X-ray variability study of the Black Hole Binary SWIFT J1753.5-012 with *Swift* in the soft band:

Is there contribution from the disk?

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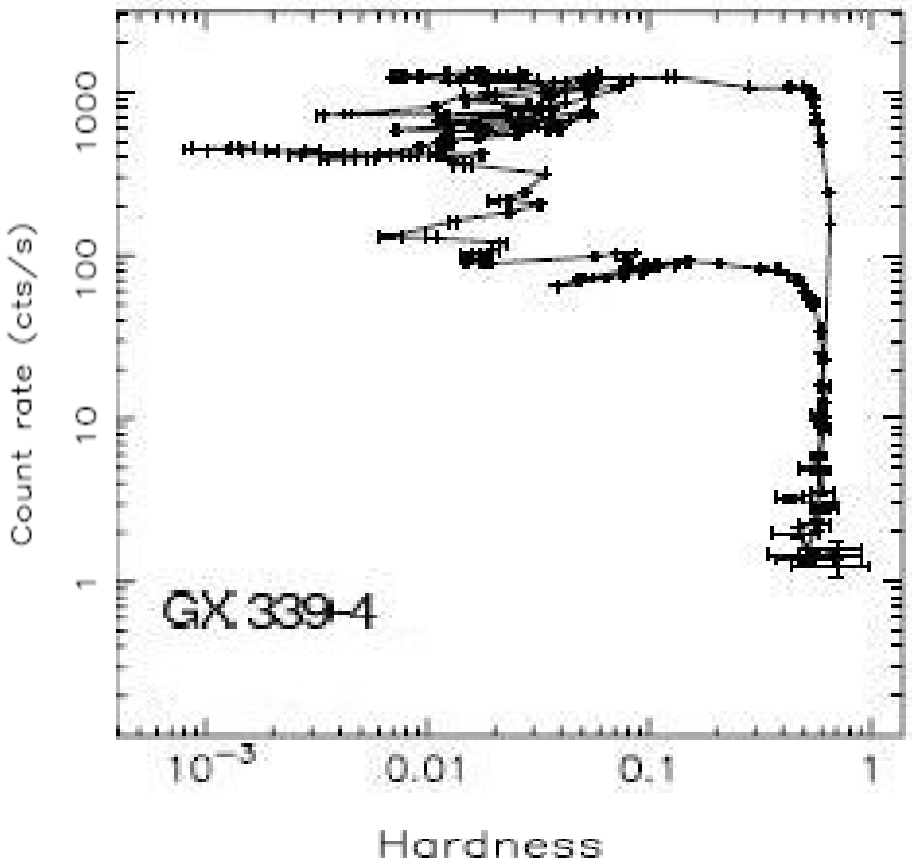
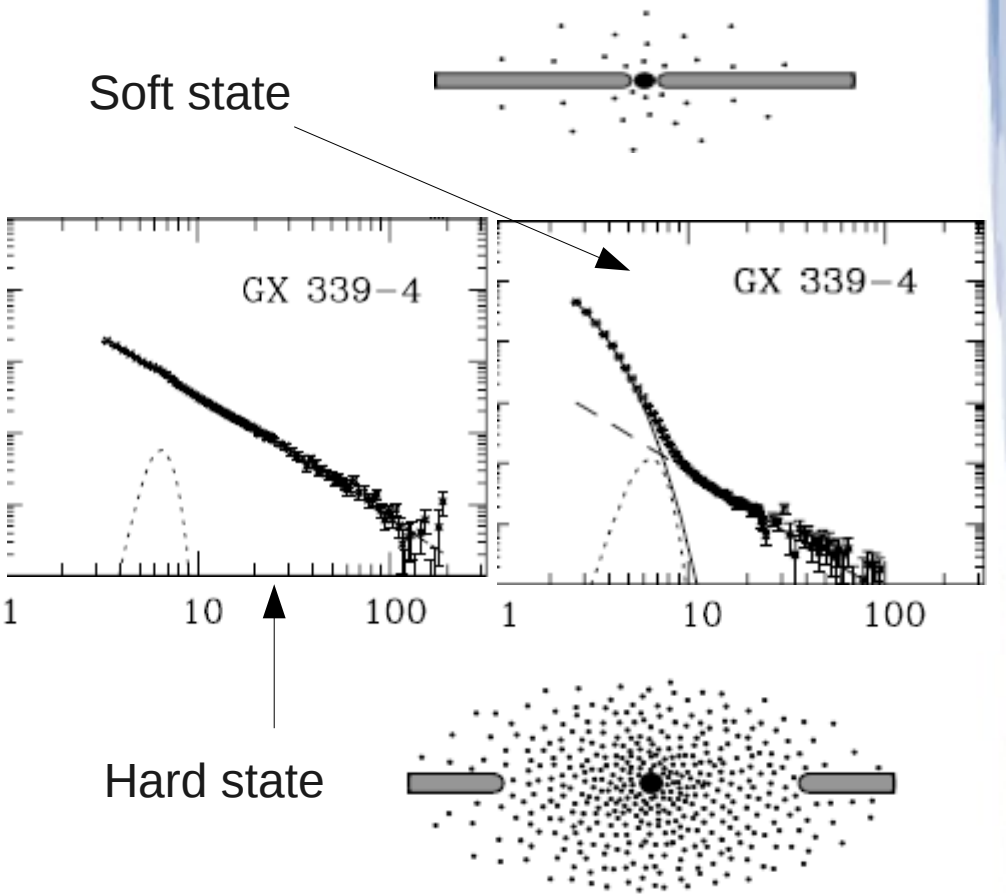
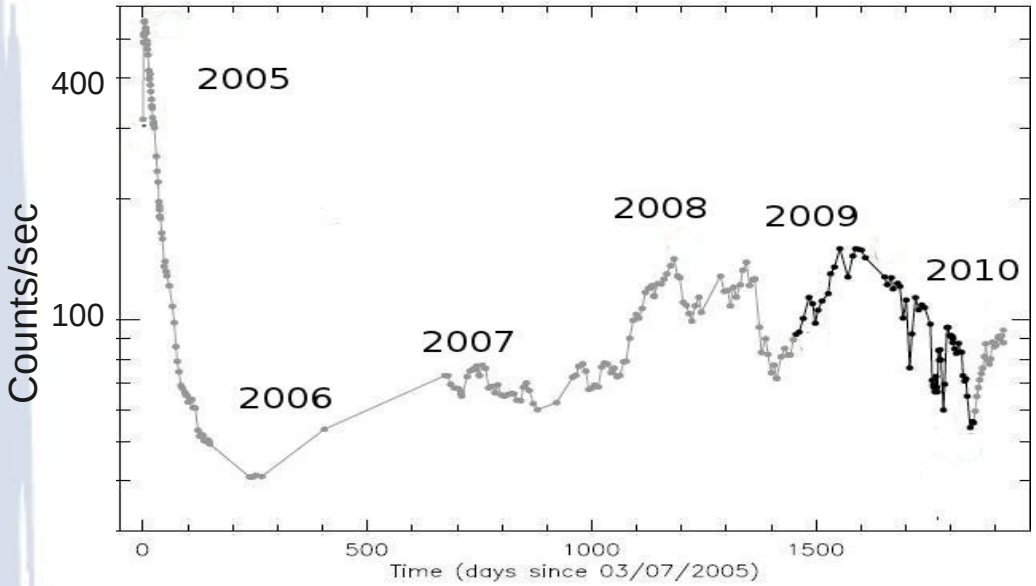
Introduction: What a typical black hole binary outburst looks/is expected to look like



