$$r_b < 12 r_g$$



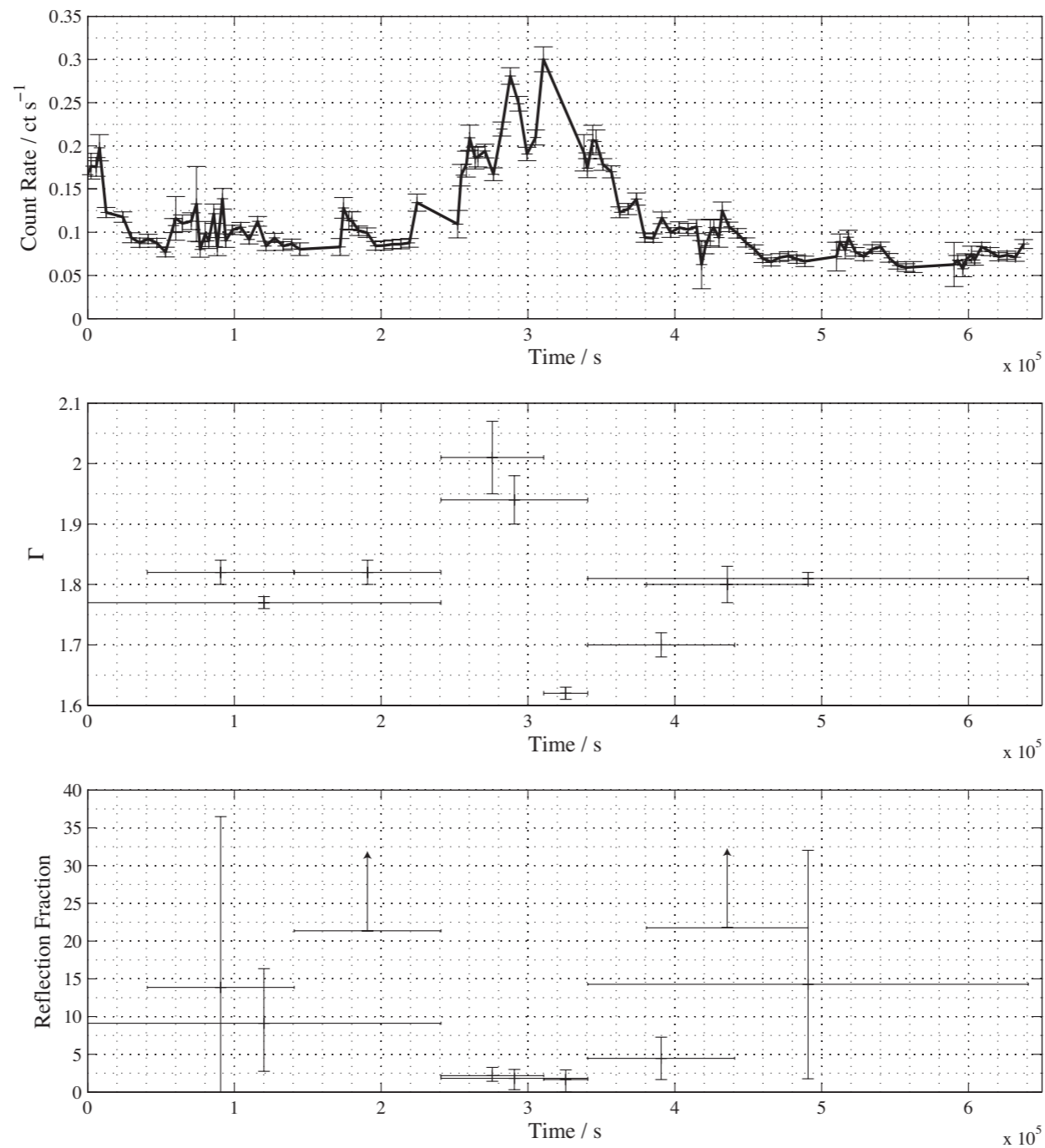
XMM Intermediate

$$r_b < 5 r_g$$

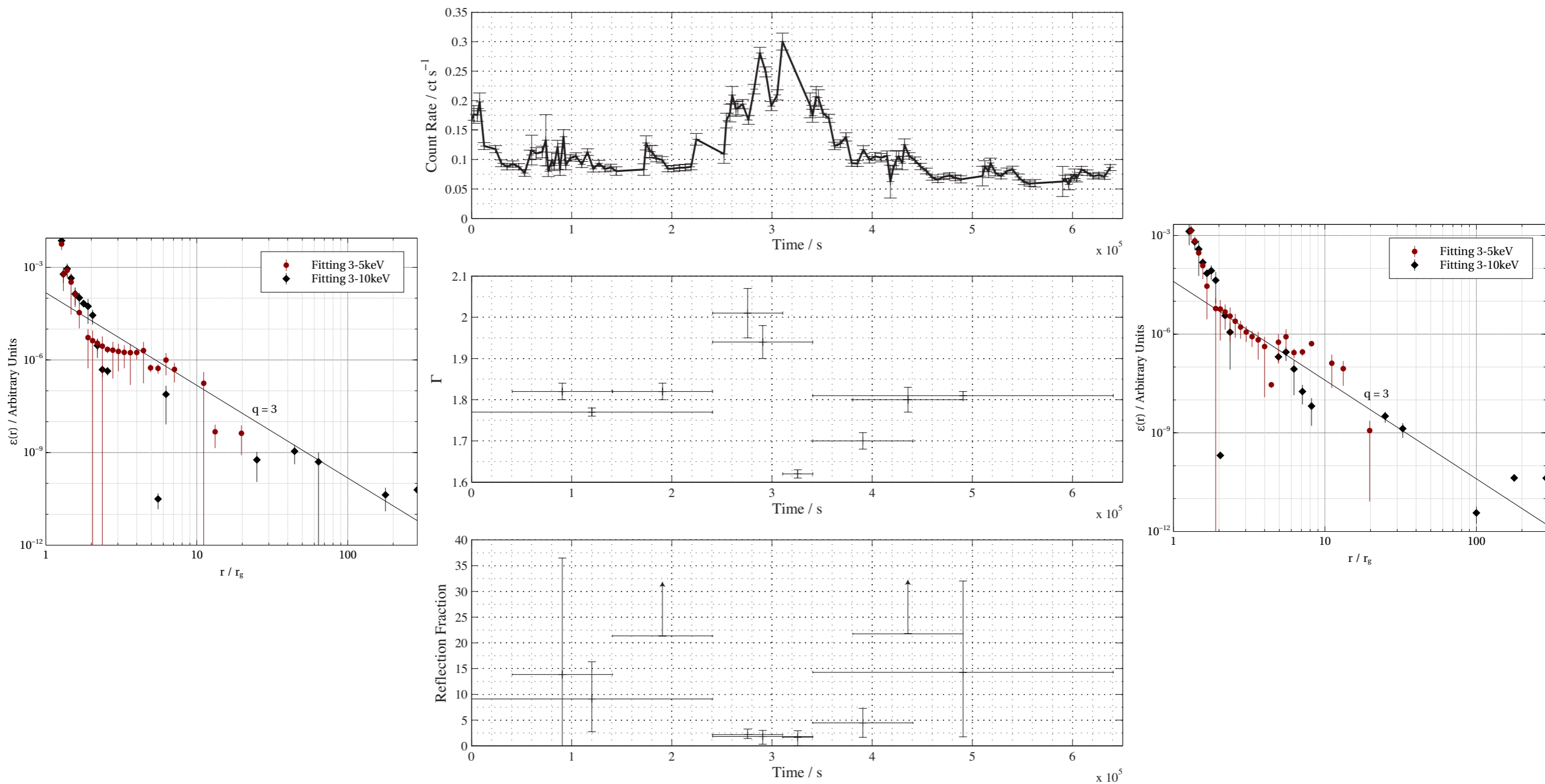


