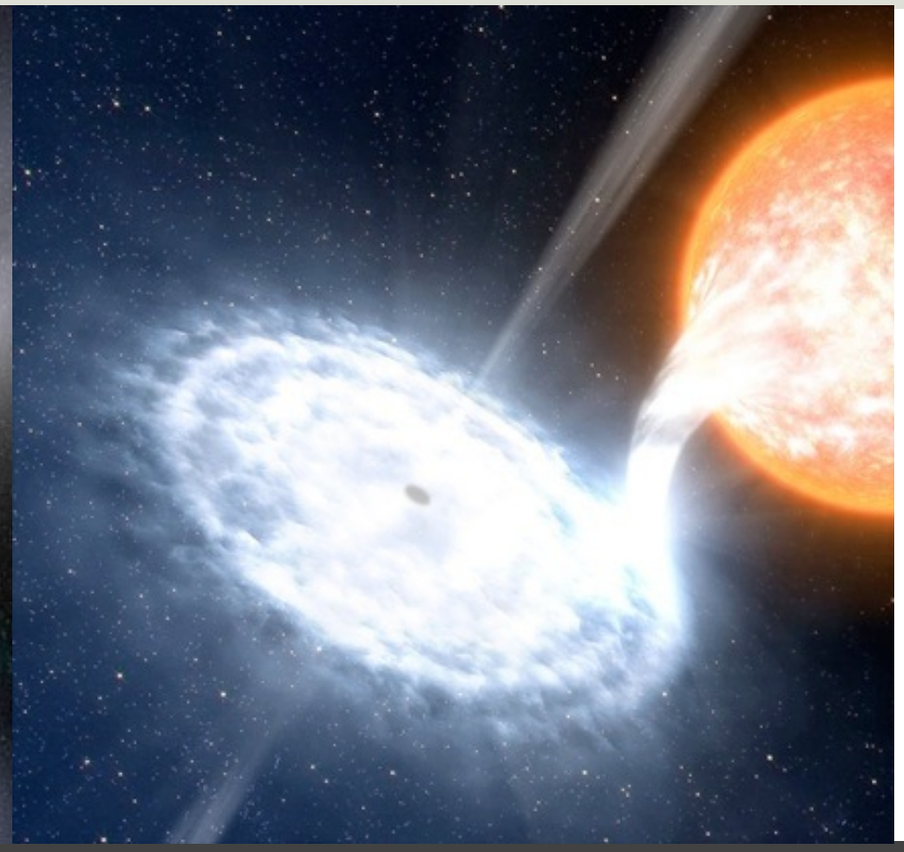

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Driving Extreme Variability: Evolving coronae & evidence for jet launching

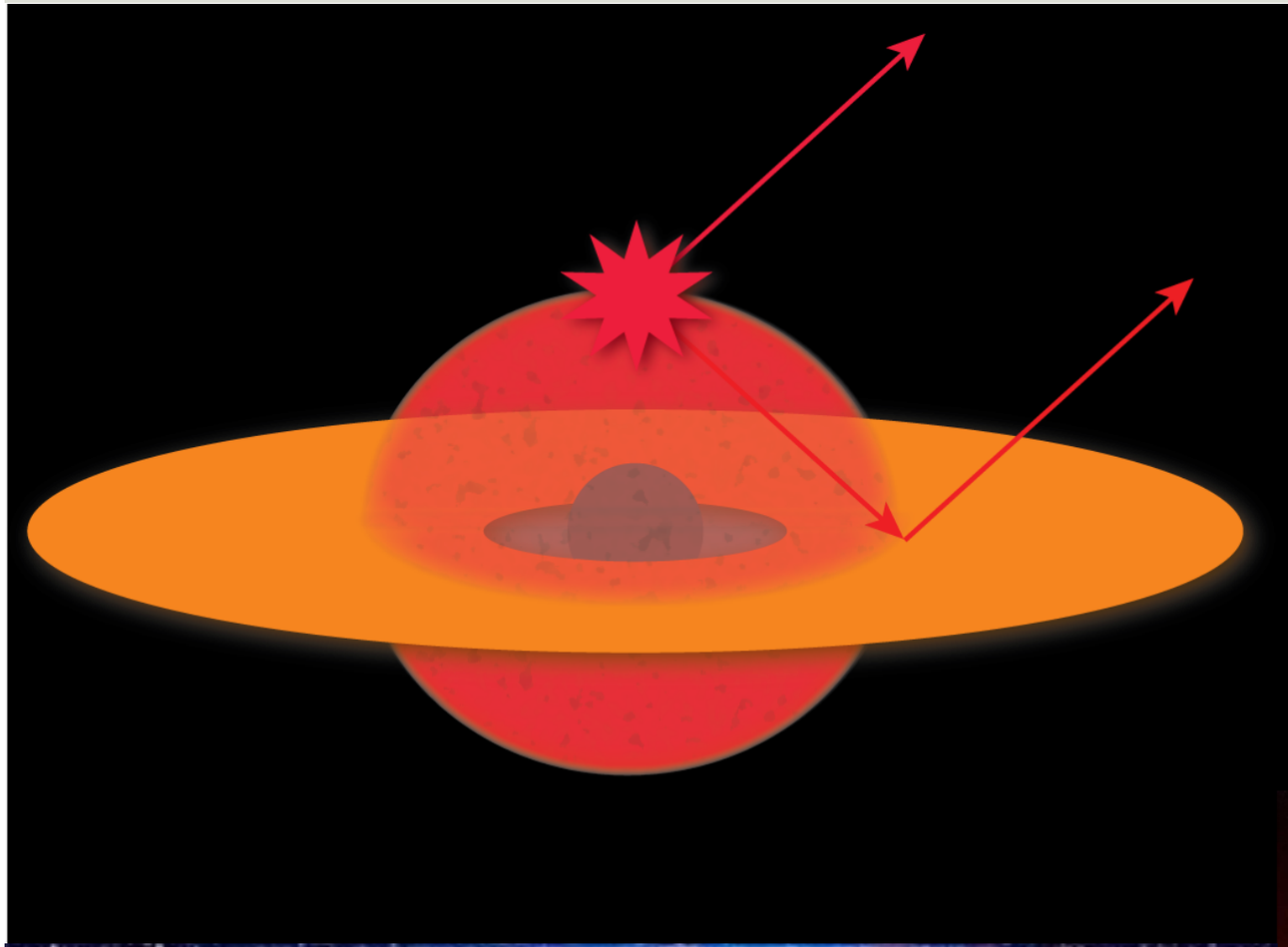
Dan Wilkins

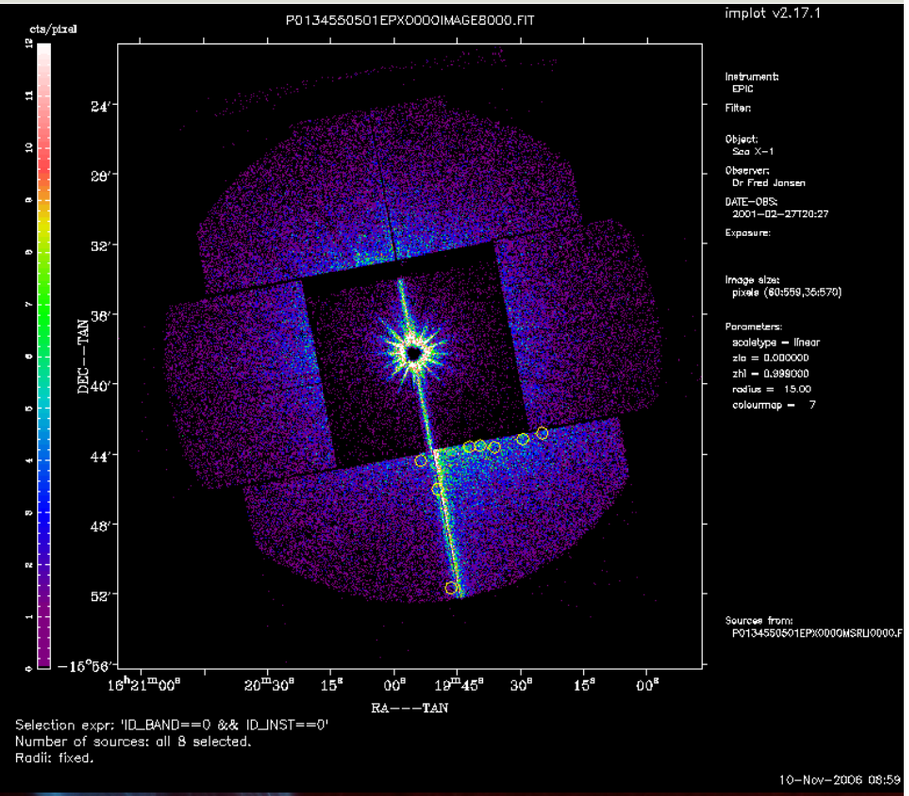
CITA National Fellow, Saint Mary's University

with Luigi Gallo, Kirsten Bonson, Andy Fabian, Dirk Grupe

XMM-Newton 2015 Science Workshop, ESAC, Madrid

CITA–ICAT

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Outline

1. Measuring the corona
2. Long timescale variability of Markarian 335
3. Short timescale variability in 2013
4. Flaring activity

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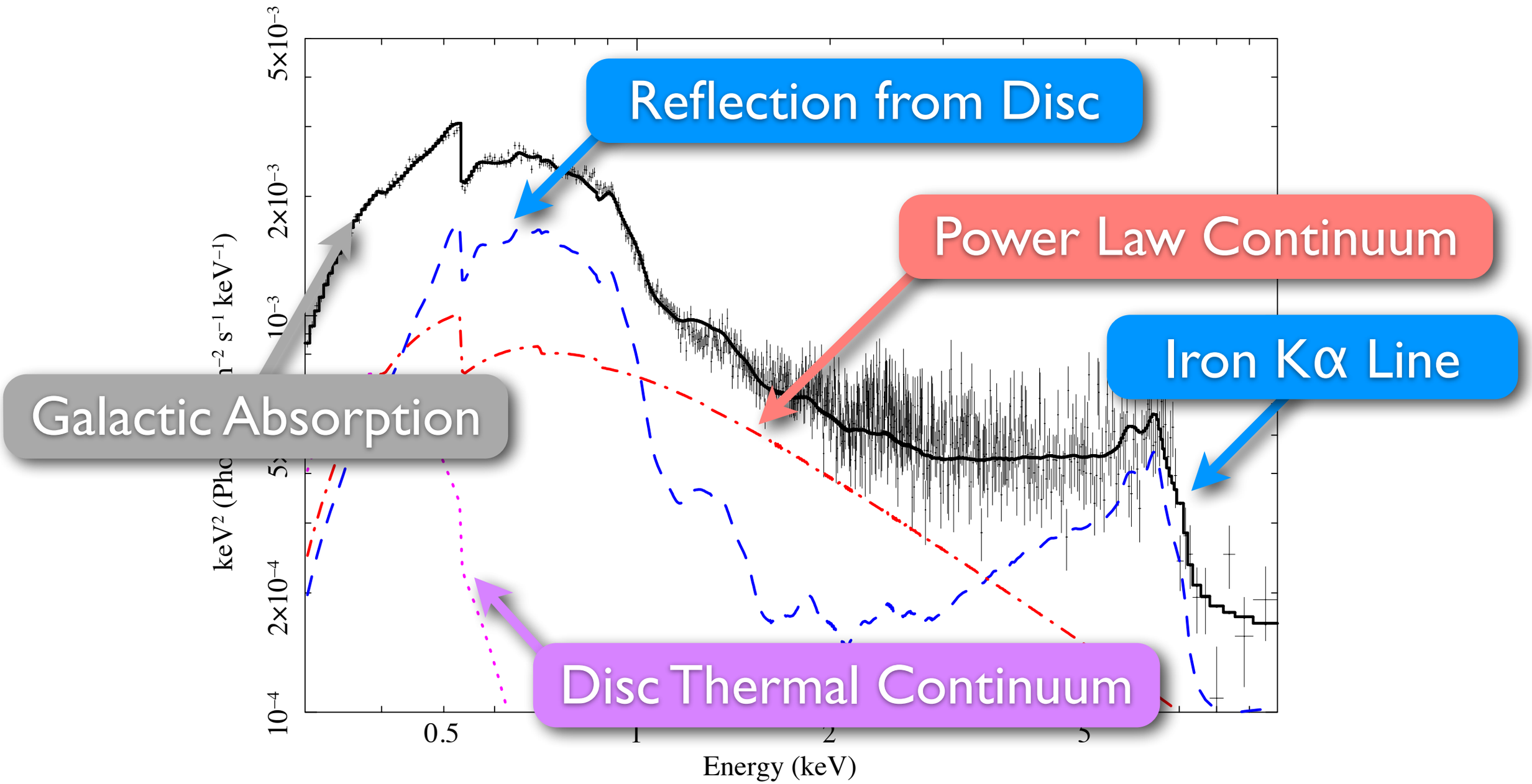
The X-ray Spectrum



Wilkins & Fabian 2012, MNRAS 424, 1284-1296
Fabian, Zoghbi, Wilkins et al 2012, MNRAS 419, 116-123

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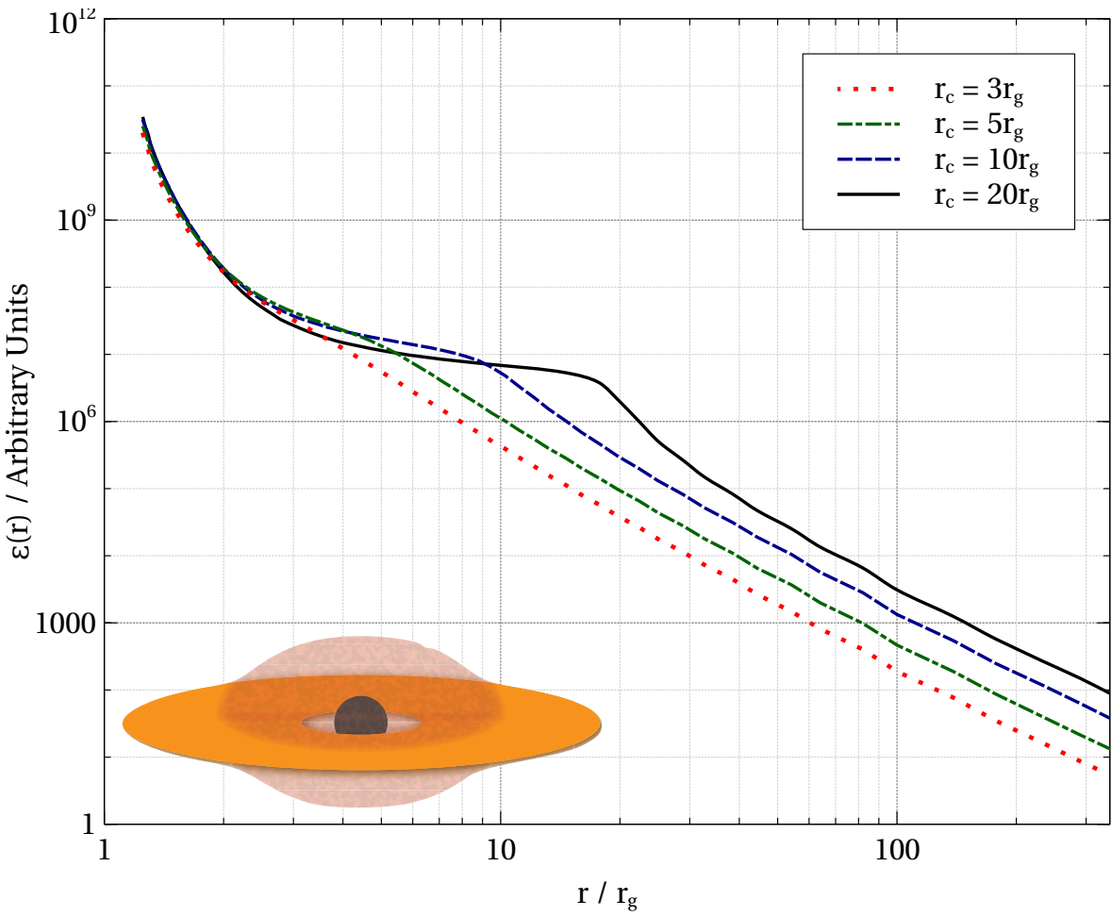
Measuring the Corona

