

(Multi- λ) Sub-second Vibrations

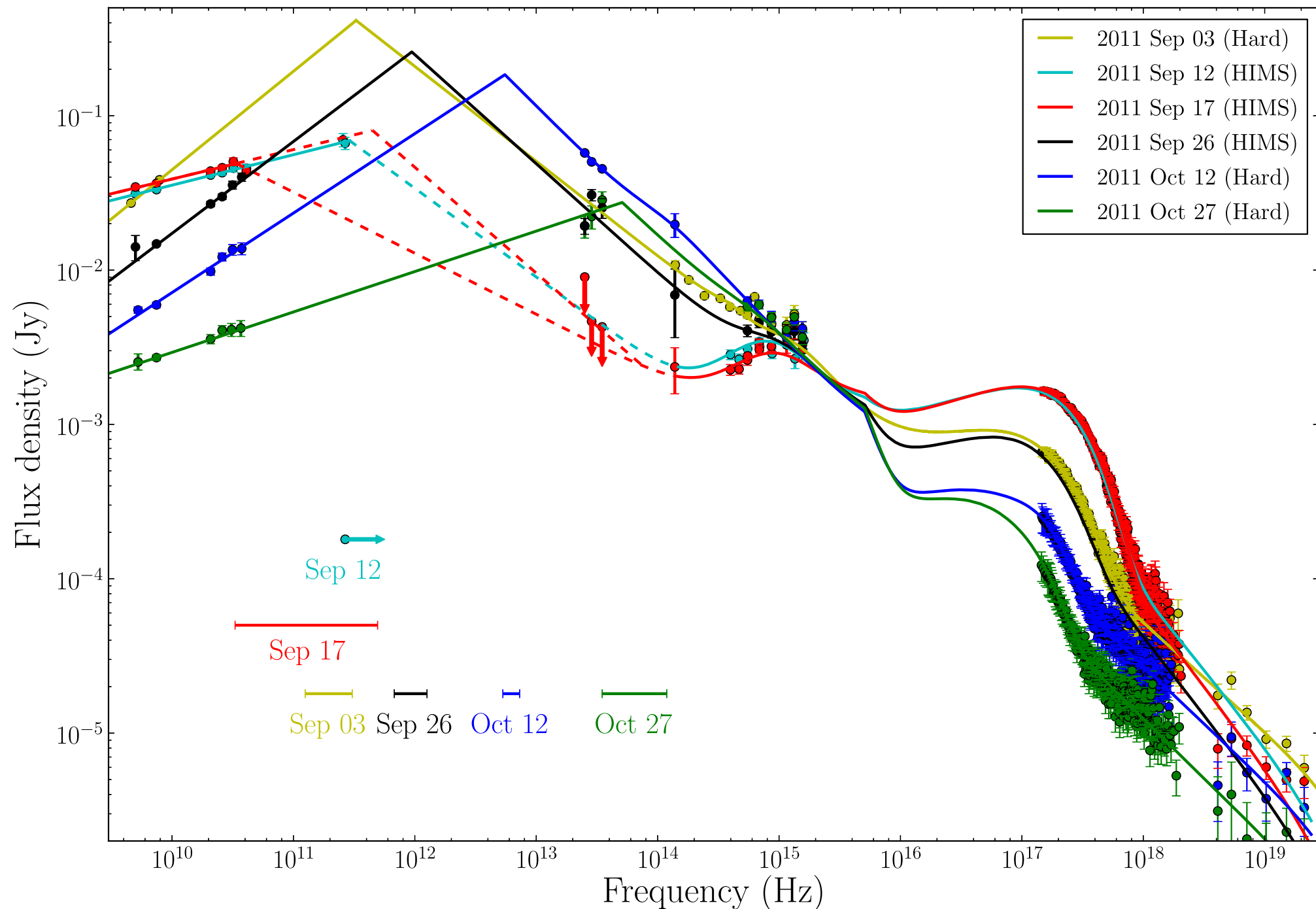
from a

Vertical Corona in a BHT (?)

Piergiorgio Casella (INAF OA-Roma)

Maccarone, Munoz Darias, O'Brien, Russell, Uttley, Vincentelli,
and many others...

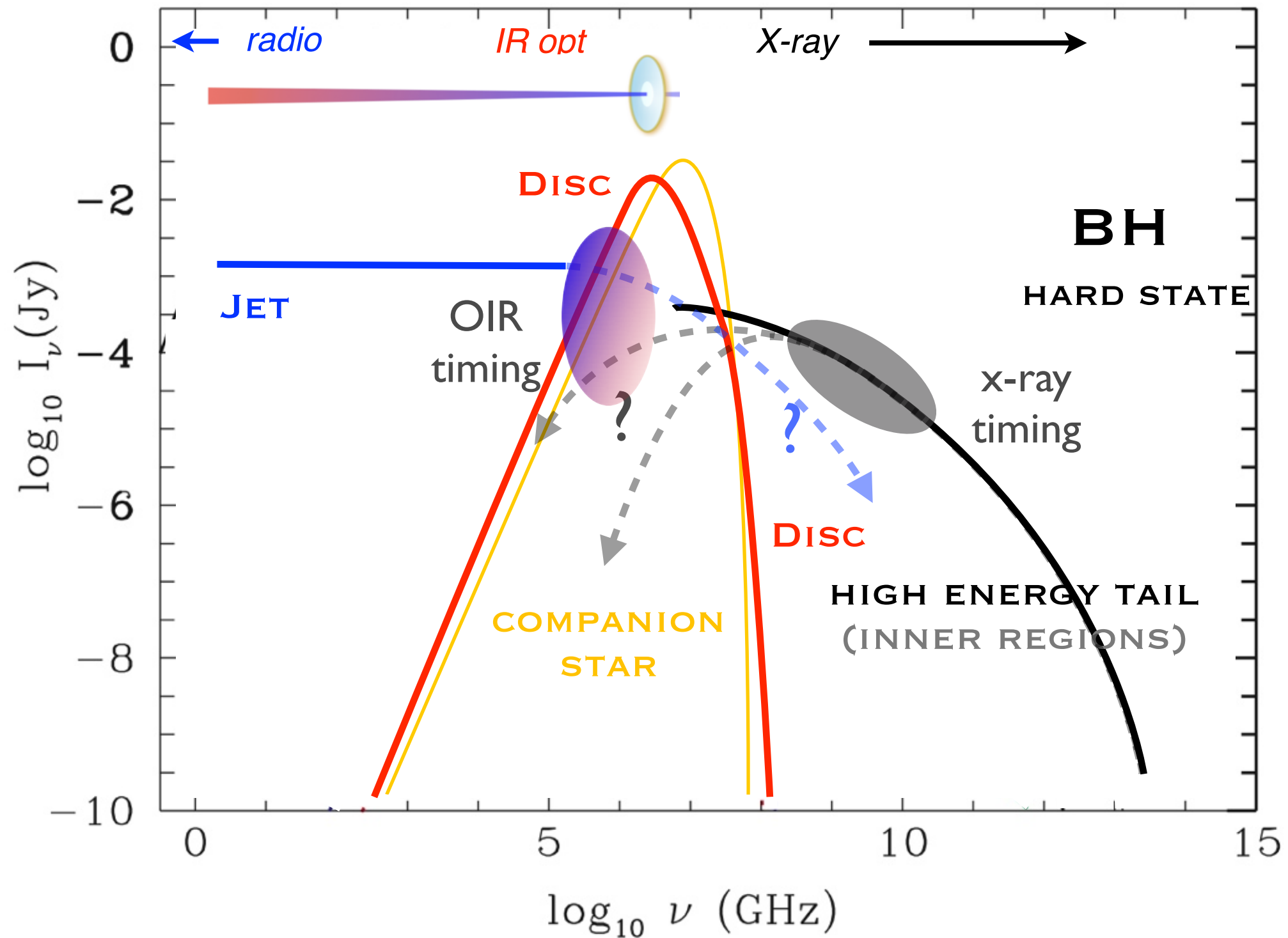
BHTs: variable multi- λ emitters



Russell T et al. (2014)