Suzaku Low

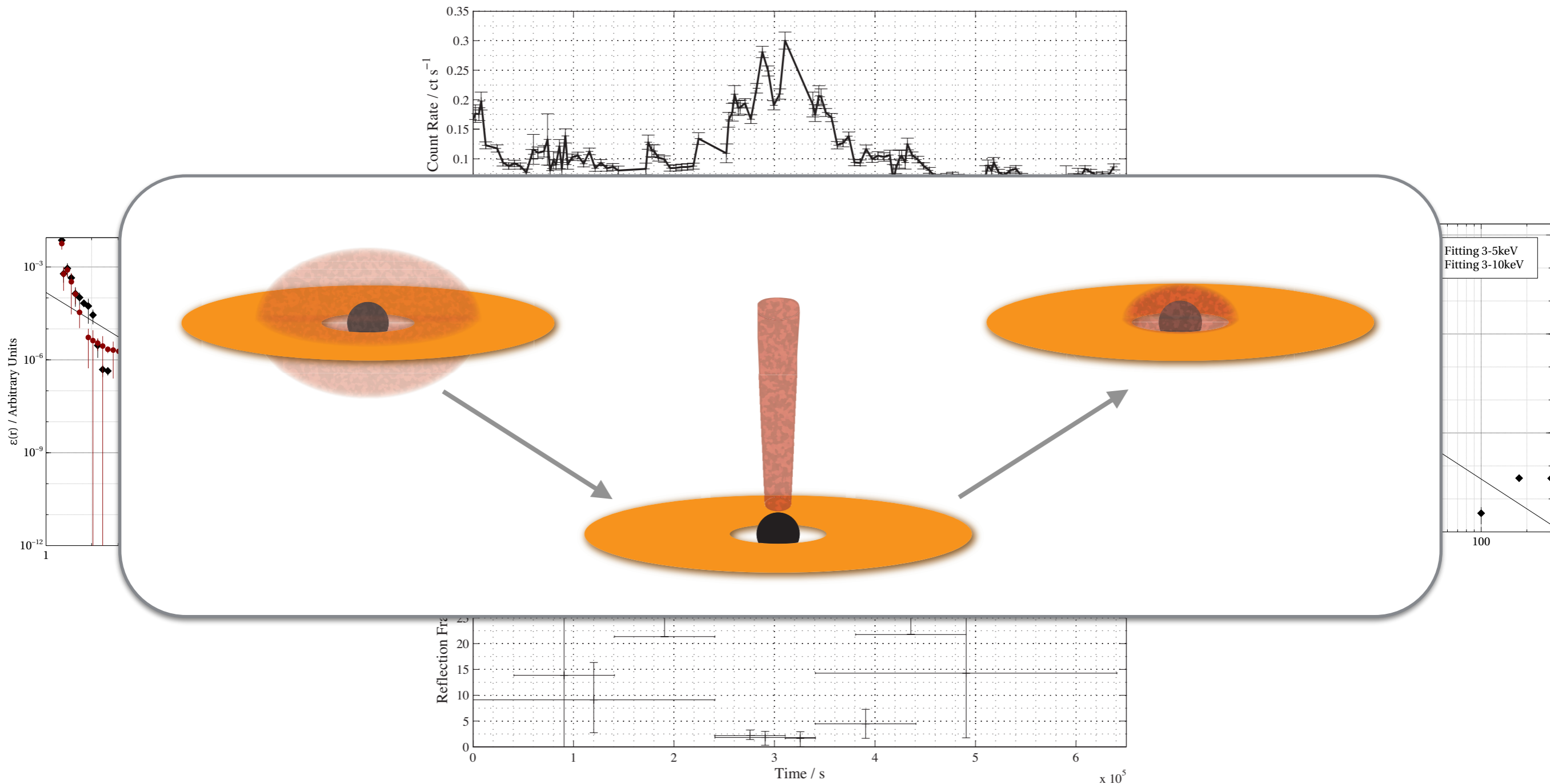
Flaring from the Corona



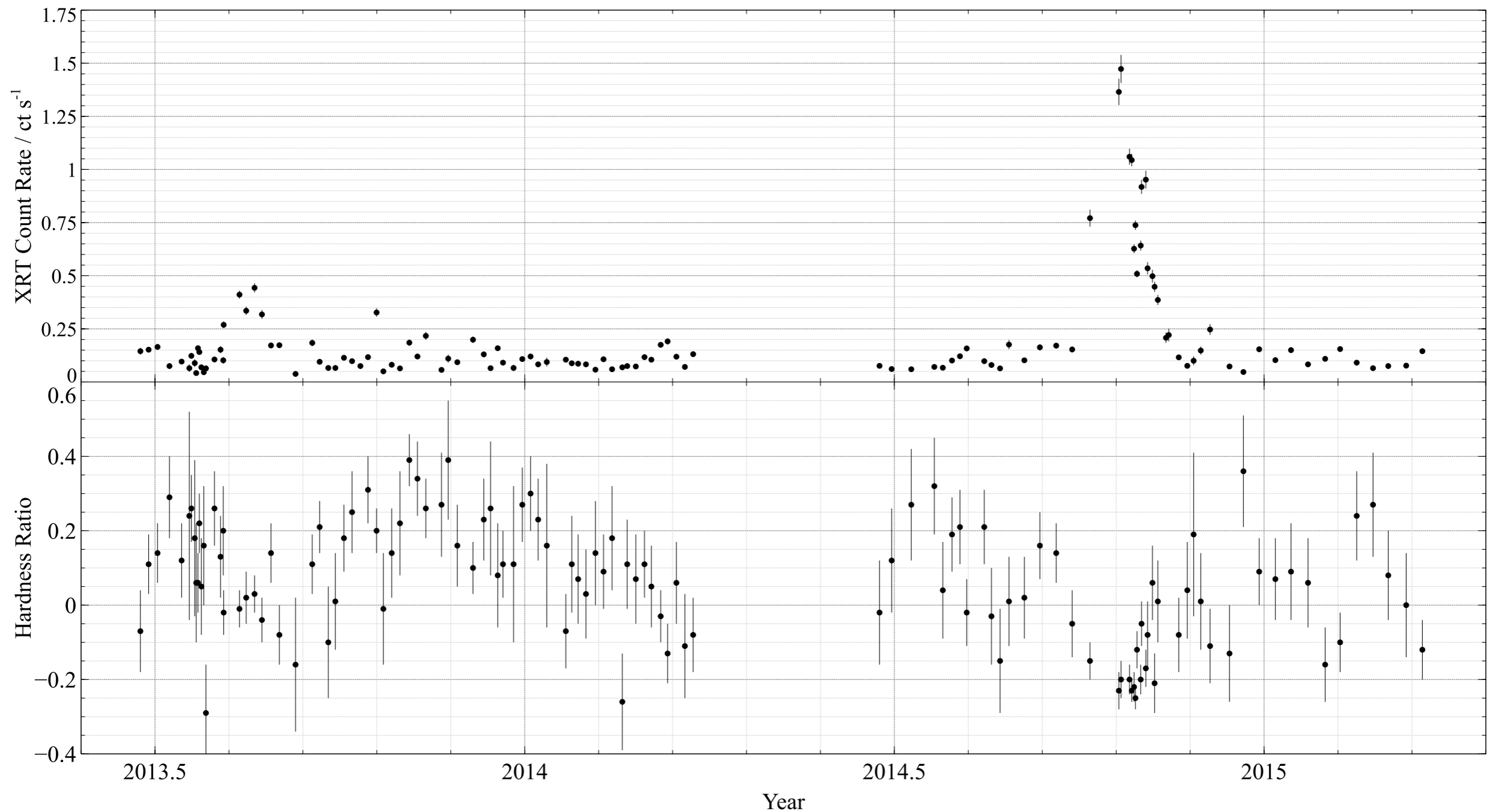
Flaring from the Corona



