Fast IR/X-ray observations from the MAXI new black-hole transients

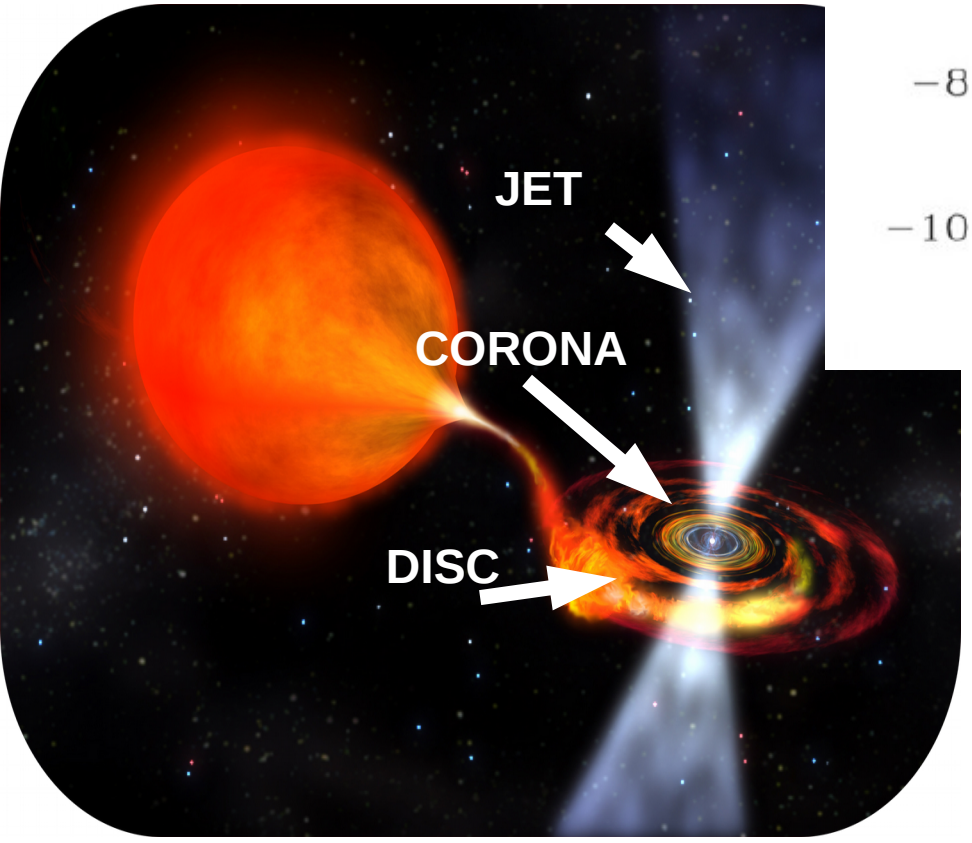
Federico M. Vincentelli

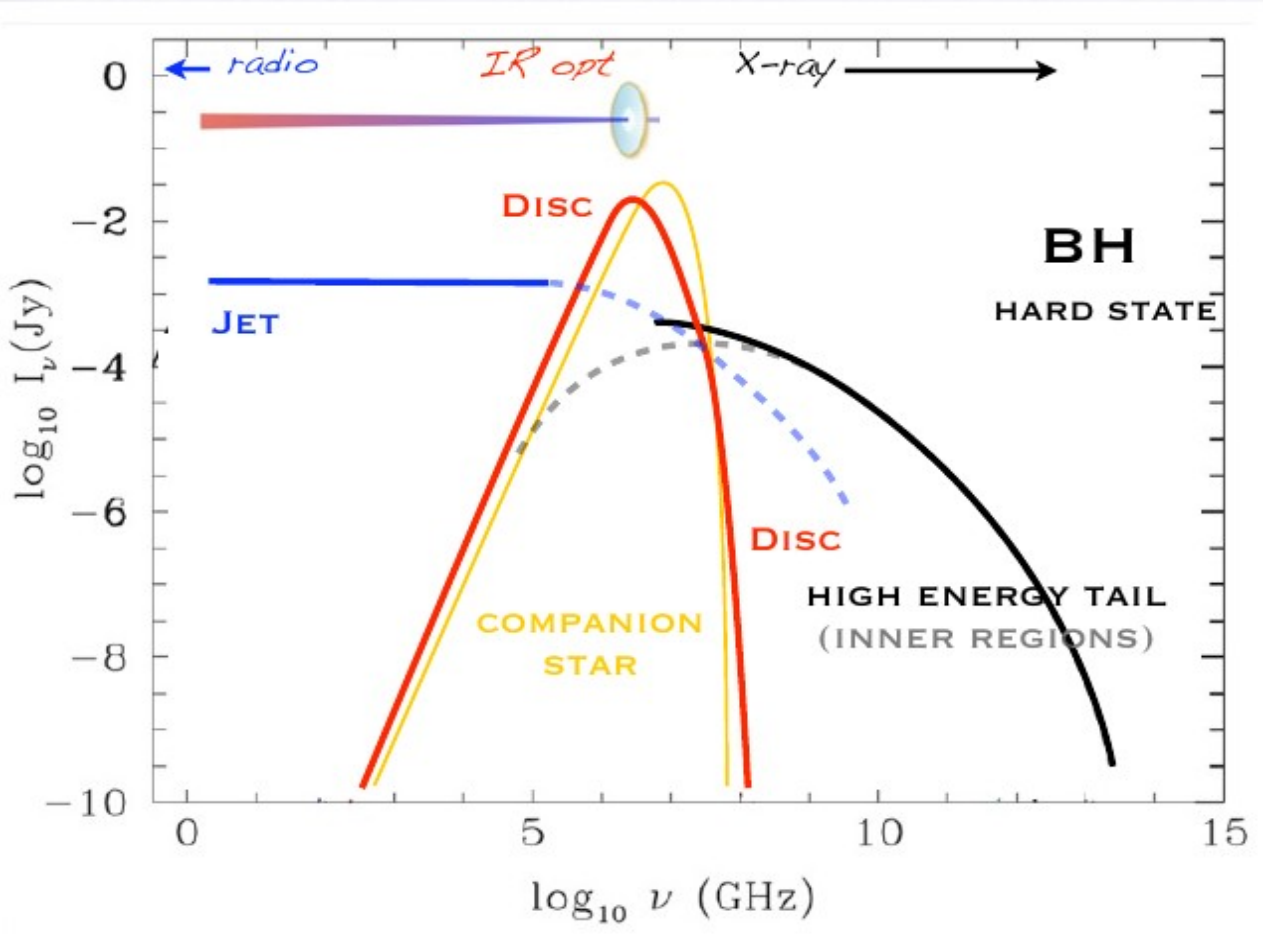
University of Southampton

In collaboration with: P. Casella (INAF-OAR), P. Uttley (UvA), D. Russell (NYUAD), B. De Marco (Nicolaus Copernicus Astronomical Center), T. Maccarone (Texas Tech University), R. Fender (Oxford) and many otherrs...