Accretion Disc Emissivity



Wilkins & Fabian 2012, MNRAS 424, 1284-1296
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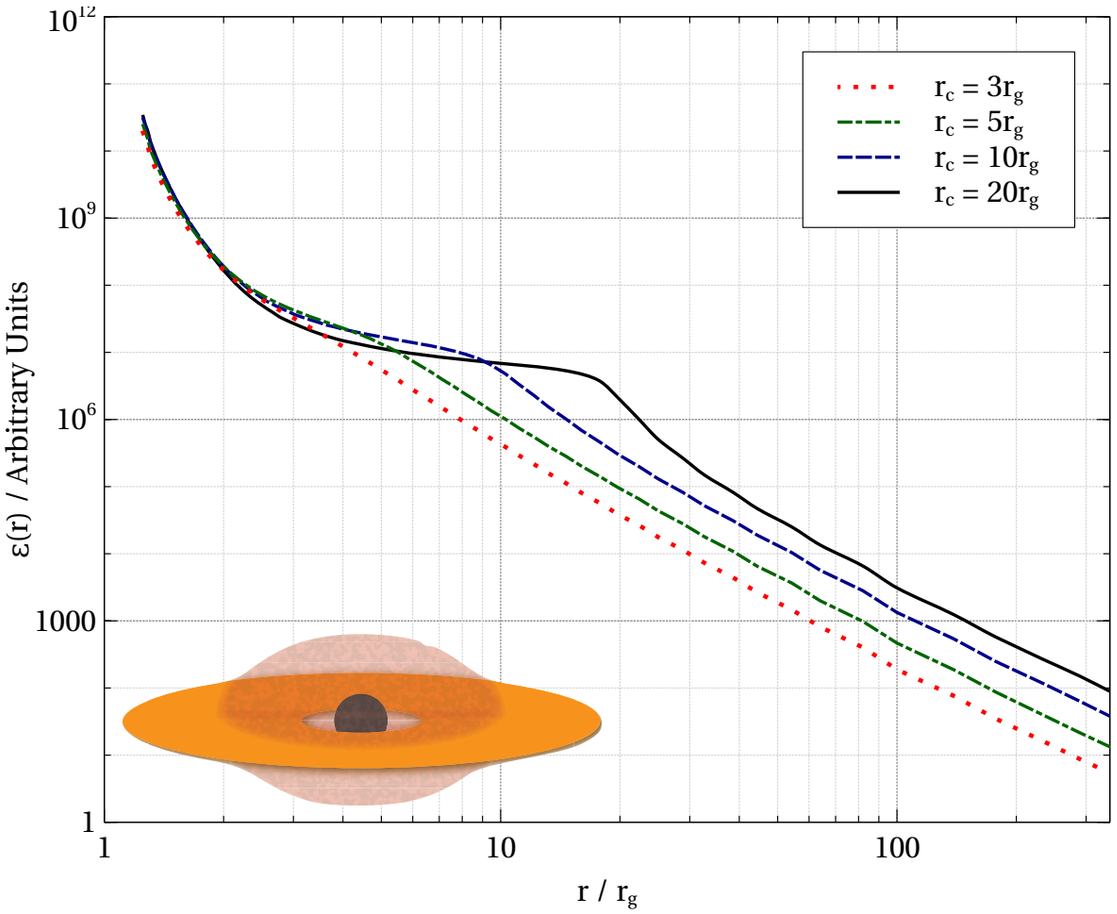
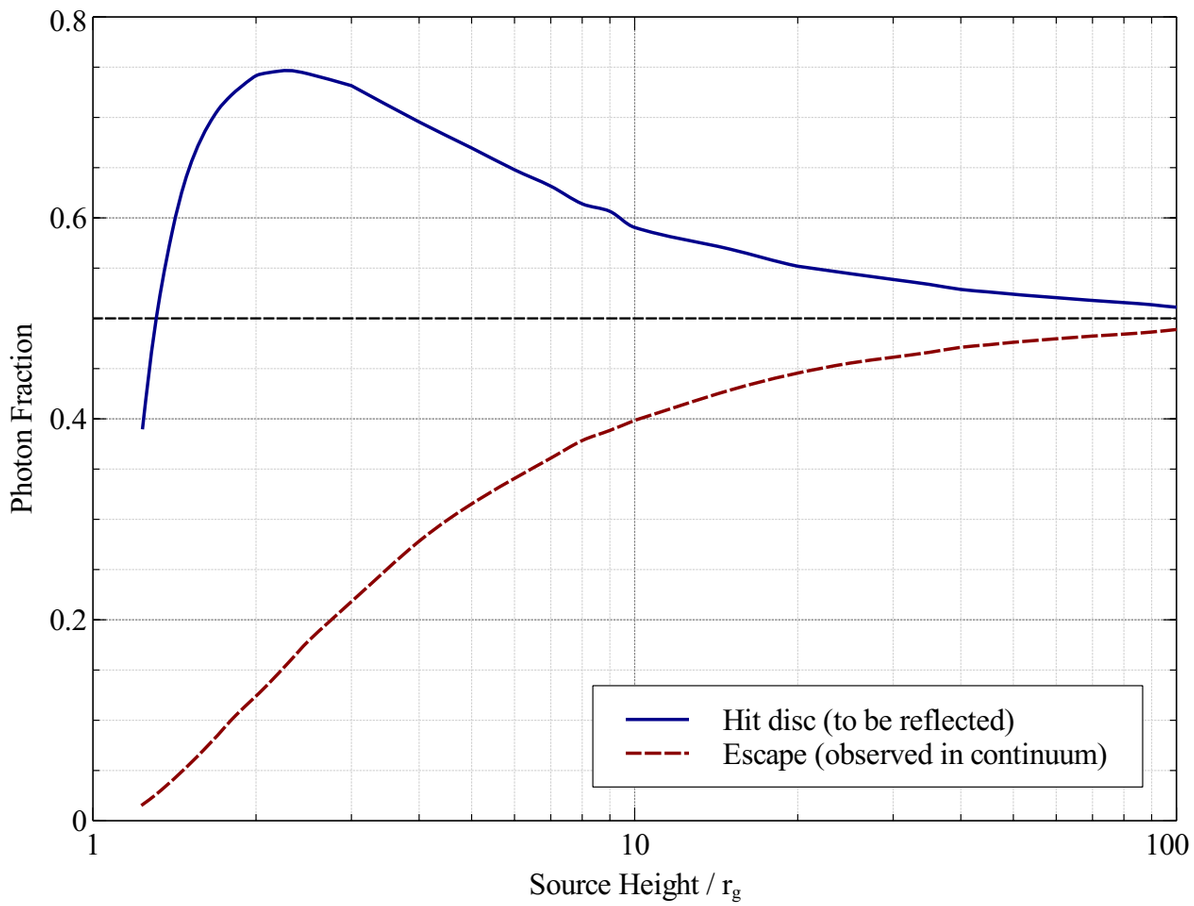
Measuring the Corona

Accretion Disc Emissivity



Reflection Fraction



Wilkins & Fabian 2012, MNRAS 424, 1284-1296
Fabian, Zoghbi, Wilkins et al 2012, MNRAS 419, 116-123

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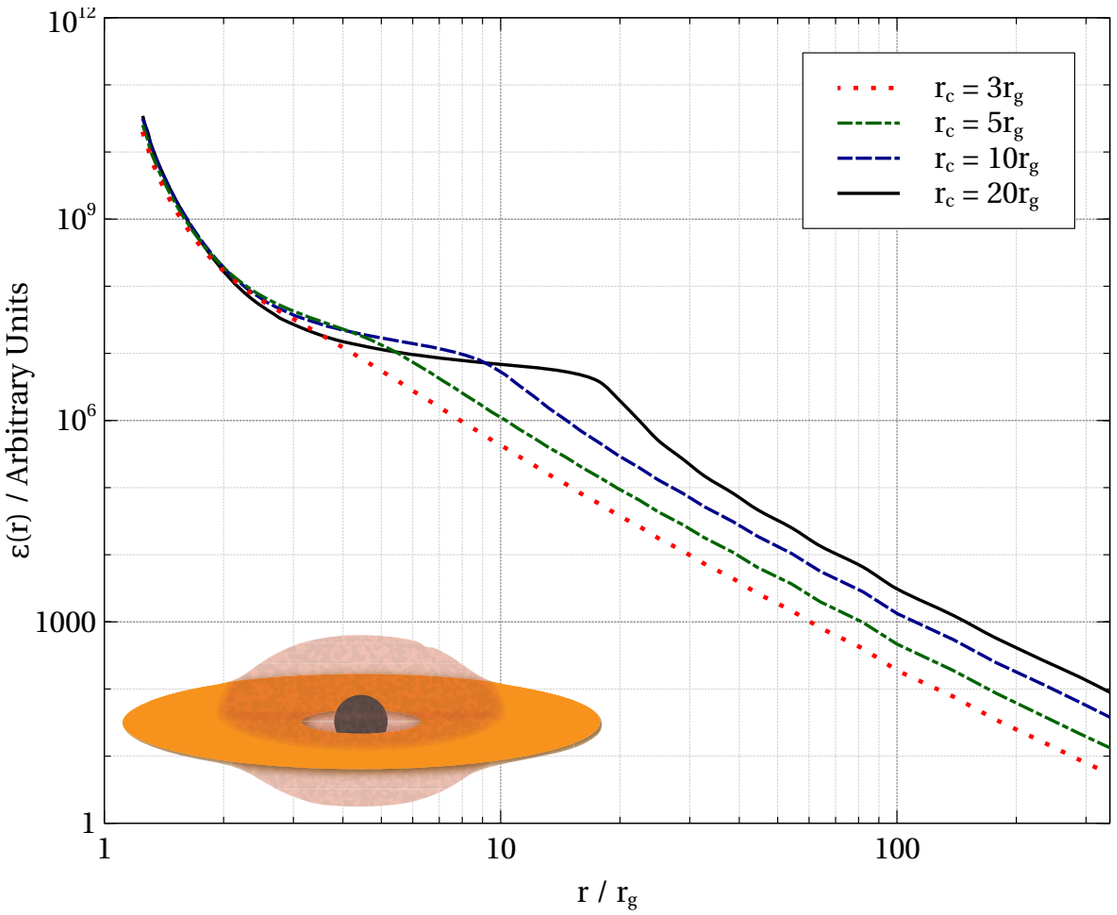
Measuring the Corona

Accretion Disc Emissivity



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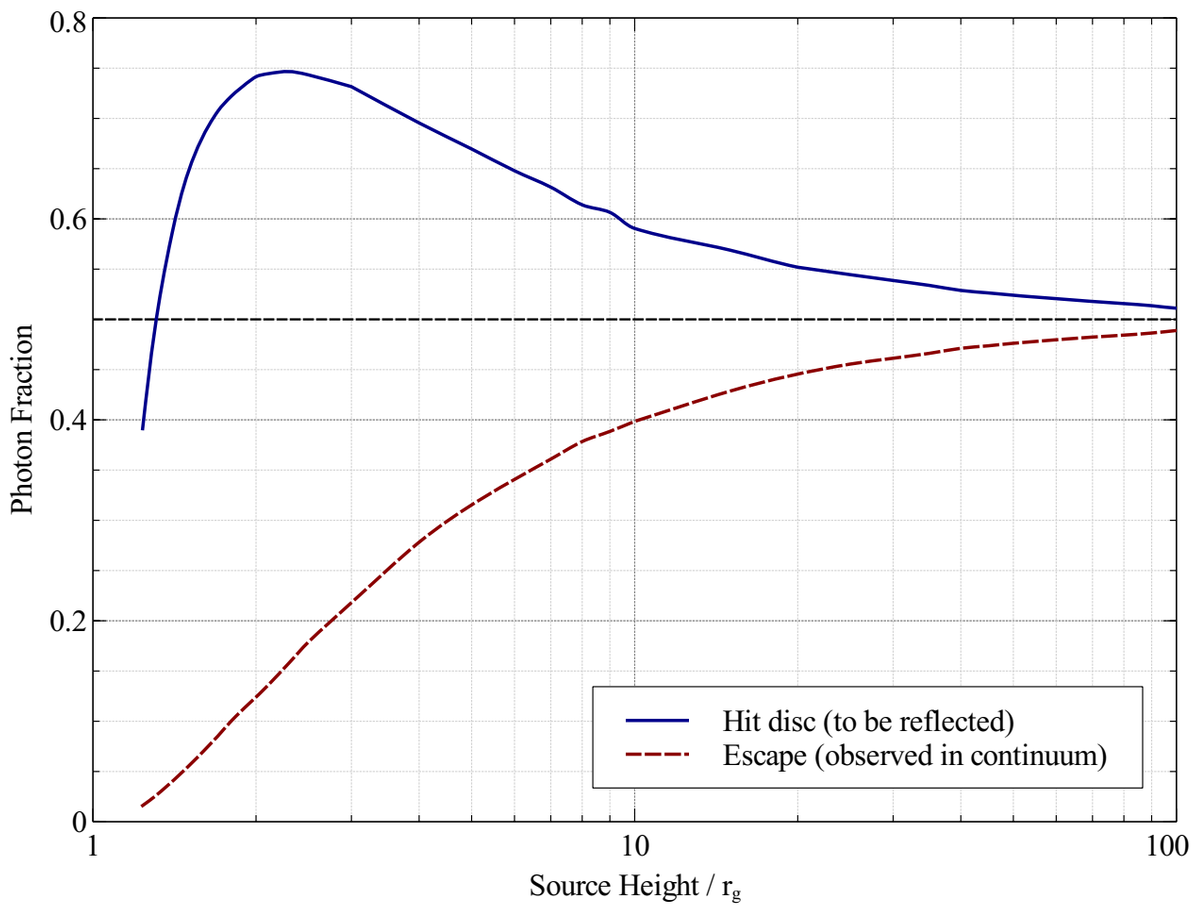

Also X-ray reverberation (Wilkins+13, Cackett+14 & Ed Cackett's talk)

Grupe et al 2007, 2012

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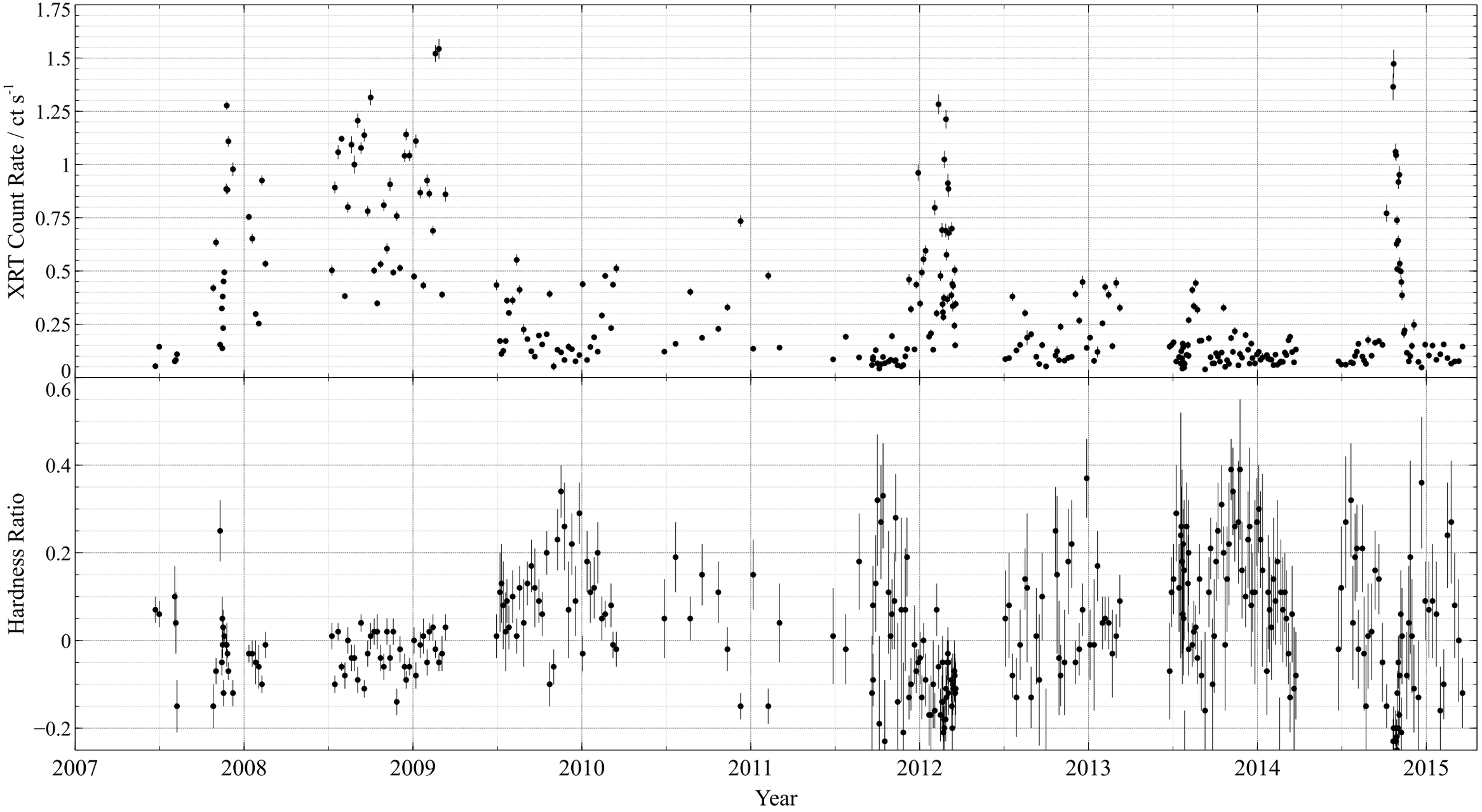
Markarian 335 – A Variable Source!