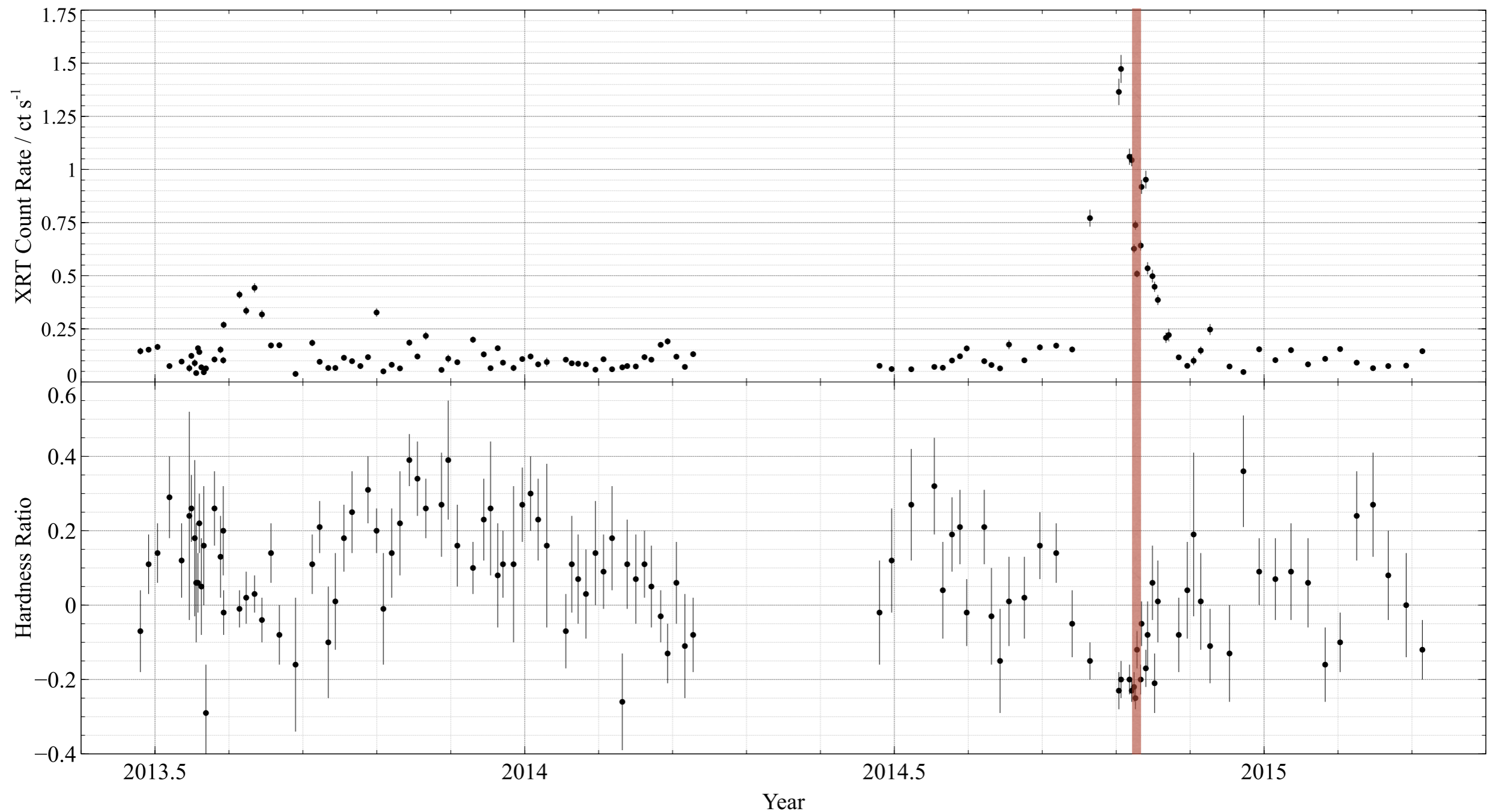
Flaring from the Corona



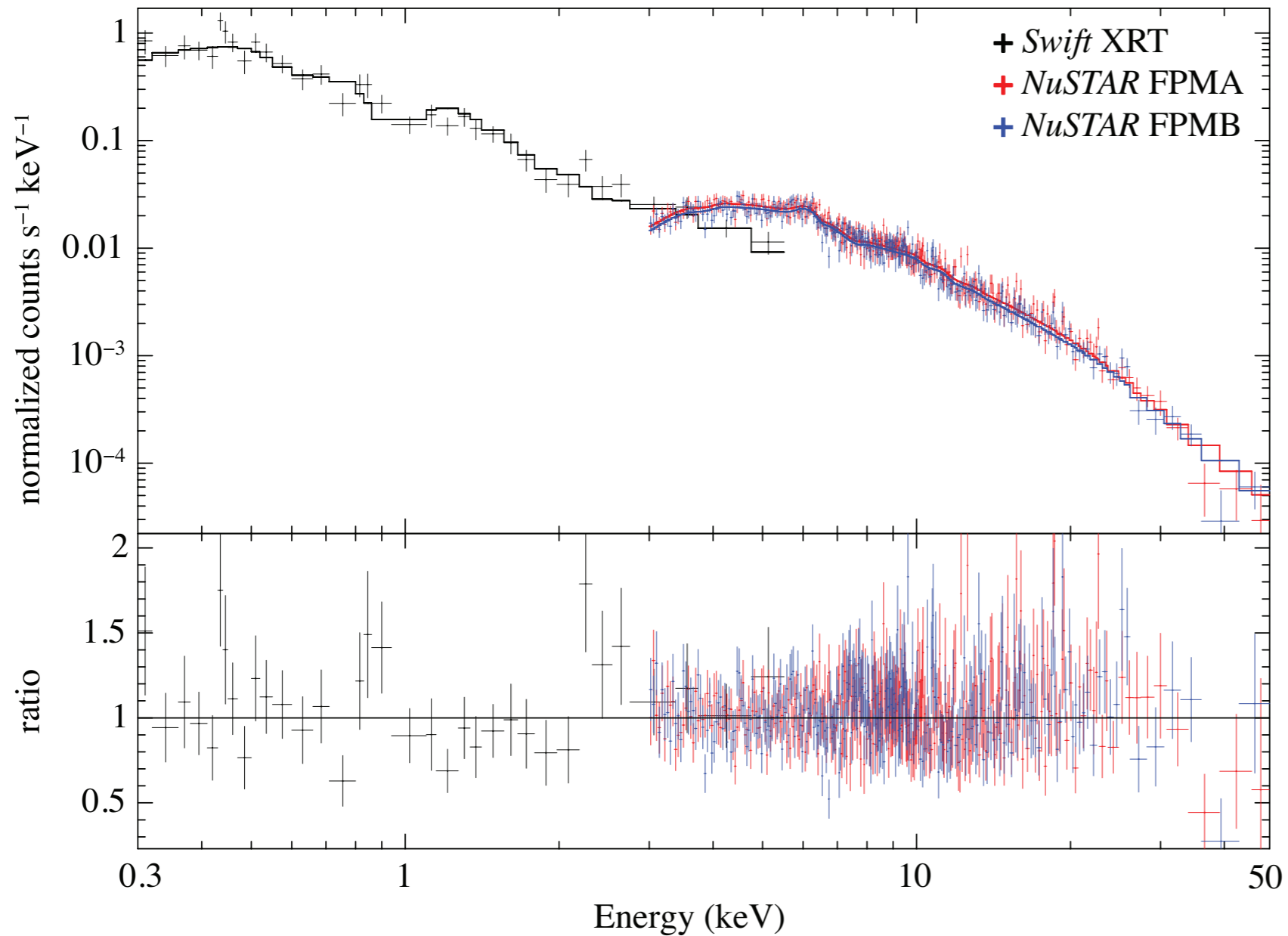
September 2014... A bigger flare...



