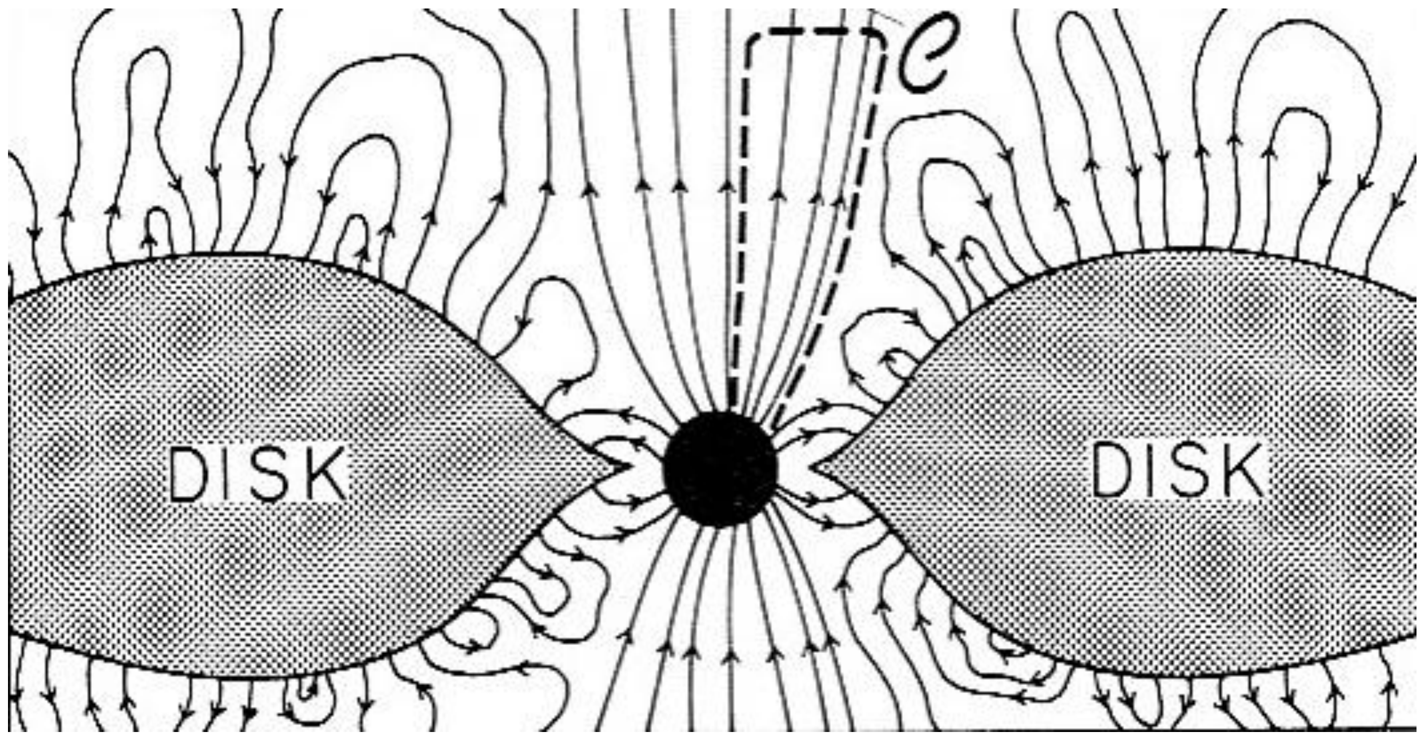
Jet-Disk Connections
&
XRB Jets

The Frustrating Five

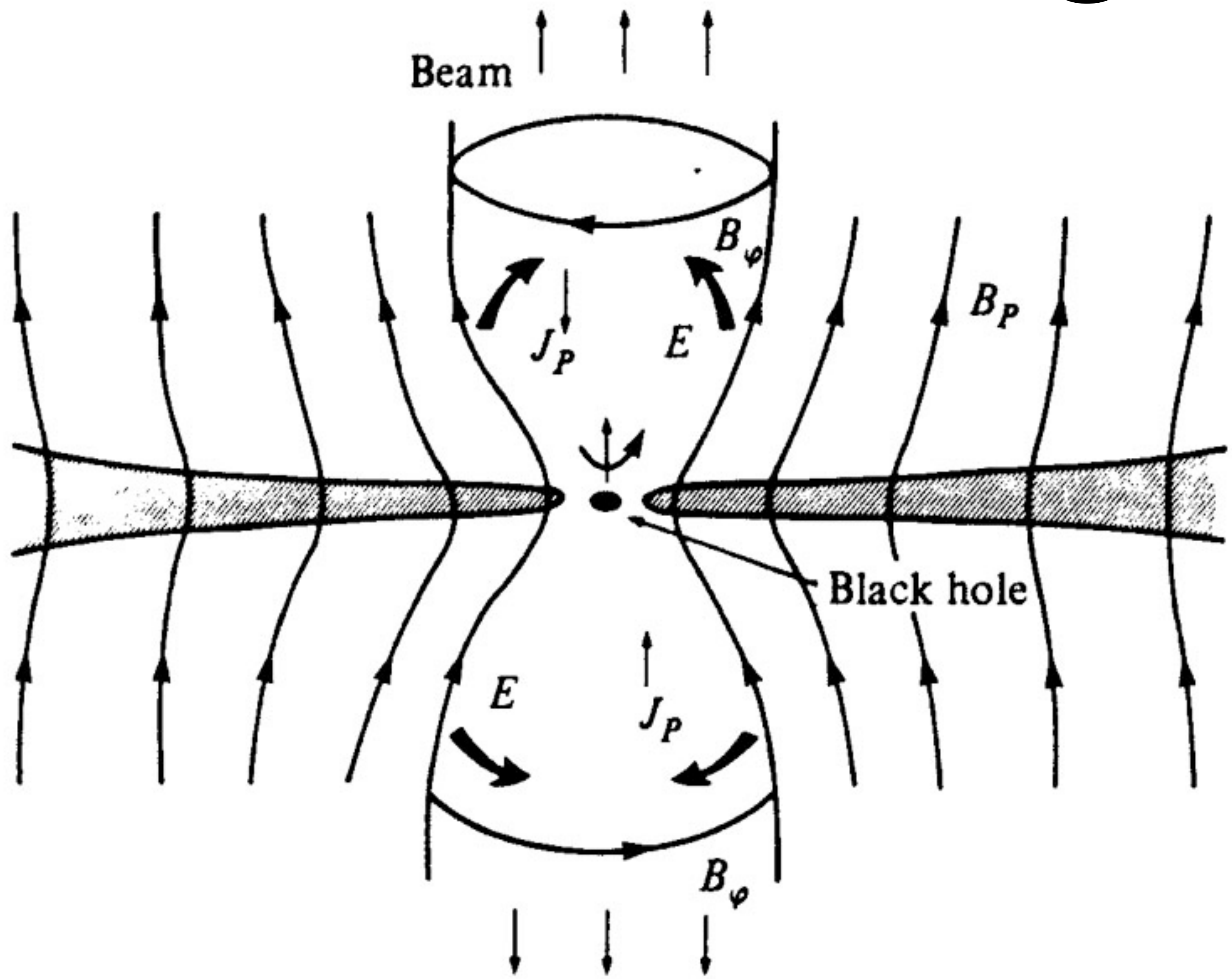
- Jet launching (spin? magnetic flux? state?)
- Jet collimation
- Jet speed
- Jet power
- Jet composition