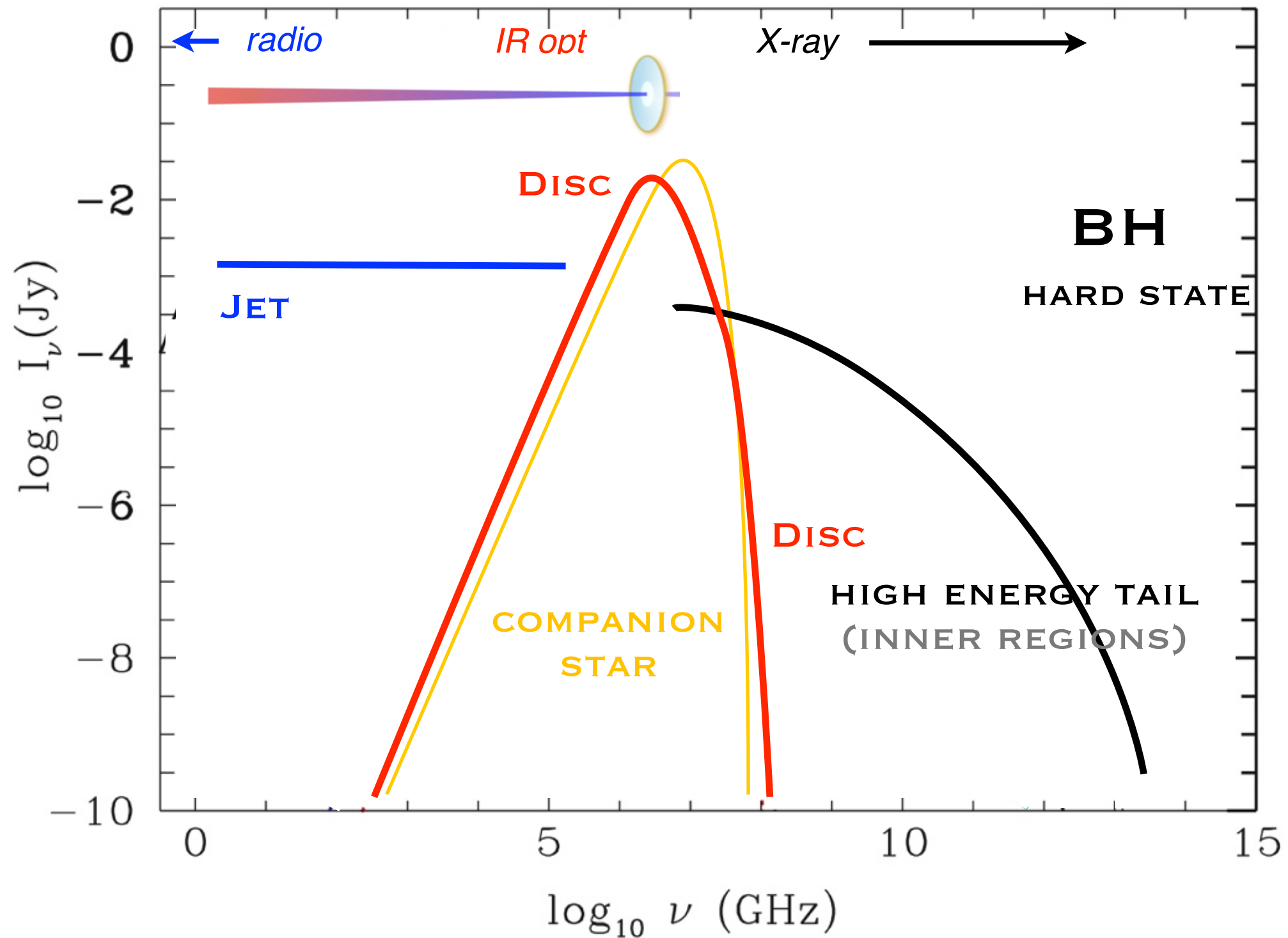
powerful
tool

Multi- λ Fast Variability



powerful
tool

Multi- λ Fast Variability



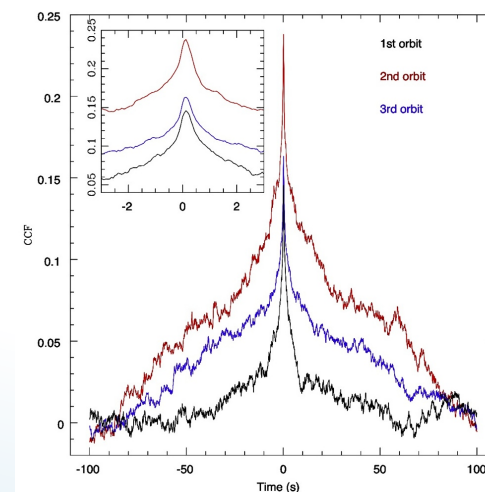


Multi- λ Fast Variability

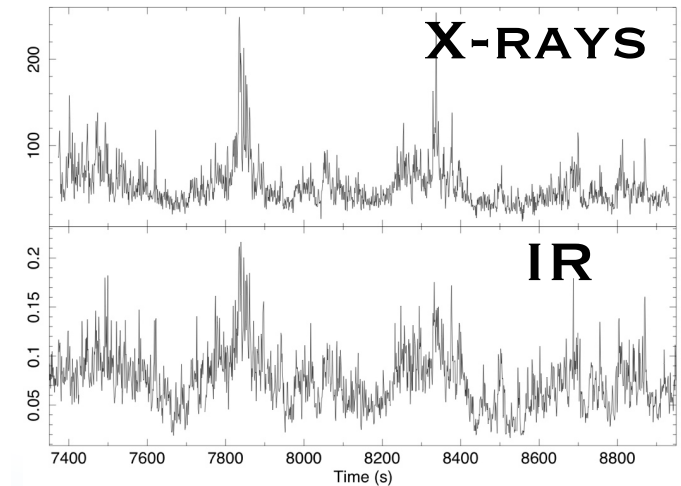
**SECURE EVIDENCE FOR JET
VARIABLE EMISSION**

PC et al. (2010)