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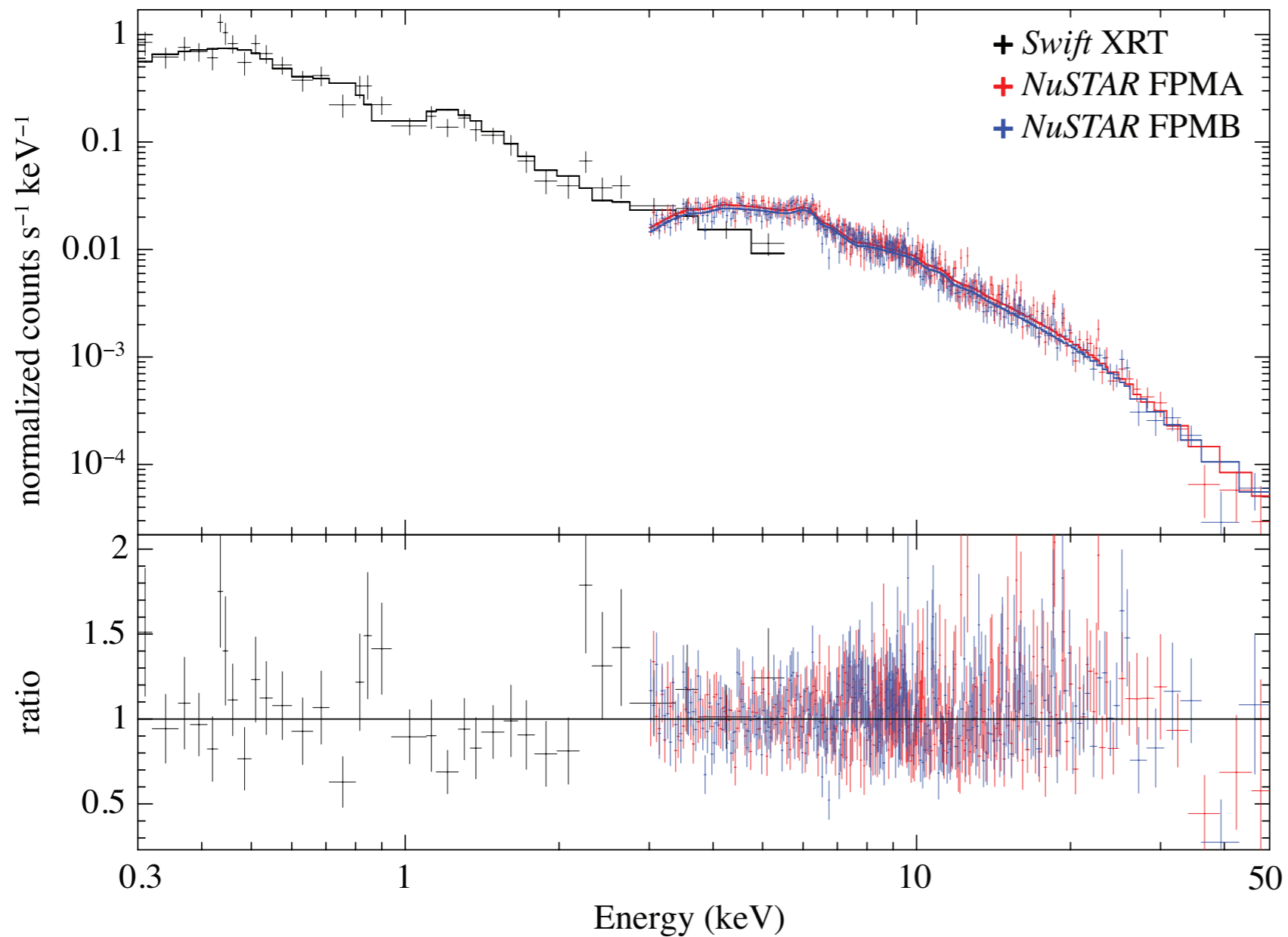


What caused the flare?

