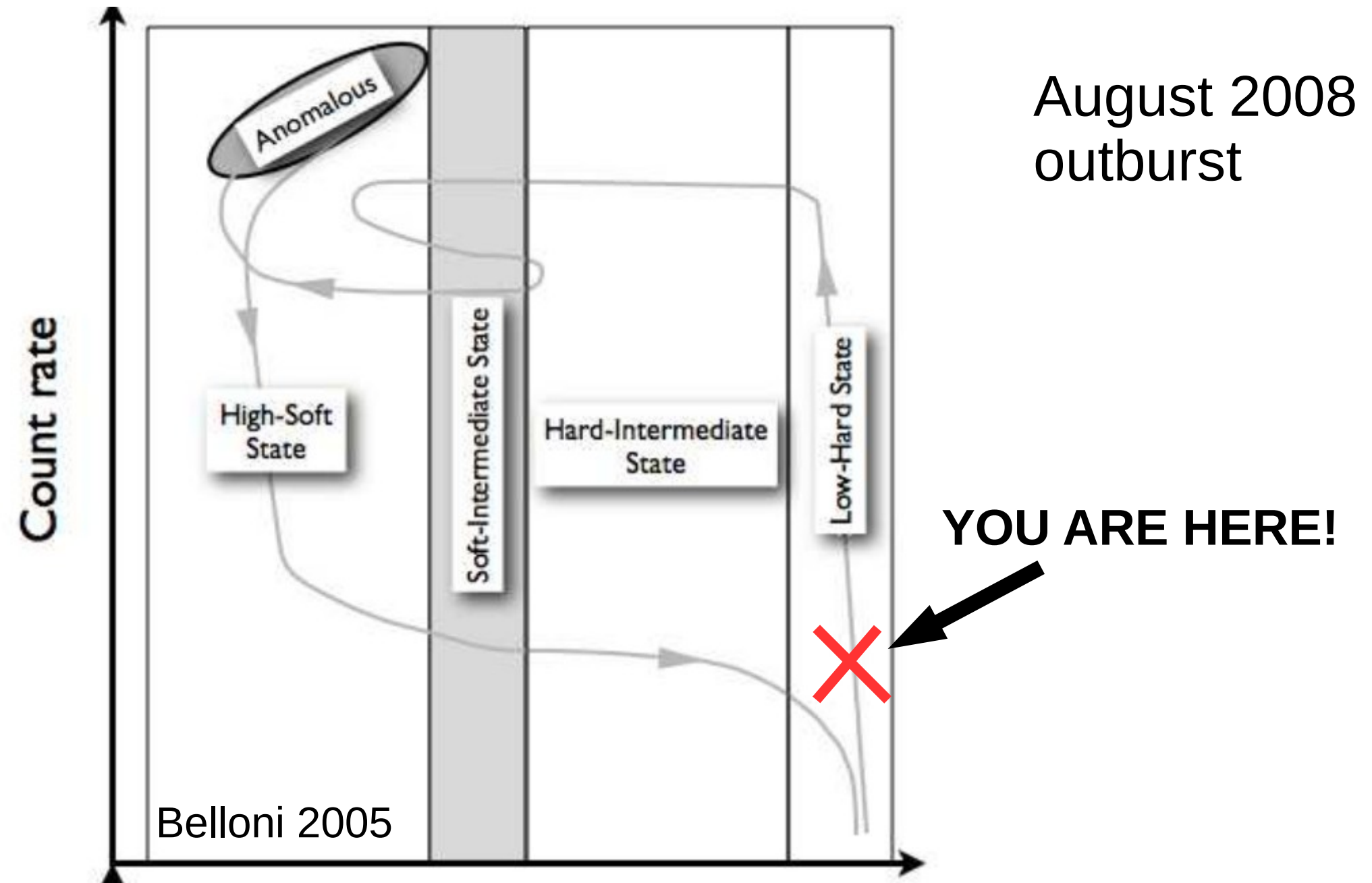


MULTIWAVELENGTH TIMING ANALYSIS OF GX 339-4

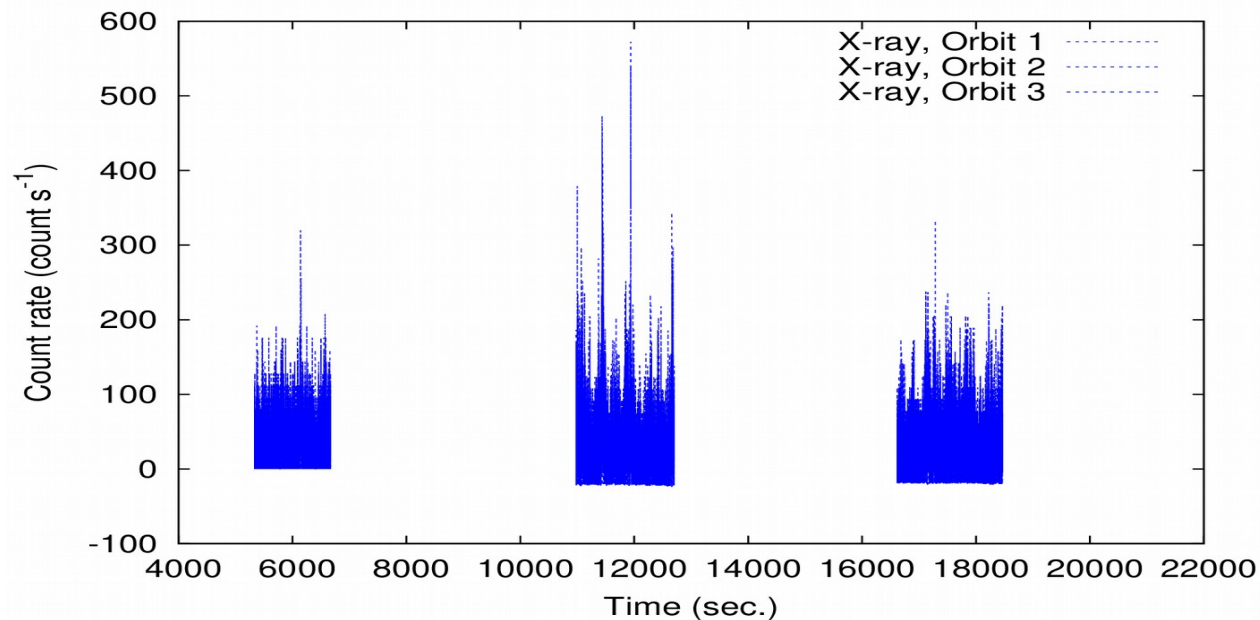
Federico Maria Vincentelli
INAF – OAR

P. Casella (OAR), P. Uttley (Amsterdam), K. O'Brien (Oxford), M. Kalmkar (OAR)

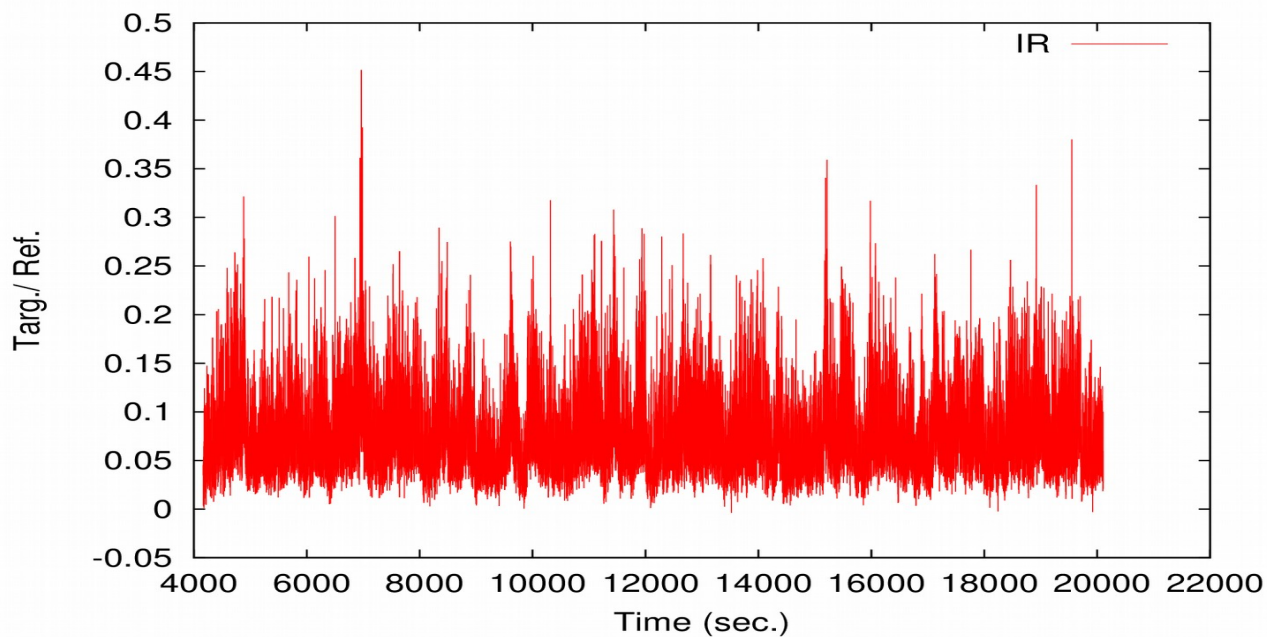
GX 339-4



X-ray: RXTE PCA 2-15 keV

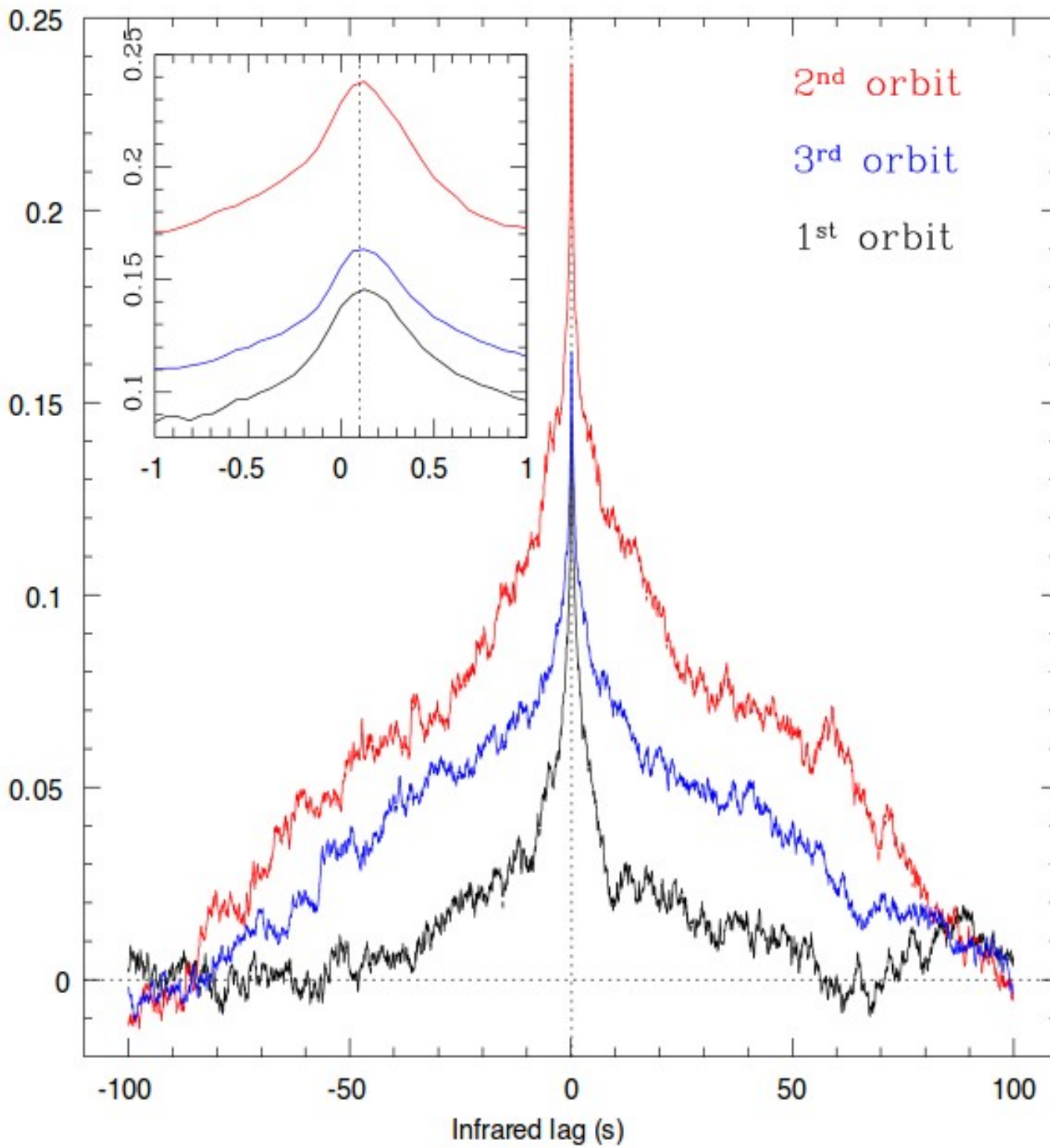


IR: ISAAC @ VLT (K band)