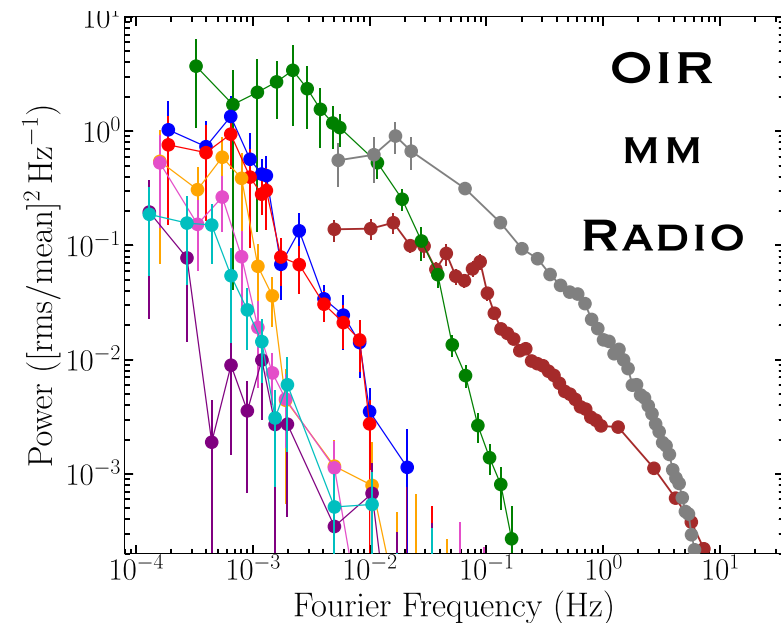
CCF



X-RAYS



PDS



JET PHYSICS

Tetarenko, PC et al. (2021)

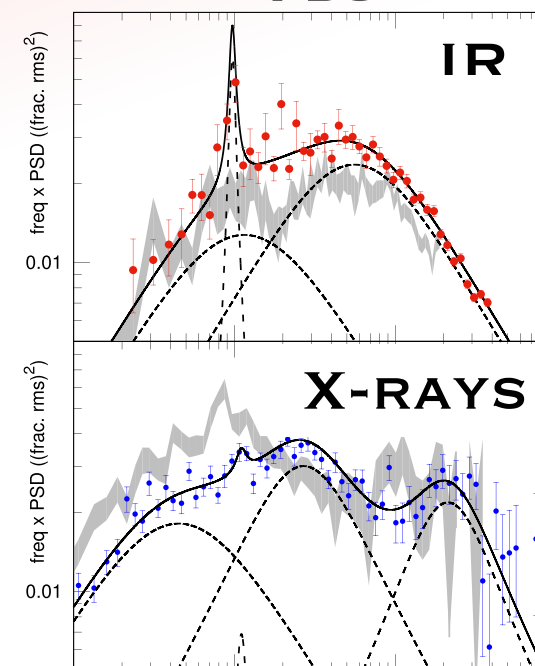
e.g.

JET GEOMETRY

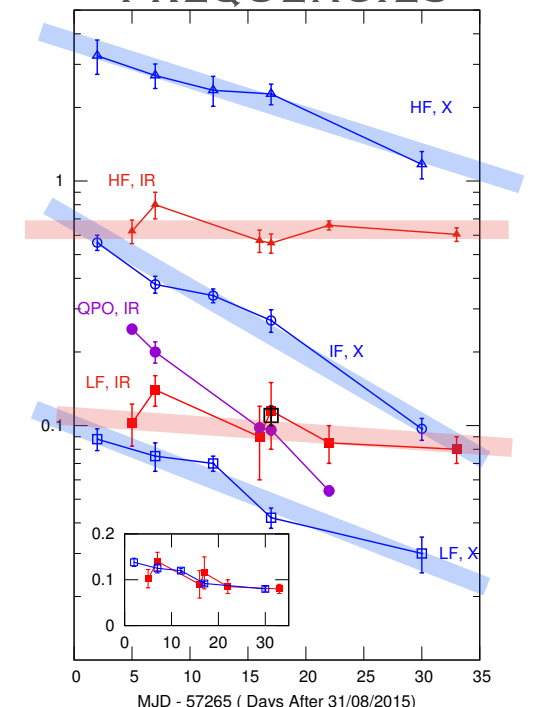
Vincentelli, PC et al. (2021)

*... and many other exciting results by
Gandhi; Veledina; Paice; etc...*

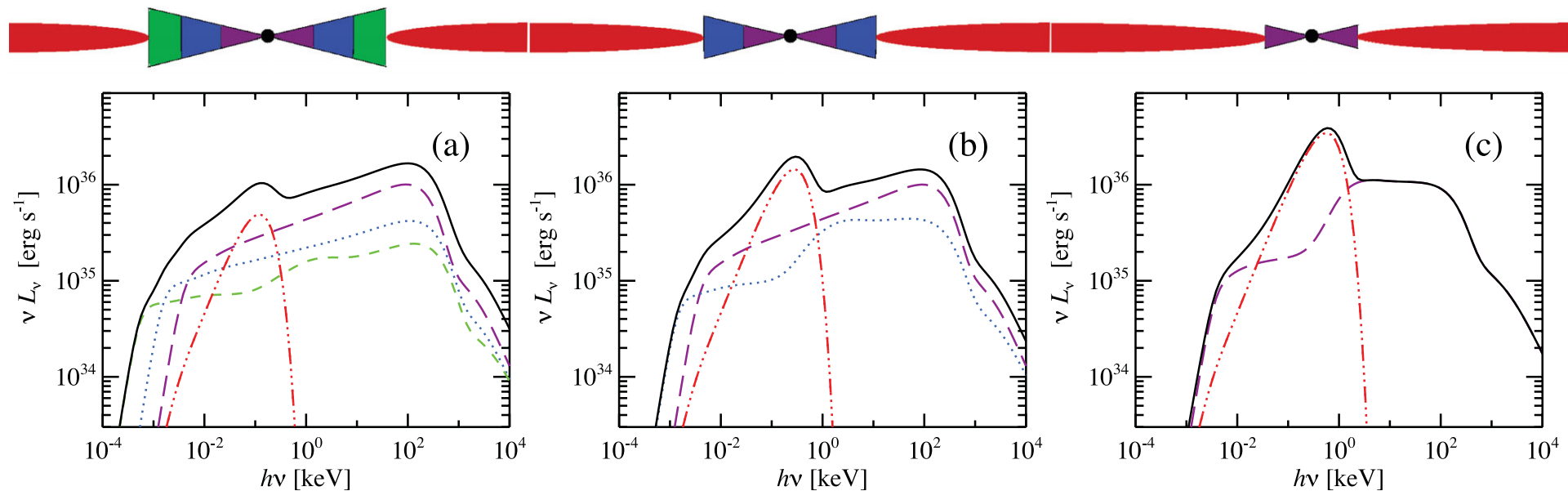
PDS



**CHARACTERISTIC
FREQUENCIES**



Chasing OIR photons from the inflow



Hard-to-Soft Transition

Hard
State

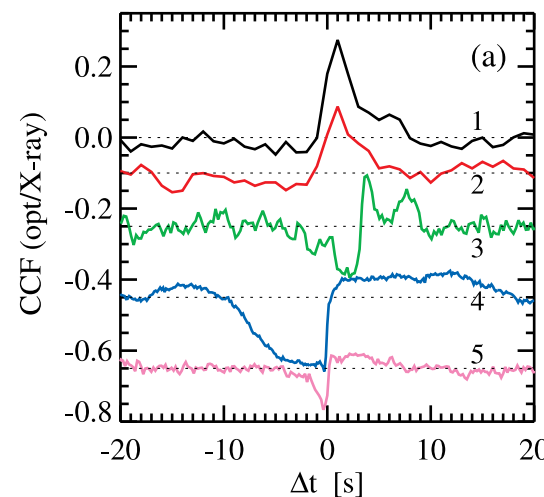
JET

Strong Variability

Hard emission



e.g.