Jet-launching



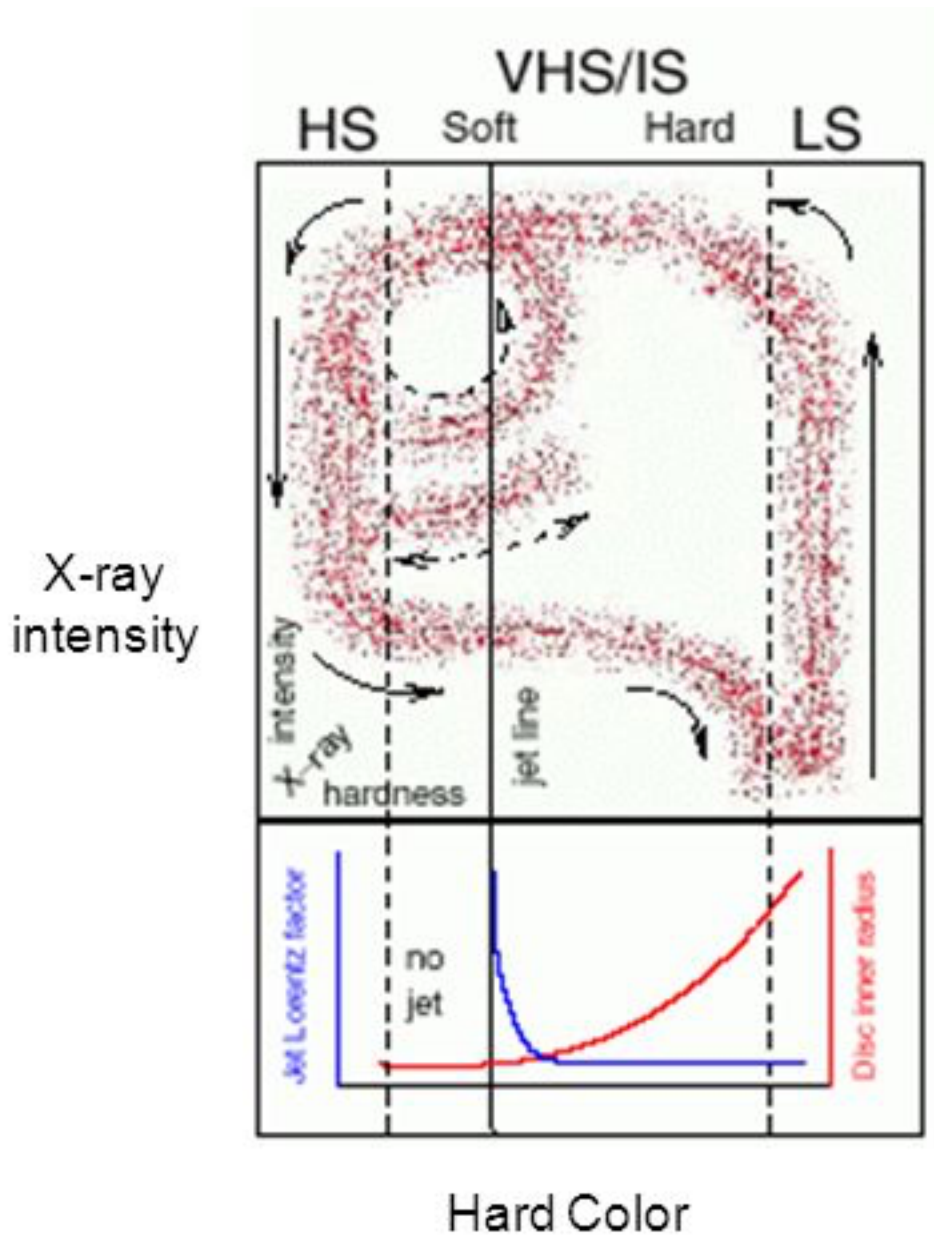
$$W_{\rm jet} \propto B^2 a^2 M^2 \sim f(\dot{m})$$