Time resolution 62.5 ms

X-ray/Infrared cross-correlation function



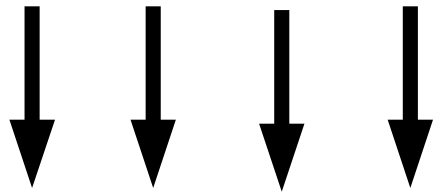
Casella et al.
2010

CCF peak at
 ≈ 100 ms

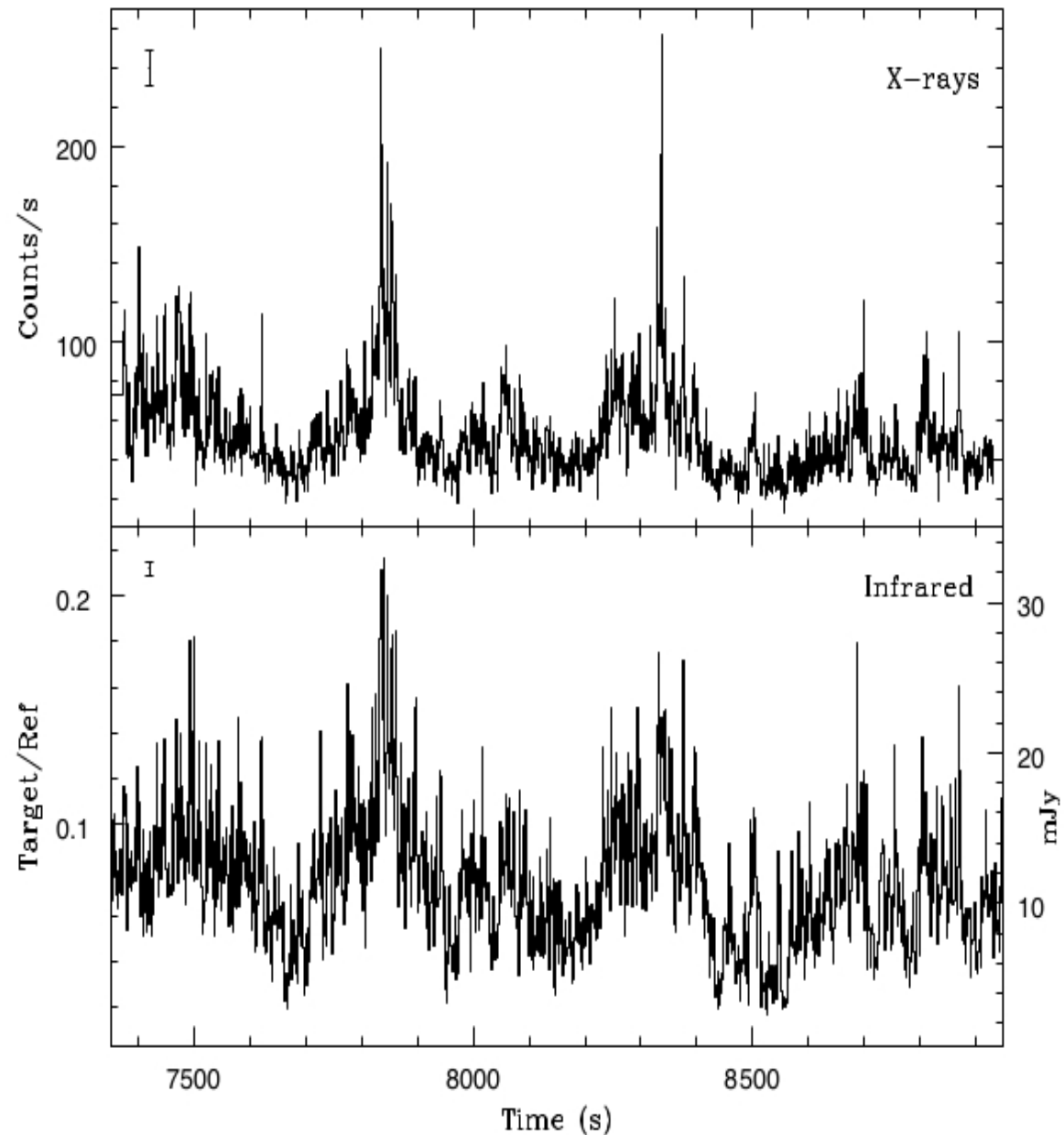
**First evidence of
IR variability from a
relativistic jet!**

**HIGH
CORRELATION!**

**VARIABILITY FROM
INFLOW**



TO THE JET!



Casella et al.
2010

Coherence

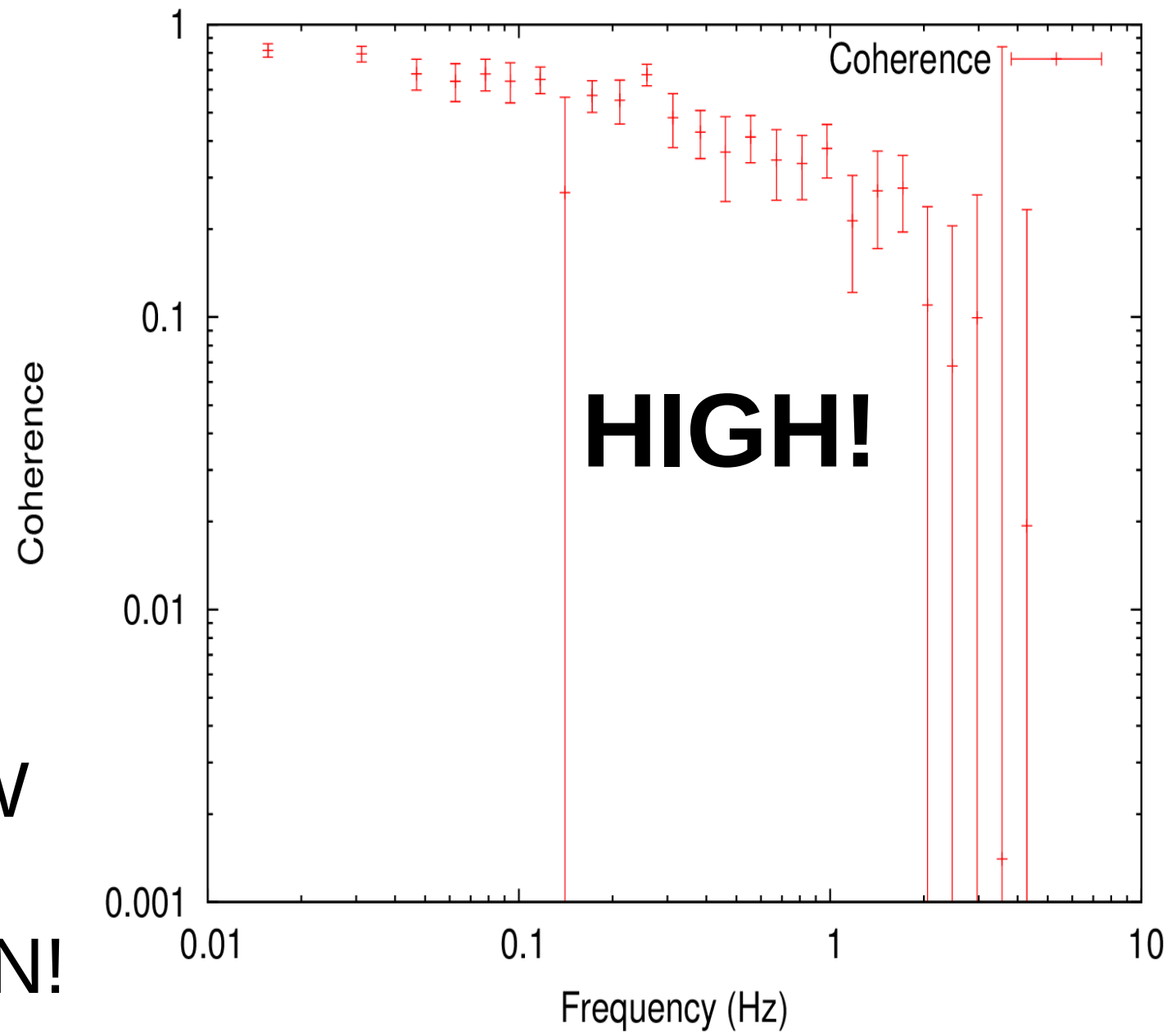
Measure degree of linear correlation:

$$\gamma^2(\nu) = \frac{|\langle S^*(\nu)H(\nu) \rangle|^2}{\langle |S(\nu)|^2 \rangle \langle |H(\nu)|^2 \rangle}$$