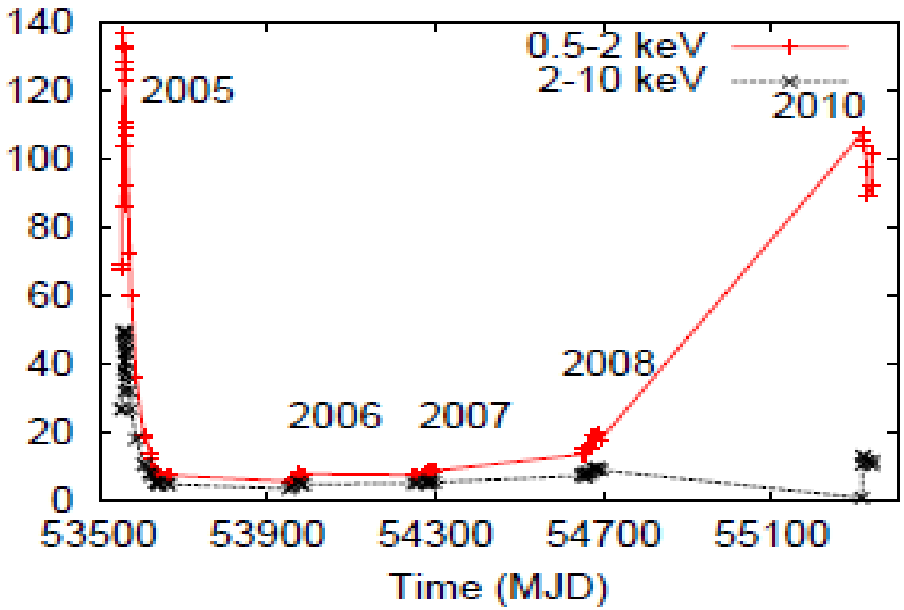


Introduction to the source SWIFT J1753.5-012

Light curve with RXTE PCA
(Soleri et al. 2012, submitted)

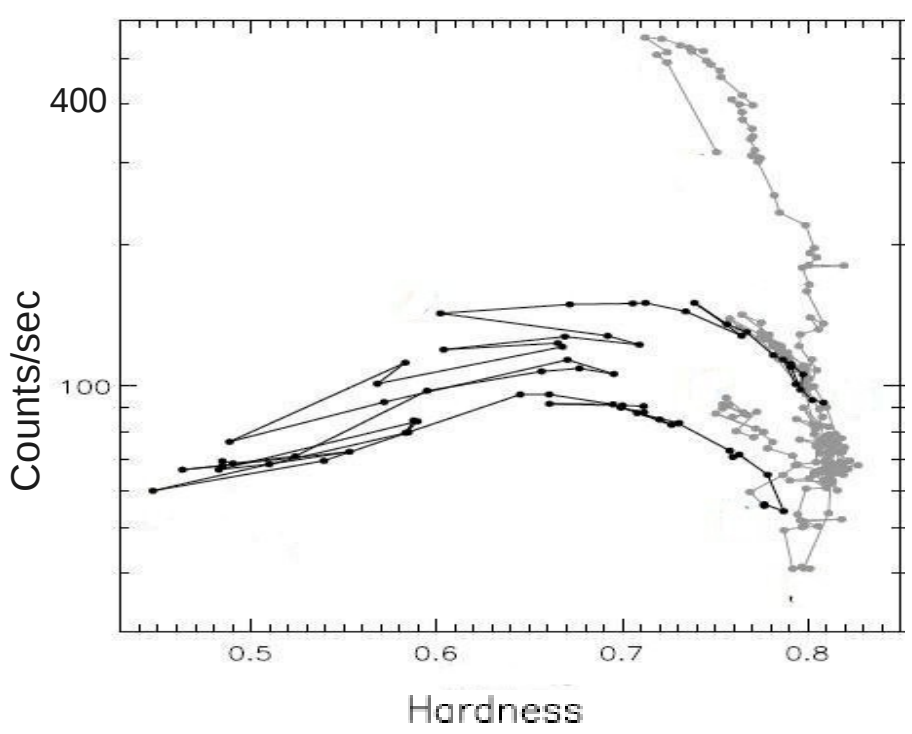


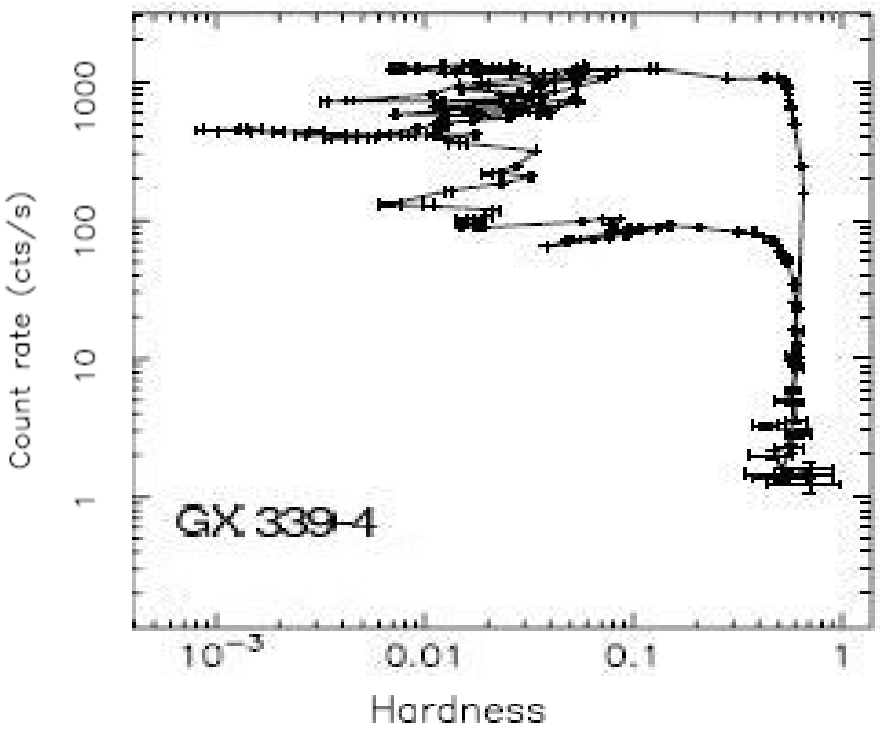
Light curve with *Swift* XRT
(Kalamkar et al. 2012, in prep.)