Wilkins & Gallo 2015, MNRAS 449, 129-146

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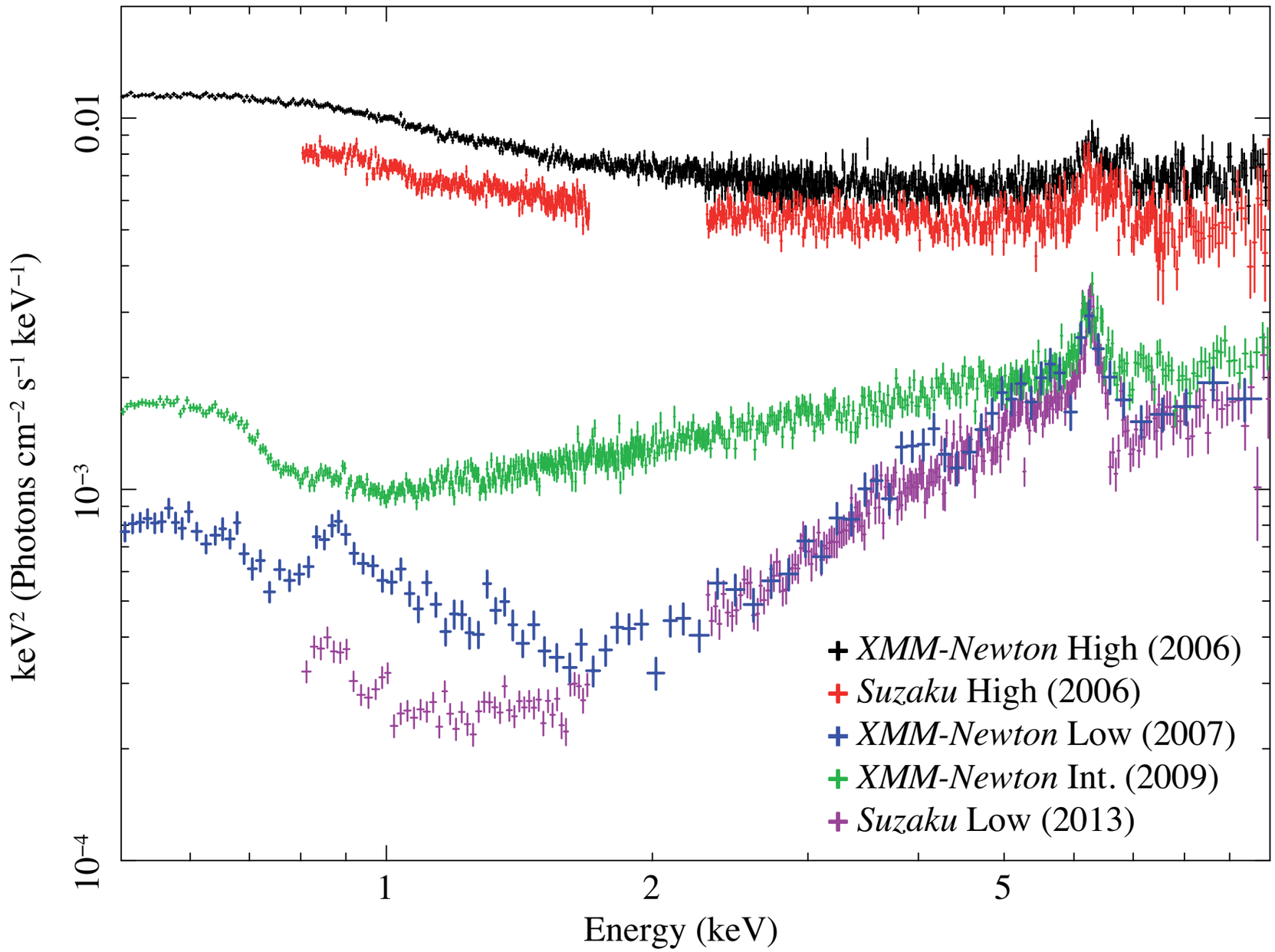
Long Timescale Variability



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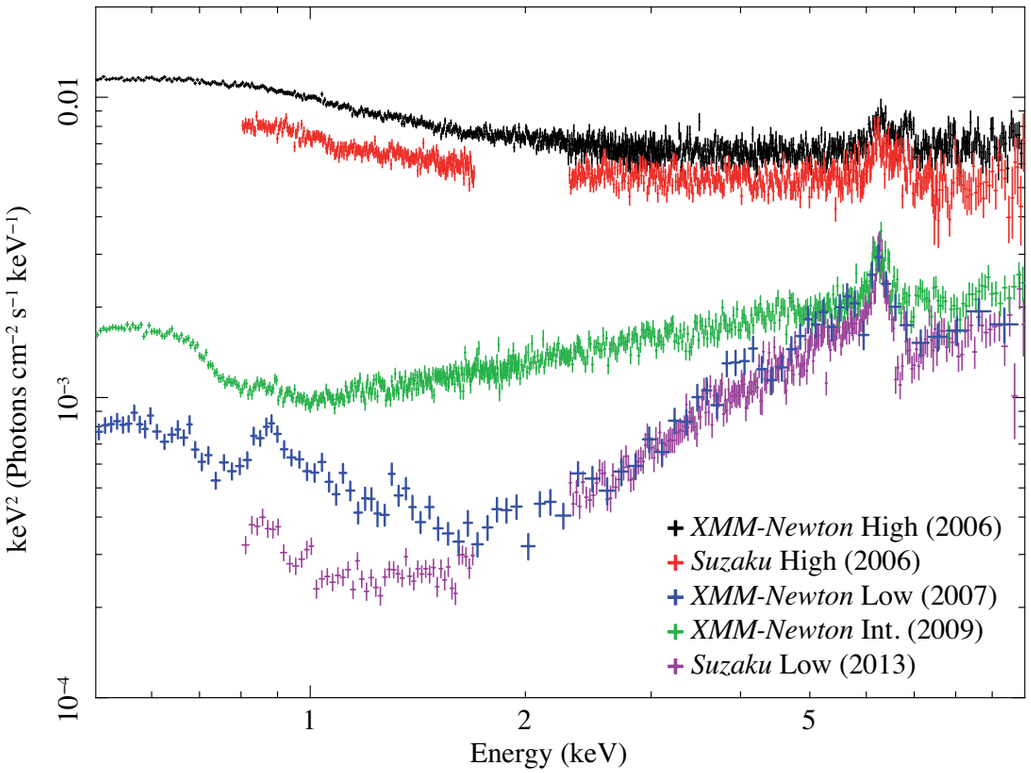

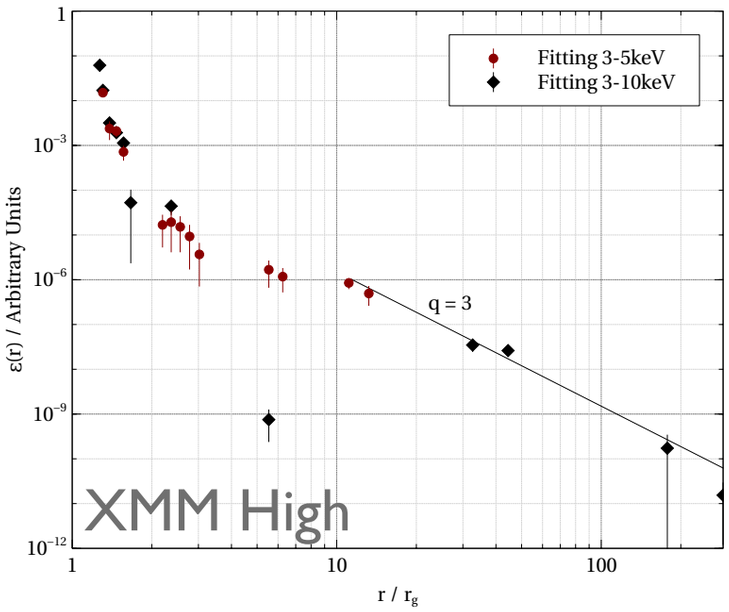

Wilkins & Gallo 2015, MNRAS 449, 129-146

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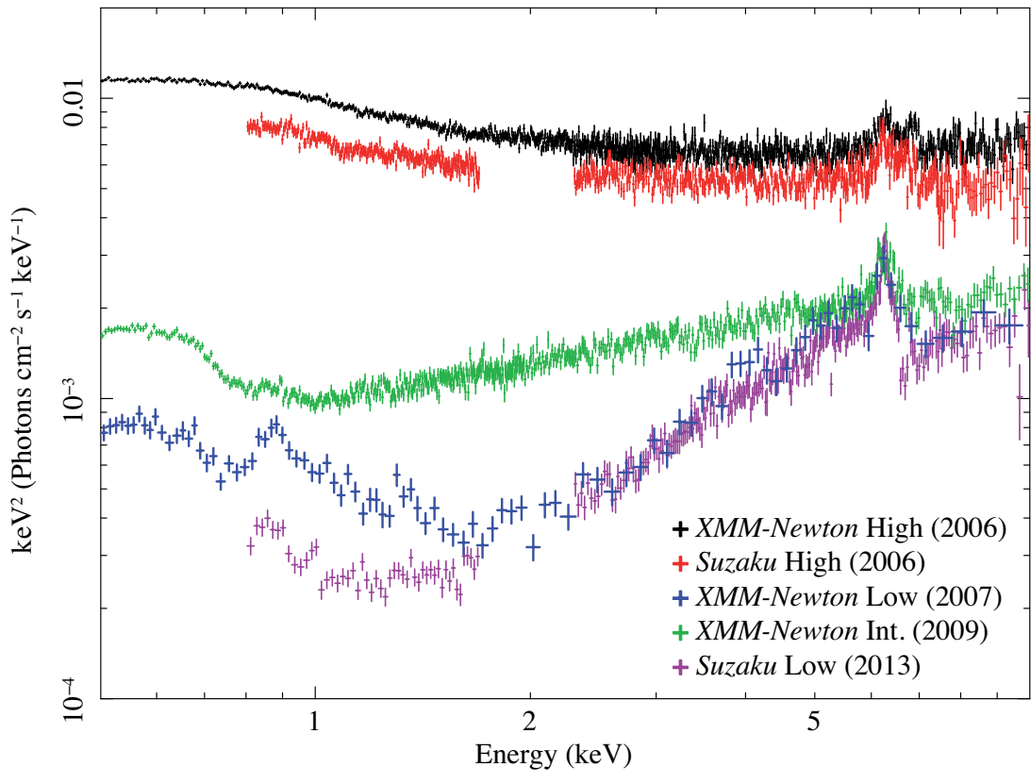

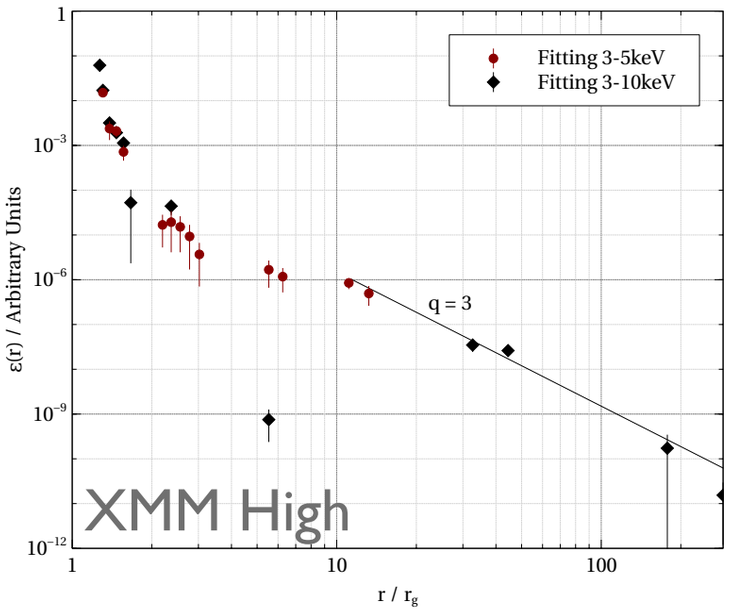

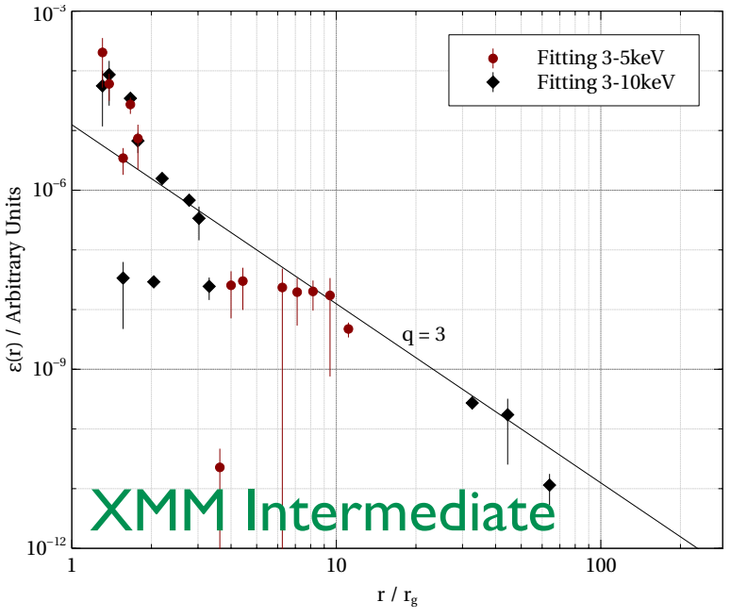

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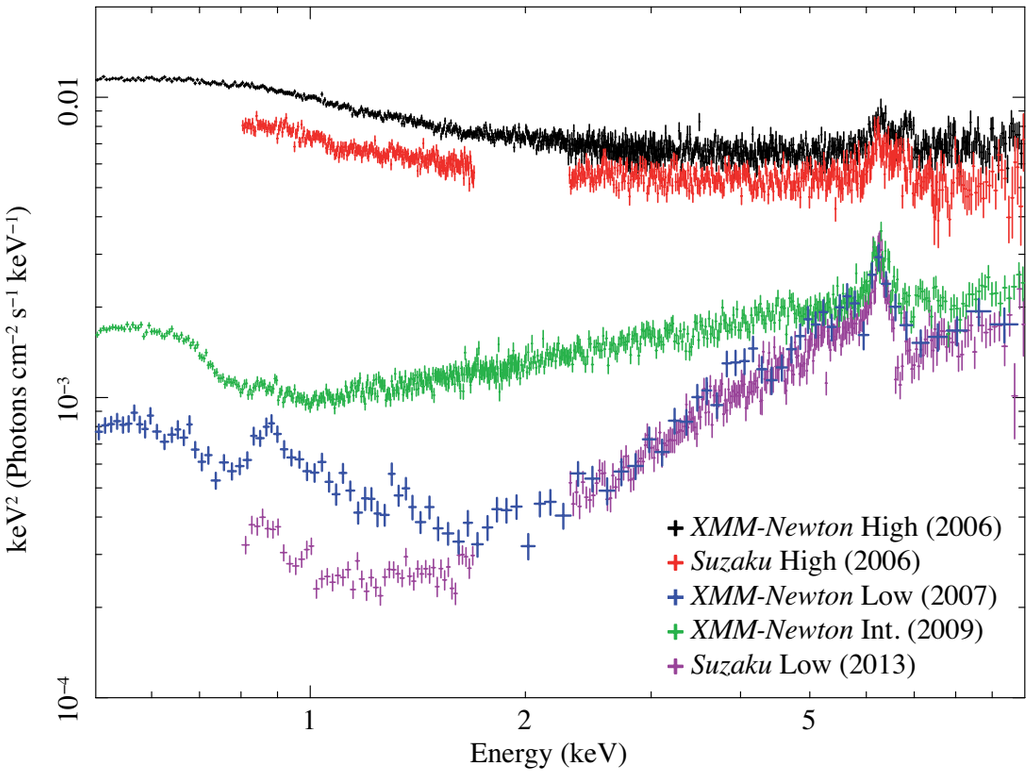