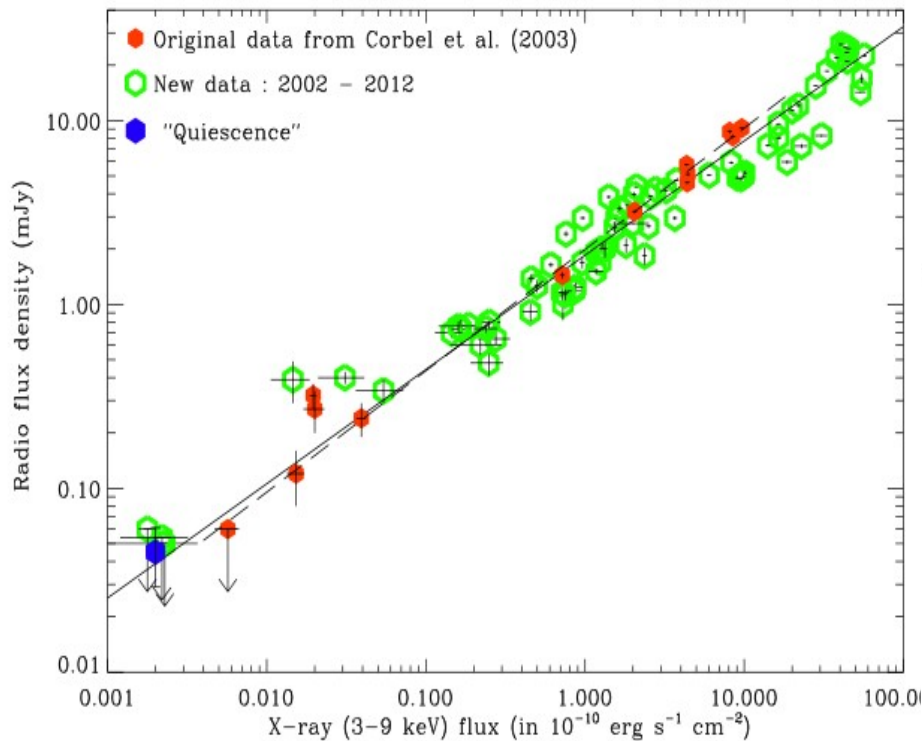
$\gamma^2=1$ maximum correlation

$\gamma^2=0$ uncorrelated

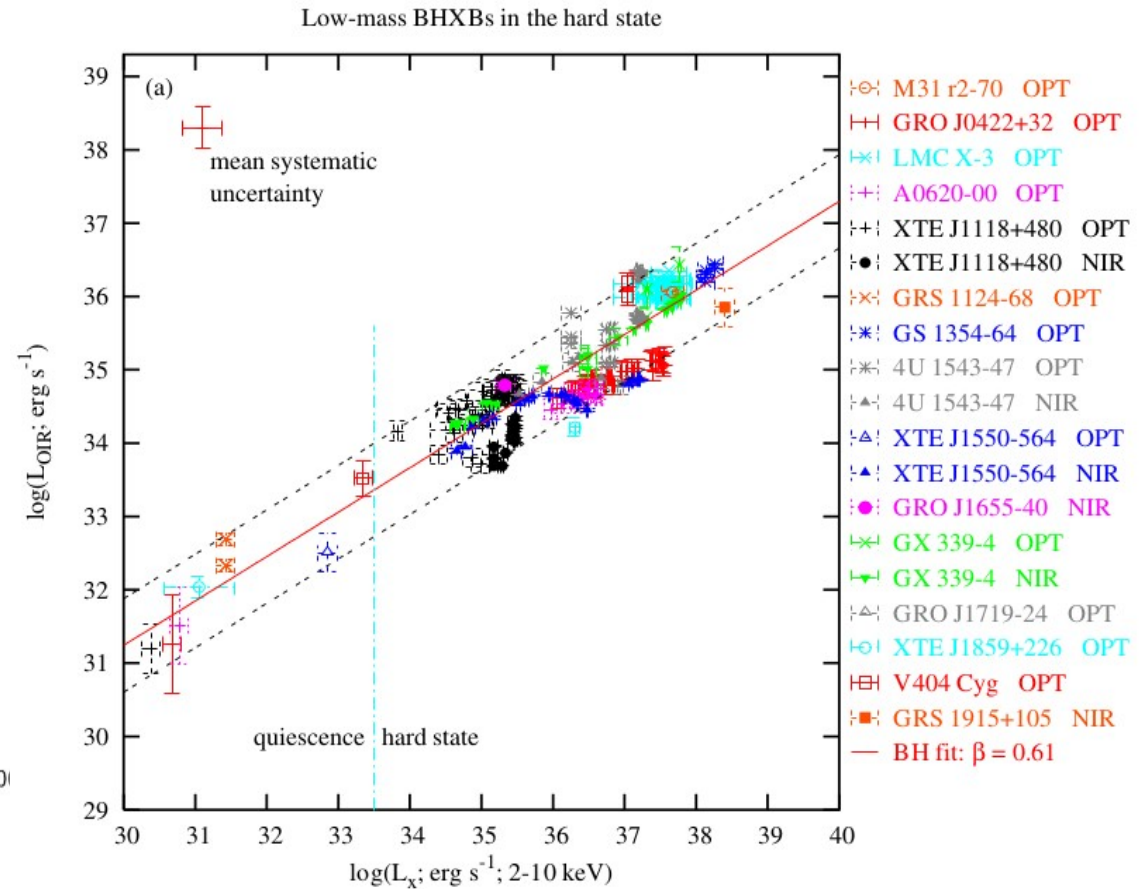
JET - INFLOW CONNECTION!