Veledina et al. (2017)
but see Ulgiati et al. (2024)

Soft
State

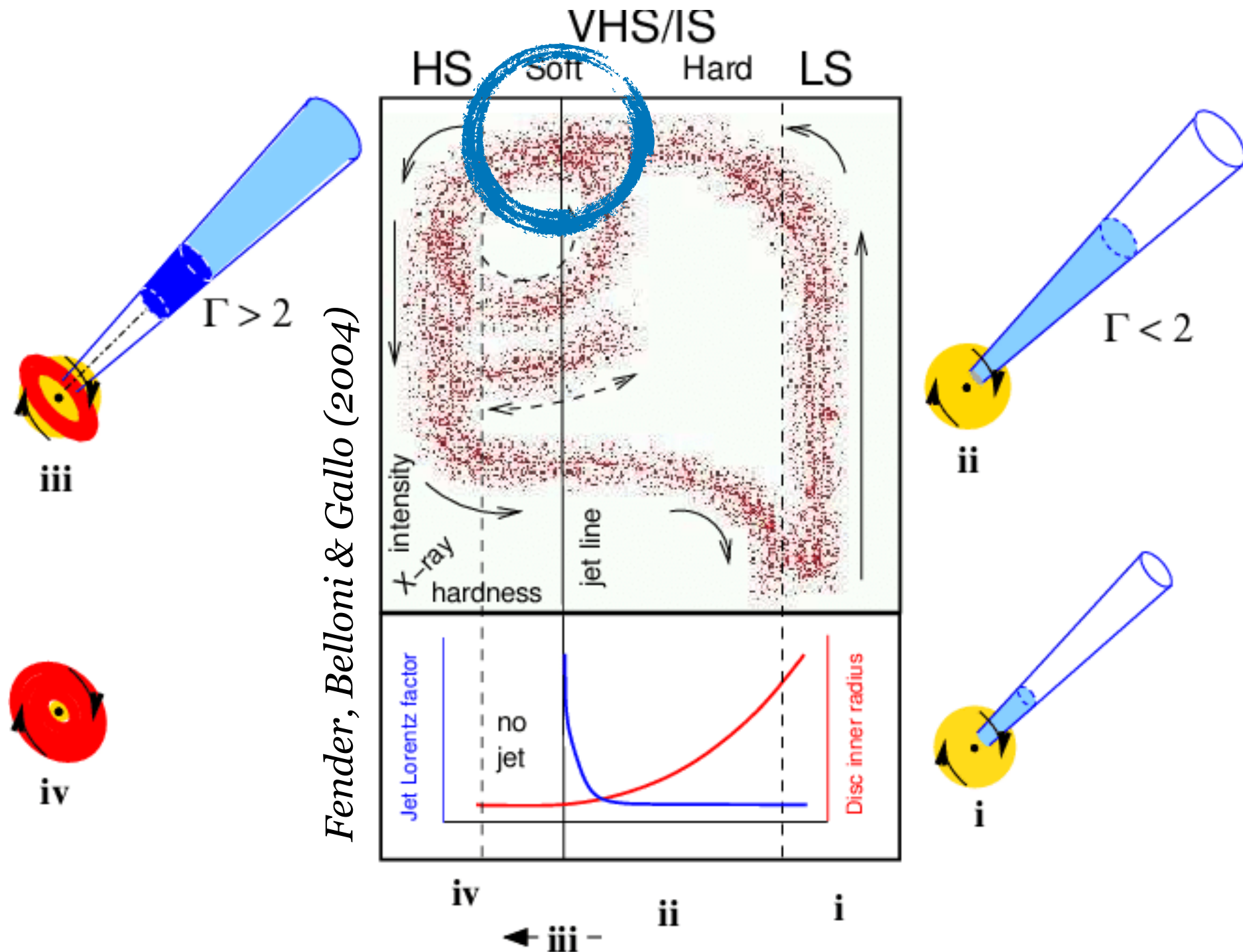
NO jet

Little variability

Little hard emission

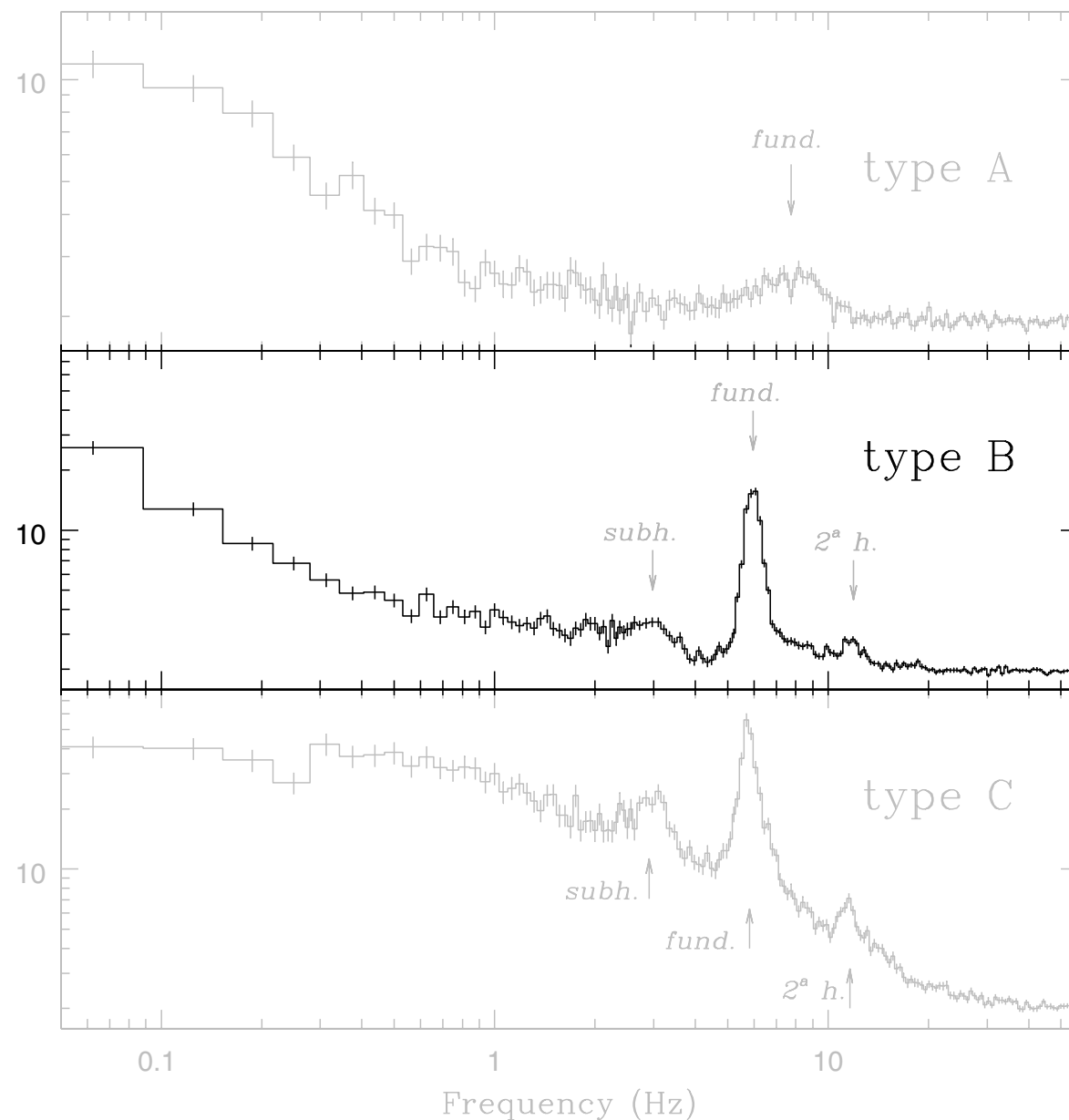
Peculiar transient regime

Soft InterMediate State



Peculiar transient regime

Soft InterMediate State



Casella et al. (2005), Motta et al. (2011)

NO Compact jet
Not yet in Soft State
Variability

Type-B QPOs
Unknown mechanism