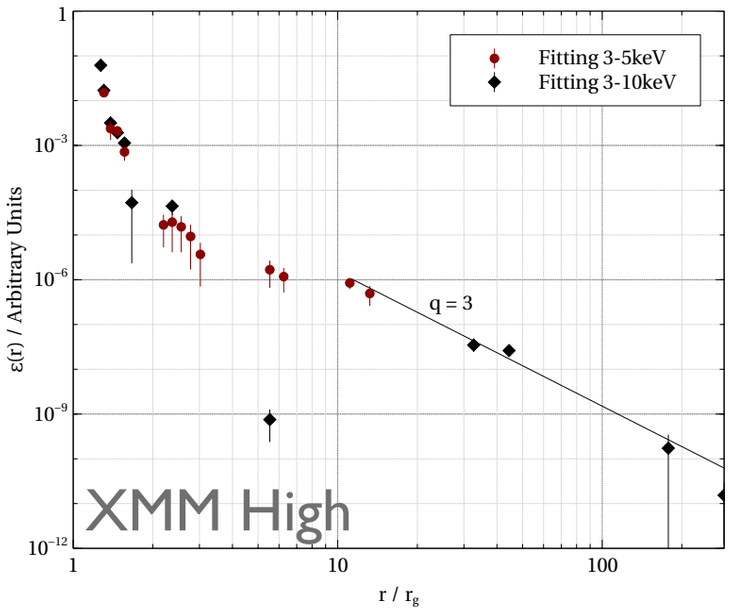

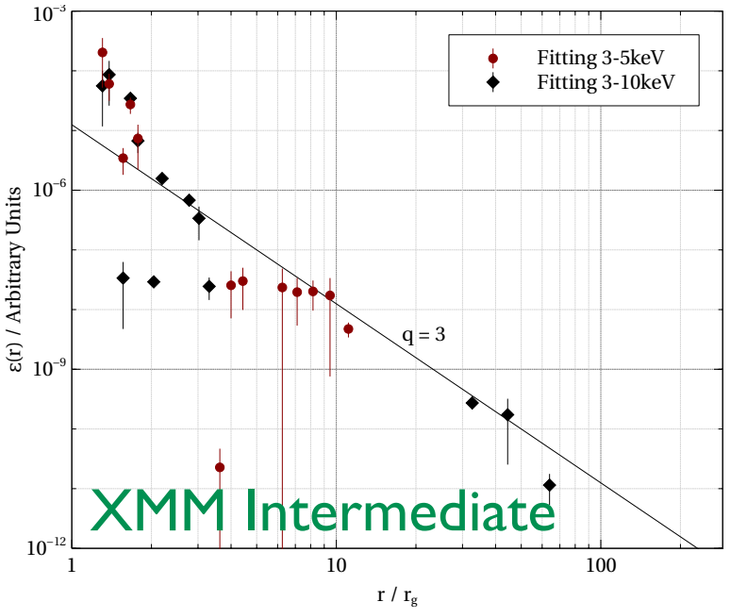

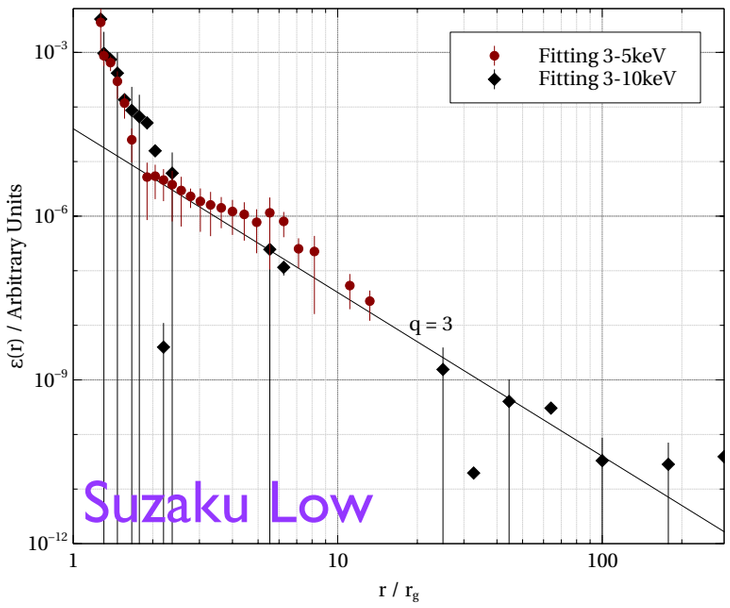

Wilkins & Gallo 2015, MNRAS 449, 129-146

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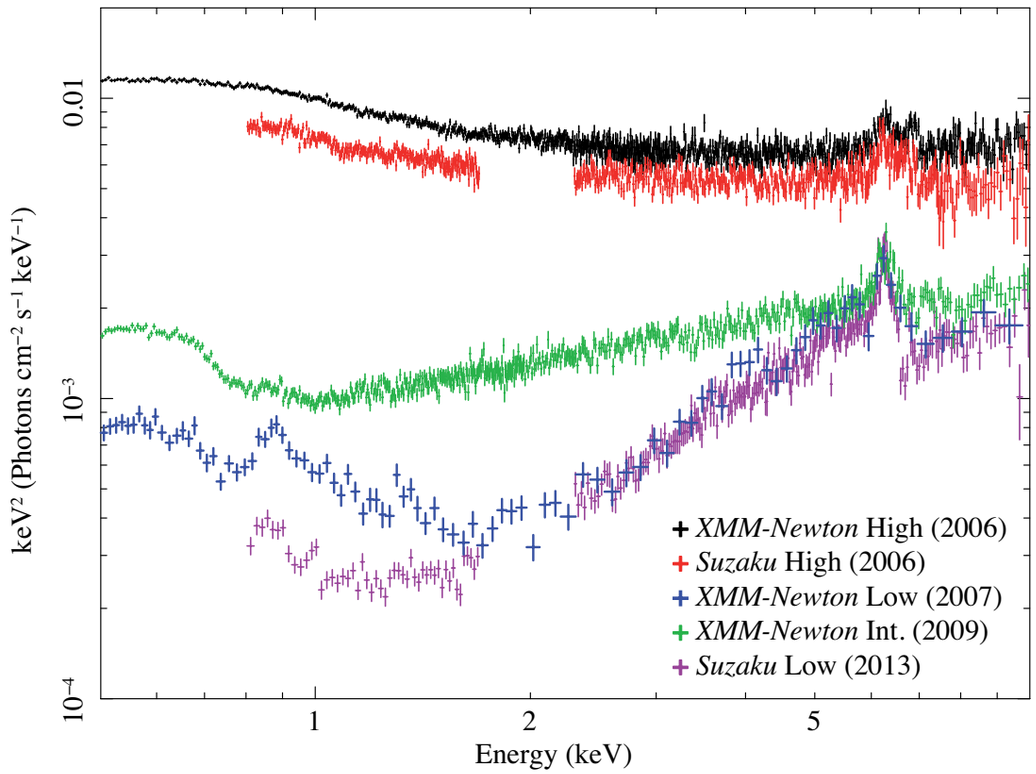
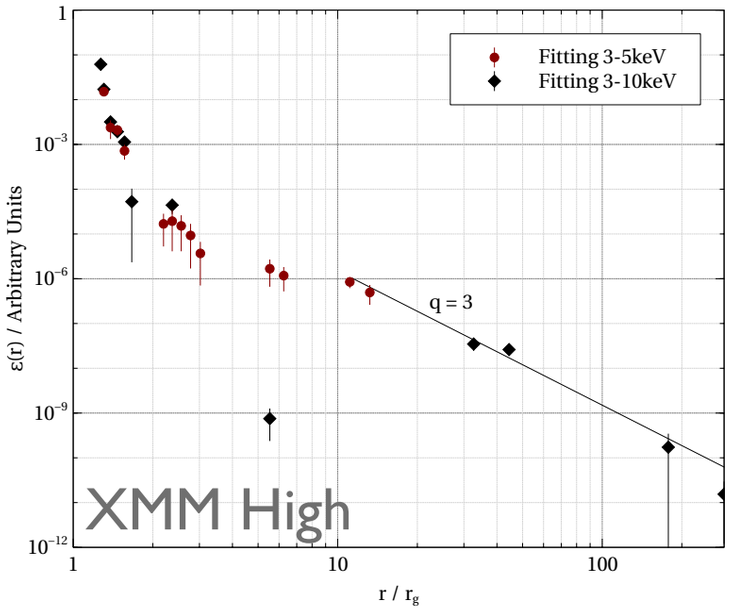
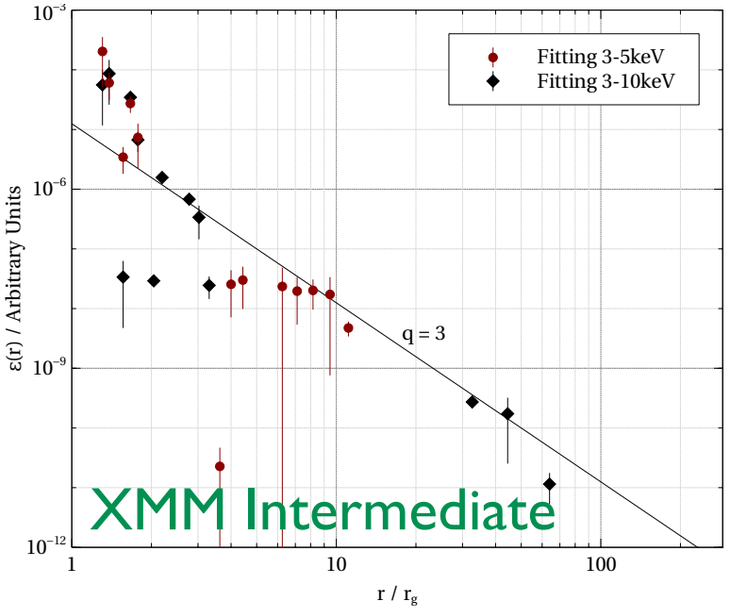
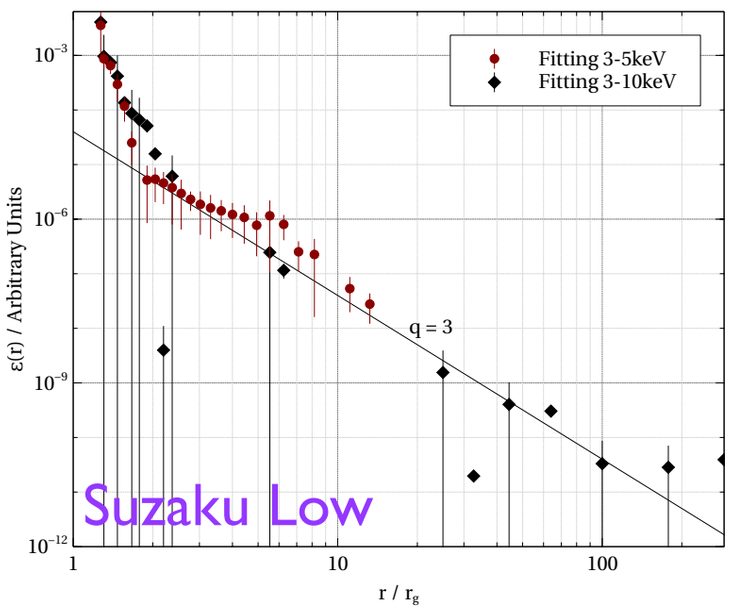
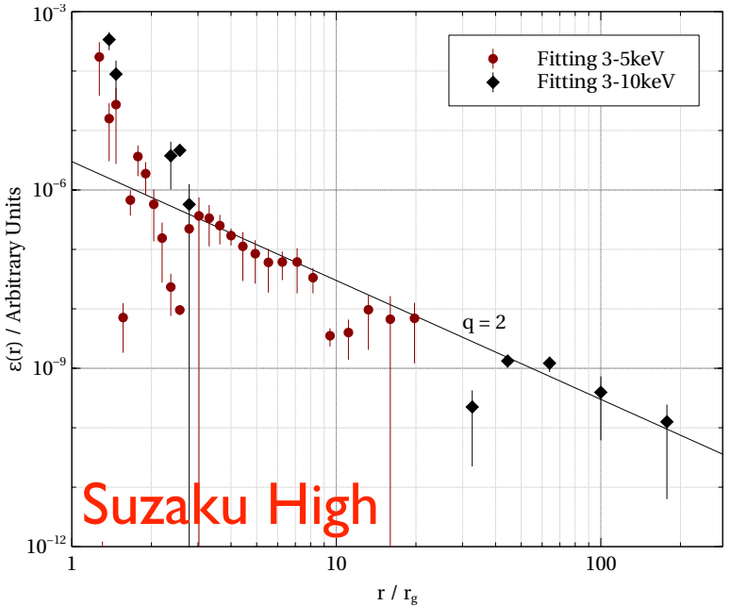




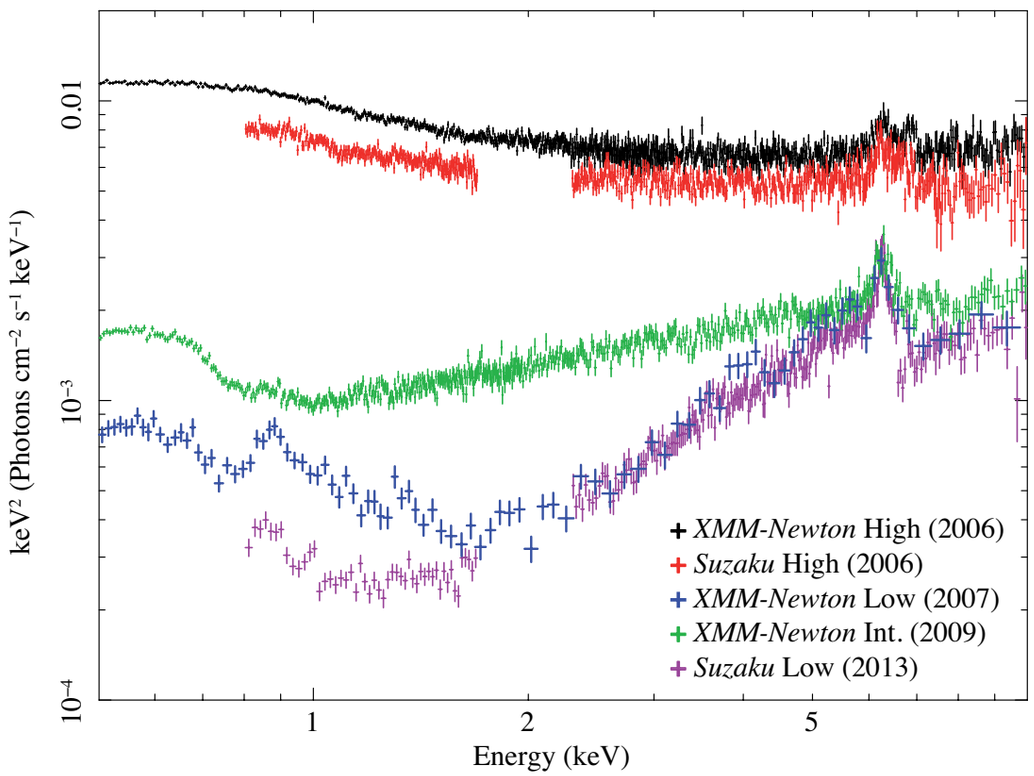




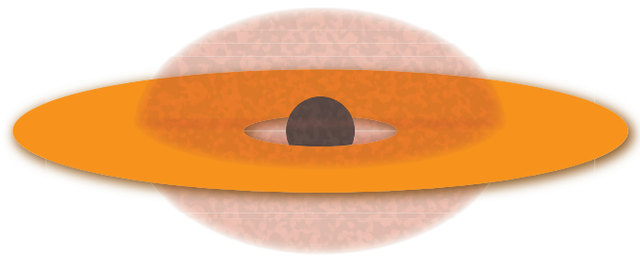


Wilkins & Gallo 2015, MNRAS 449, 129-146

Long Timescale Variability

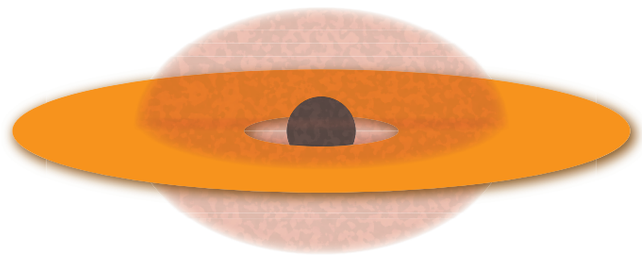


$r_b = 26^{+10}_{-7}\, r_g$ $R = 1.3^{+0.5}_{-0.2}$ $\Gamma = 2.52^{+0.01}_{-0.01}$