Low Mass X-ray Binaries in a Nutshell

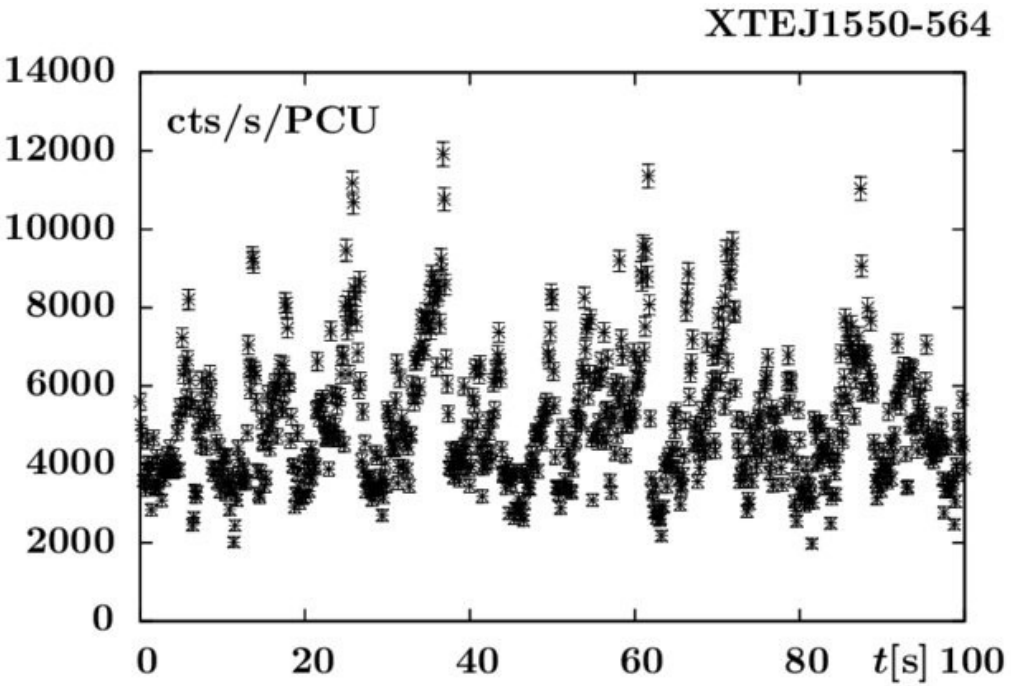
Multi-wavelength Emission





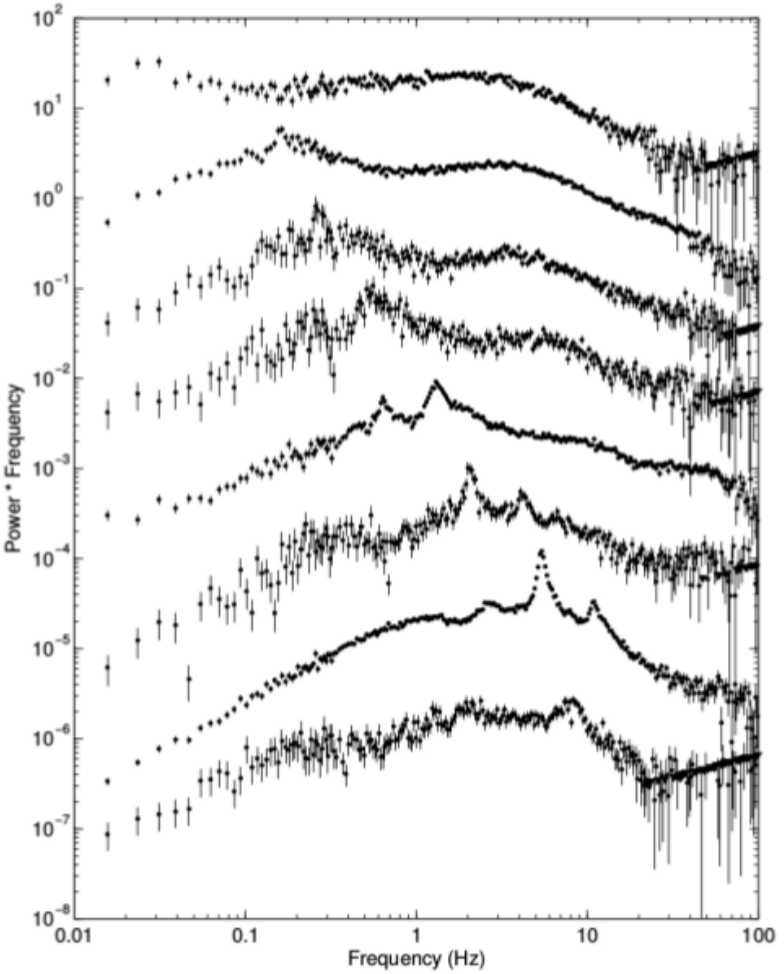
3 Main spectral components

X-ray variability



X-ray emission highly variable

Timescales < 0.1 s

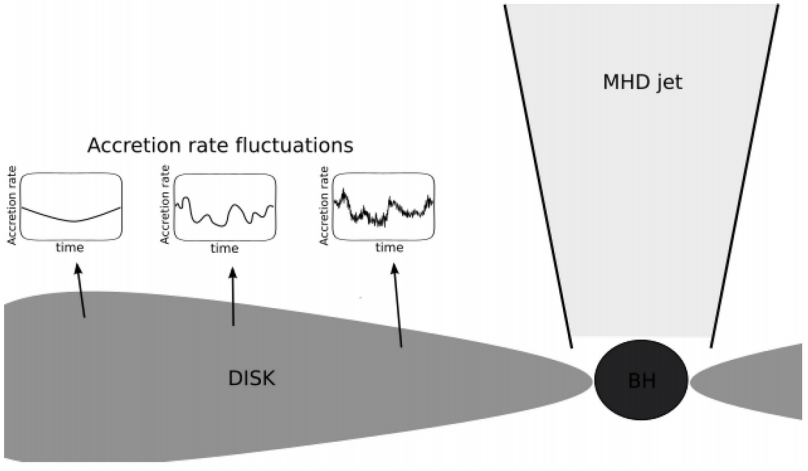


Strong stochastic noise

Broad component and QPOs

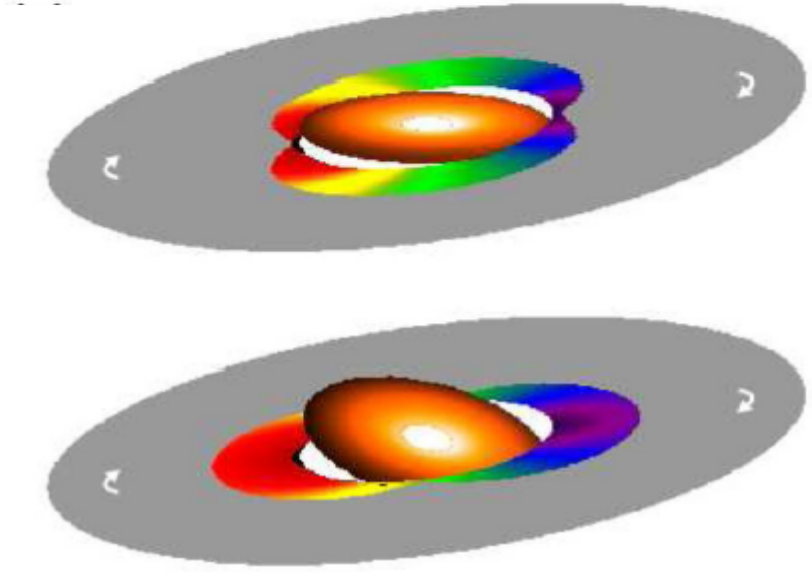
Properties evolving in time

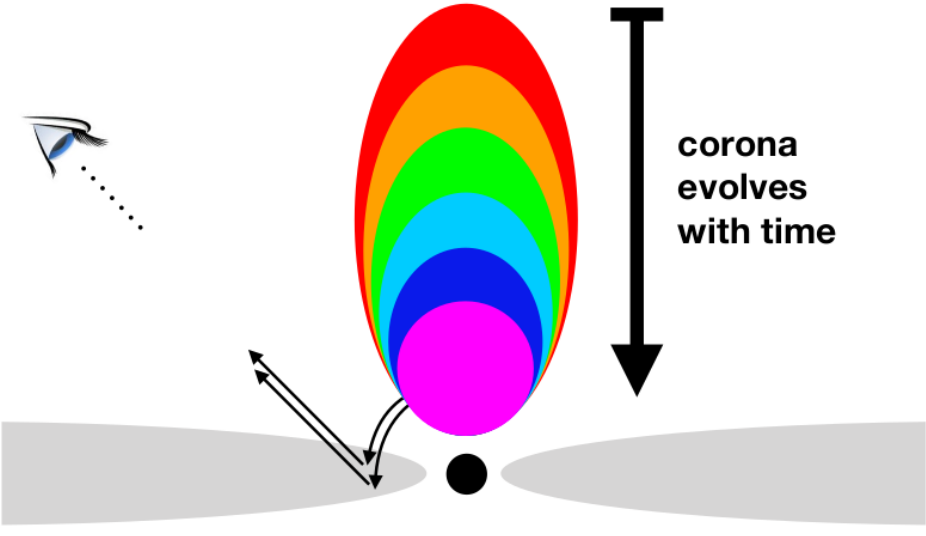
ariability



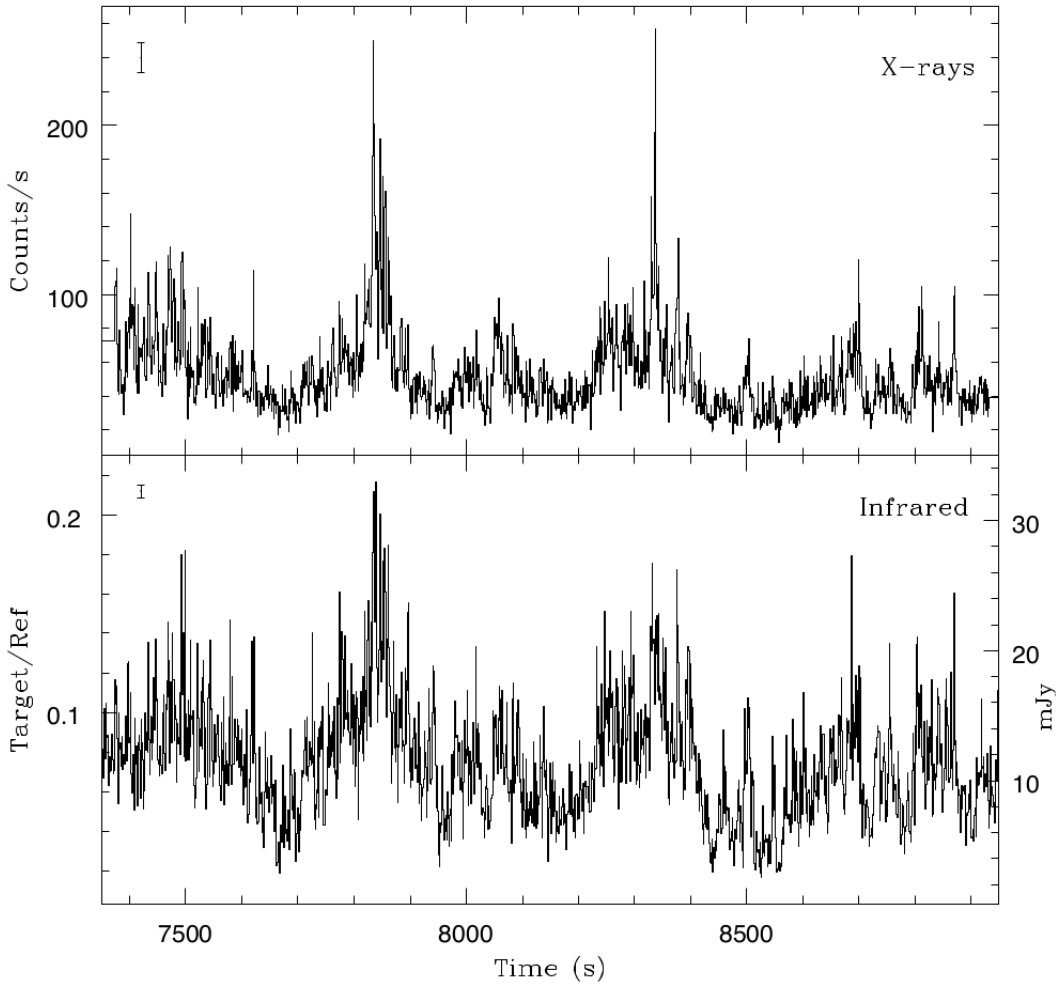