Flux vs Flux

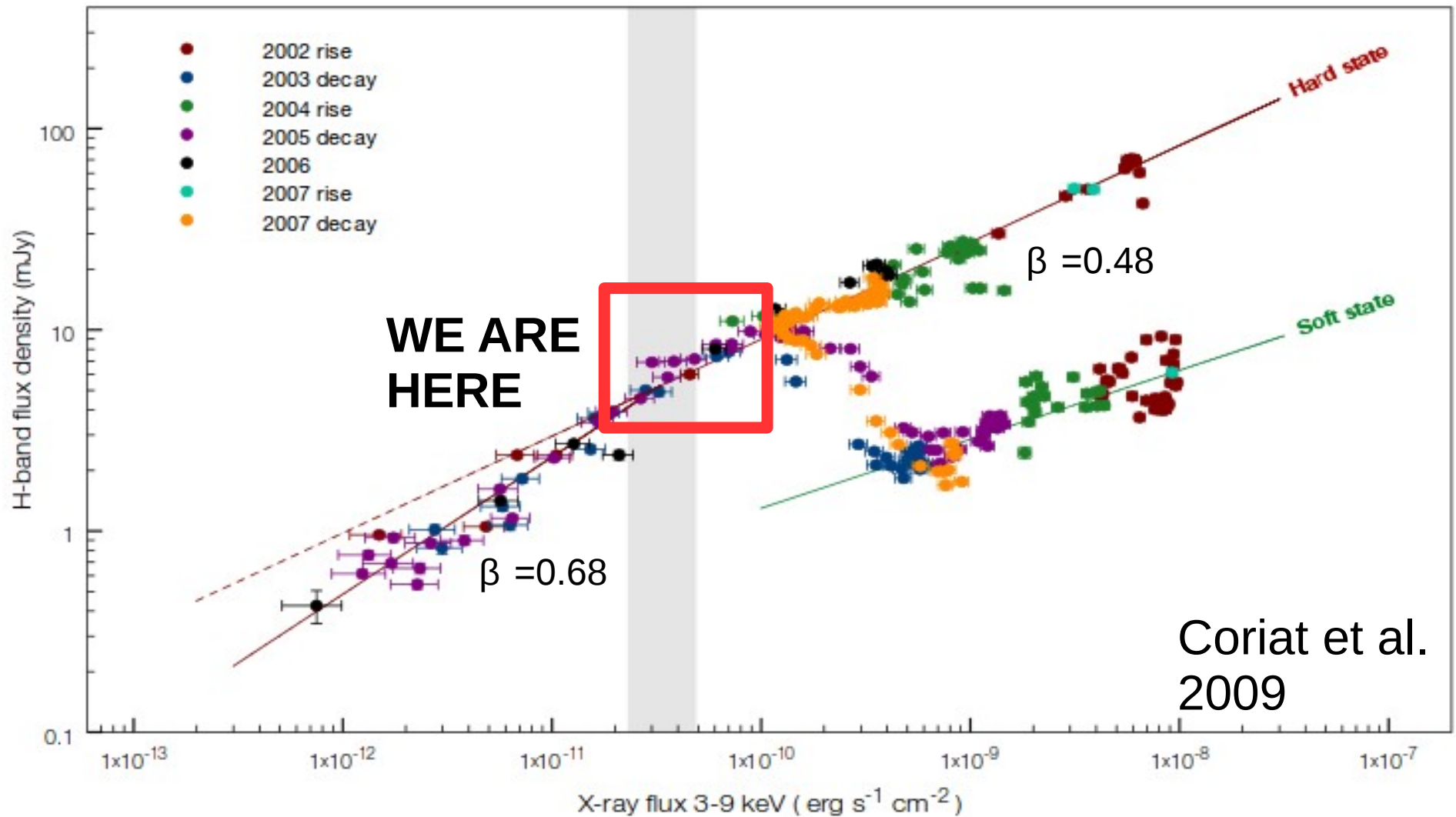


Corbel et al.
2012

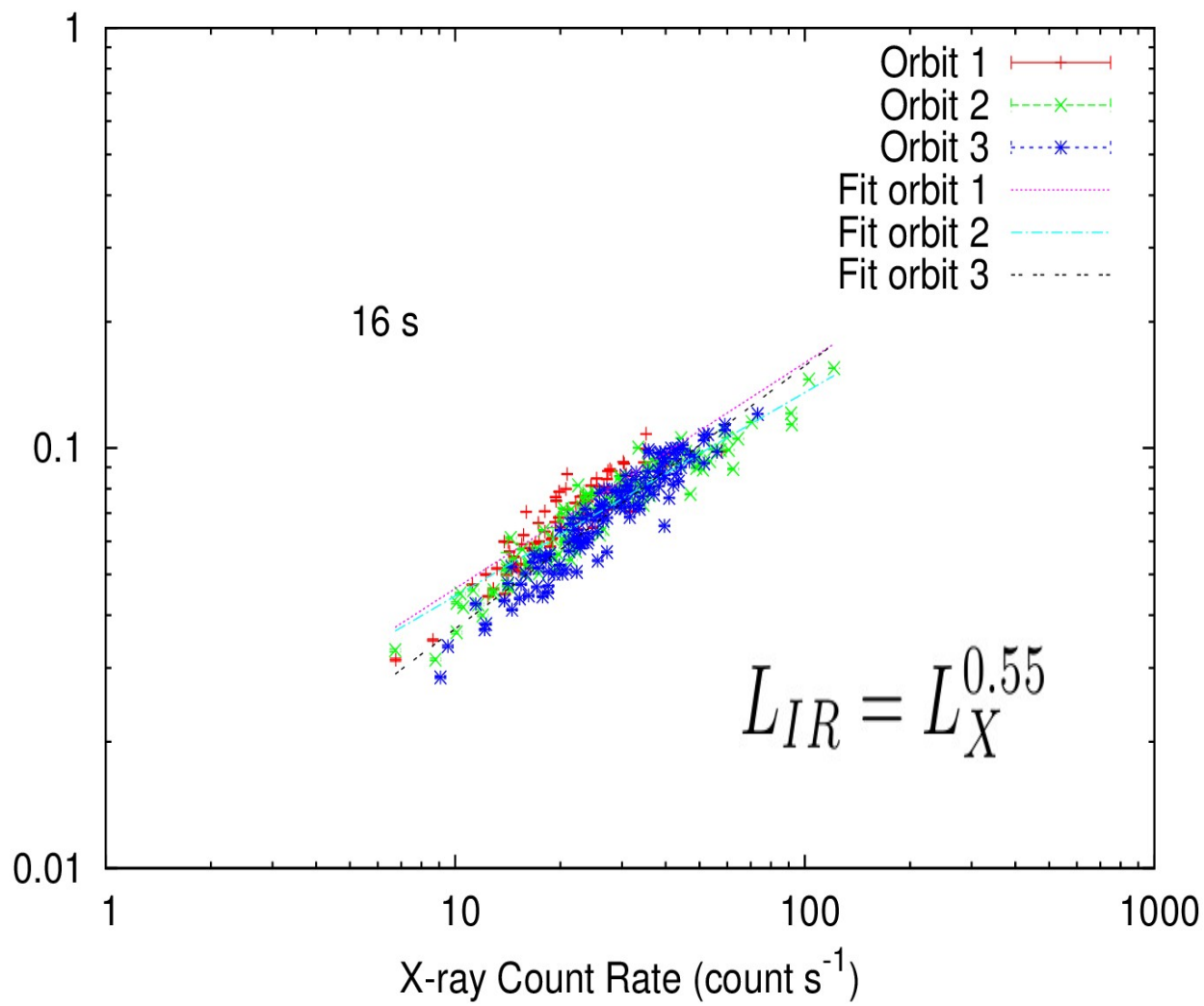


Russell et al.
2006

Flux vs Flux



IR Targ. / Ref.