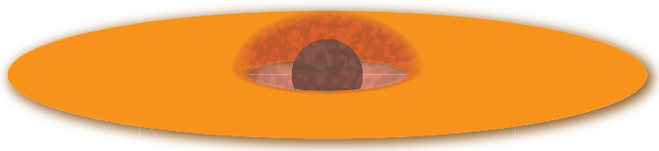
XMM High

$r_b < 12\, r_g$ $R = 1.8^{+0.4}_{-0.3}$ $\Gamma = 1.90^{+0.02}_{-0.02}$



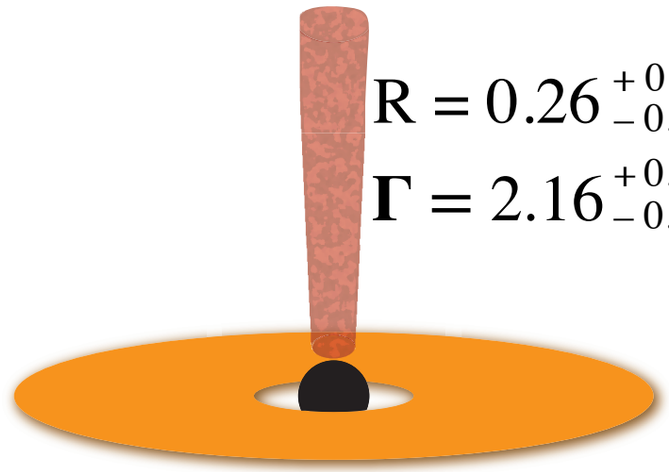
XMM Intermediate

$r_b < 5\, r_g$ $R = 6^{+4}_{-3}$ $\Gamma = 1.91^{+0.04}_{-0.07}$



Suzaku Low

$R = 0.26^{+0.04}_{-0.02}$ $\Gamma = 2.16^{+0.02}_{-0.01}$



Suzaku High

Wilkins et al. 2014, MNRAS 443, 2746-2756

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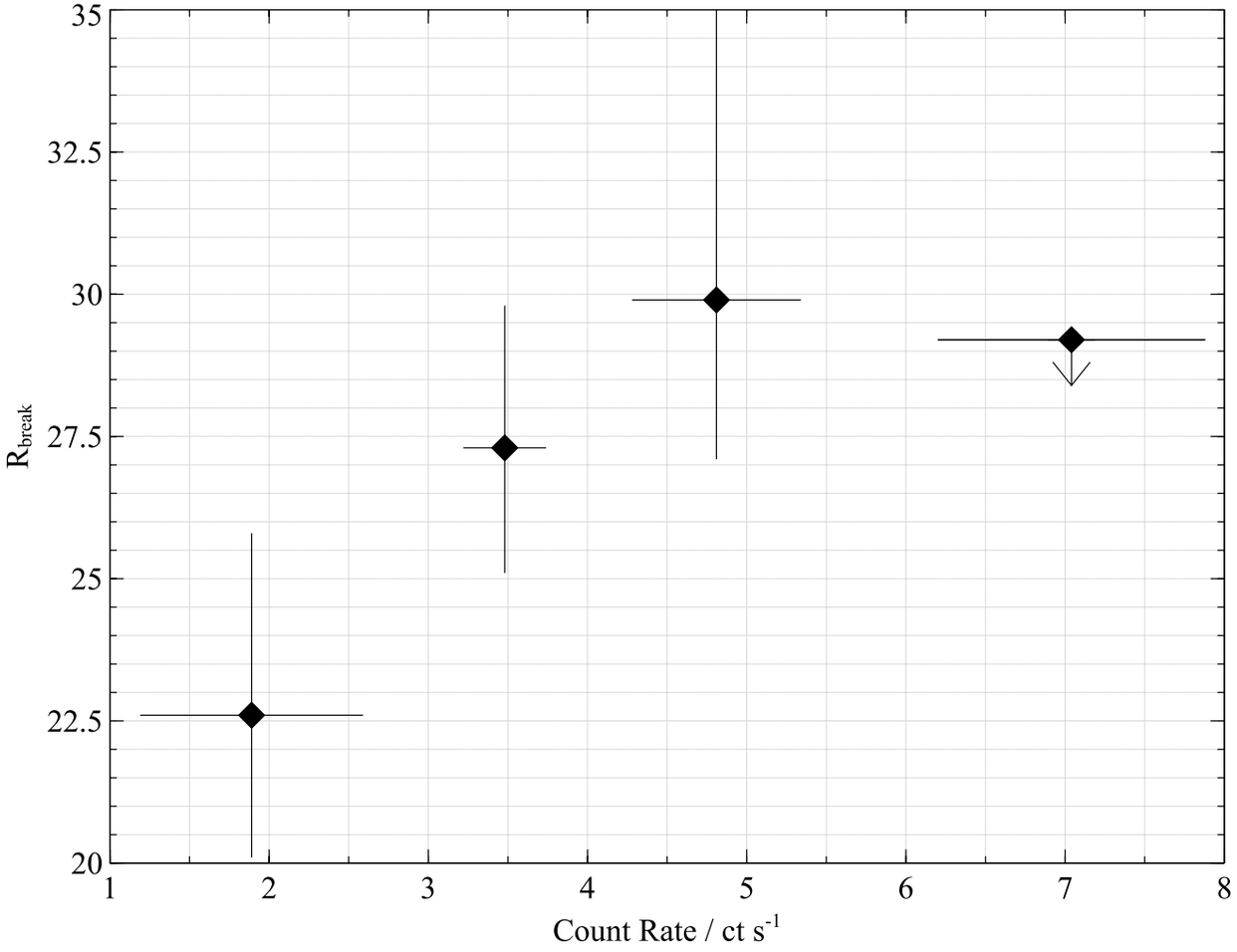
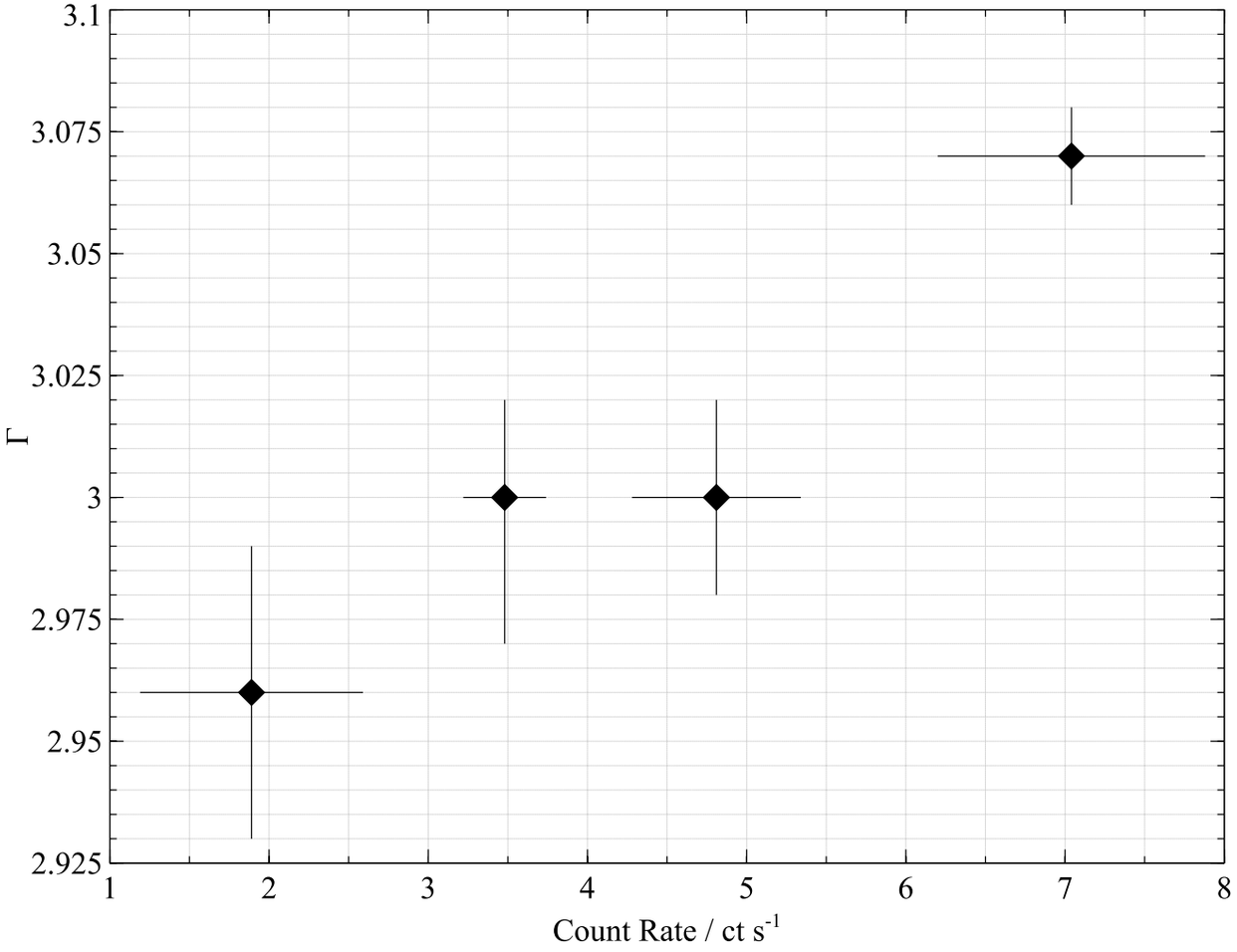
1H0707-495

Emissivity Break Radius



Continuum Spectrum



Wilkins & Gallo 2015, MNRAS 449, 129-146

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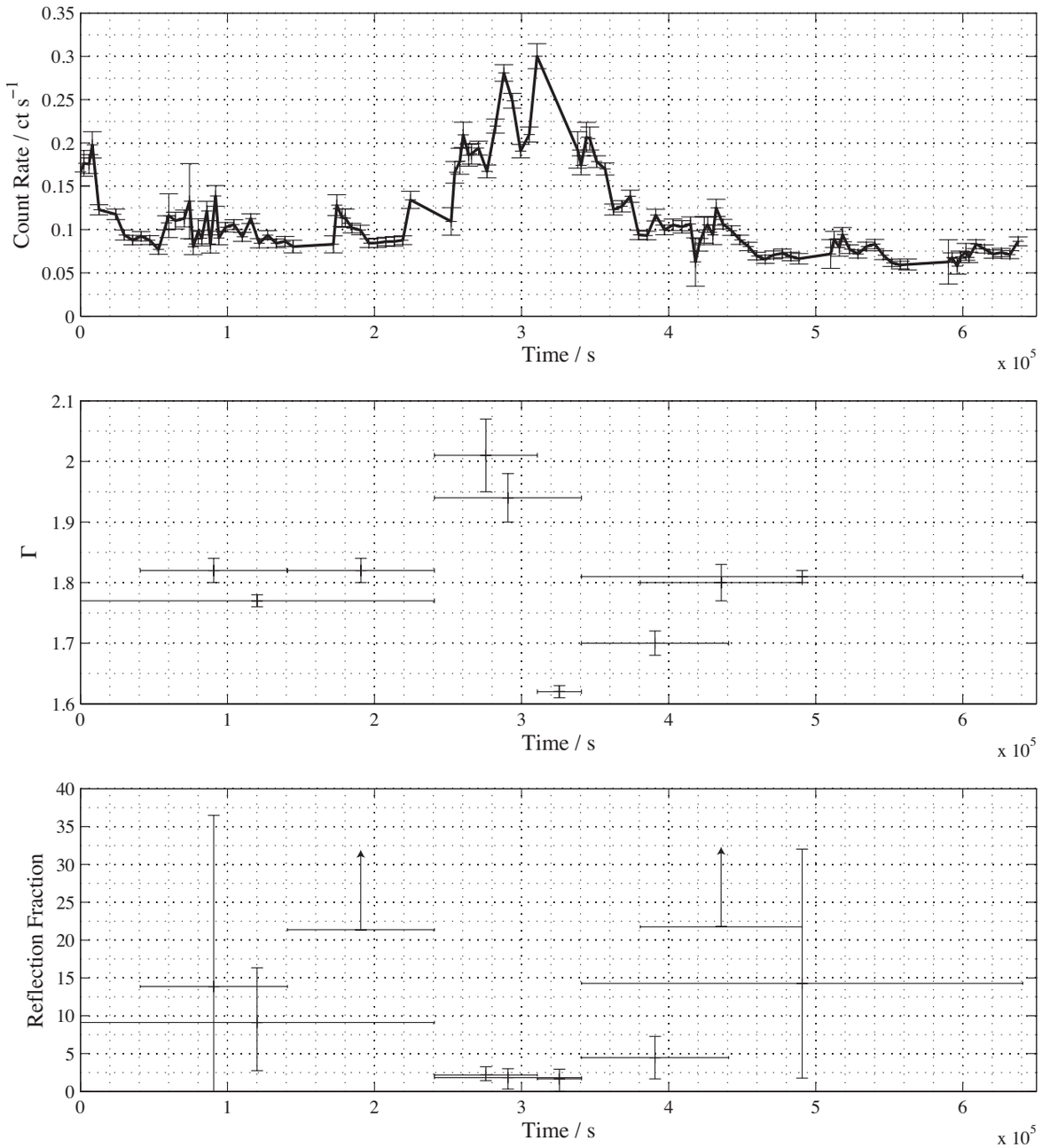
A Flare from Markarian 335



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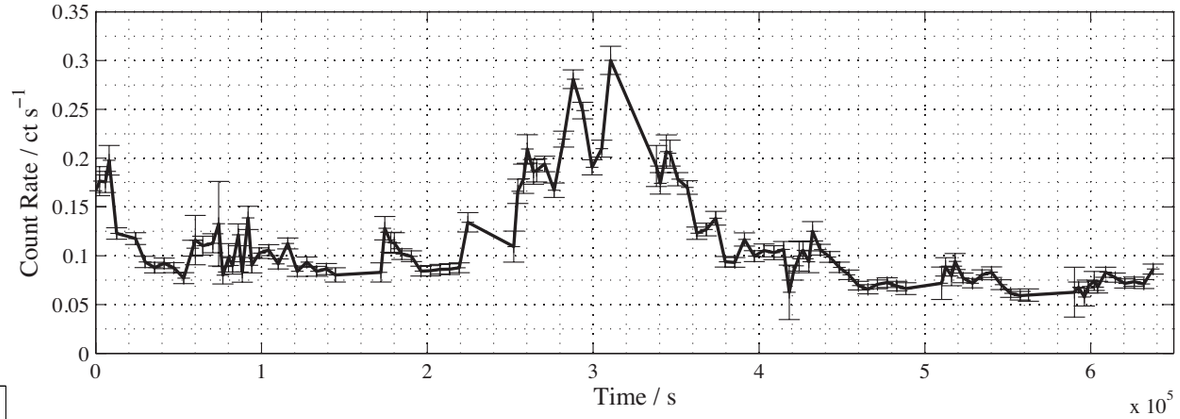