Unknown geometry

2010 Campaign on GX 339-4

X-rays fast phot.: RXTE	~7.8 ms
Optical fast phot.: Ultracam (NTT)	62.6 ms
Infrared fast phot.: ISAAC (VLT)	62.5 ms
mid-IR : VISIR (VLT)	slower
X-ray/optical/UV: Swift	slower
Optical: LCO	much slower

2010 Campaign on GX 339-4

8 May 2010

Type-B

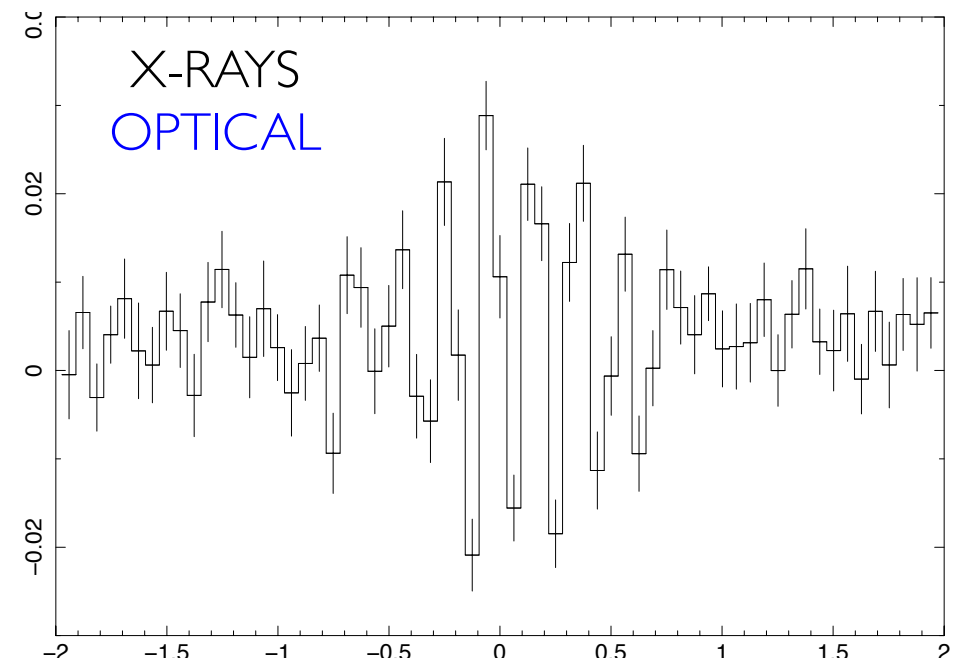
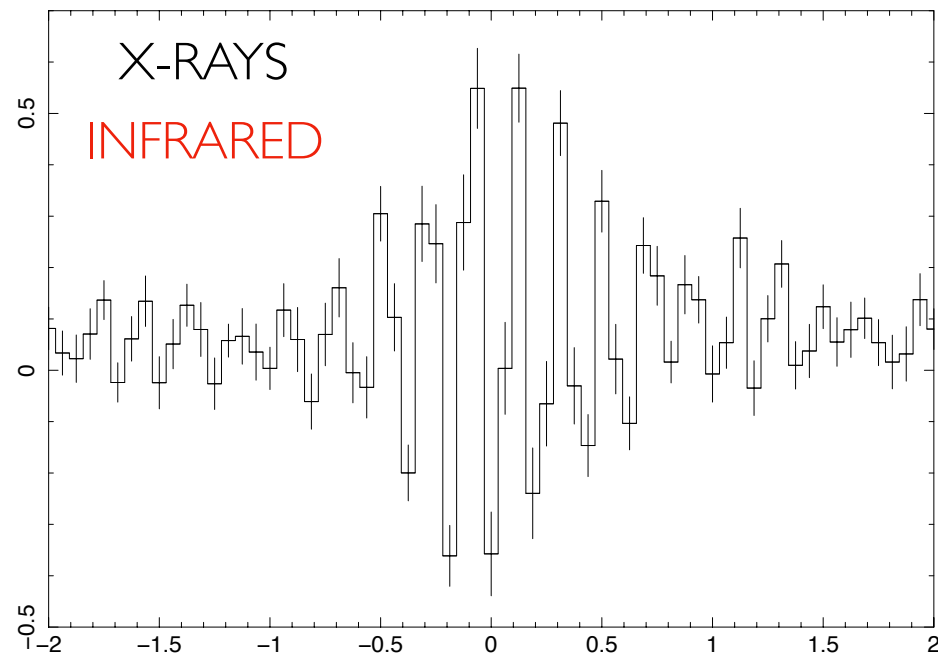
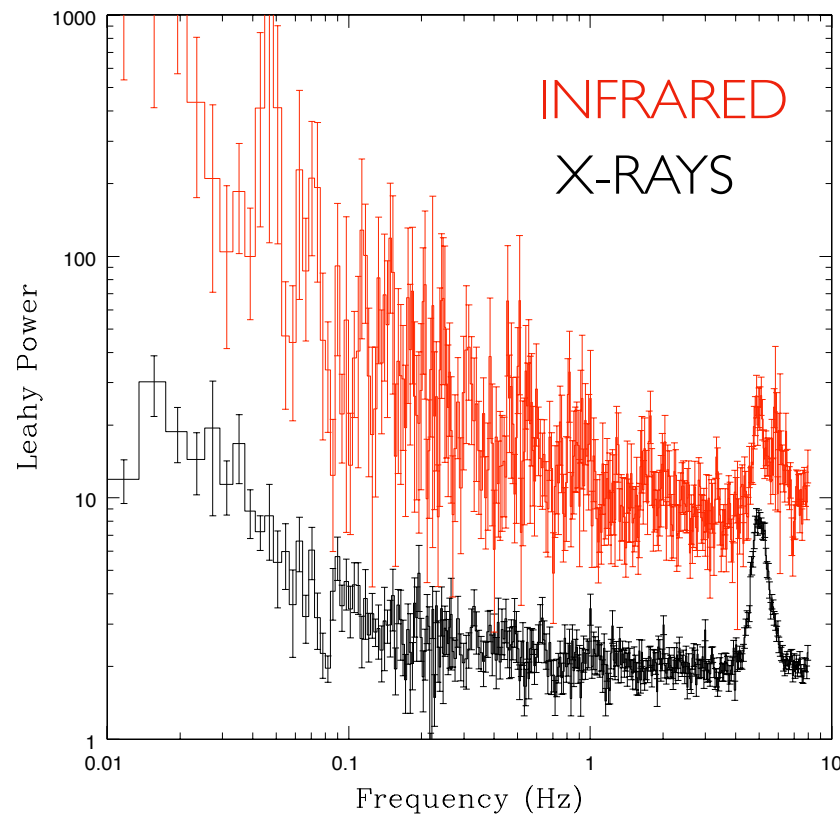
QPO