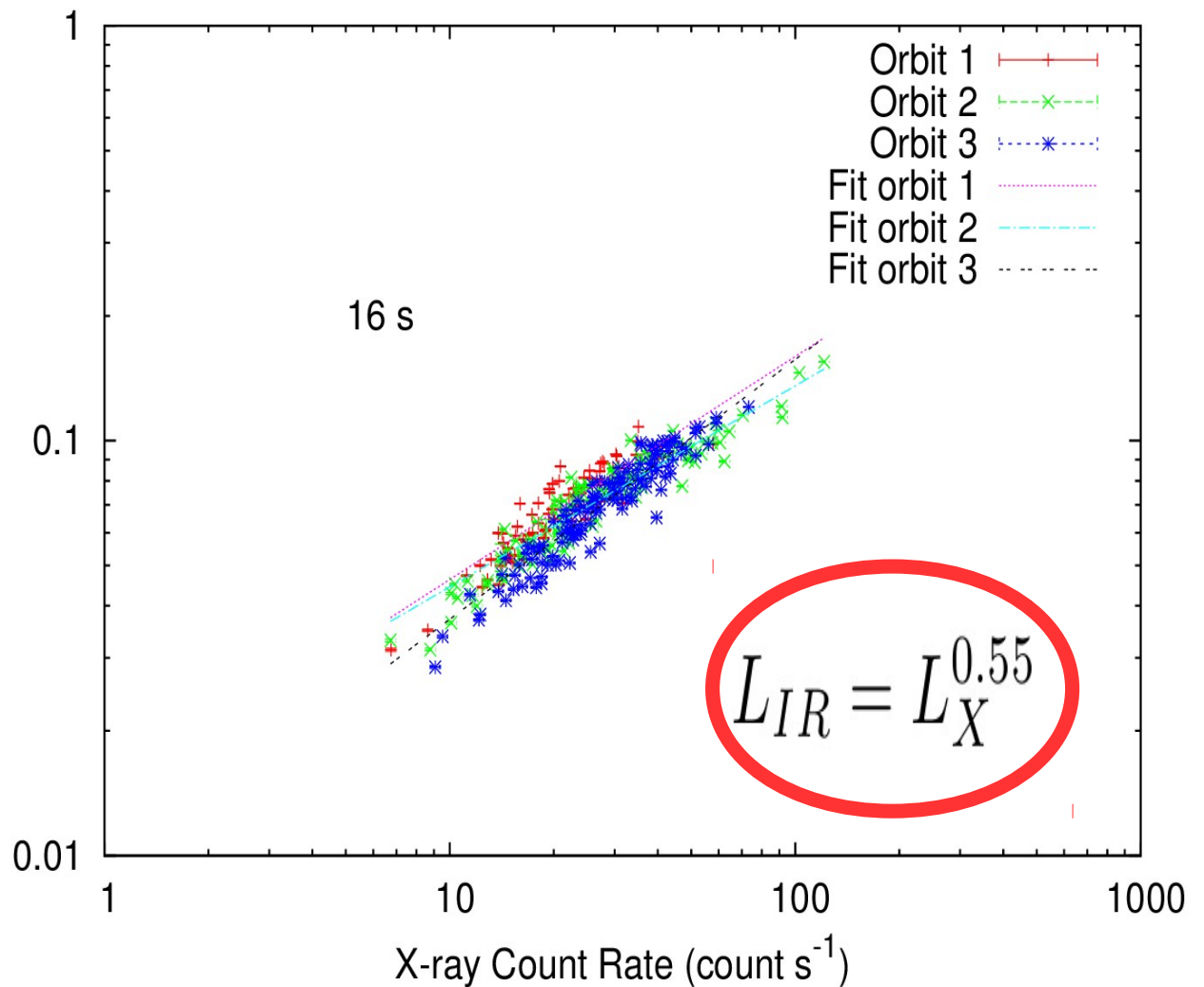


LONG AND SHORT
TIME SCALES

**SAME
CORRELATION**

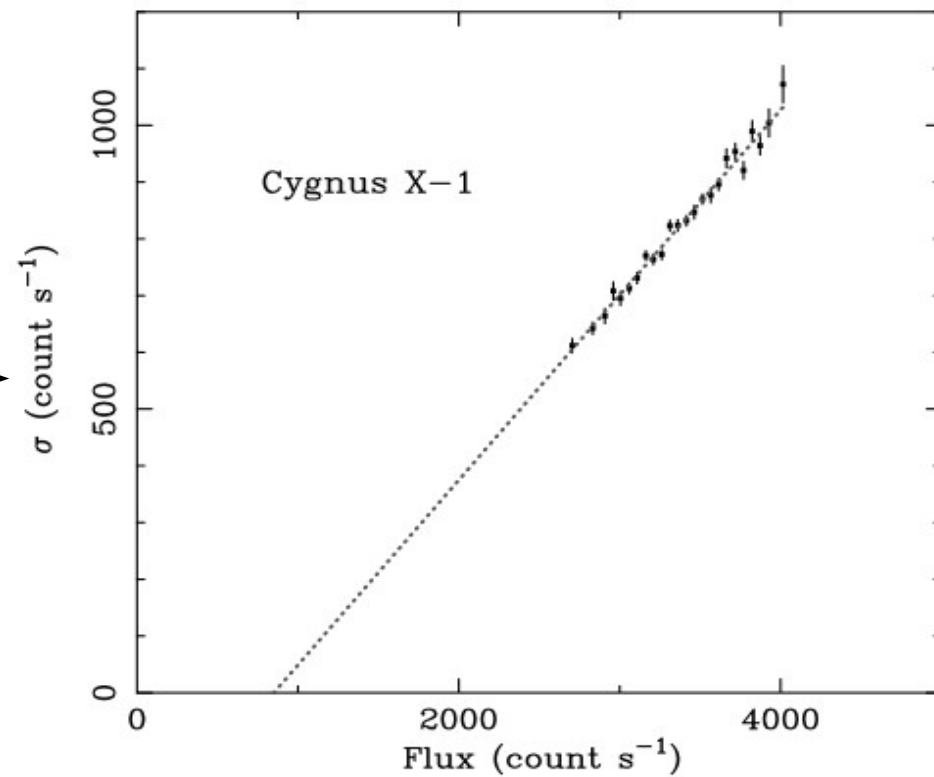
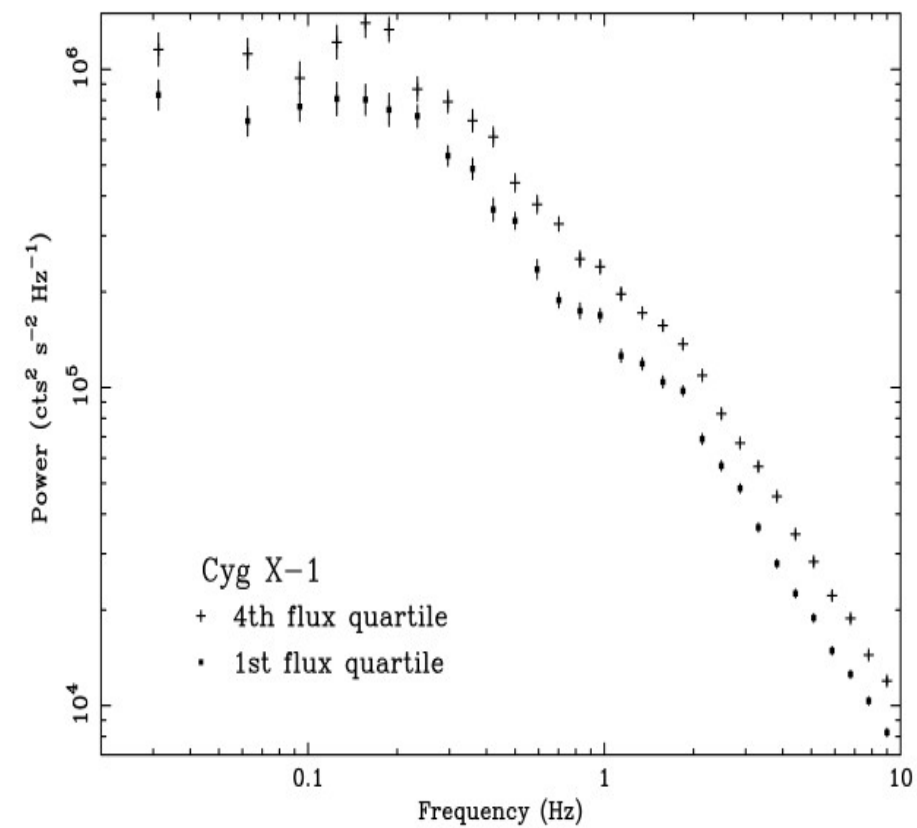
This means that:

IR Targ. / Ref.



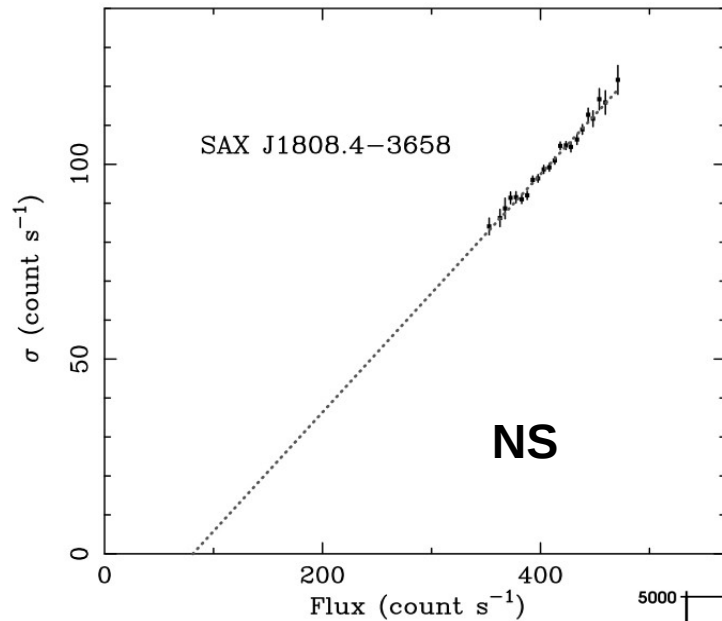
- Jet reacts quickly to changes in the X-rays

rms vs Flux

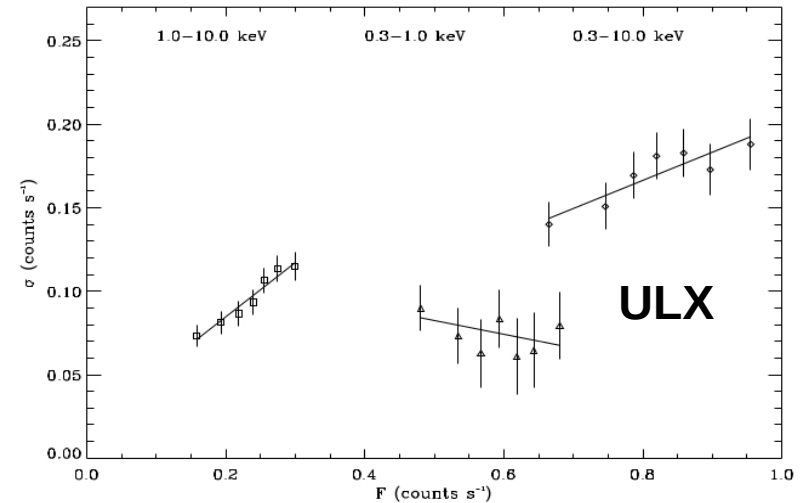


rms vs Flux

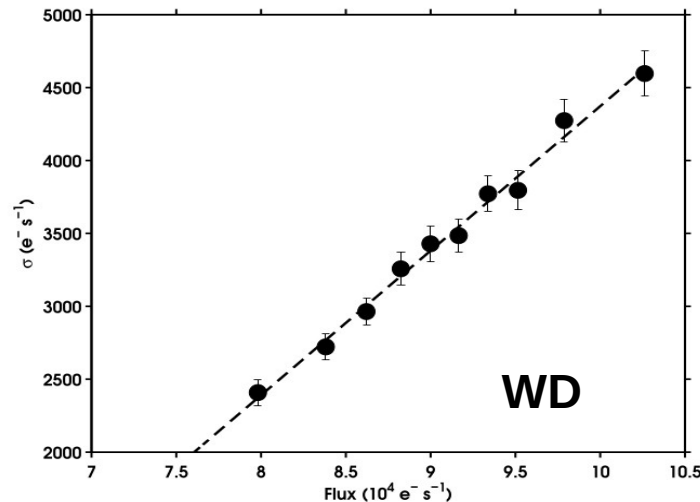
Typical of accretion mechanism!!