SWIFT J1753.5-012 has a peculiar outburst

RXTE PCA Hardness Intensity diagram



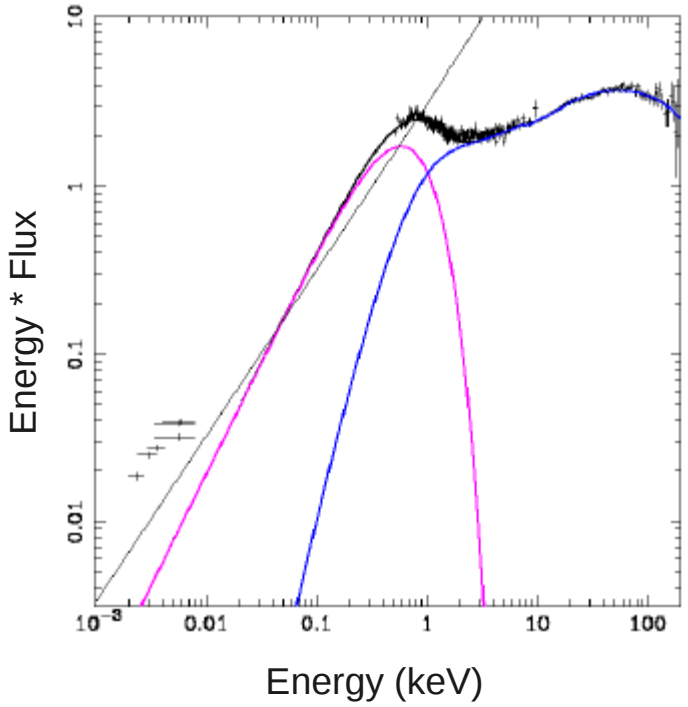


(Soleri et al. 2012, submitted)

1. **Presence of accretion disk in the Low hard state** (Miller et al. 2006 with RXTE and XMM-*Newton)* at low intensity

2. **Presence of accretion disk in the Low hard state** (Chiang et al. 2010, with *Swift* and RXTE in 2005-2007) in the peak of the outburst

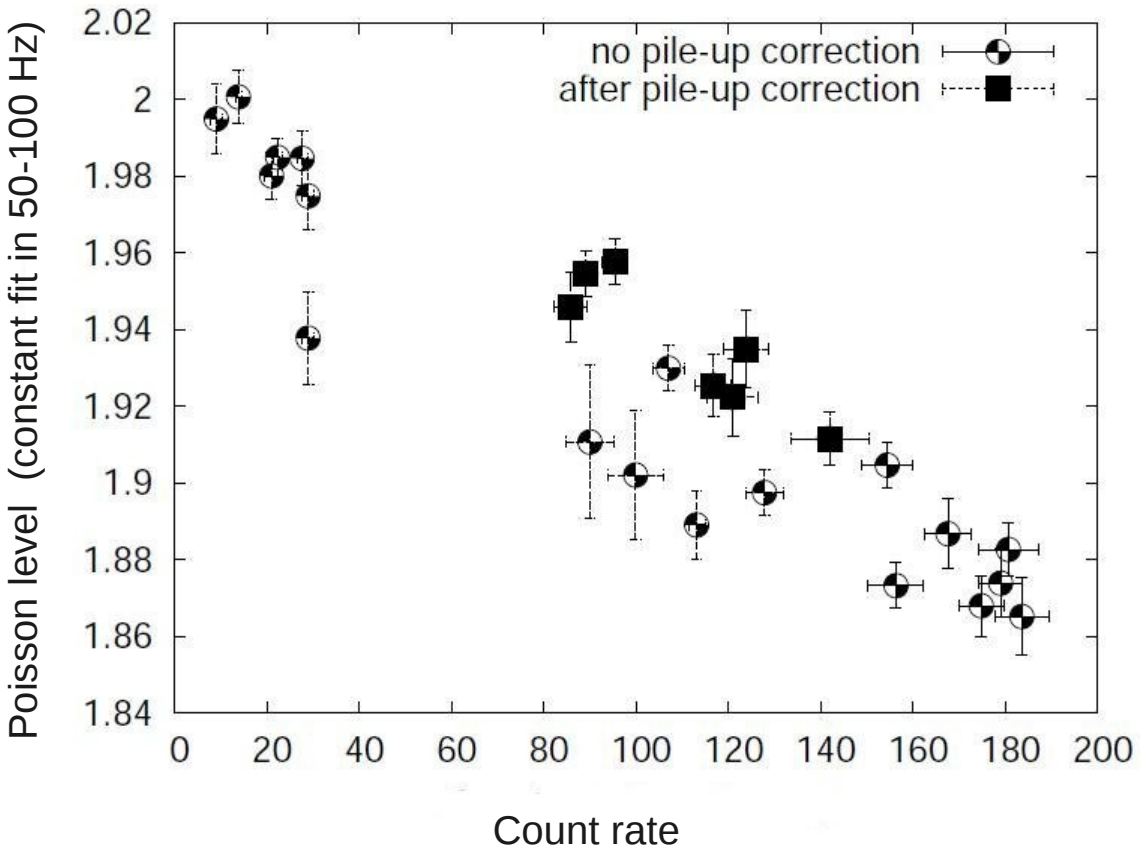
3. **Extra variability on longer time scale** (2.7-270s) in the **soft band** (< 2 keV) and **intrinsic to the disk** (Wilkinson & Uttley et al. 2009 with XMM in 2006) at low intensity