Constraints on geometry
(e.g. Esin 1997, Ingram & Done 2011, Kara 2019)

And physical processes
(e.g. Uttley et al 2001, Churazov 1999)





Short Timescale Variability



X-ray fluctations in accretion flow

Also O-IR variable on ~seconds timescales!

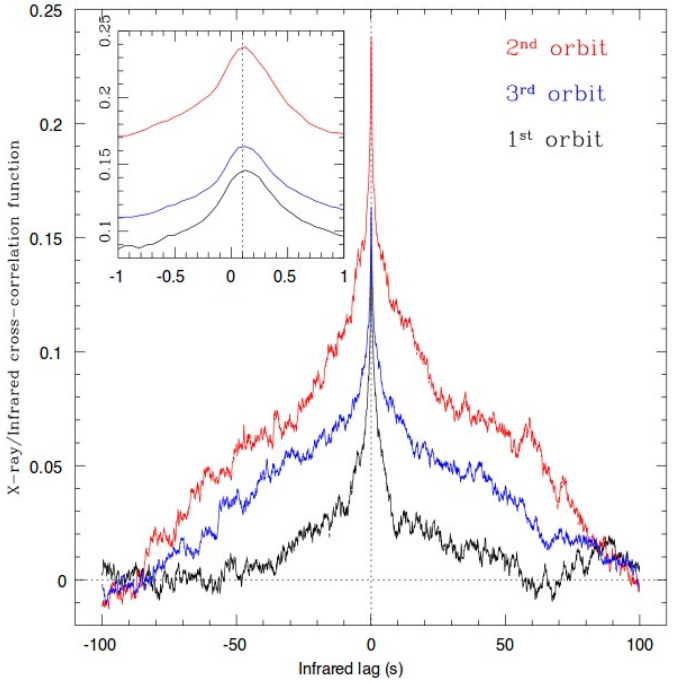
VARIABILITY IS CORRELATED

What is the origin?

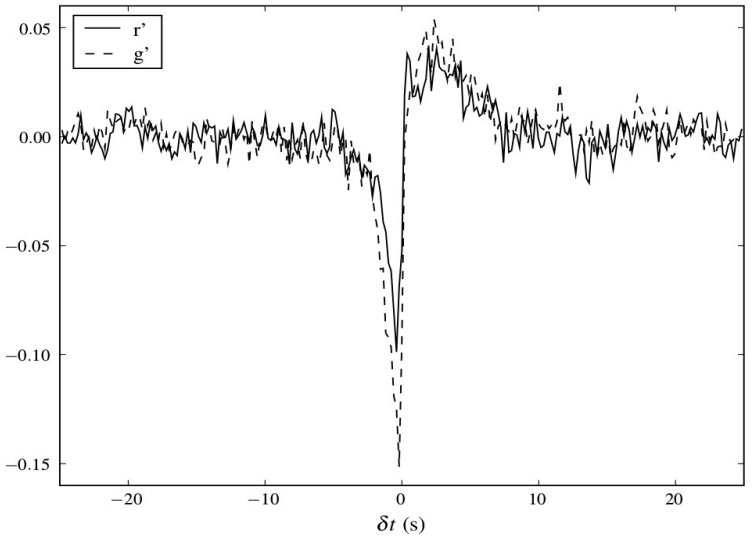
O-IR Short Timescale Variability

Cross correlation function: understanding physical process

2 behaviour observed:

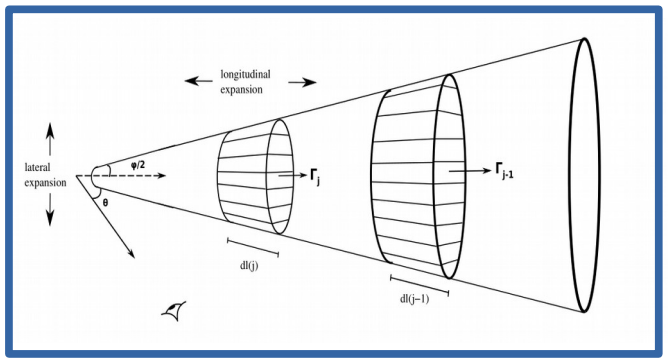


-Symmetric CCF
-peaked at 0.1 s

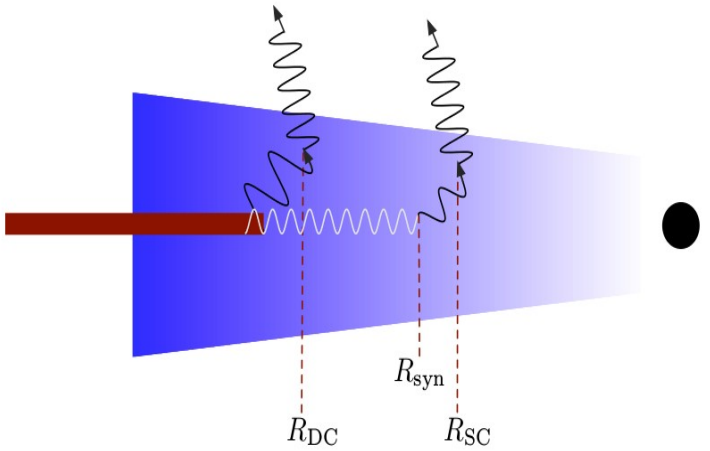


-Asymmetric CCF
-pre-cognition deep

JET VS HOT INFLOW

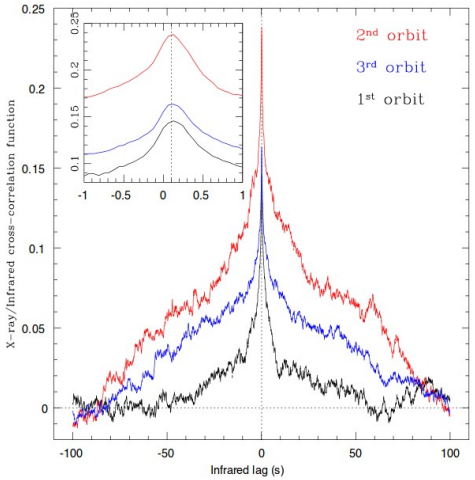


IR Generated by shocks from shells launched in the jet



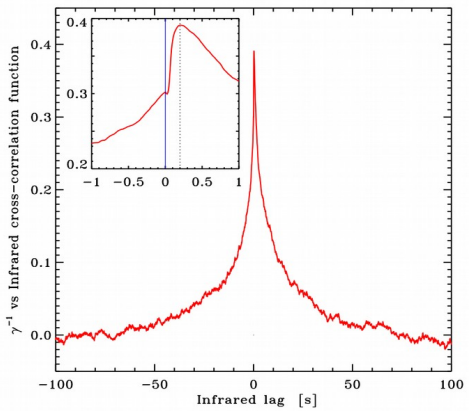
Synchrotron radiation from hot flow (optical)

Observed



(Casella+2010)

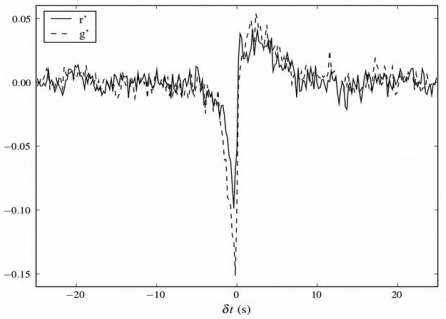
Model



(Malzac 2014)

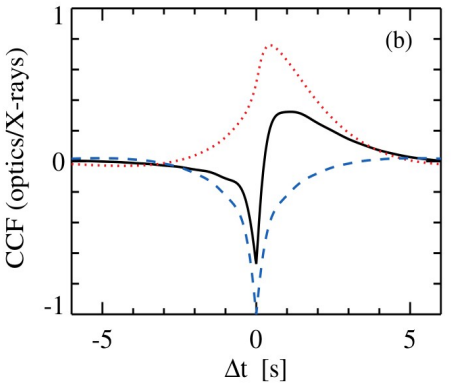
Self Synchrotron Compoton from same electrons (X-rays)

Observed



(Durant+ 2011)

Model



(Veledina+ 2011)

SmartNet

Simultaneous Multiwavelength Astronomy Research in Transients NETwork

RADIO

Outer jet

Base of the jet!