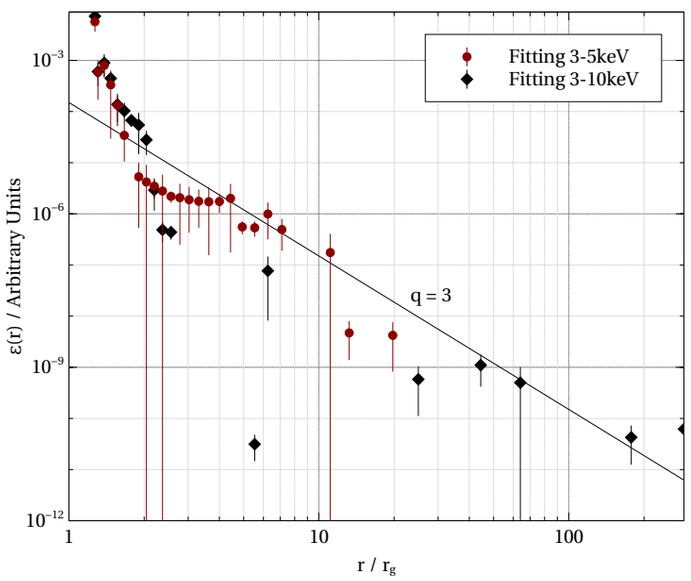

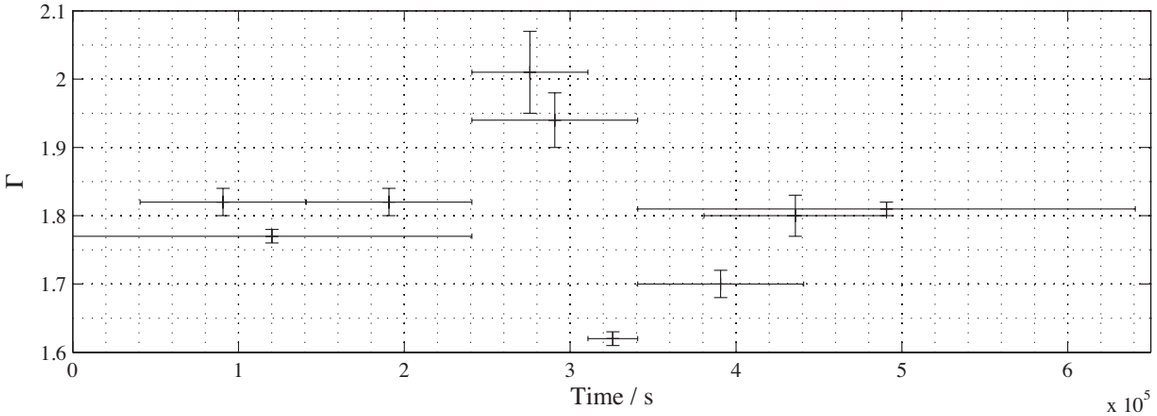

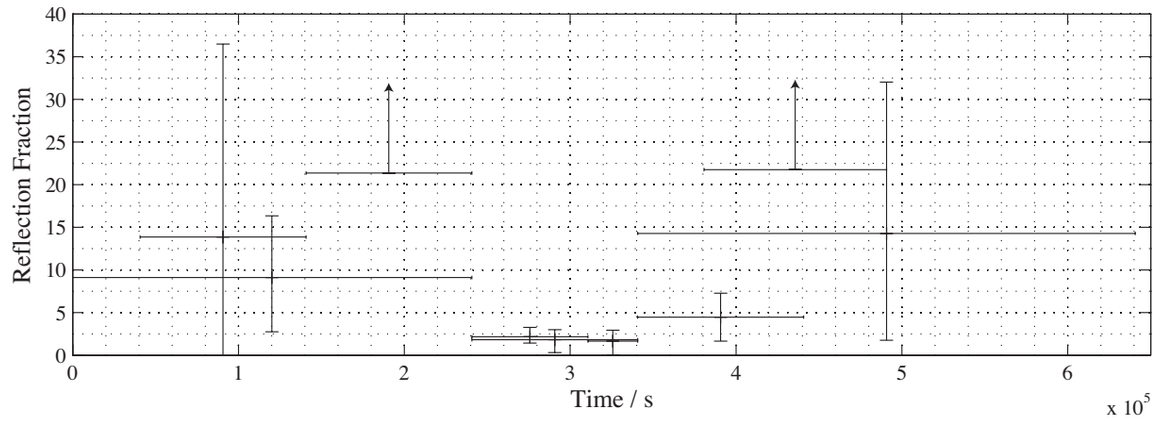

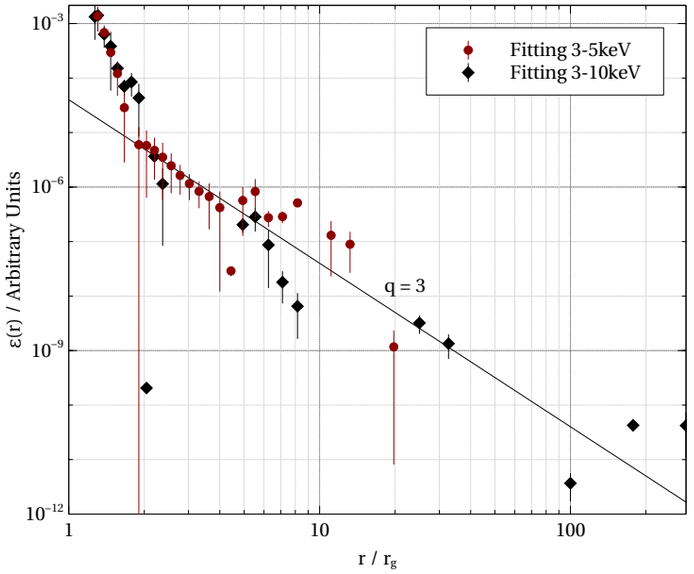

Wilkins & Gallo 2015, MNRAS 449, 129-146

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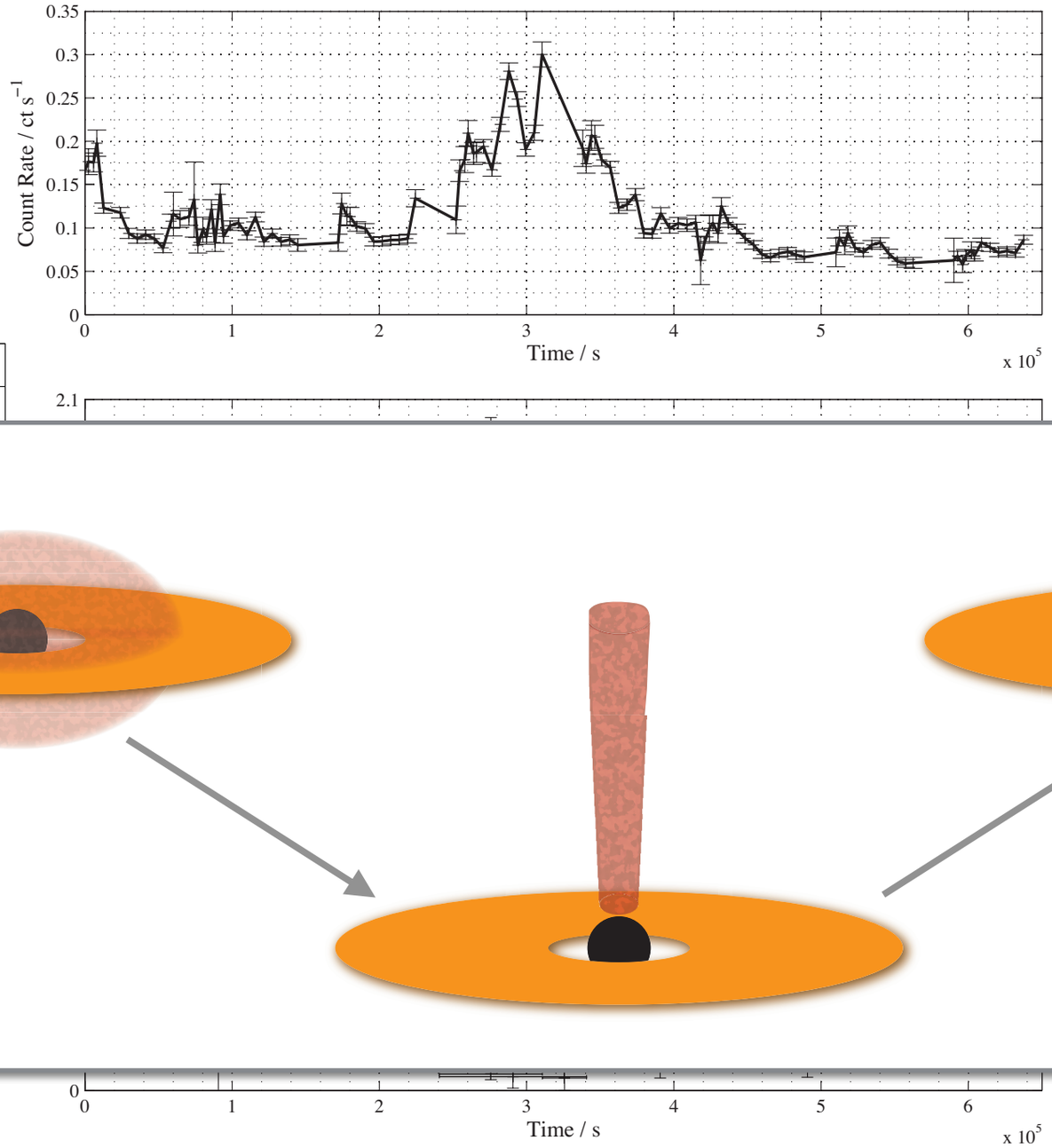

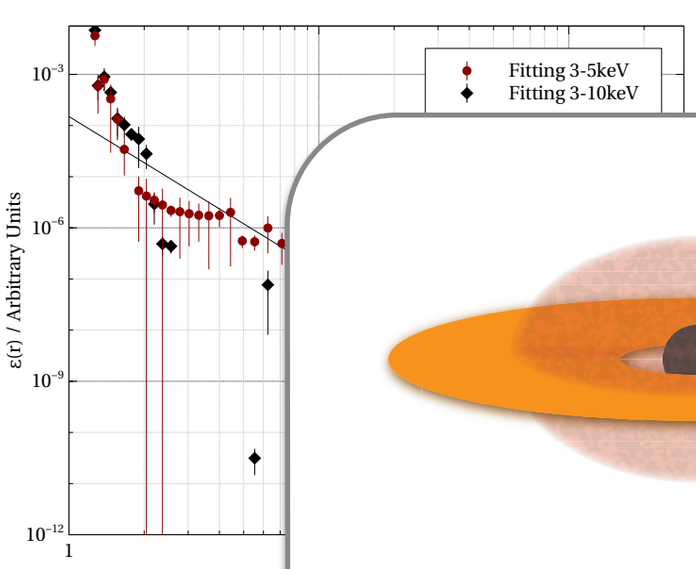

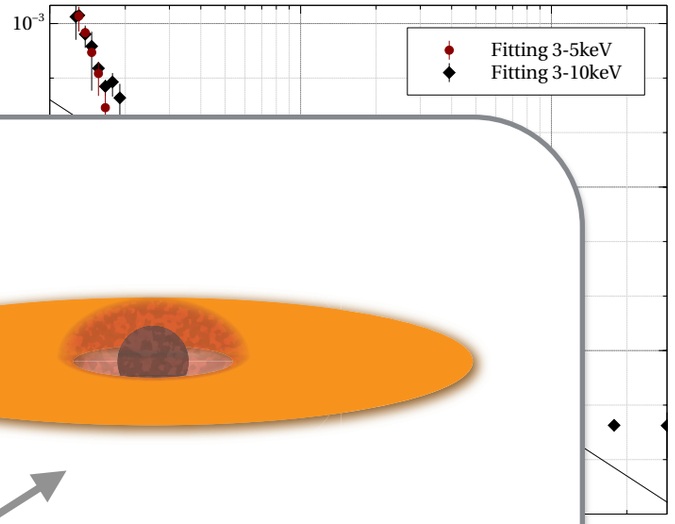

Gallo, Wilkins et al. 2015, MNRAS 446, 633-650
Wilkins & Gallo 2015, MNRAS 449, 129-146
McKinney at al. 2012, MNRAS 423, 3083-3117

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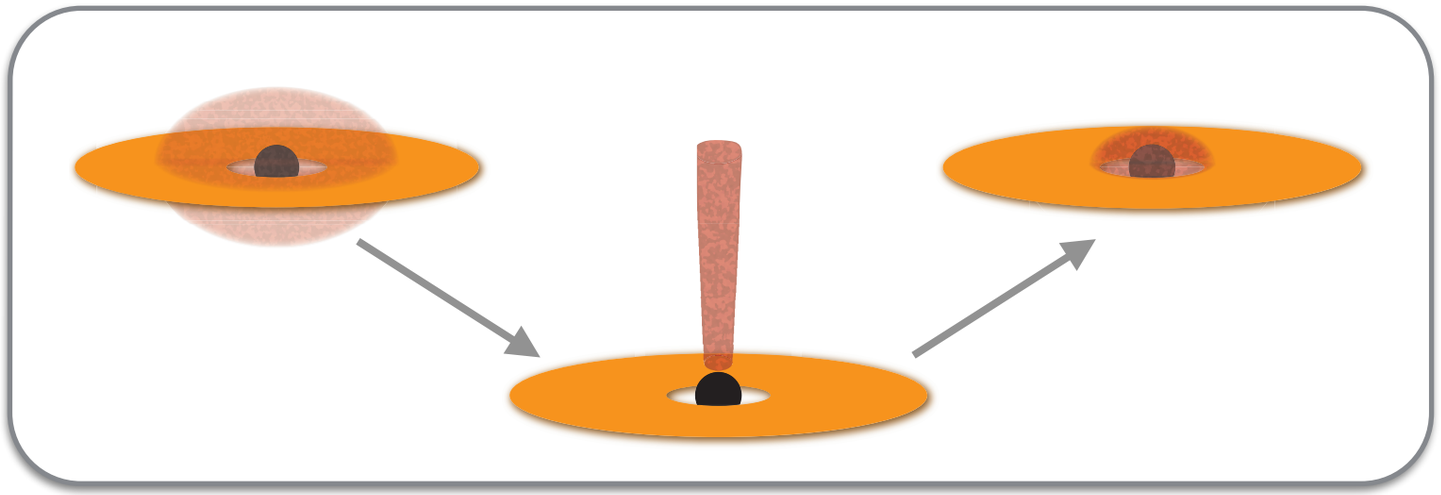
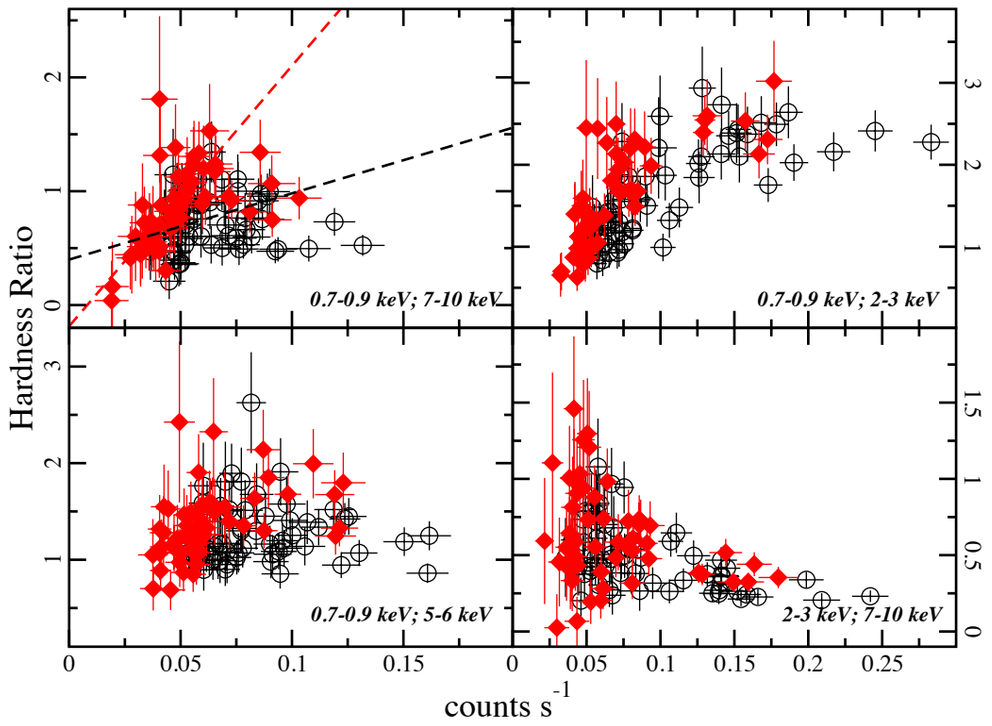
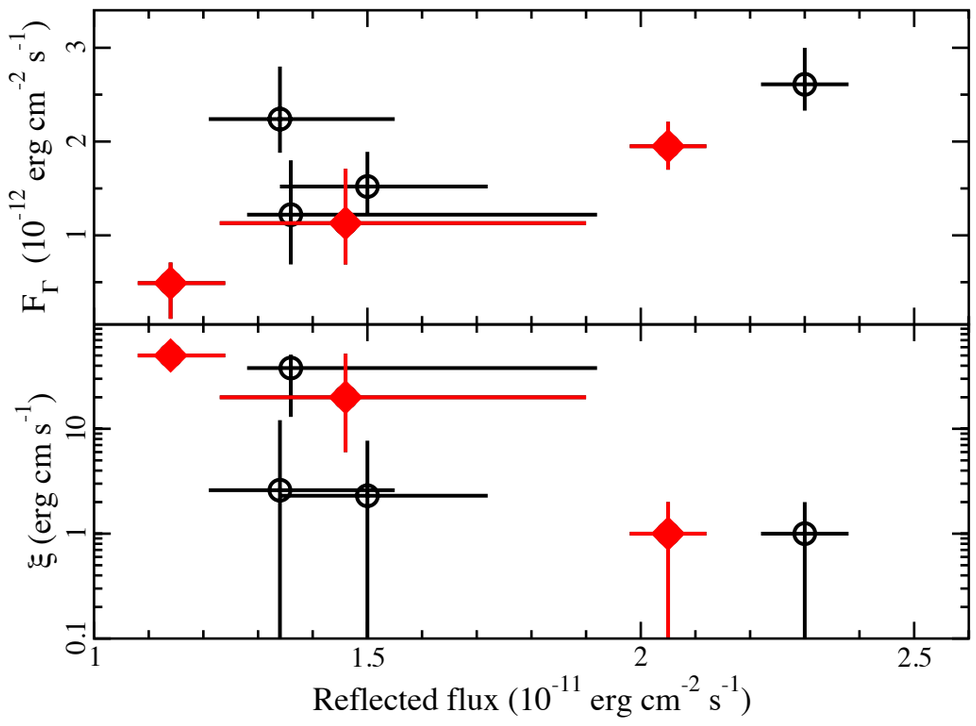
Cause of the Flare?







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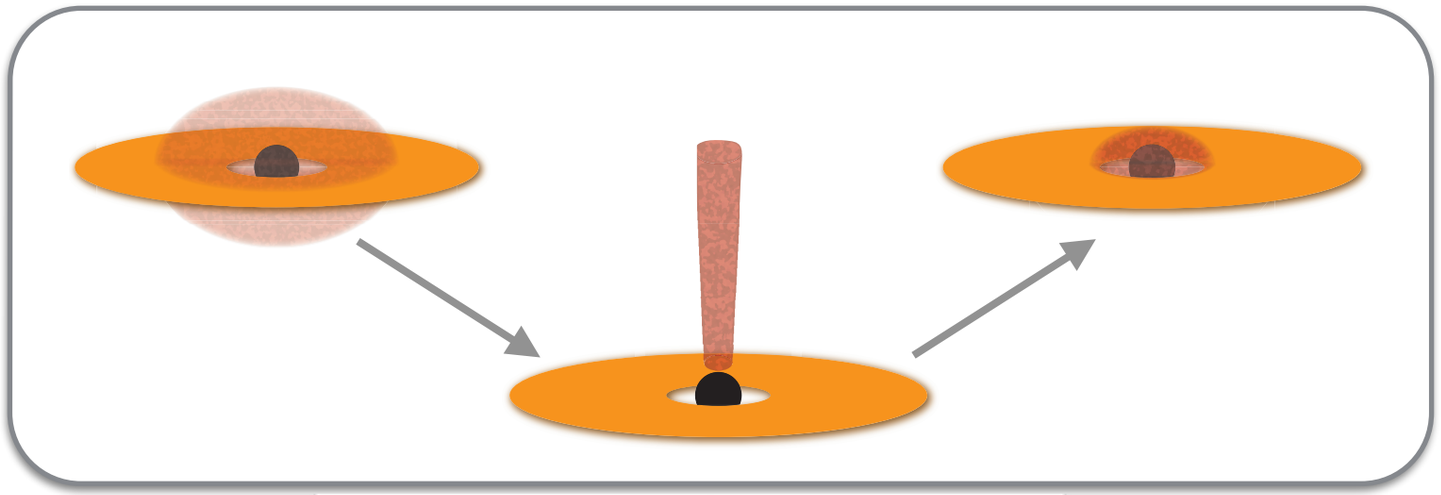