Jet-launching

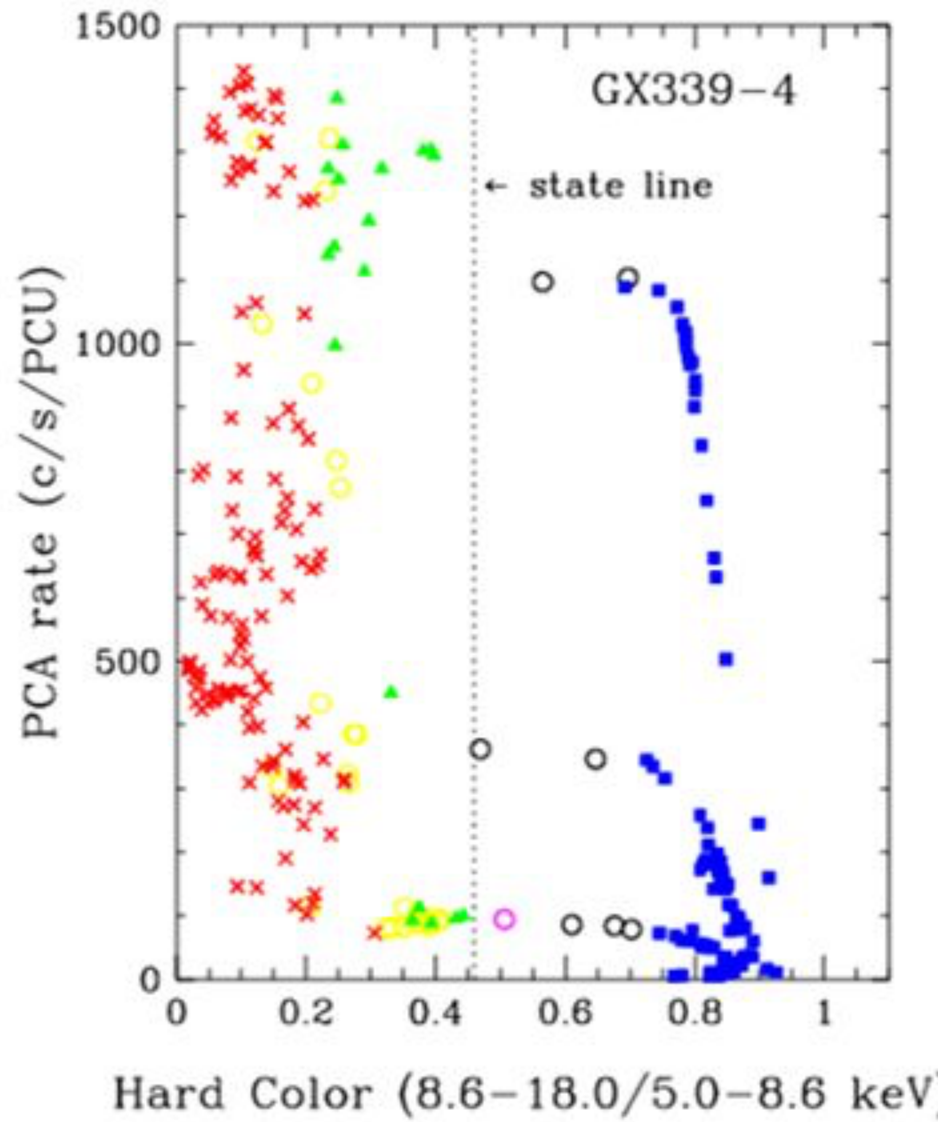


$$W_{\rm jet} \propto B^2 \Omega R^3 \sim f(\dot{m})$$

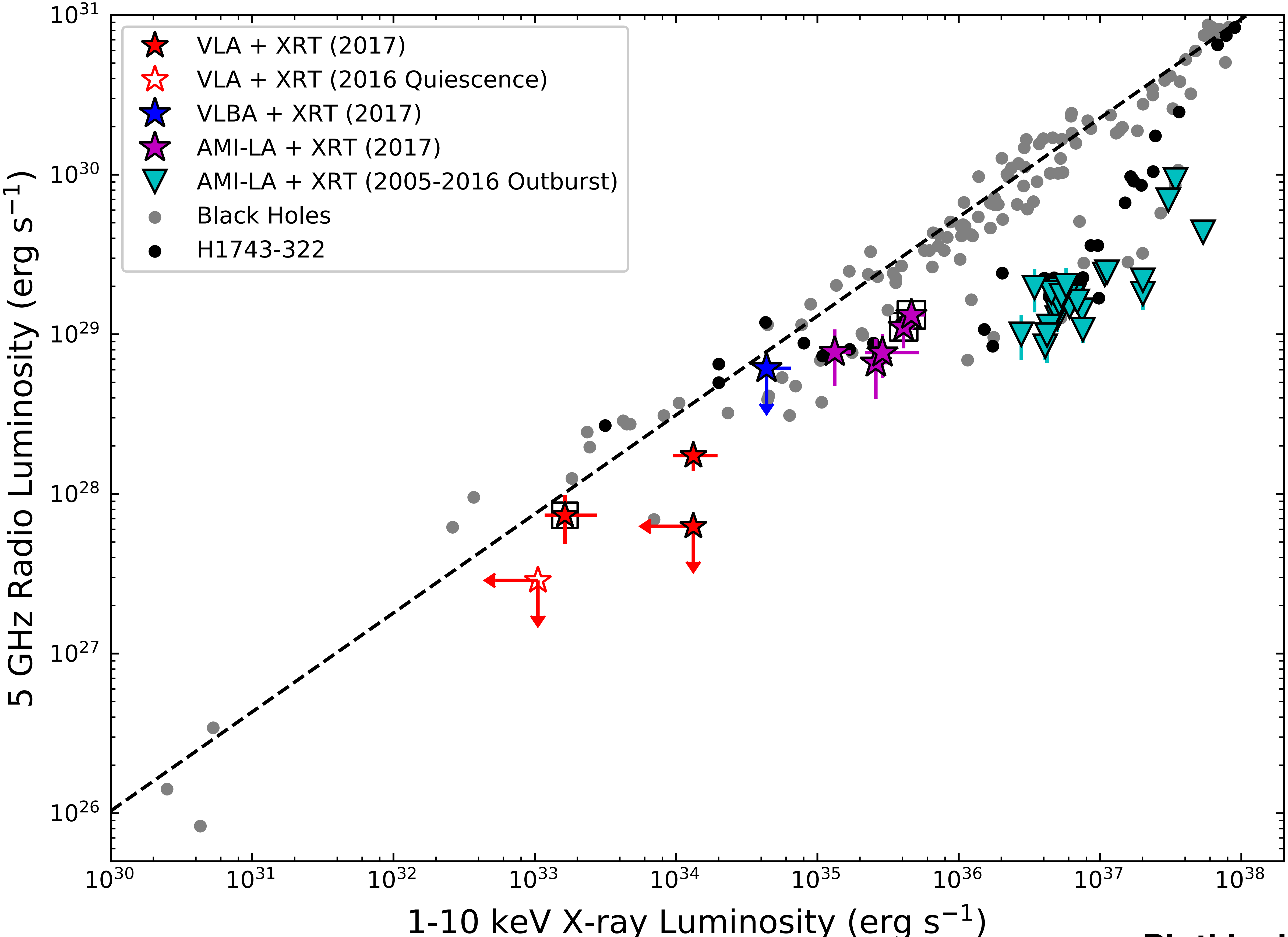
Jet-Disk Coupling



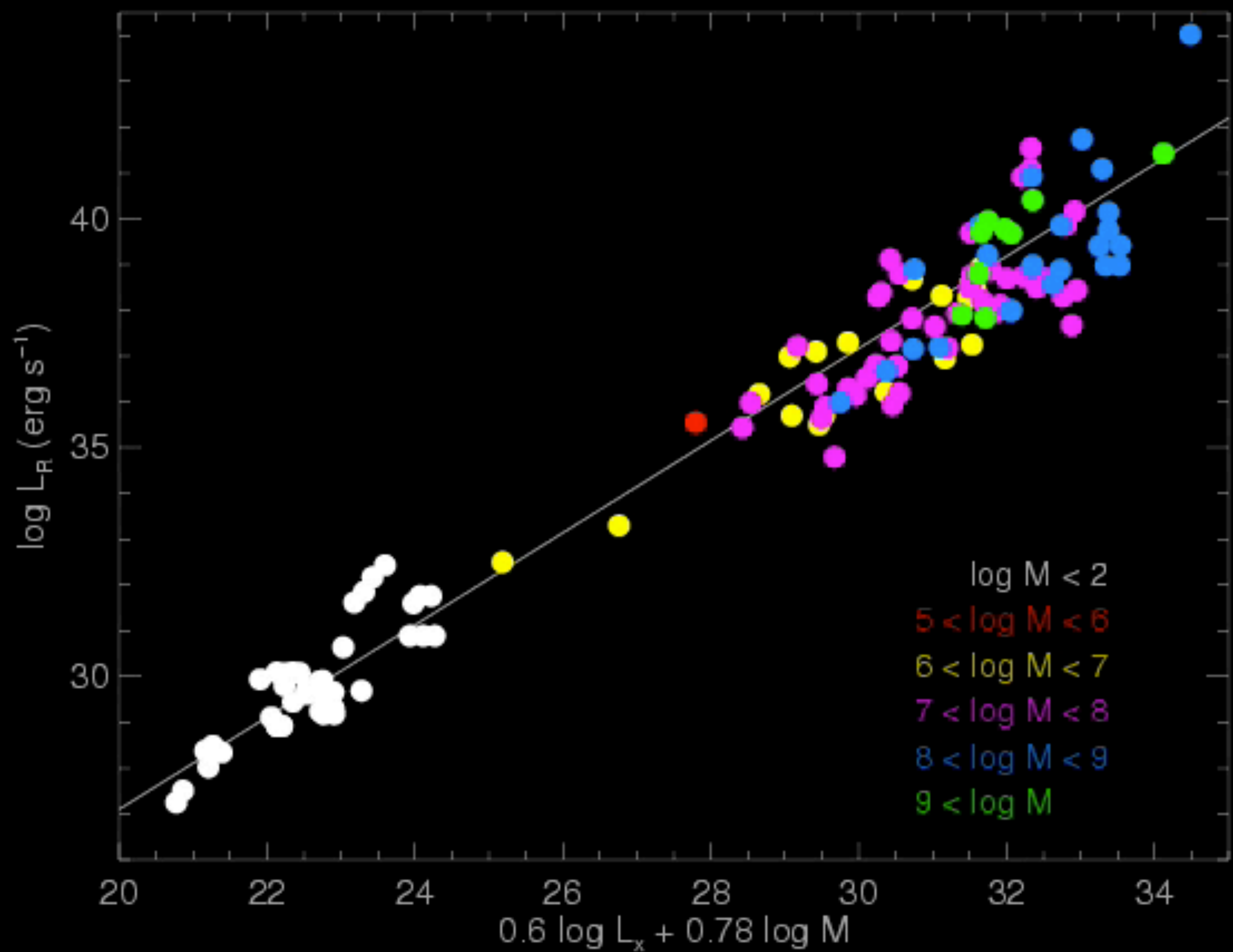