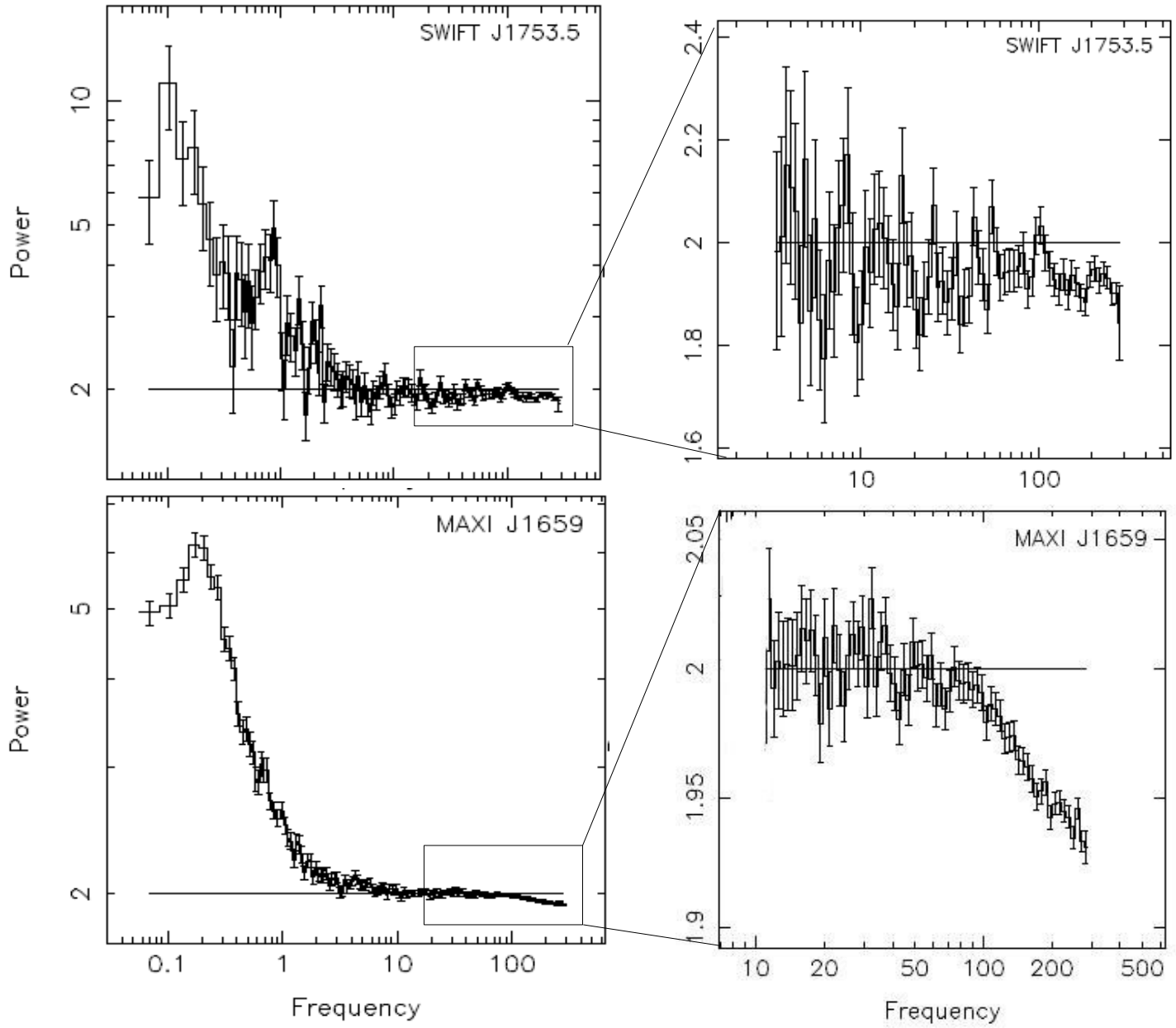
Chiang et al. 2010

Caveats

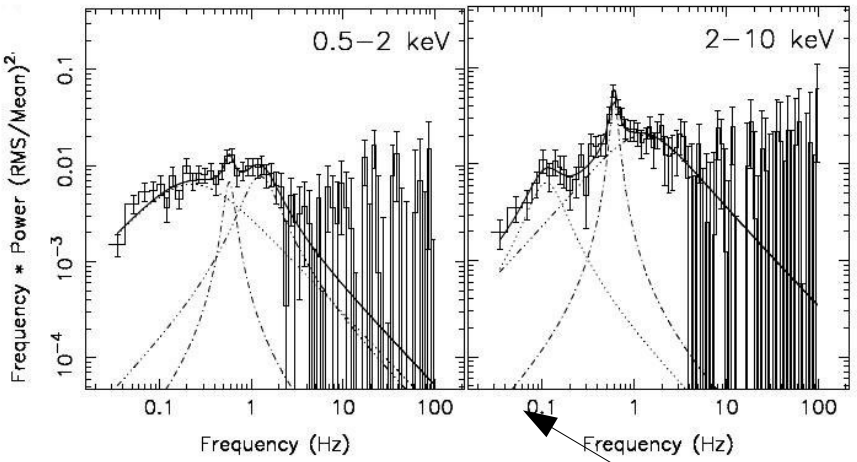
Poisson Noise level decreases with count rate due to pile-up effects



Caveats


SWIFT J1753.5
Power
10
5
2
SWIFT J1753.5
2.4
2.2
2
1.8
1.6
10
100
MAXI J1659
Power
5
2
0.1
1
10
100
Frequency
MAXI J1659
2.05
2
1.95
1.9
10
20
50
100
200
500
Frequency

Energy dependent behavior of the variability



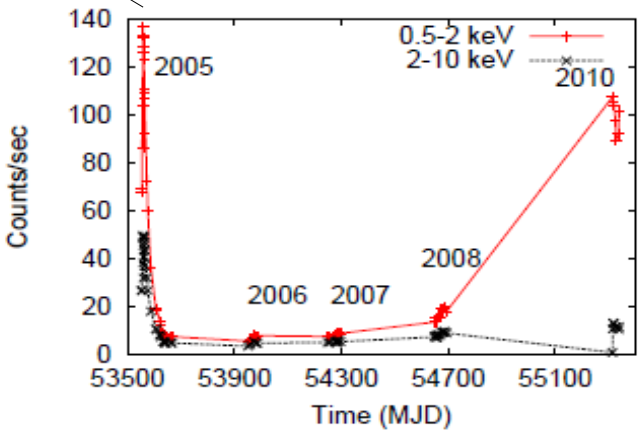
Representative power spectra of an observation in the peak of the outburst

At high intensity three components are detected in both the energy bands:

1. Low frequency (0.07-0.3 Hz)

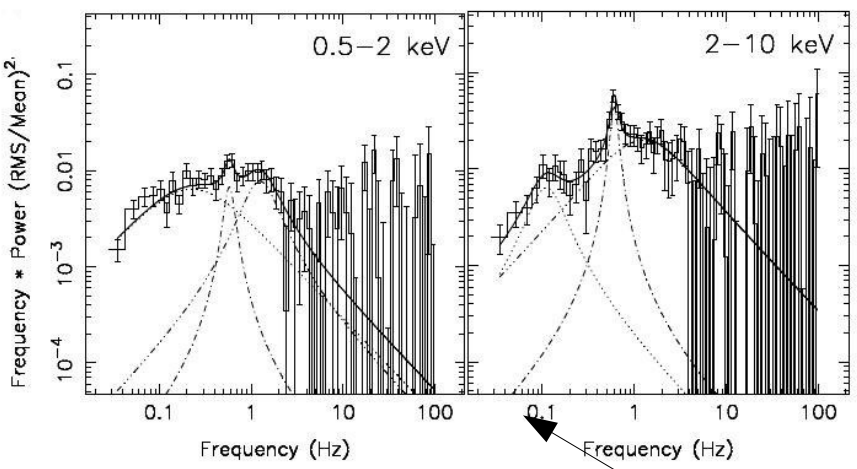
2. a QPO (0.5-0.9 Hz)

3. High frequency (0.8-1.6 Hz)

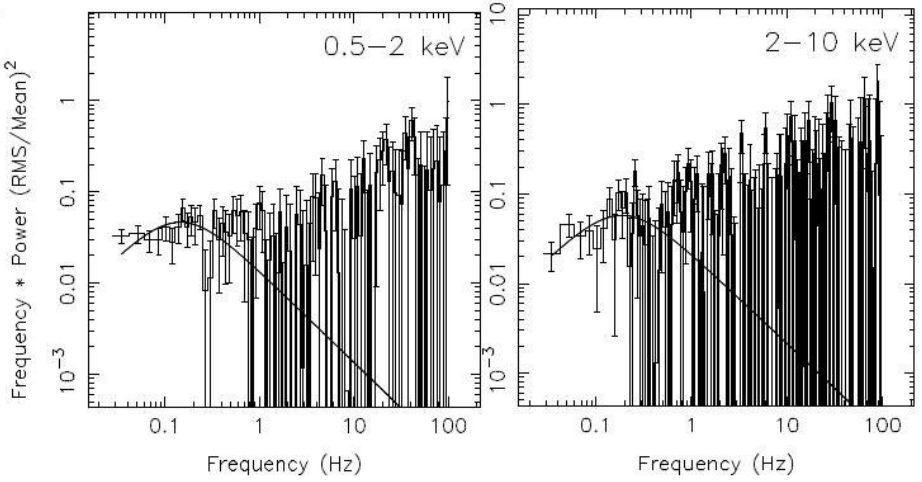


Swift XRT light curve

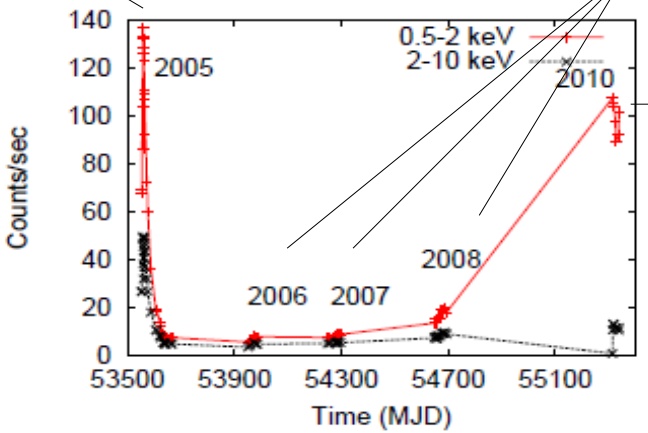
Energy dependent behavior of the variability



Representative power spectra of an observation in the peak of the outburst



Power spectra of an observation at low intensity



Swift XRT light curve

Featureless power spectrum

At high intensity three components are detected in both the energy bands:

1. Low frequency (0.07-0.3 Hz)

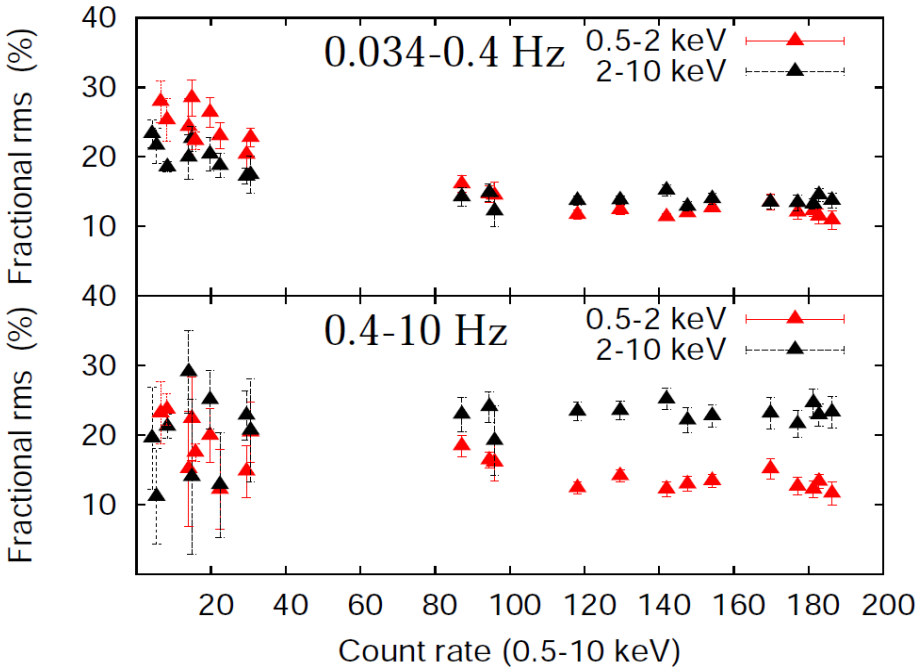
2. a QPO (0.5-0.9 Hz)

3. High frequency (0.8-1.6 Hz)

At low intensity only one component is detected:

1. Low frequency (0.1-0.3 Hz)

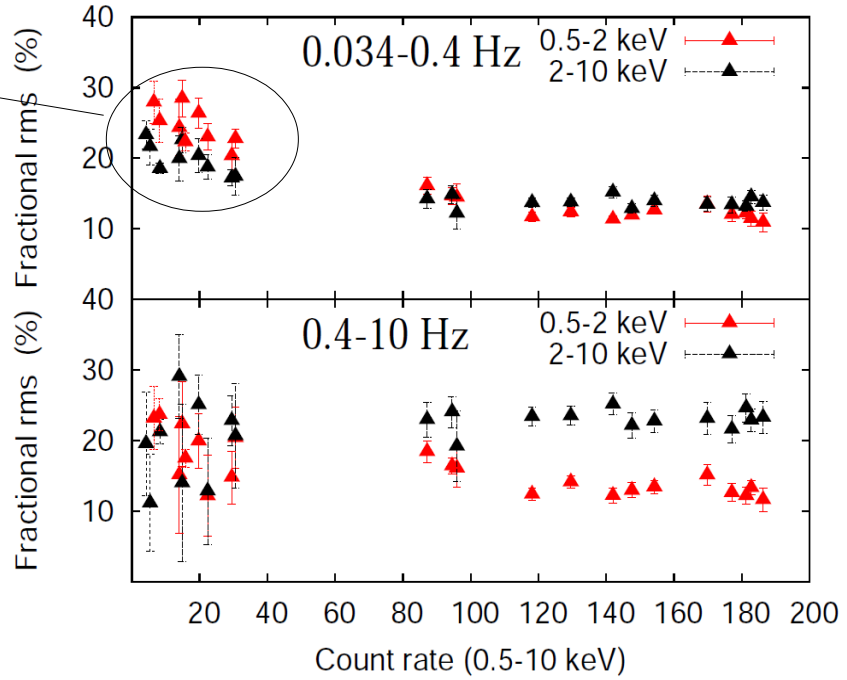
Energy dependent behavior of the variability



Energy dependent behavior of the variability

At low frequency low intensity:

✽ The variability in the soft band is higher than in the hard band – in agreement with Wilkinson et al. 2009



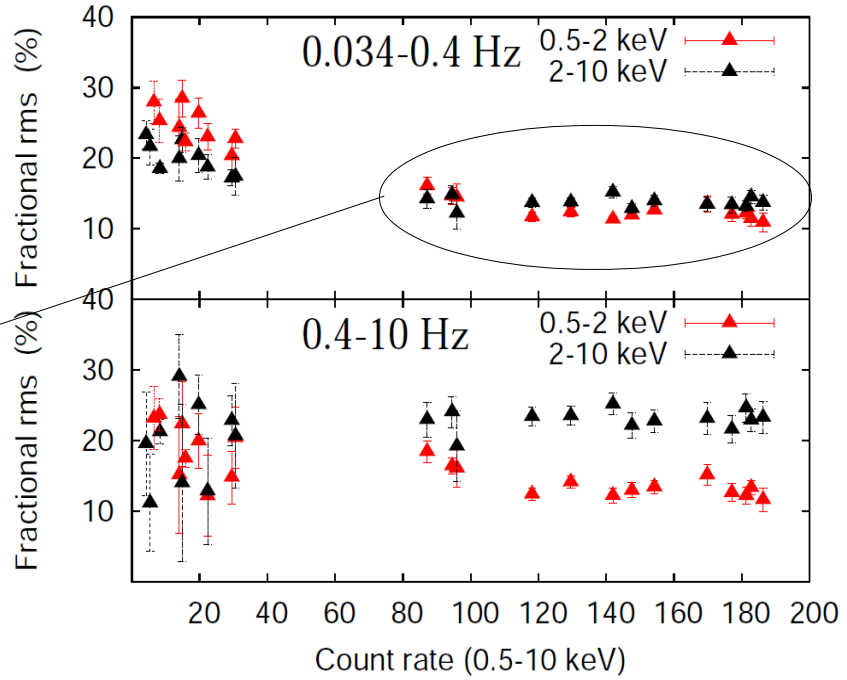
Energy dependent behavior of the variability

At low frequency low intensity:

✽ The variability in the soft band is higher than in the hard band – in agreement with Wilkinson et al. 2009

At low frequency high intensity:

✽ The hard band has slightly higher variability than the soft band.



Energy dependent behavior of the variability

At low frequency low intensity:

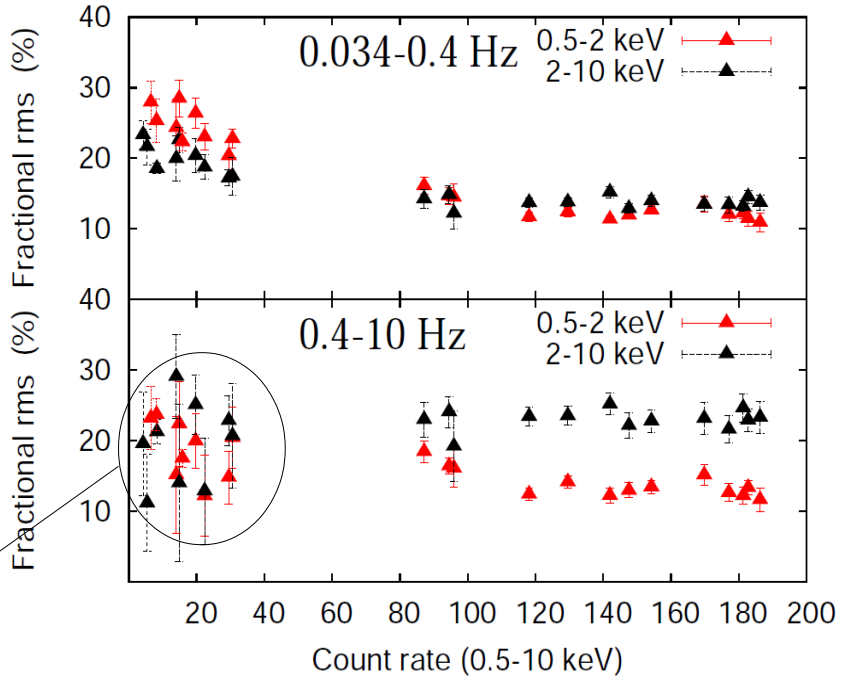
✽ The variability in the soft band is higher than in the hard band – in agreement with Wilkinson et al. 2009

At low frequency high intensity:

✽ The hard band has slightly higher variability than the soft band.