O-IR

Inflow

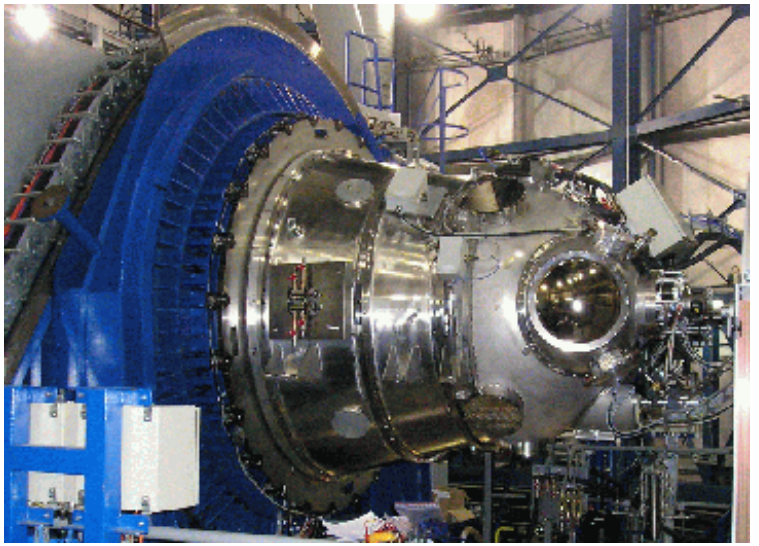
X-RAYS

We NEED
STRICTLY Simultaneous
Multi-wavelength coverage

FAST IR PHOTOMETRY

Observations taken at VLT

HAWKI in FastPhot mode

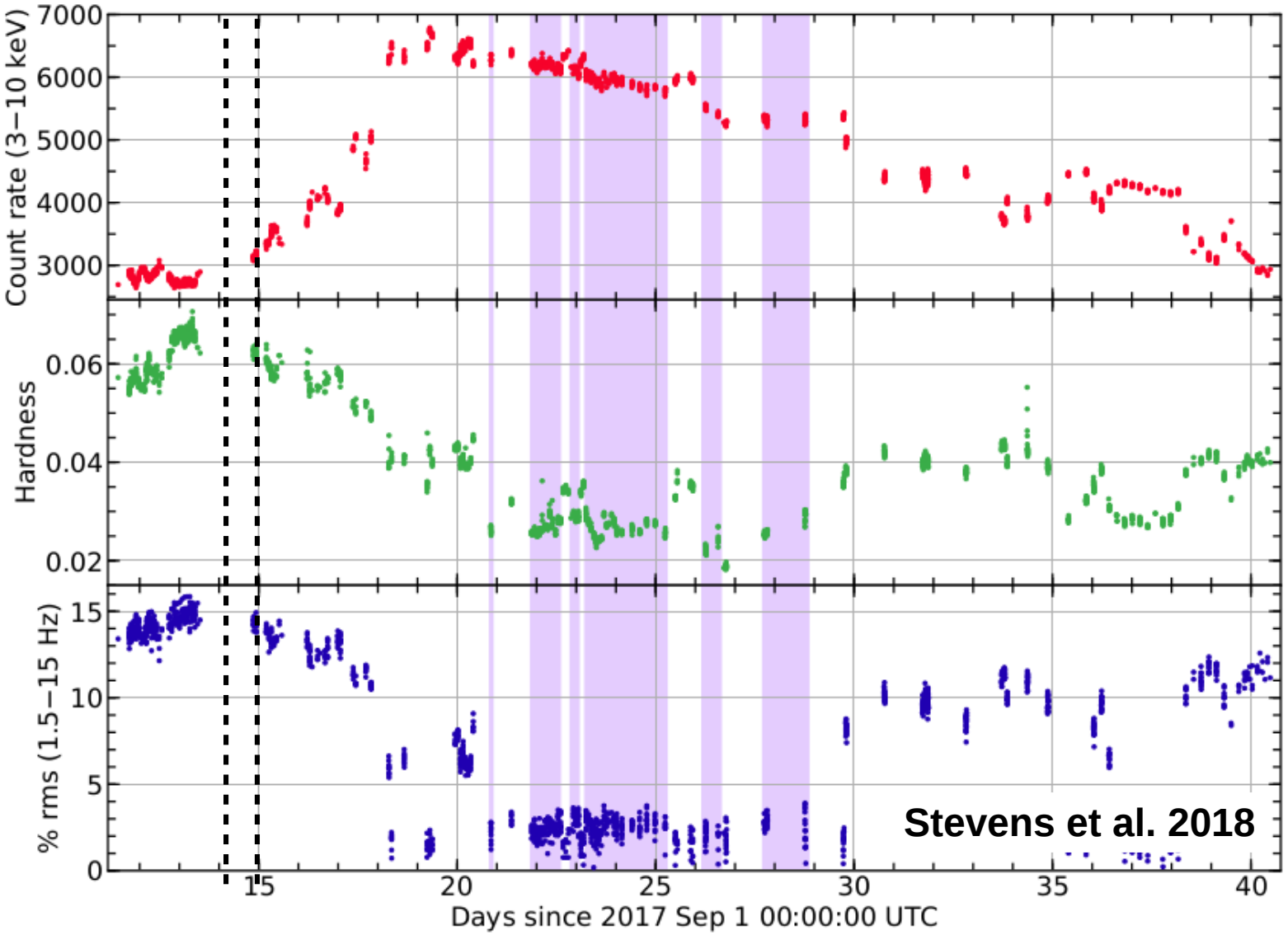


Fastest observation in NIR

Time resolution of ~0.1 s

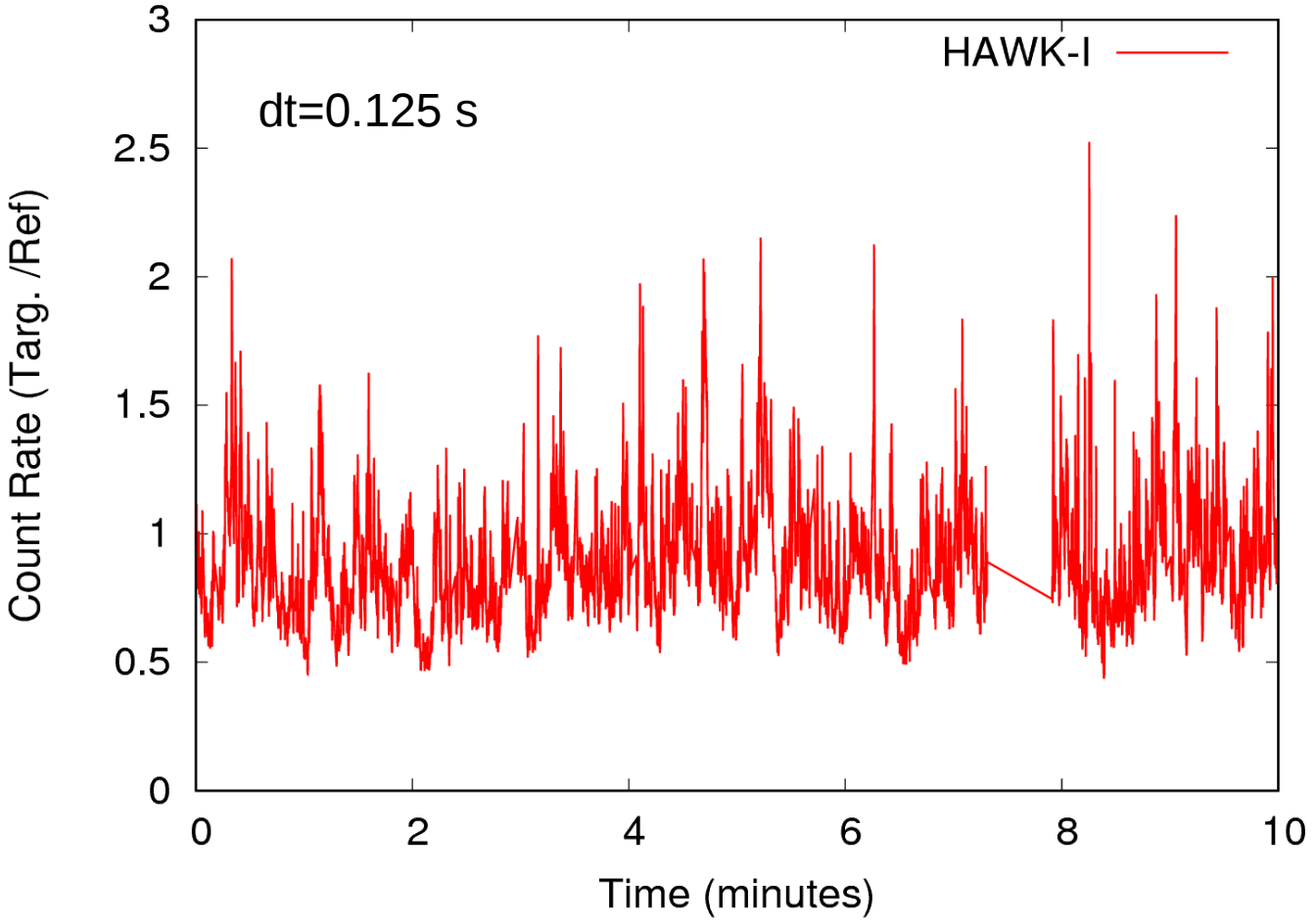
CASE OF MAXI J1535-571:

2 Strictly simultaneous XMM/VLT Observations



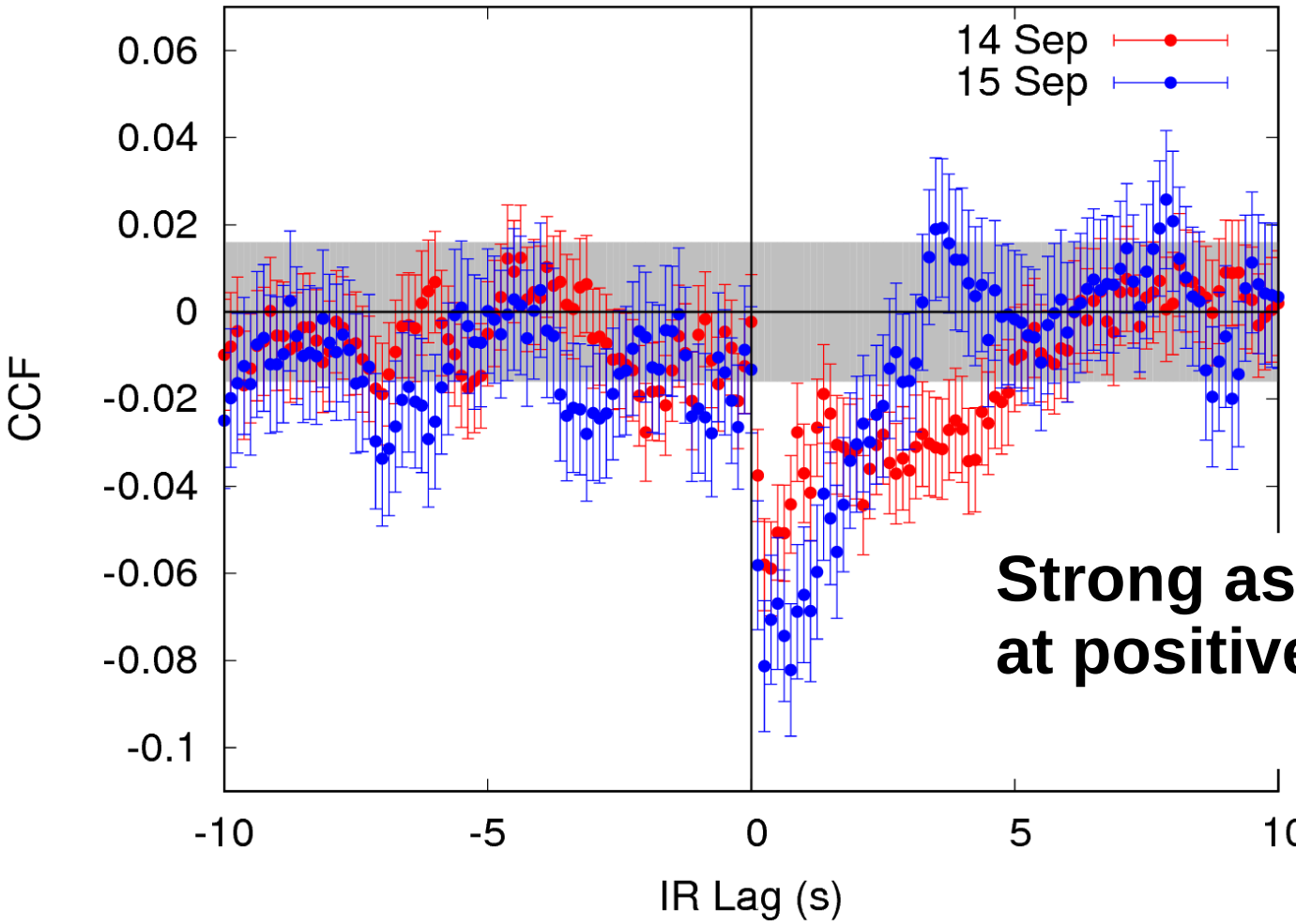
CASE OF MAXI J1535-571:

IR Lightcurve: Incredibly variable!