Fender, Belloni, & Gallo 2004



Remillard 2005

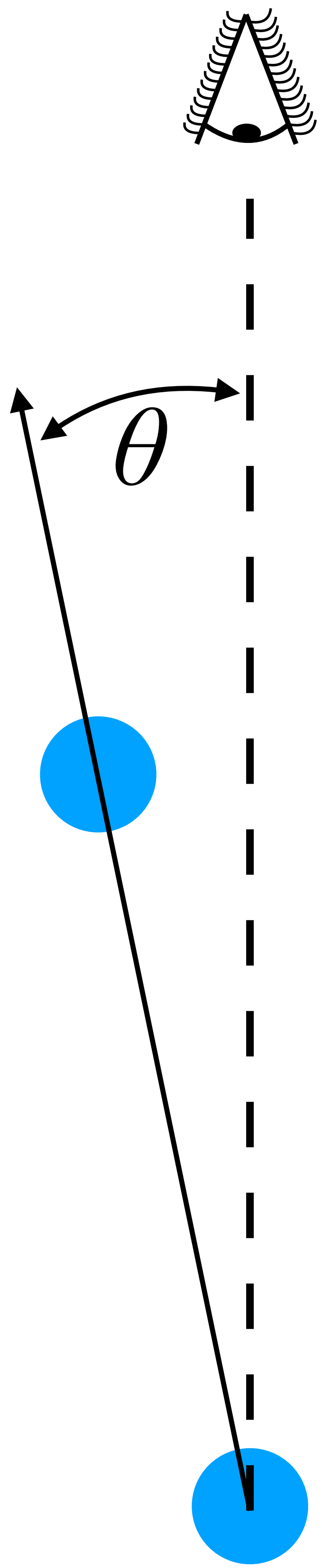

VLA + XRT (2017)
VLA + XRT (2016 Quiescence)
VLBA + XRT (2017)
AMI-LA + XRT (2017)
AMI-LA + XRT (2005-2016 Outburst)
Black Holes
H1743-322
5 GHz Radio Luminosity (erg s^{-1})
1-10 keV X-ray Luminosity (erg s^{-1})
10^{26}
10^{27}
10^{28}
10^{29}
10^{30}
10^{31}
10^{30}
10^{31}
10^{32}
10^{33}
10^{34}
10^{35}
10^{36}
10^{37}
10^{38}