Frequency = 5 Hz

$\text{RMS}_{\text{X-ray}} = 5.6 \pm 0.1 \%$

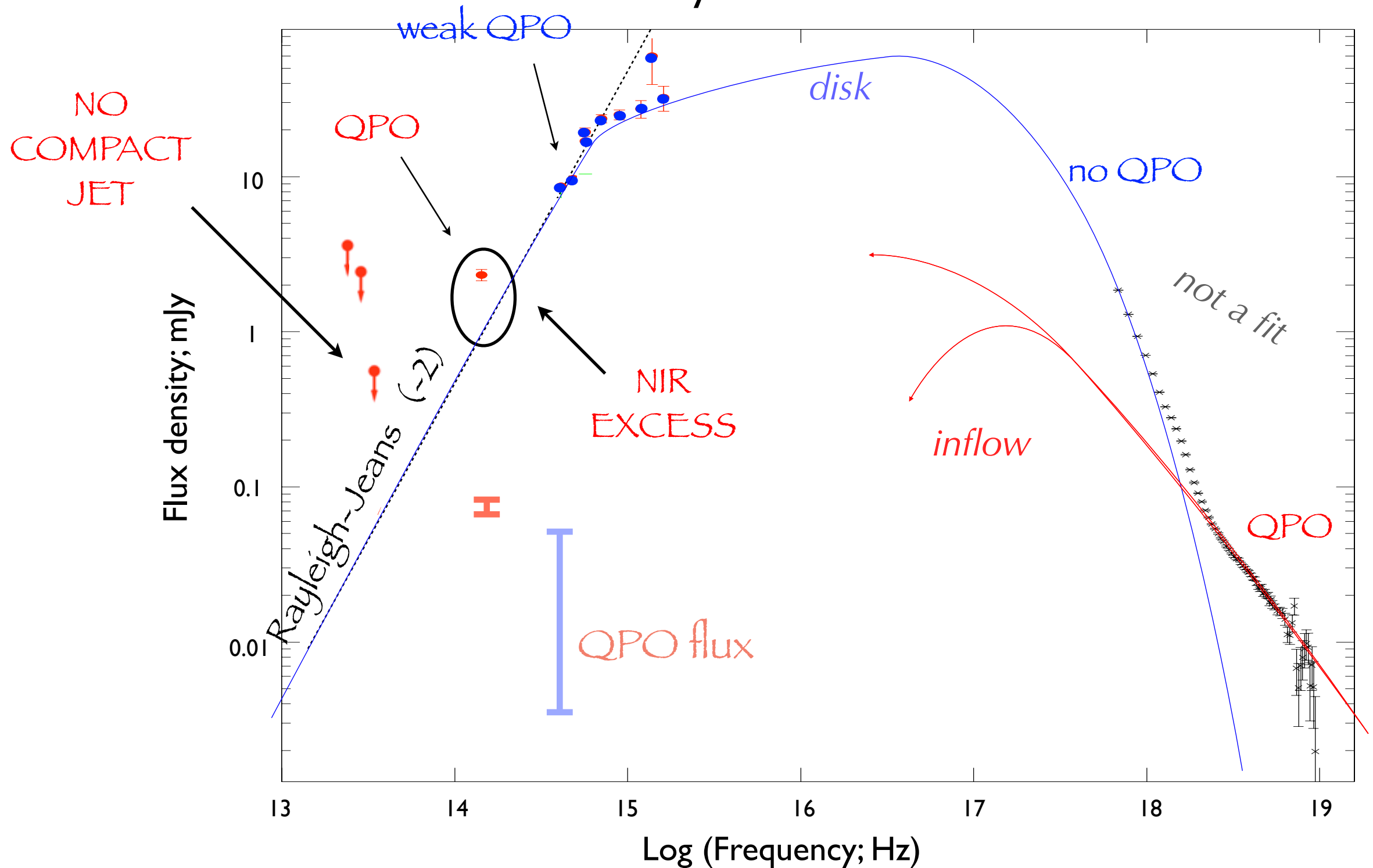
$\text{RMS}_{\text{IR}} = 3.1 \pm 0.2 \%$