MAXI J1535-571:

CROSS-CORRELATION FUNCTION:



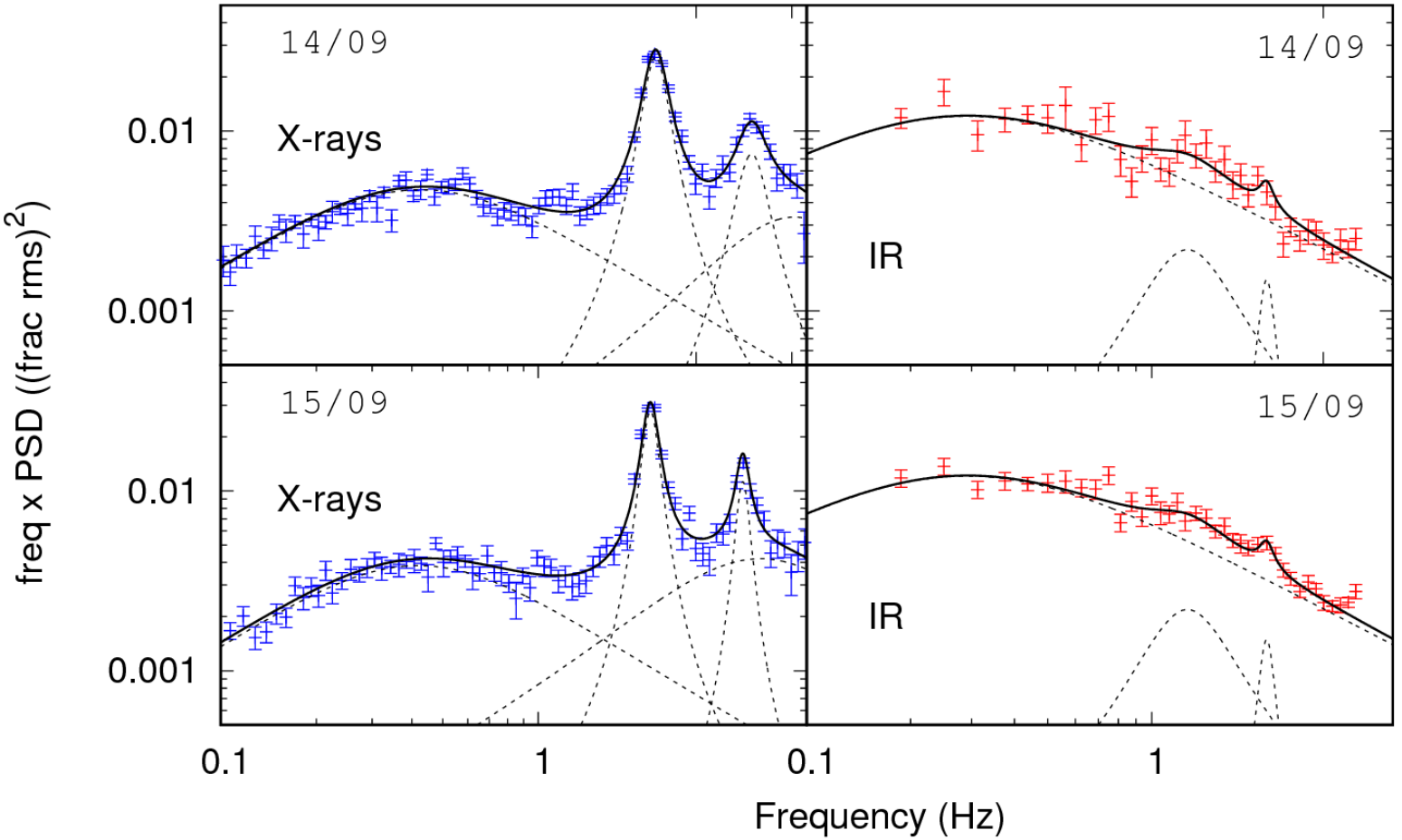
Strong asymmetric dip at positive lags!

Vincentelli et al. (in prep)

CASE OF MAXI J1535-571:

Strong QPOs in X-rays

FIRST DETECTION of IR QPO at the same frequency!



Vincentelli et al. (in prep)

CASE OF MAXI J1535-571:

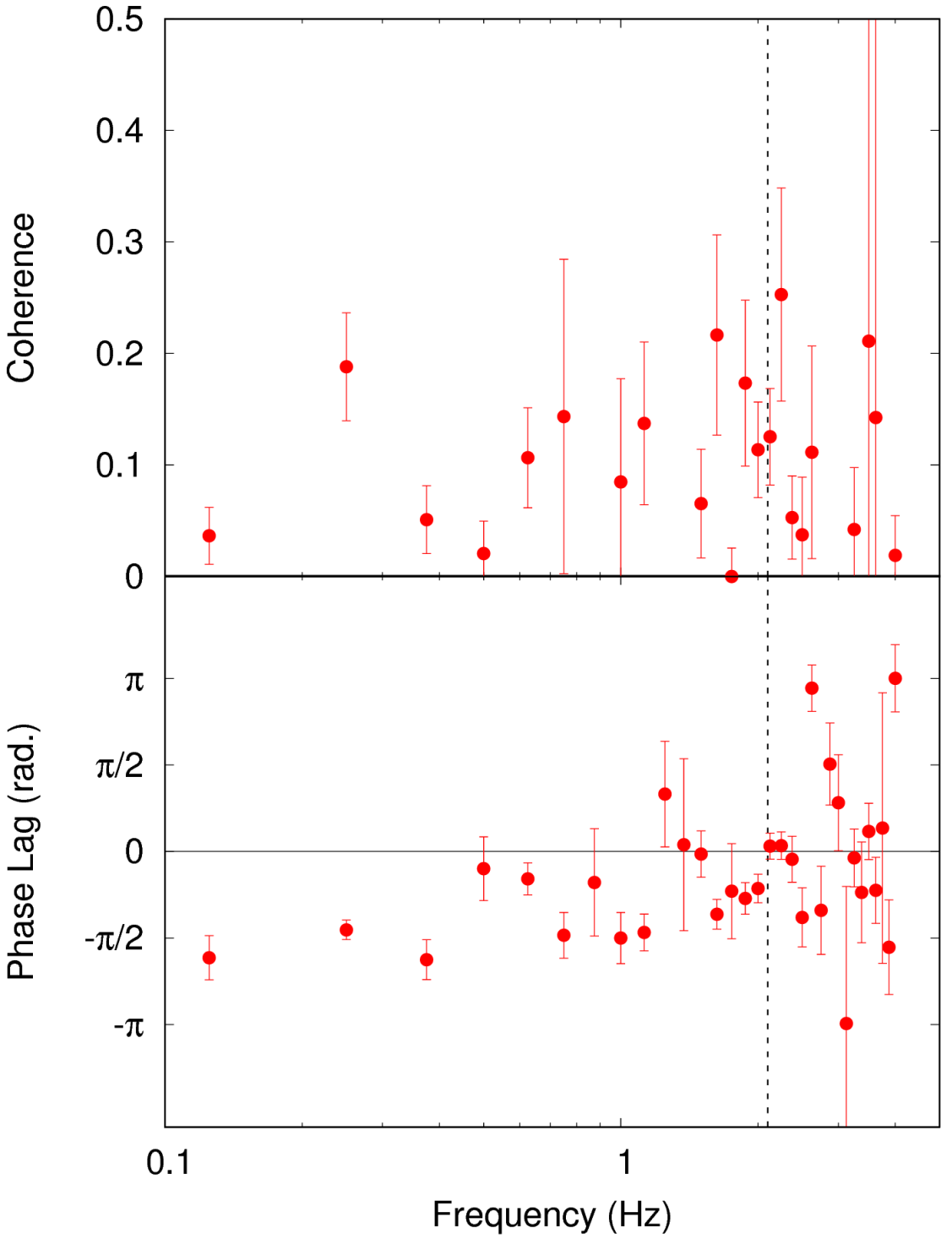
Vincentelli et al. (in prep)