Plotkin+'17



log L$_R$ (erg s^{-1})
0.6 log L$_x$ + 0.78 log M
log M < 2
5 < log M < 6
6 < log M < 7
7 < log M < 8
8 < log M < 9
9 < log M

Jet Variability



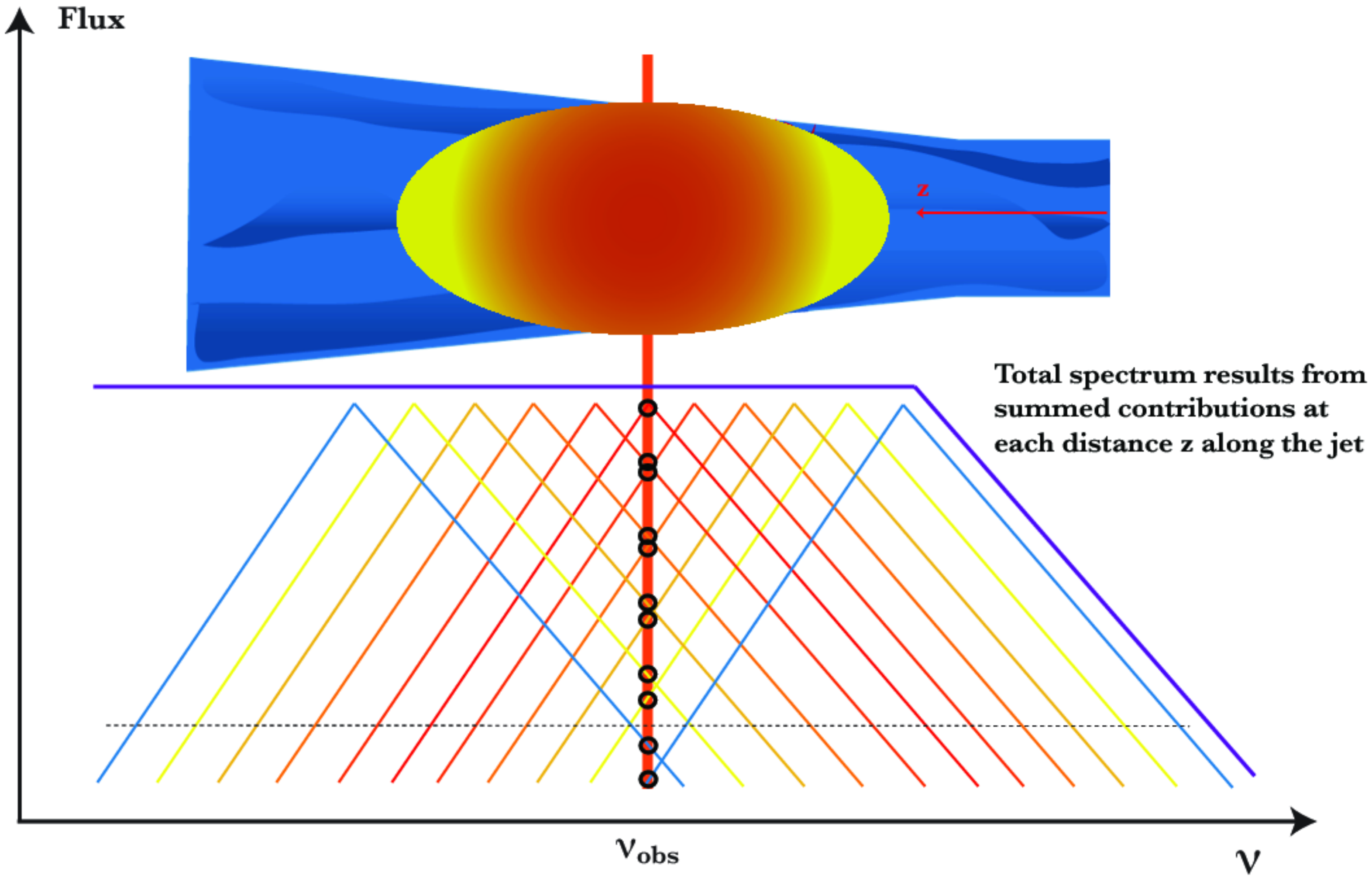
$$\Delta t_{\rm obs} = \delta t \cos\left(\theta\right)\left(1-\beta\right) \sim \frac{\delta t}{\Gamma^2}$$