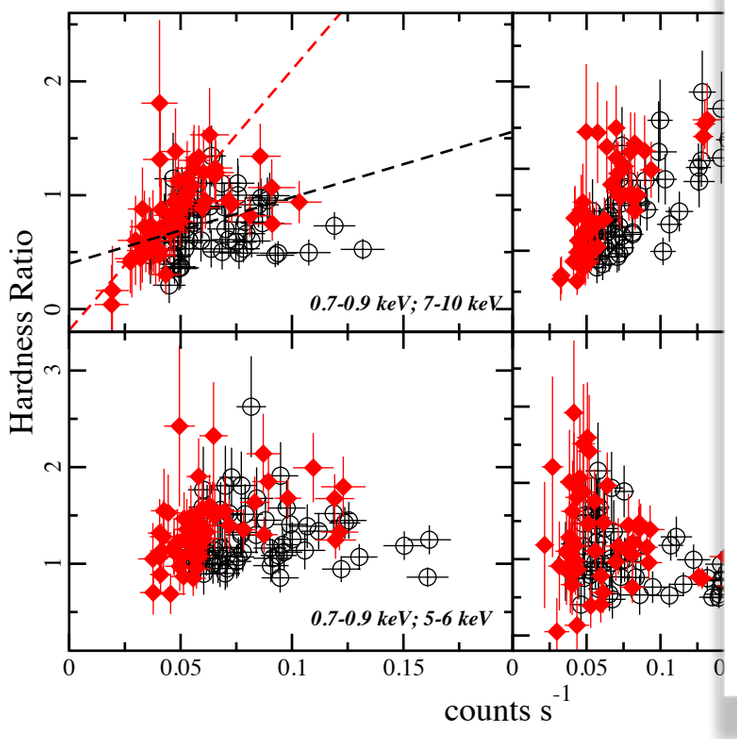

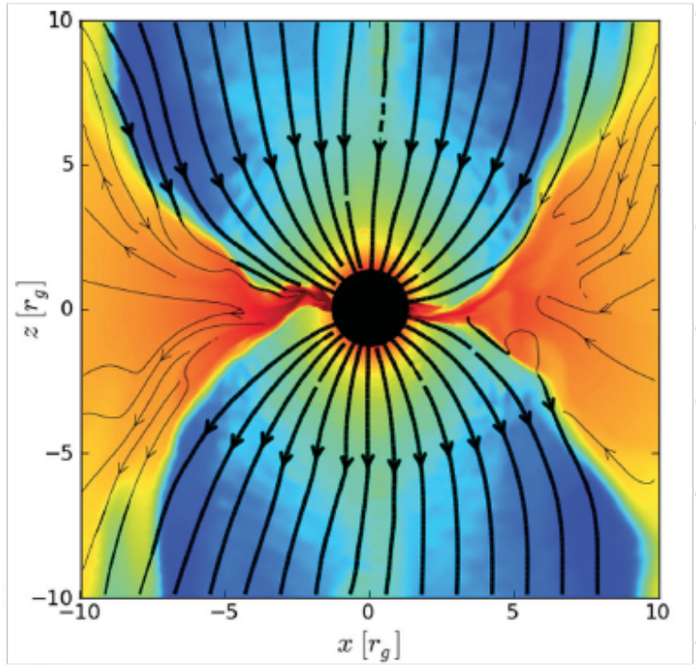

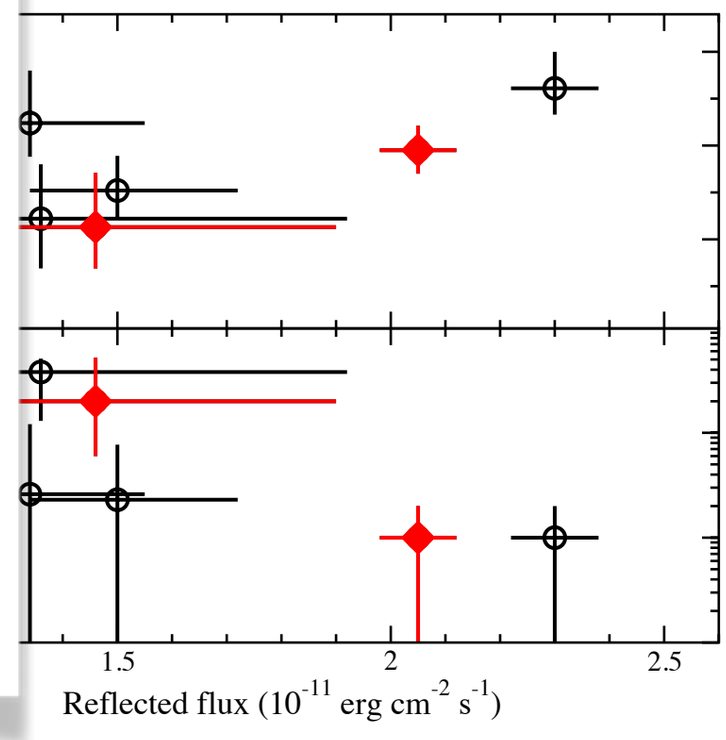

Wilkins et al 2015, MNRAS submitted

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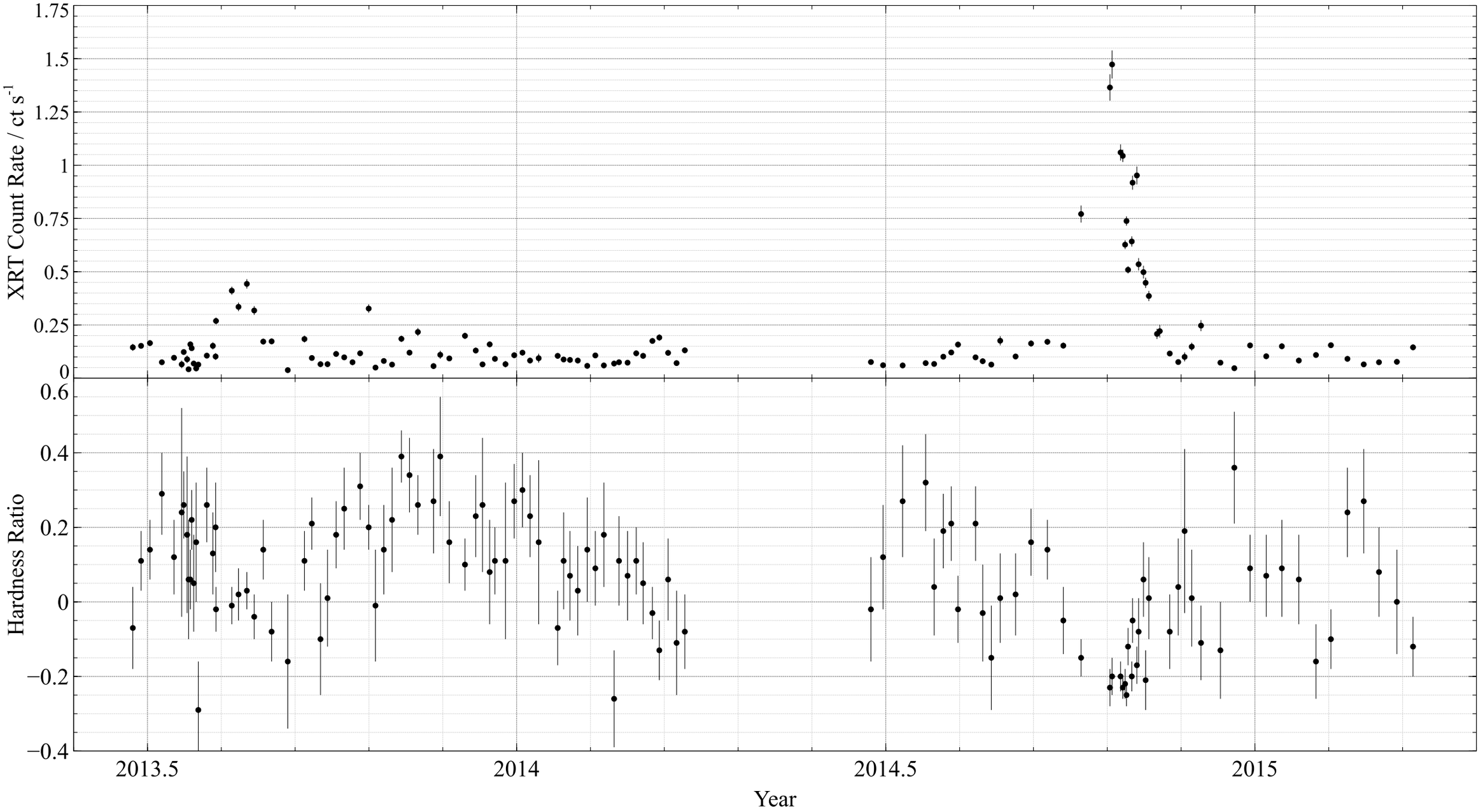
A Bigger Flare…



Wilkins et al 2015, MNRAS submitted

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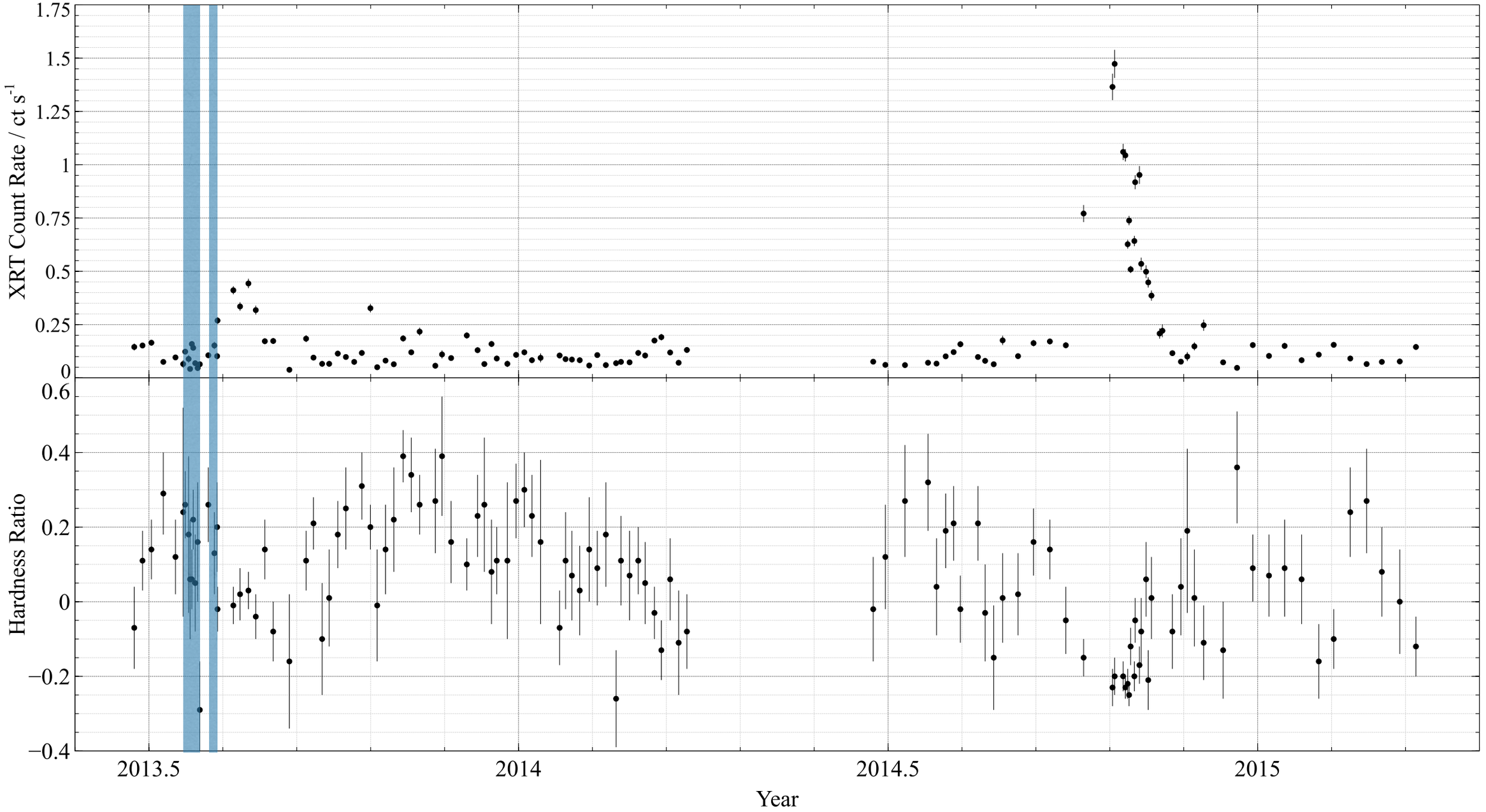

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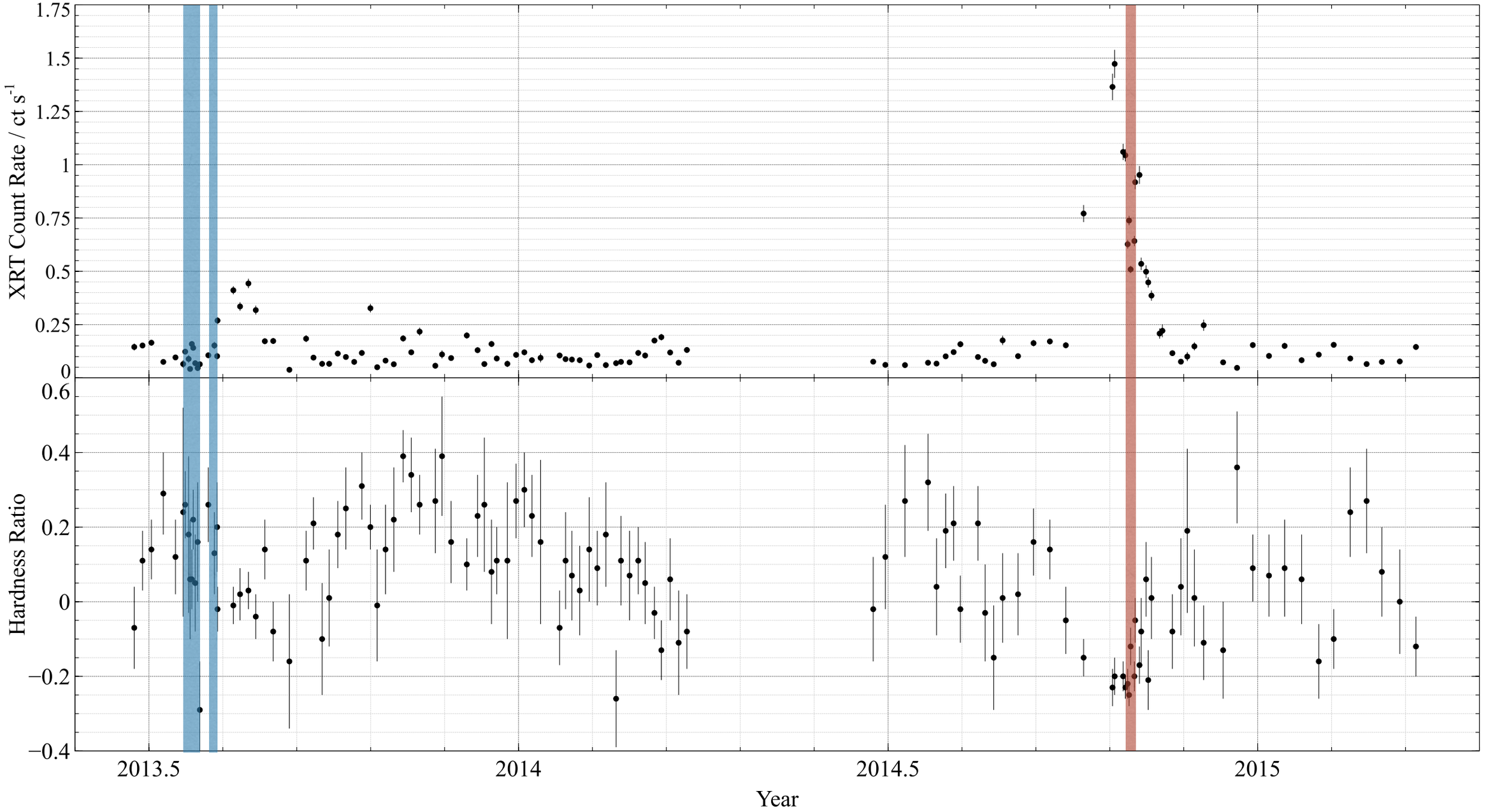
A Bigger Flare…



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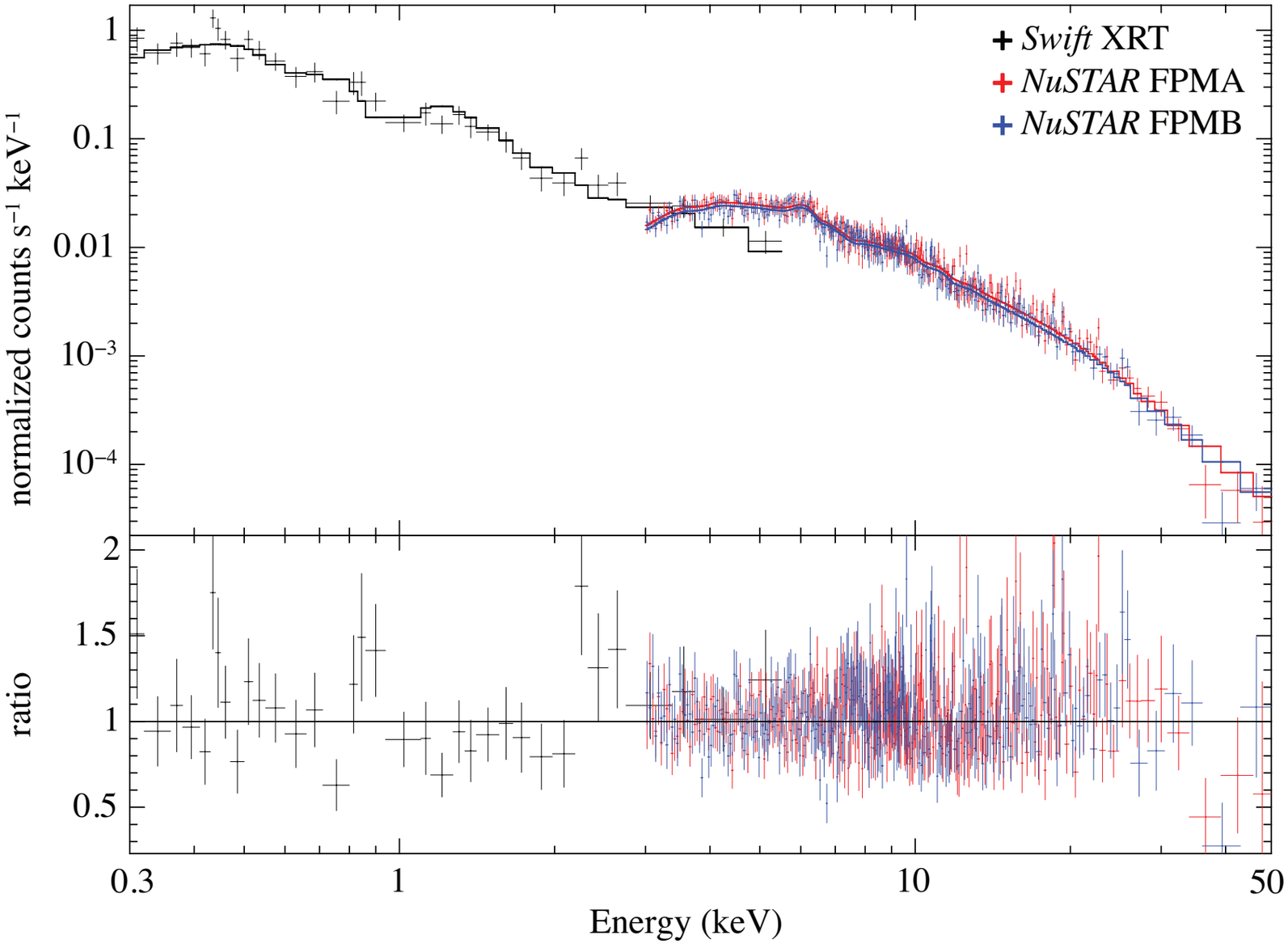
What caused this flare?