CROSS-SPECTRAL ANALYSIS

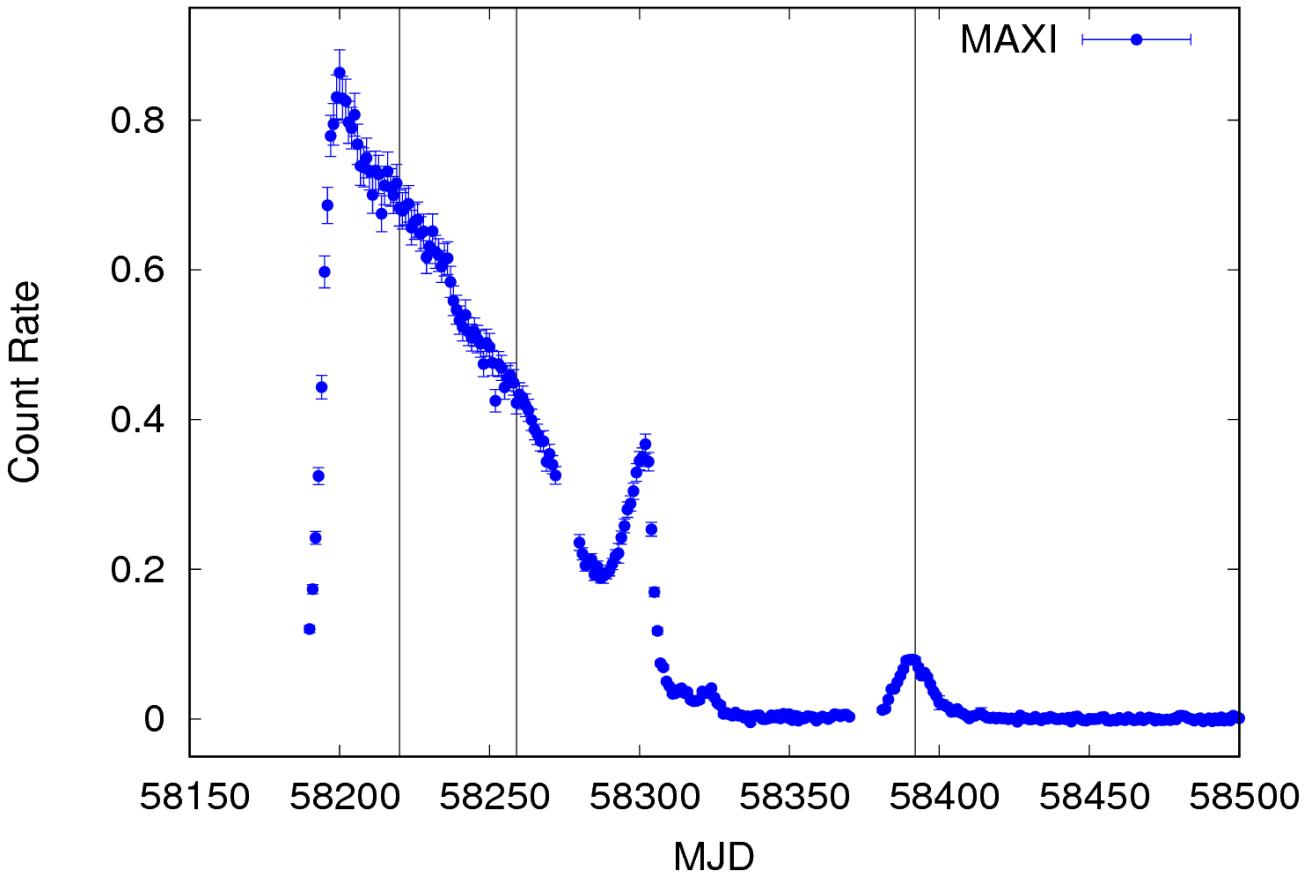
- Low coherence

- 0 lag at QPO!

- Negative lag at low frequencies



MAXI 1820+070



3 FastIR observations during 2018

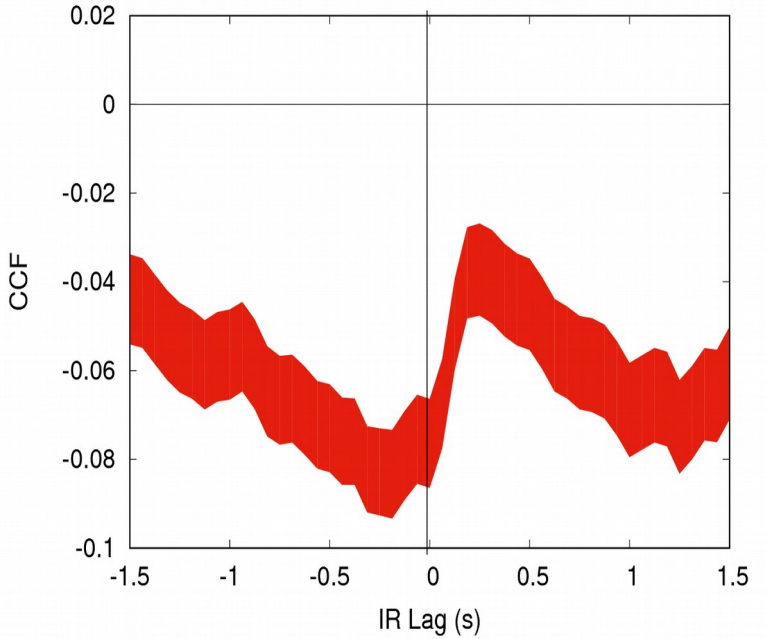
1 has XMM strict simutaneity

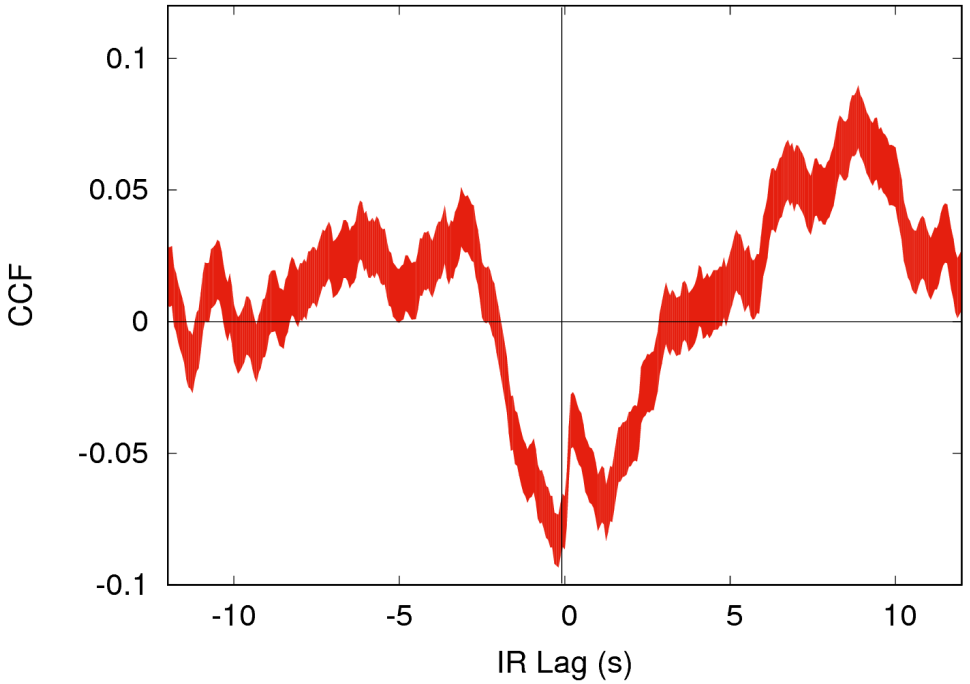
Remaining 2 has partial coverage with Nicer (wok in progress)