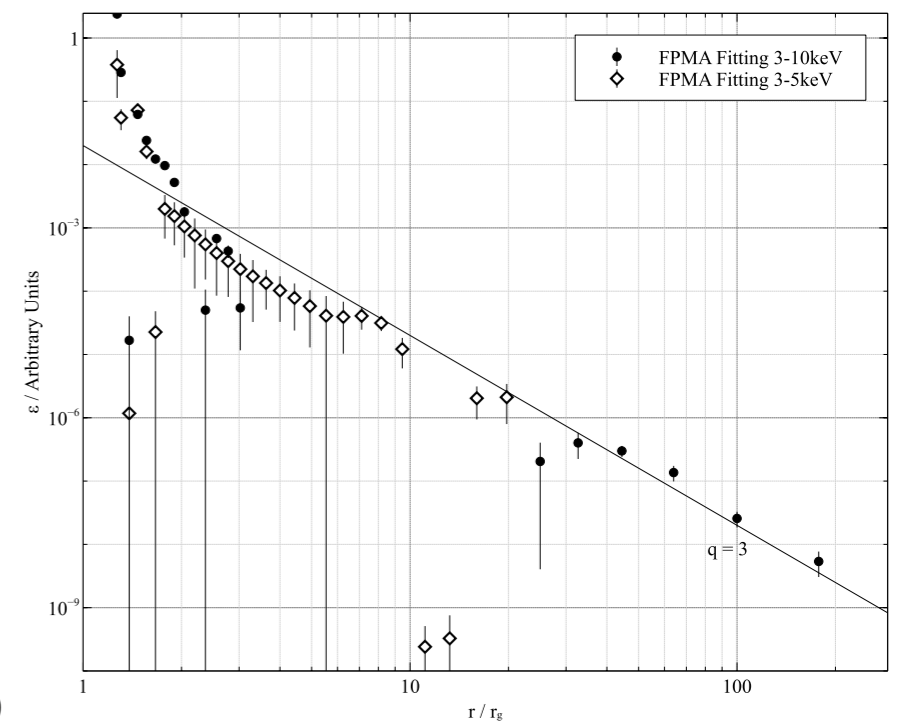


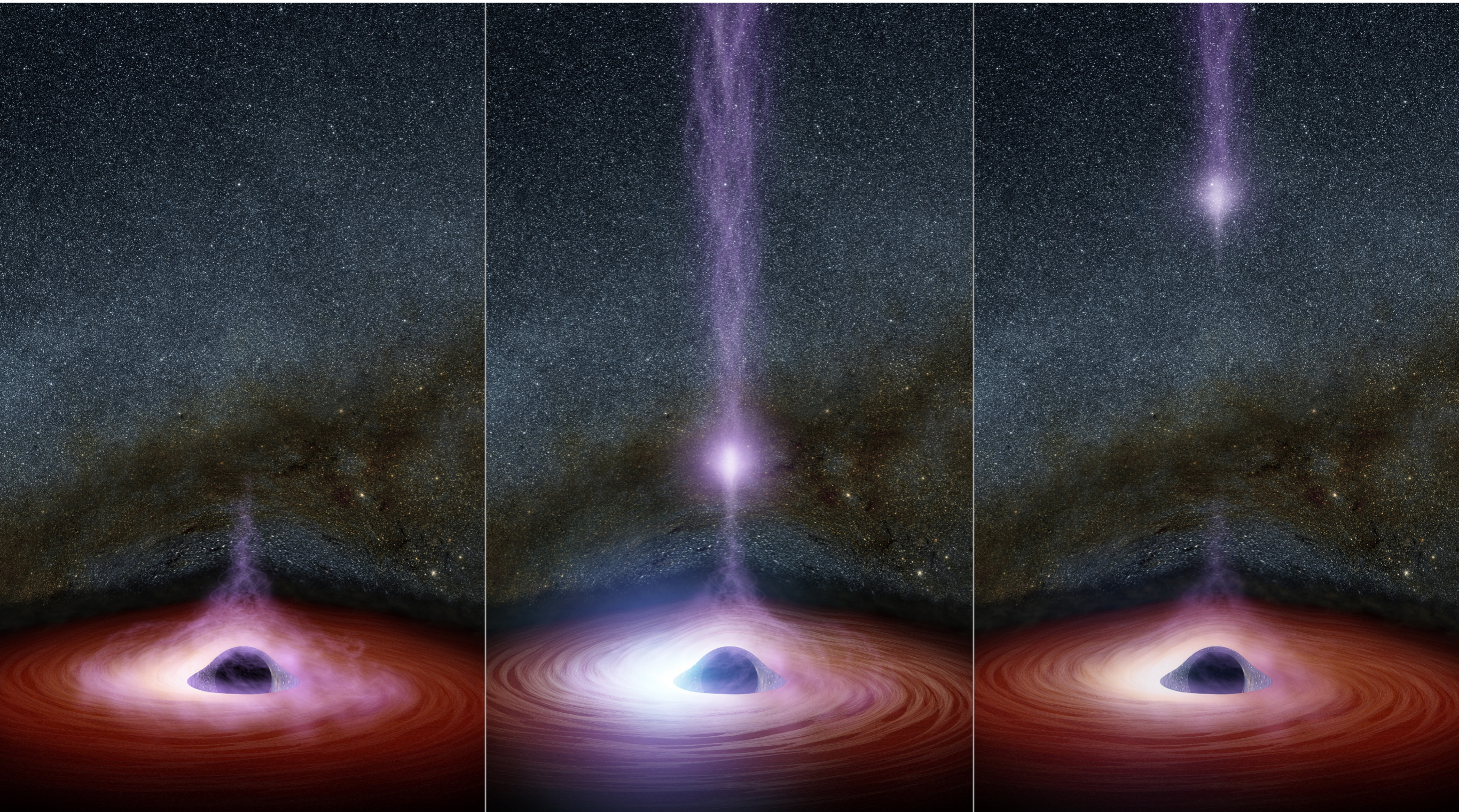
Continuum Γ	$2.43^{+0.05}_{-0.09}$
Disc r_{in}	$1.235^{+0.16}$
Ref. Frac.	$0.41^{+0.15}_{-0.15}$

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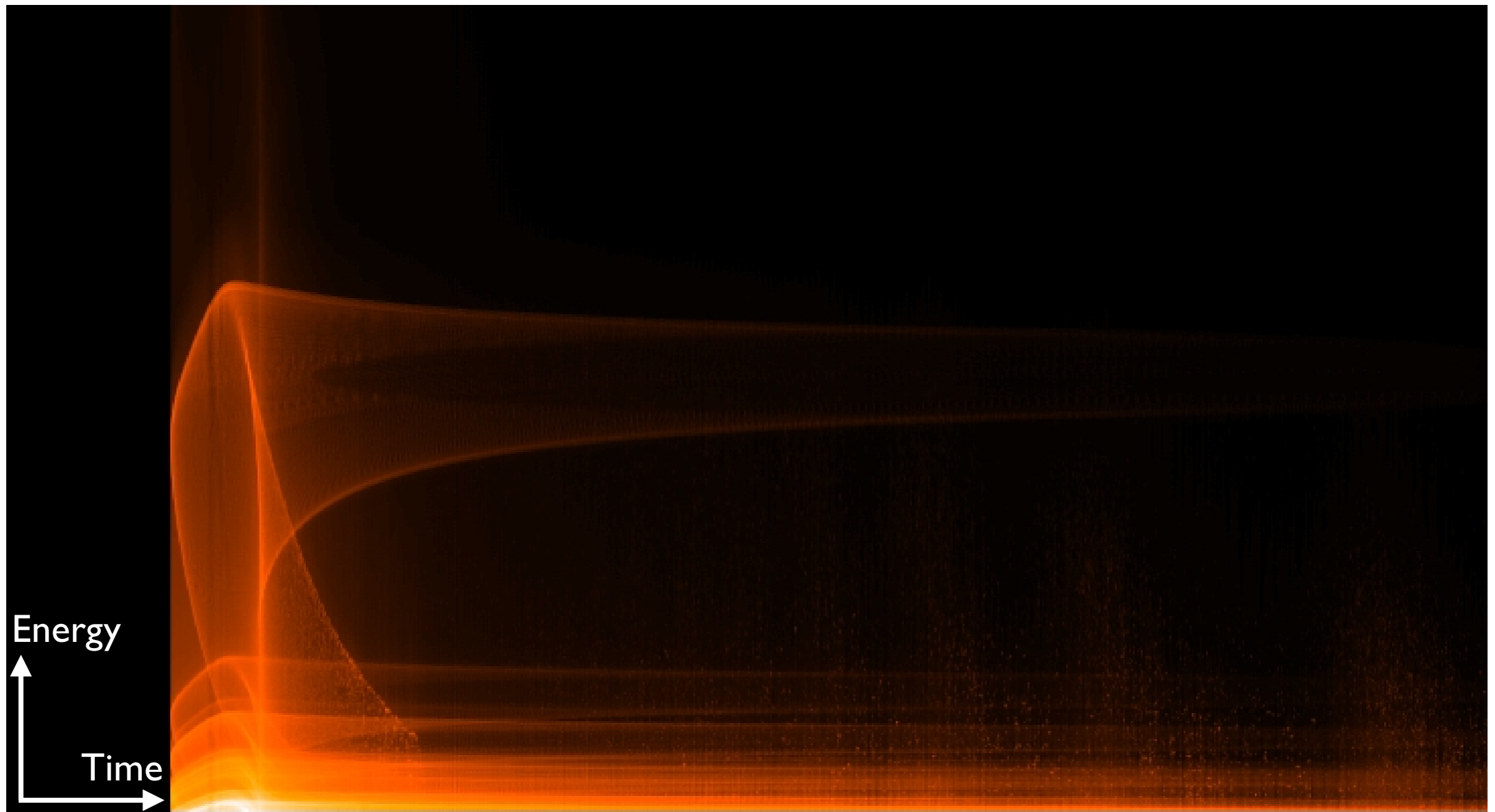