$0.04 \% < \text{RMS}_{\text{opt}} < 0.5 \%$



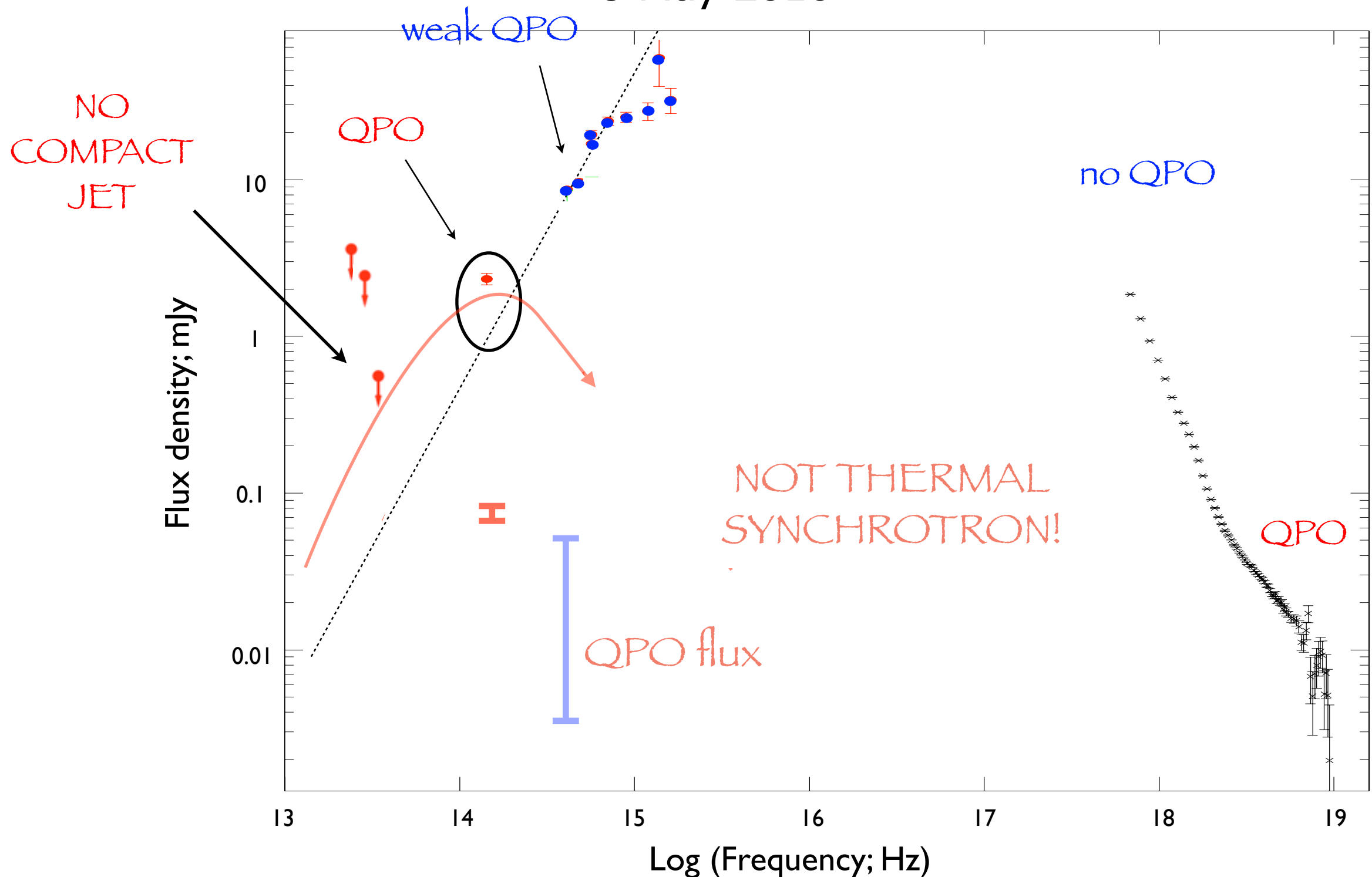
2010 Campaign on GX 339-4

8 May 2010

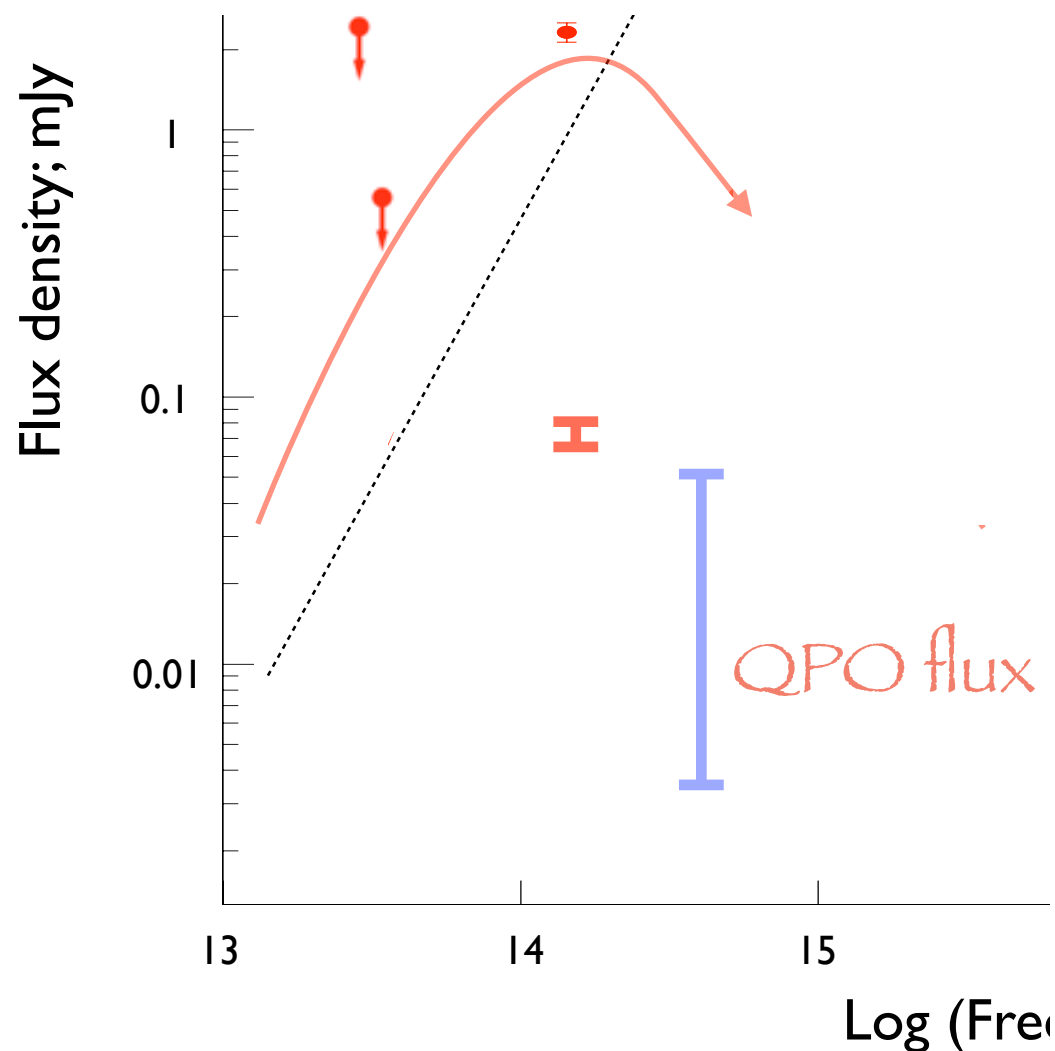
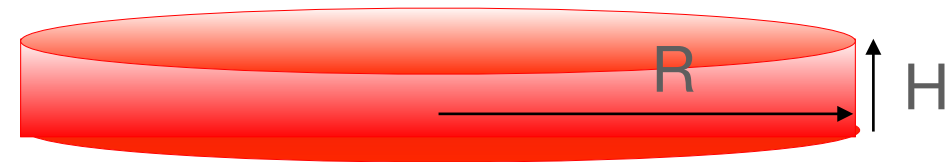


2010 Campaign on GX 339-4

8 May 2010



2010 Campaign on GX 339-4

ONE-ZONE model(cylinder; $p_{\text{el}} = 2.5$ $\gamma_{\text{max}} \gg \gamma_{\text{min}} = 1$) $\nu_{\text{break}} \sim 1.4 \times 10^{14}$ Hz (K_s filter) $S_{\text{peak}} \sim 1$ mJy

2010 Campaign on GX 339-4

Chaty et al. (2011)

ONE-ZONE model

(cylinder; $p_{el} = 2.5$ $\gamma_{max} \gg \gamma_{min} = 1$)