At high frequency low intensity:

✽ Can't say much . . .
The variability is comparable in both the energy bands



Energy dependent behavior of the variability

At low frequency low intensity:

✽ The variability in the soft band is higher than in the hard band – in agreement with Wilkinson et al. 2009

At low frequency high intensity:

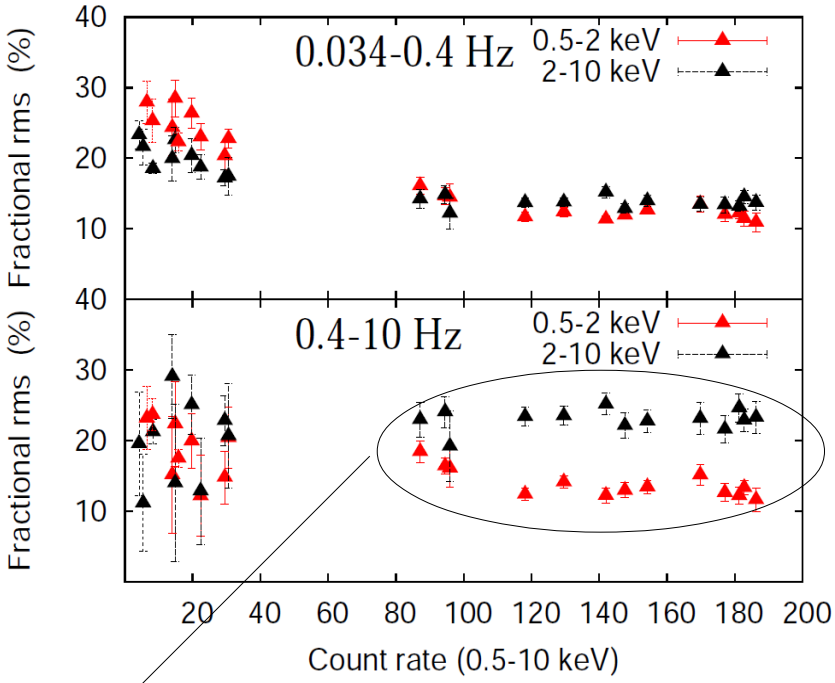
✽ The hard band has slightly higher variability than the soft band.

At high frequency low intensity:

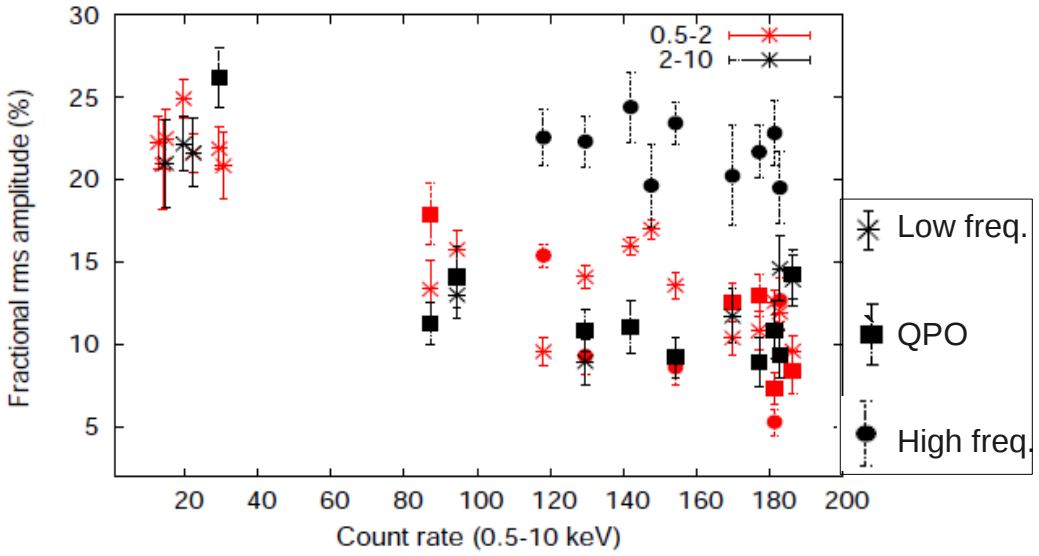
✽ The variability is comparable in both the energy bands

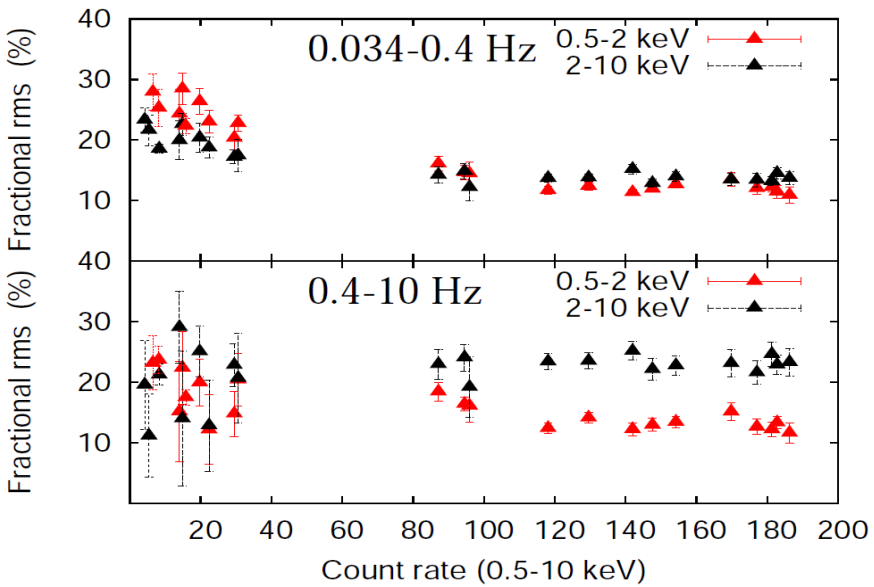
At high frequency high intensity:

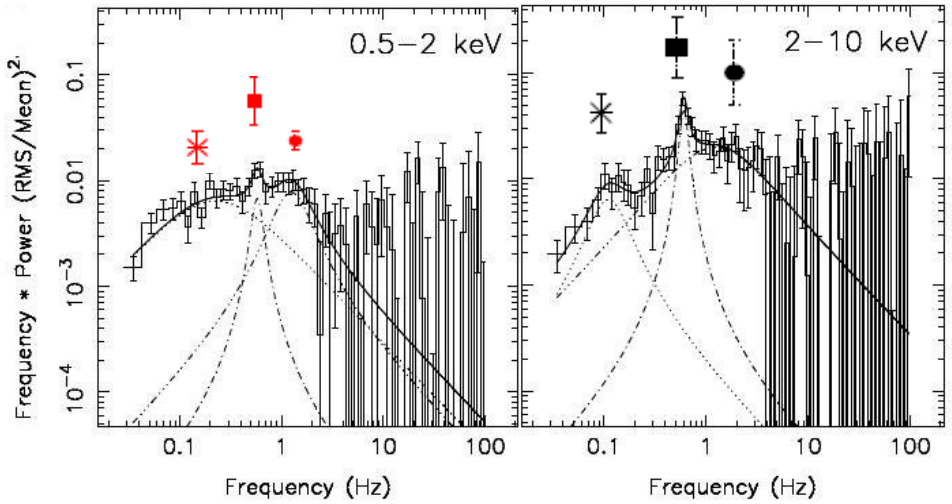
✽ The hard band is significantly more variable than the soft band