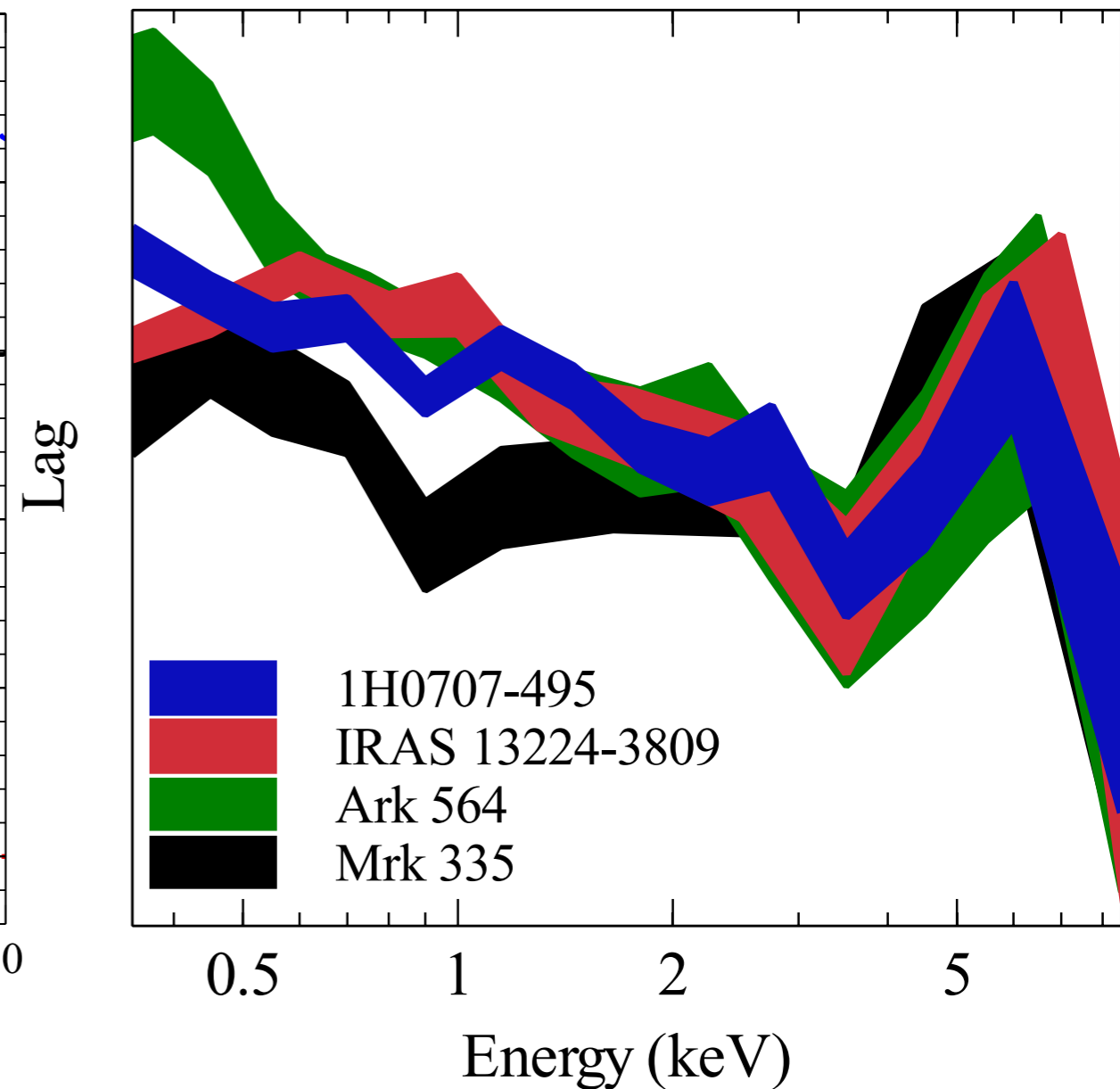
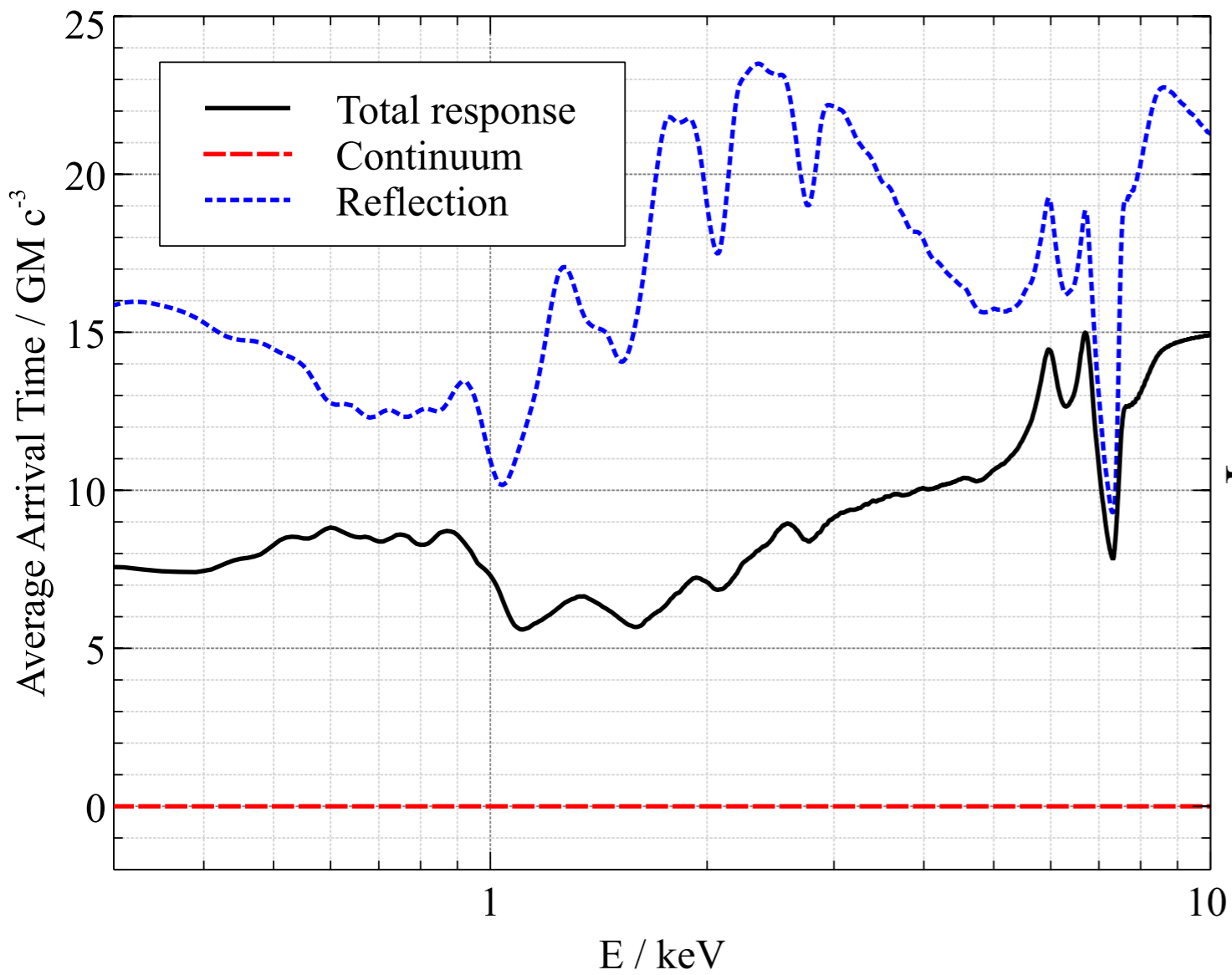
Wilkins et al. 2016a