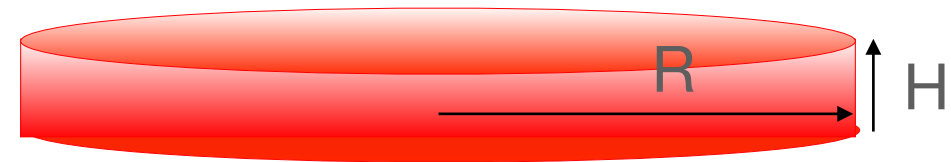
$v_{break} \sim 1.4 \times 10^{14}$ Hz (K_s filter)

$S_{peak} \sim 1$ mJy

$D \sim 7$ kpc

(equipartition: $\xi = 0.5$)

def: $h = H/R$



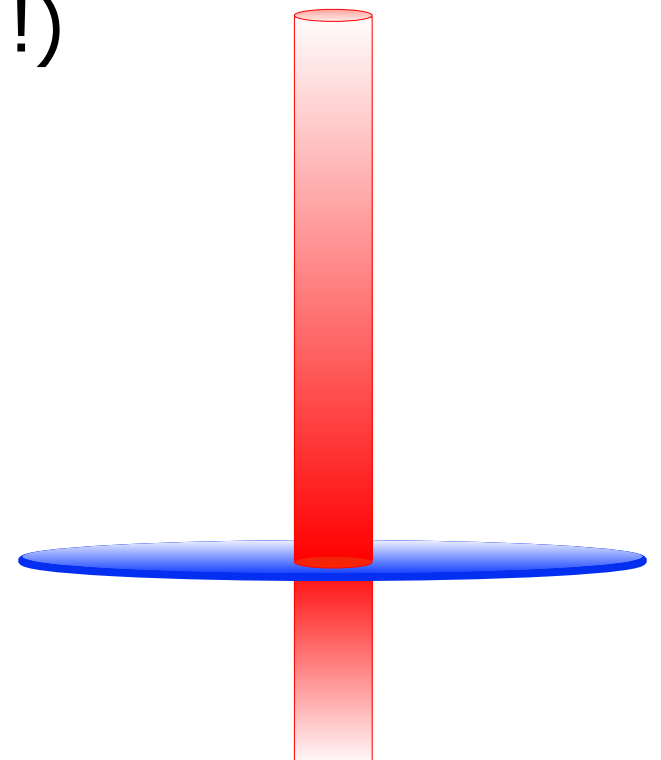
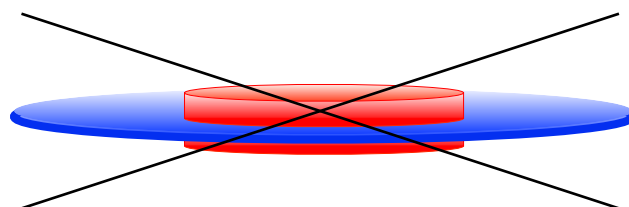
$B \sim 10^5$ G ($h^{1/9} v_{break}^{-1} D^{-2/9} \xi^{-2/9} S_{peak}^{-1/9}$)

$R \sim 850 h^{-0.5}$ km ($v_{break}^{-1} D^{17/18} \xi^{-1/18} S_{peak}^{17/36}$)

$R_{IN (disk)} = 40-50$ km (*Motta et al. 2011*)

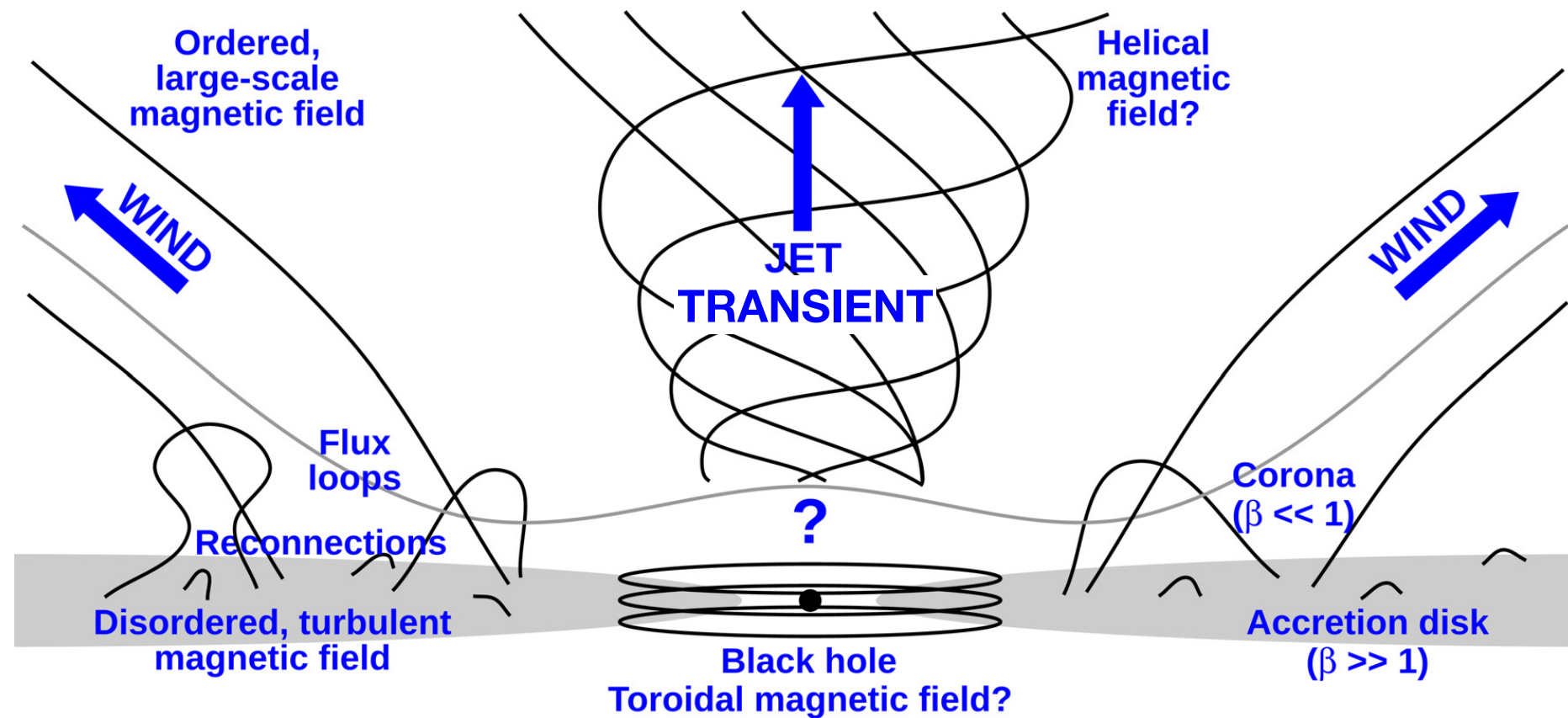
$\rightarrow H \sim 400 * R$ (!!!)

?



Soft InterMediate State

Dobbie et al. (2009)



AND

a lot of synchrotron IR emission