MAXI 1820+070

21-April

HAWK-I vs XMM

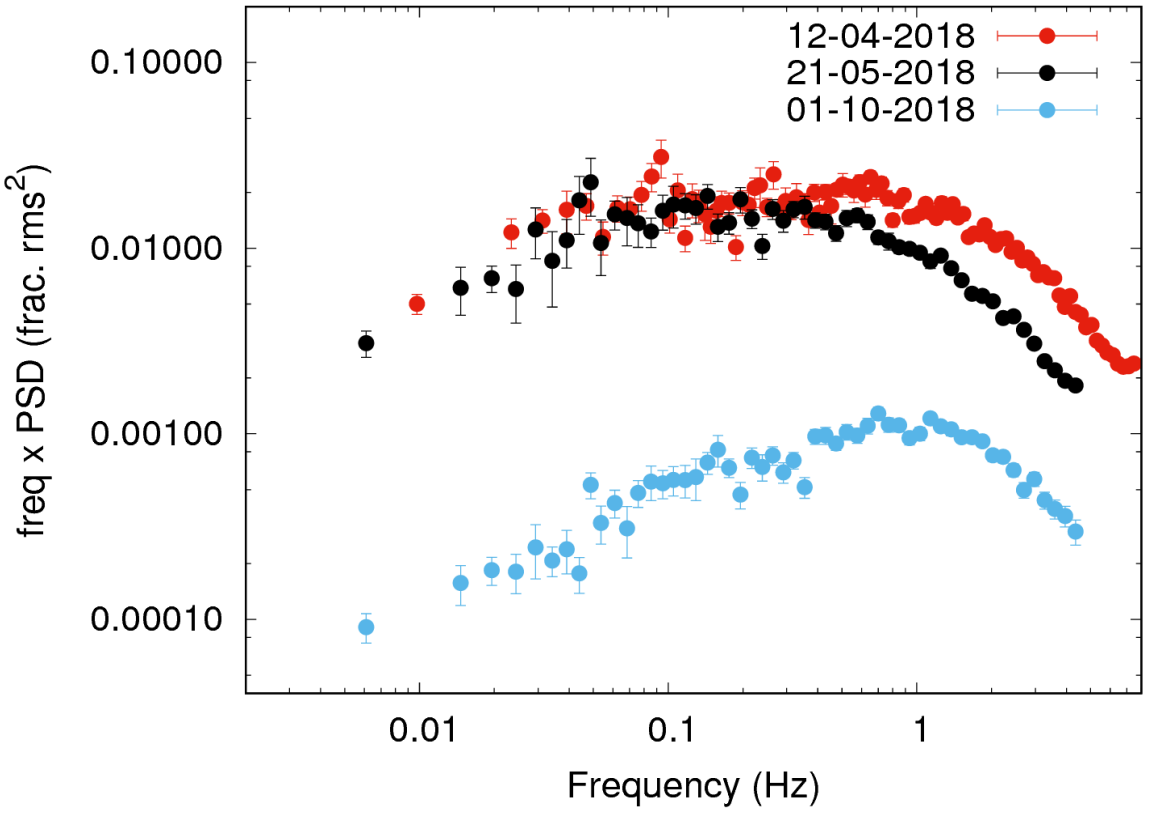




FIRST BHT WITH

HOT-INFLOW AND JET?

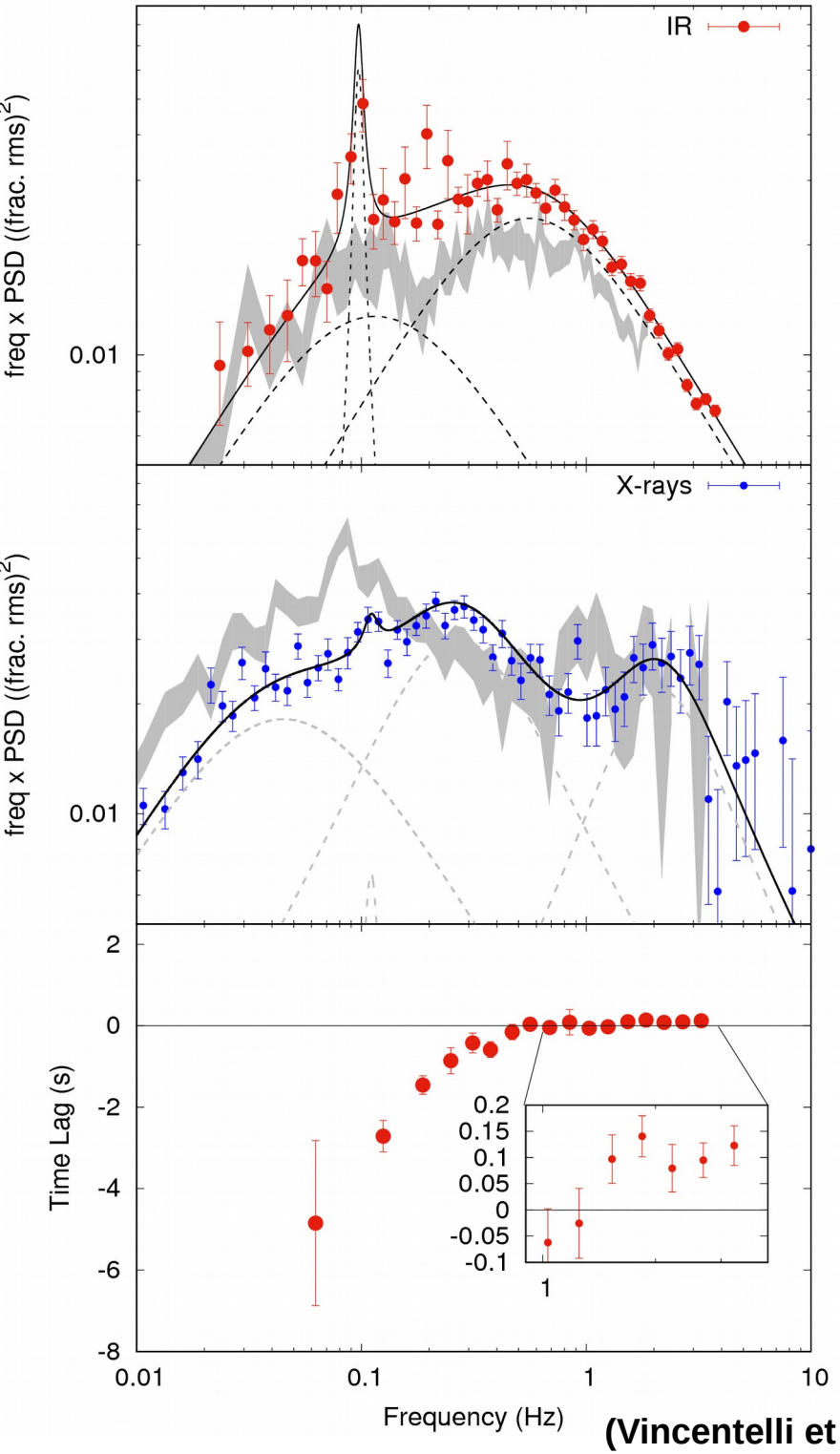
MAXI 1820+070



Evolution of the IR PSD

Main changes at low freq.

High Frequencies have similar break!



(Vincentelli et al, submitted)

Constant high frequency break

Already seen in GX 339-4
(Vincentelli et al, submitted)

Difficult to reconcile with hot inflow

Constant break expected by internal shocks

Or constant launching radius?

Summary

- Variability important tool to constrain geometry

- Fast O-IR variability growing field

- Hot inflow and internal shocks 2 main models for O-IR emission

- MAXI J 1535 First IR/X-ray QPO at same frequency

- MAXI J 1820: evidence for hot inflow and jet coexisting

THANK YOU