Finding structure within the corona

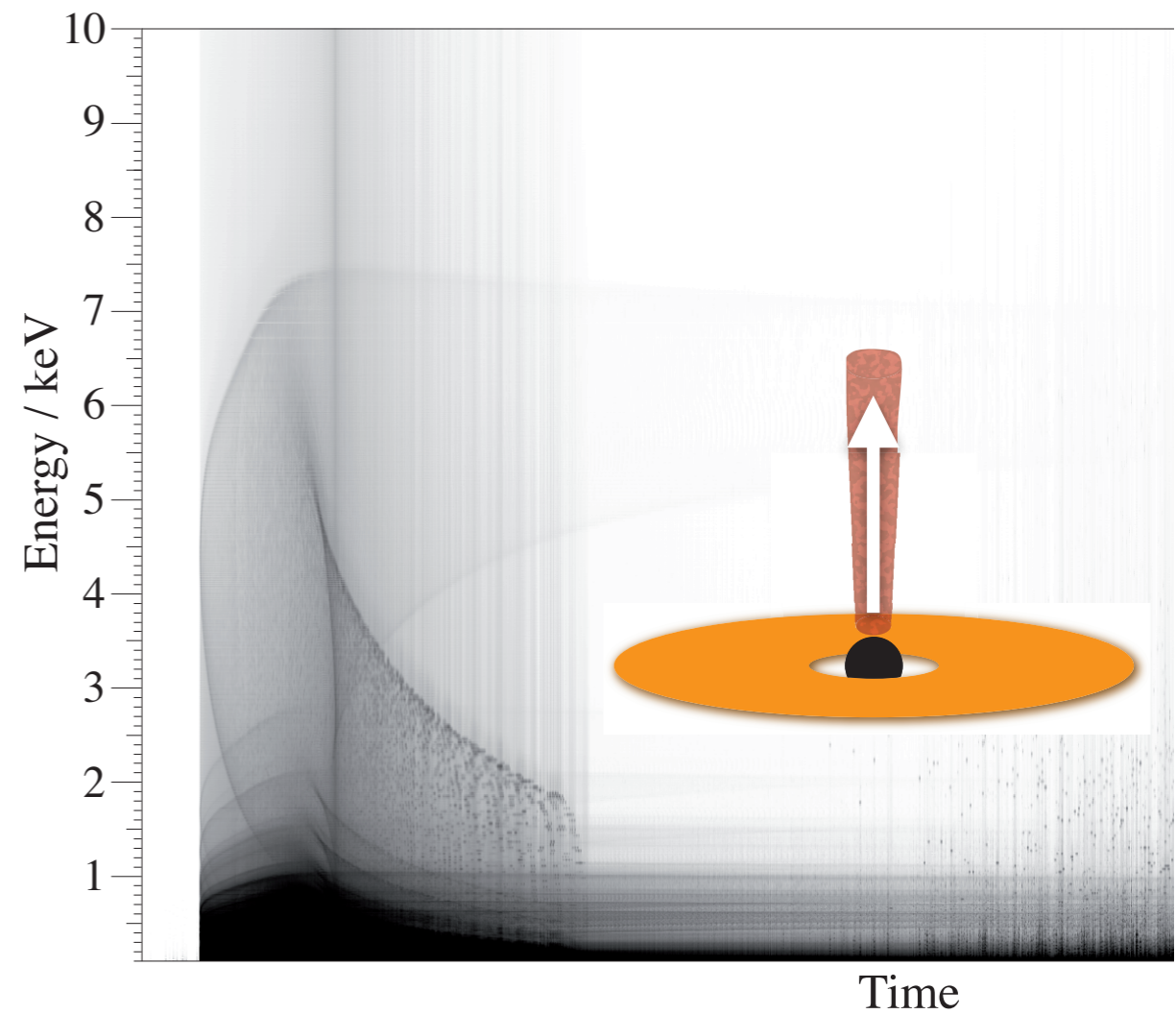
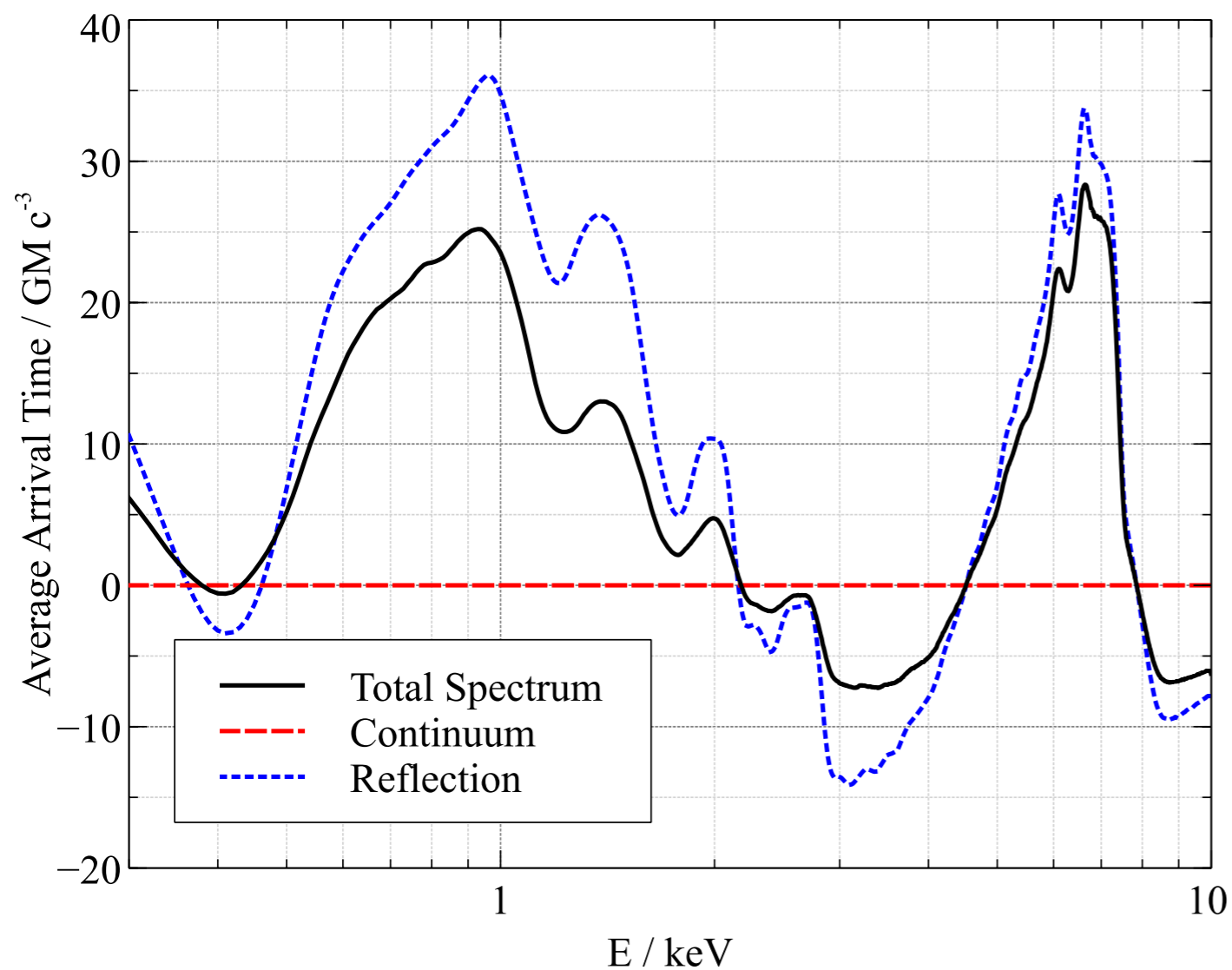
Reverberation Response