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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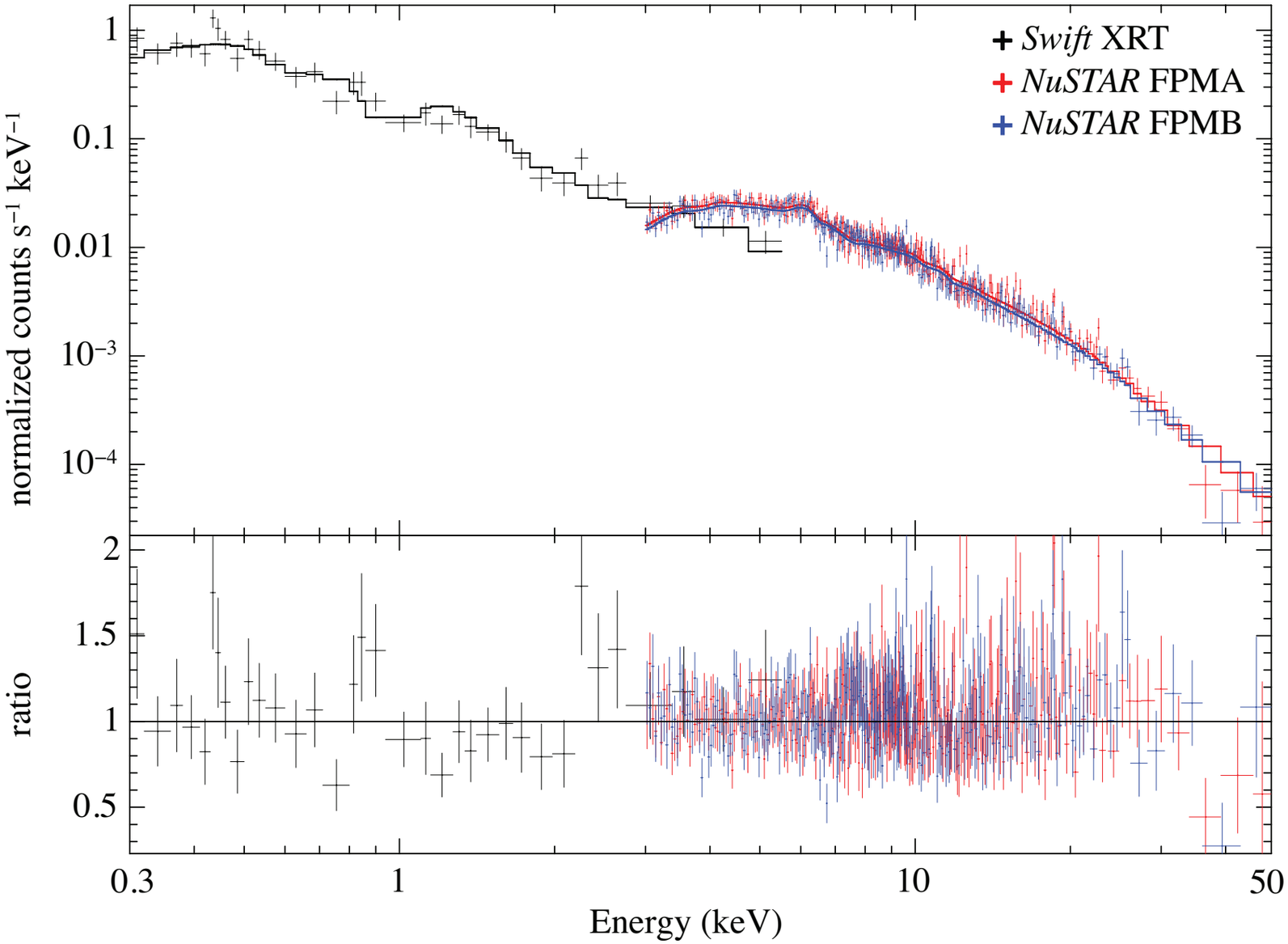

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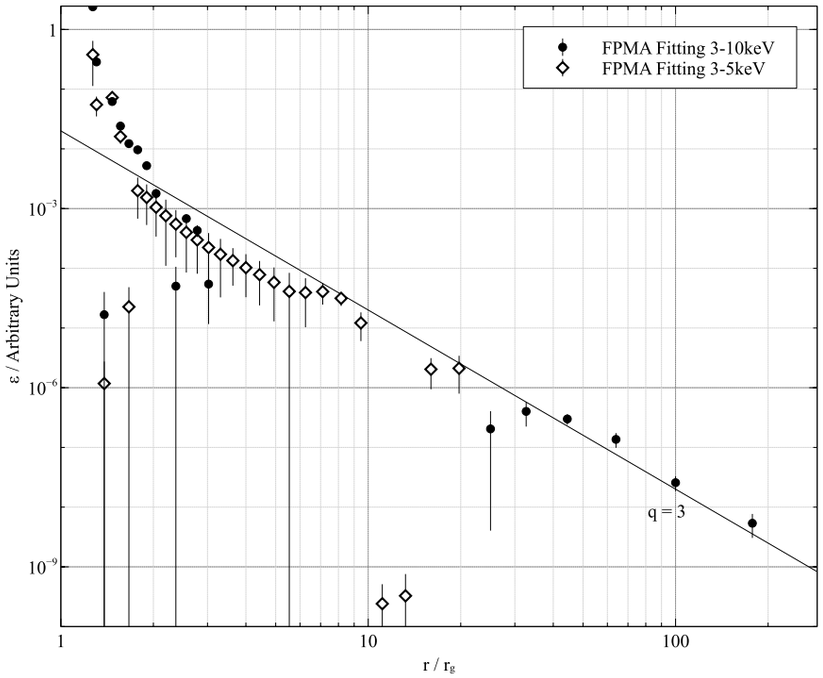

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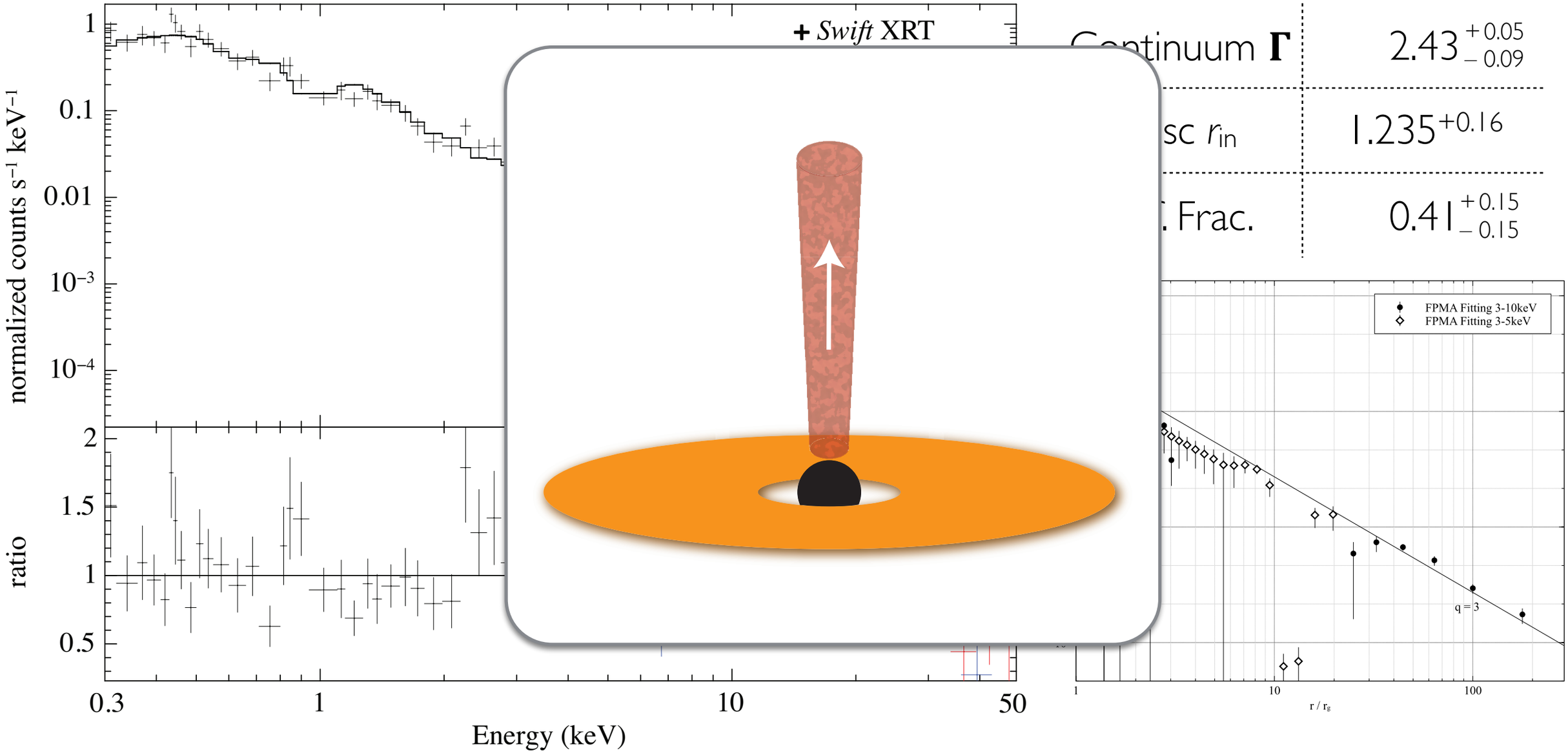

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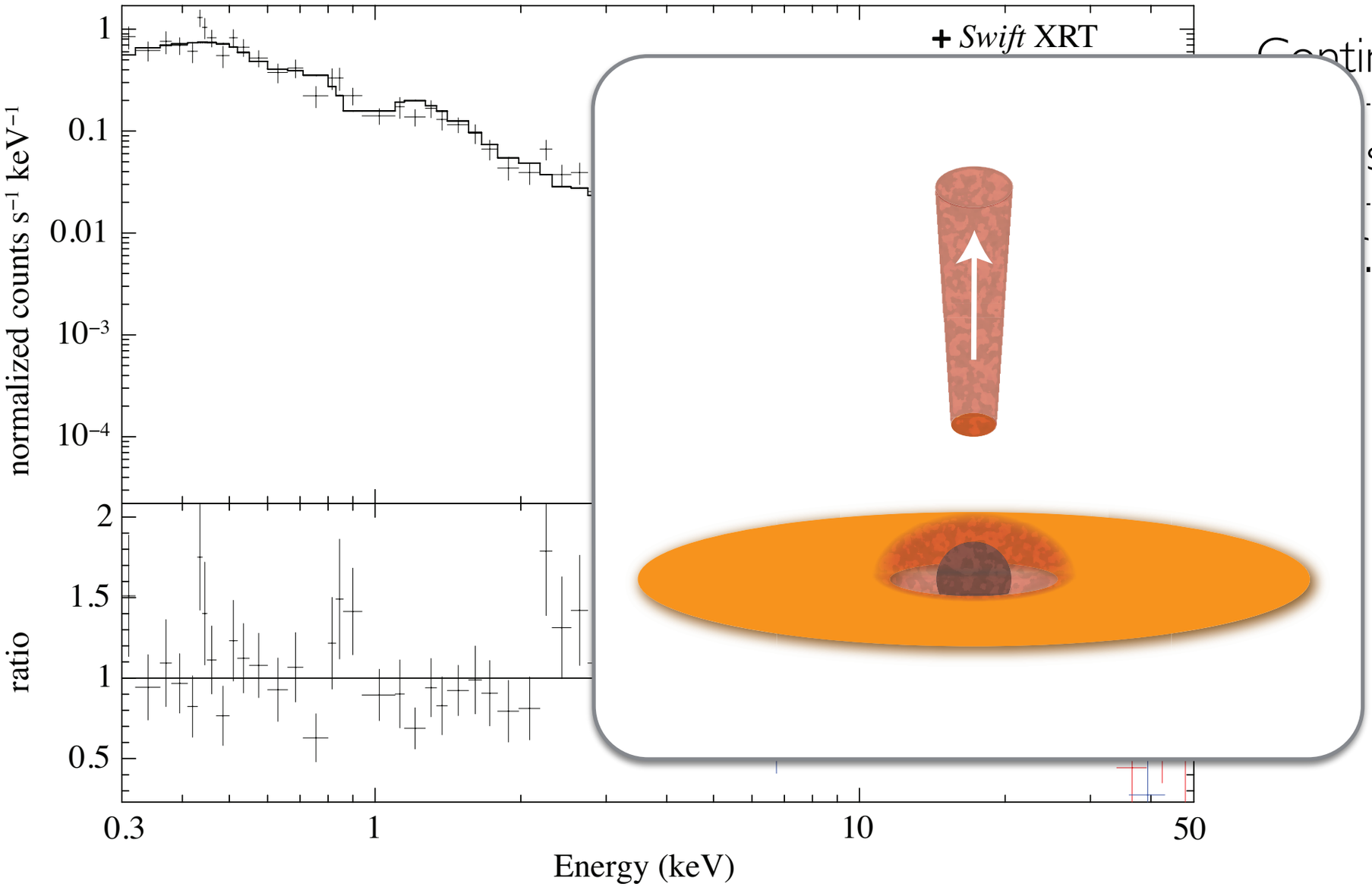

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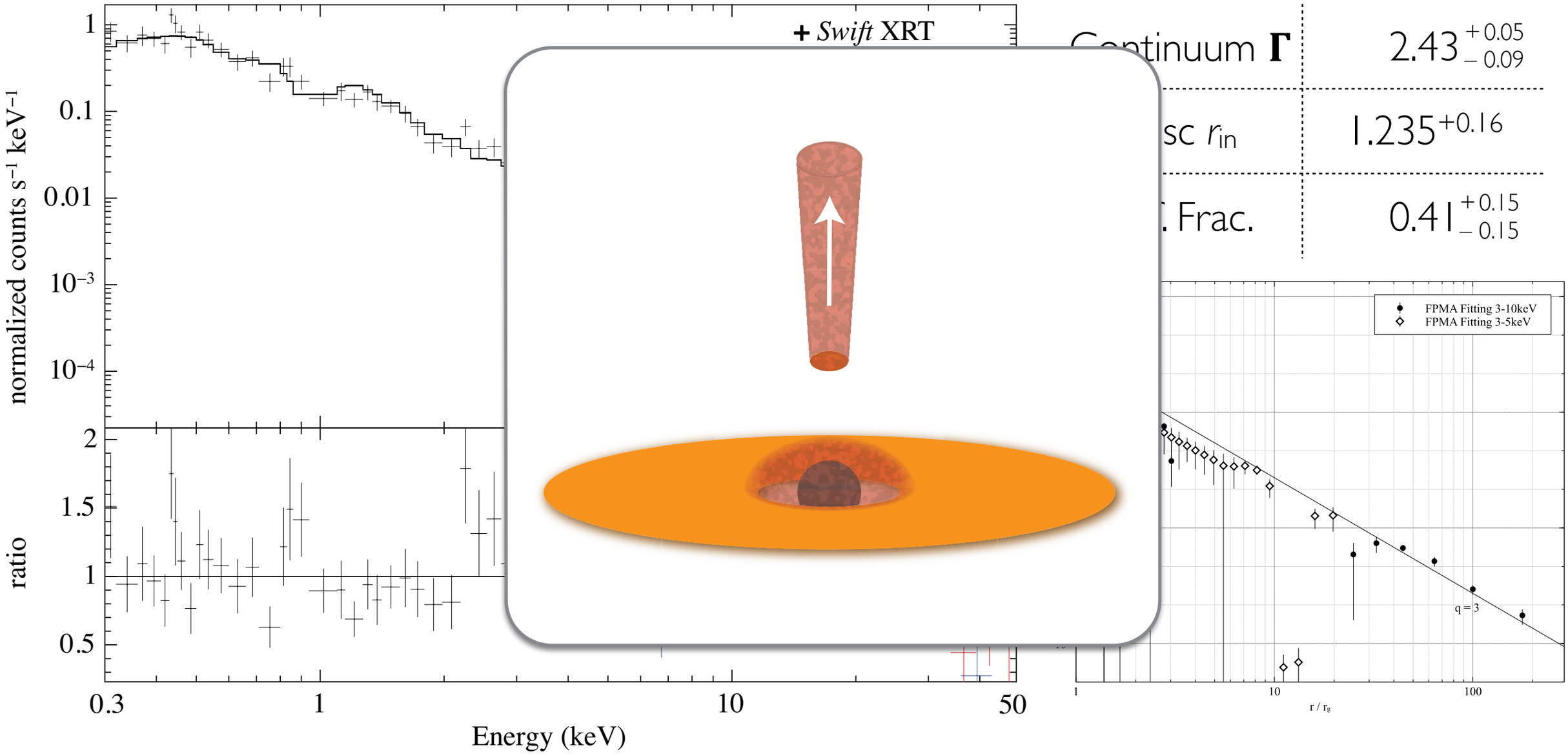

E-mail: drw@ap.smu.ca

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Conclusions

- Relativistic X-ray reflection lets us measure the geometry and energetics of the corona
- Corona expands and cools as luminosity increases
- Long timescales — radial expansion, short timescale flares — vertical collimation?
- Short timescale variability during low flux epochs can be complex: X-ray flares, corona reconfiguration and evidence for aborted jet, potentially revealing the physics of the corona