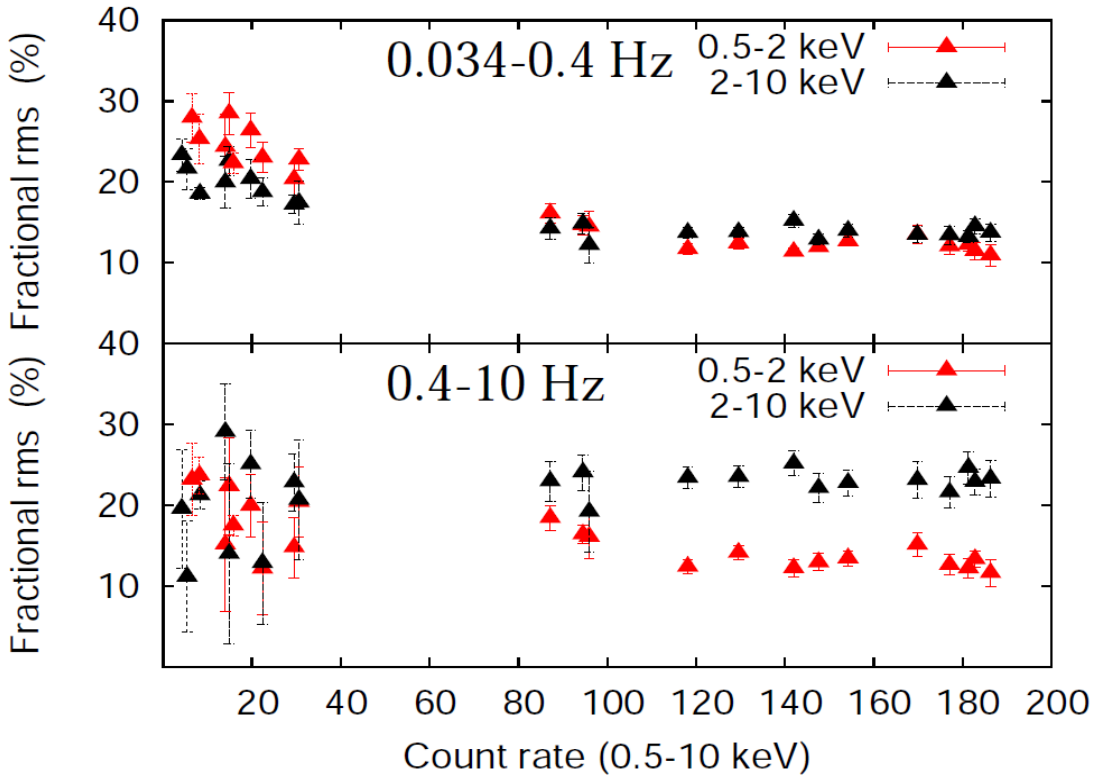
Energy dependent behavior of the variability

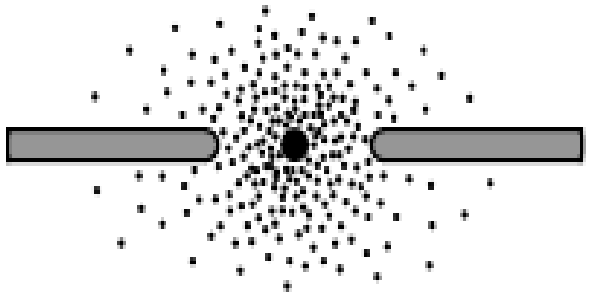






Can any model explain this behavior?





Summary

- We report, for the first time, detailed broad band variability study in the soft band of SWIFT J1753.5-0122 with *Swift*

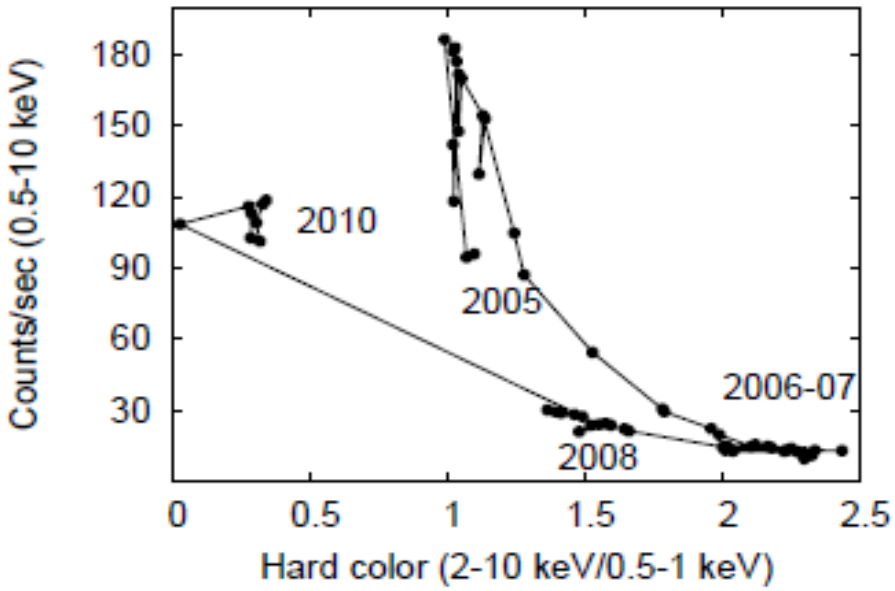
- The hard and soft components in the emission show different variability behavior suggesting different point of origin – hot flow and disc, respectively

- **We observe that the hot flow is more variable at high intensity while the disc is more variable at low intensity**

- Hence, we demonstrate that variability studies can be done with *Swift* XRT, with the following caveats:
  - Don't fix the Poisson level at 2.0 in the *Swift* power spectrum. Estimate it !!!
  - Check the behavior of the power spectrum at high frequency

Extra slides

Swift XRT HID



Hardness Intensity Diagram with Swift XRT (Kalamkar et al. 2012, in prep)