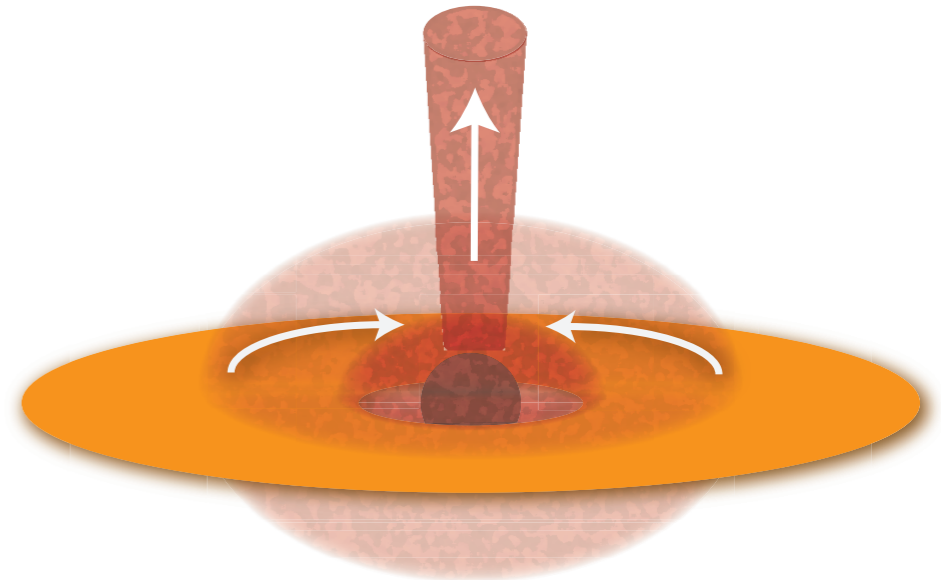
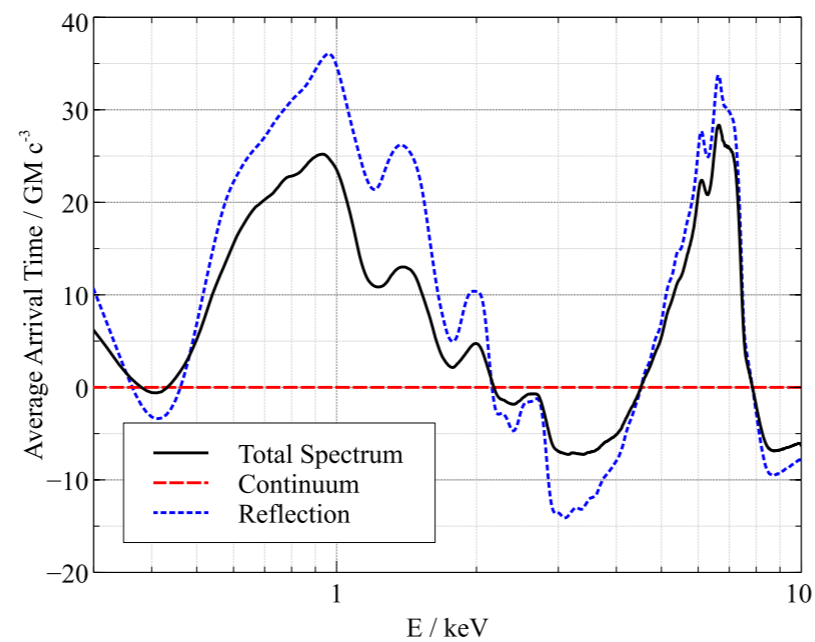
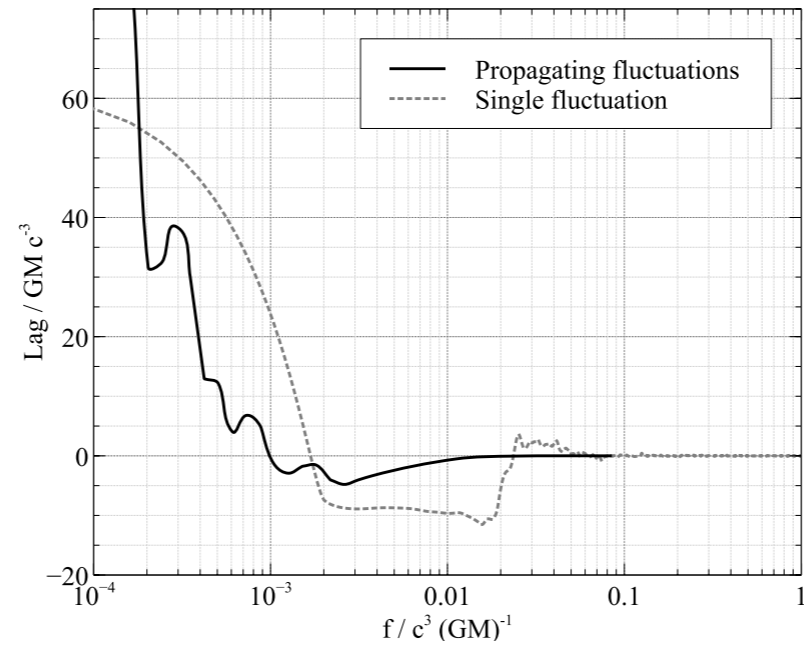
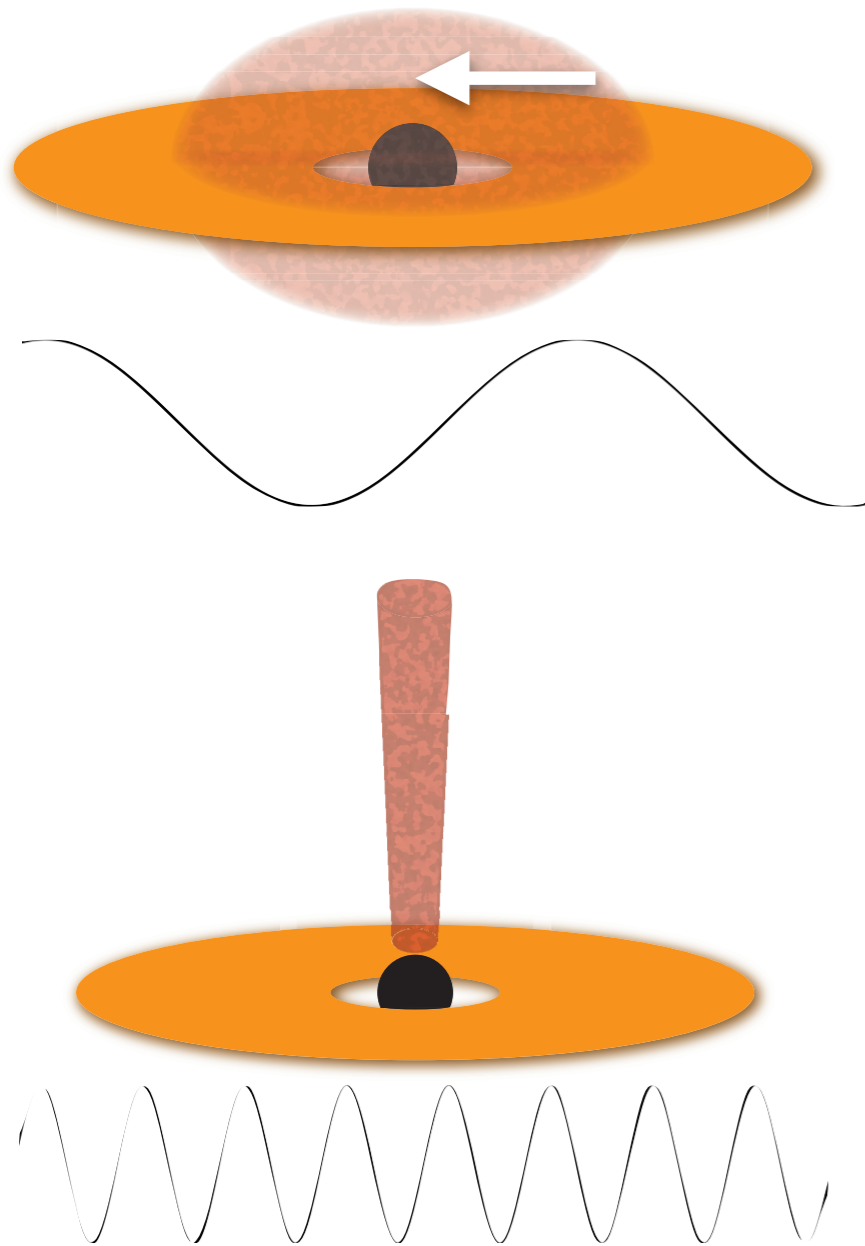
Comparing to Reality



What is the dip at 3keV?



A tale of two coronae?



Summary

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- X-ray reflection from the disc reveals the geometry and extent of the corona
- Variability accompanied by expansion and contraction of corona
- Flaring events correspond to collimation and launching of the inner regions of the corona
- Evidence of collimated core within extended corona
- Understand the physics of the corona, how it is powered by the accretion flow and how jets are launched