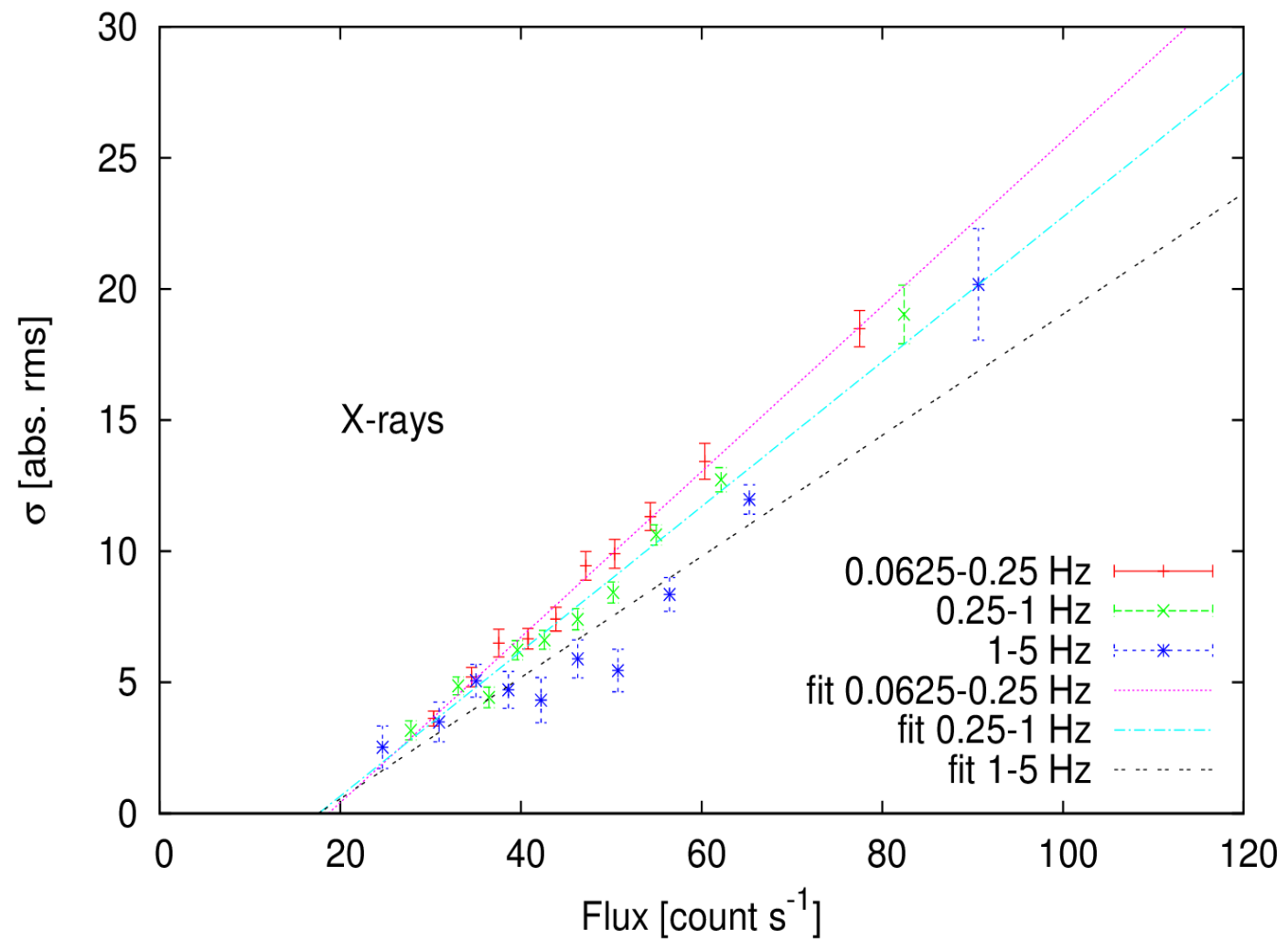
Uttley &
Mc Hardy
2001



Heil & Vaughan
2010

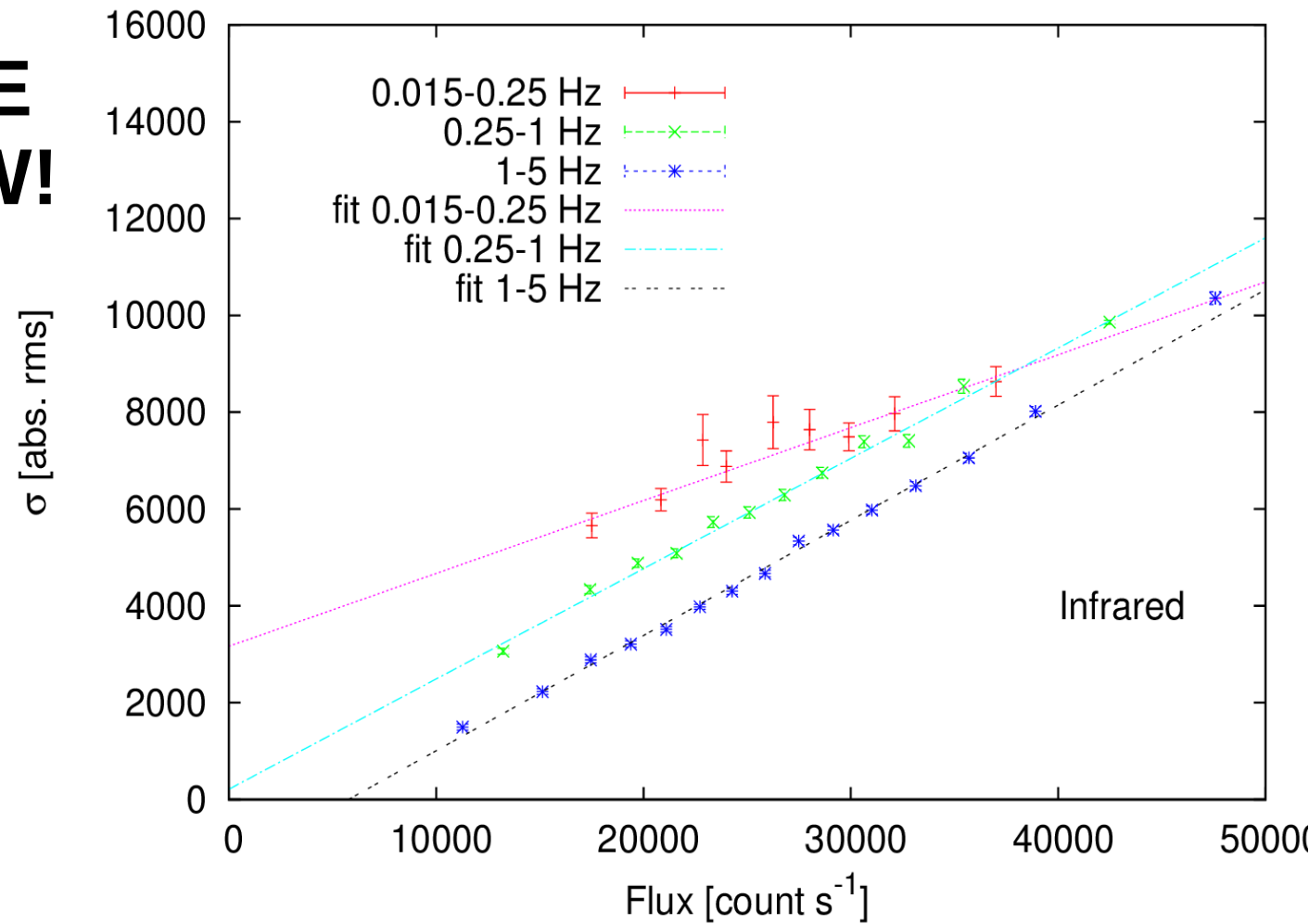


Scaringi et al.
2012



- SIMILAR SLOPE
- NON LINEARITY

FIRST EVIDENCE FROM OUTFLOW!



- DIFFERENT SLOPES
- NON LINEARITY

Conclusions

- **Strong connection** between inflow and jet at time scales of seconds
- First evidence of linear rms-flux relation from **OUTFLOW!**

Future

- Neutron Stars...
- Different stages of the of the outburst...
- Several data sets, new incoming....to be continued!

Conclusions

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THANK YOU