$$\delta t_{\rm radio} \sim \frac{D_{\tau=1}}{\beta c}$$

$$\delta t_{\rm X-ray} \sim \;\; ???$$

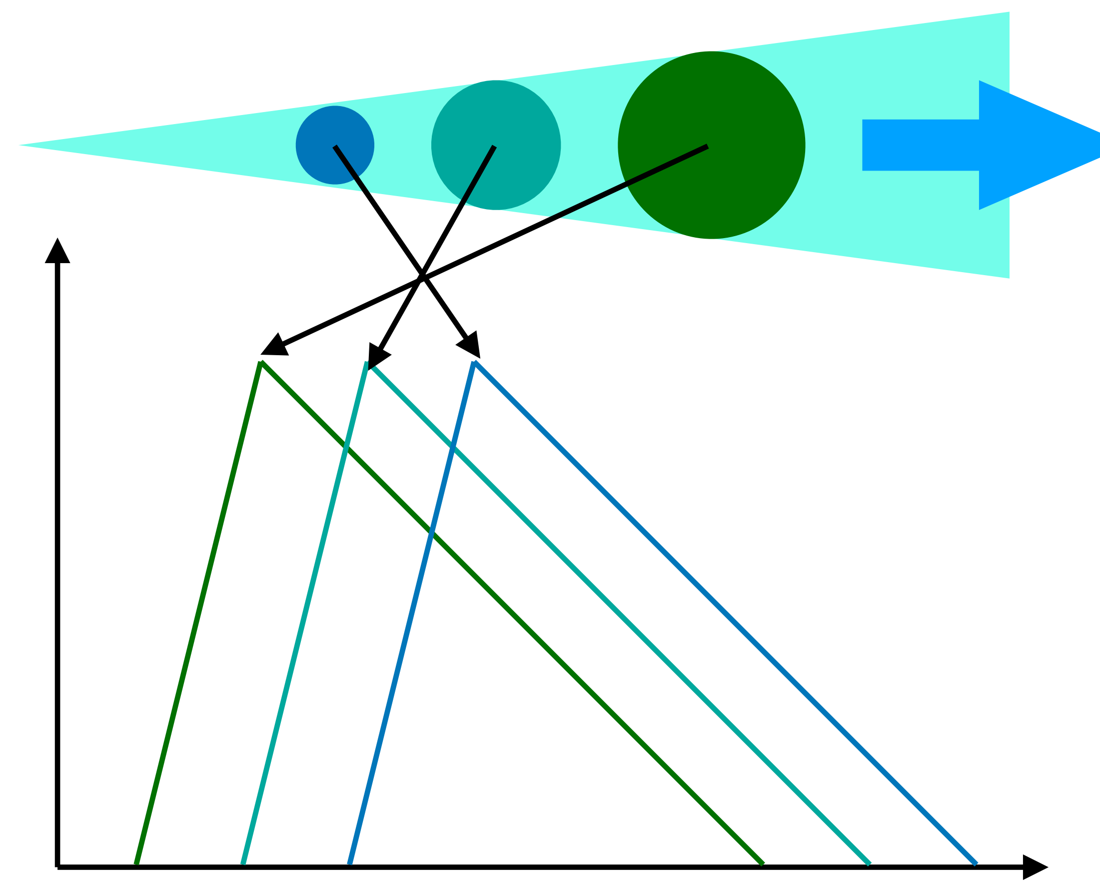
Opacity

Continuous Flow



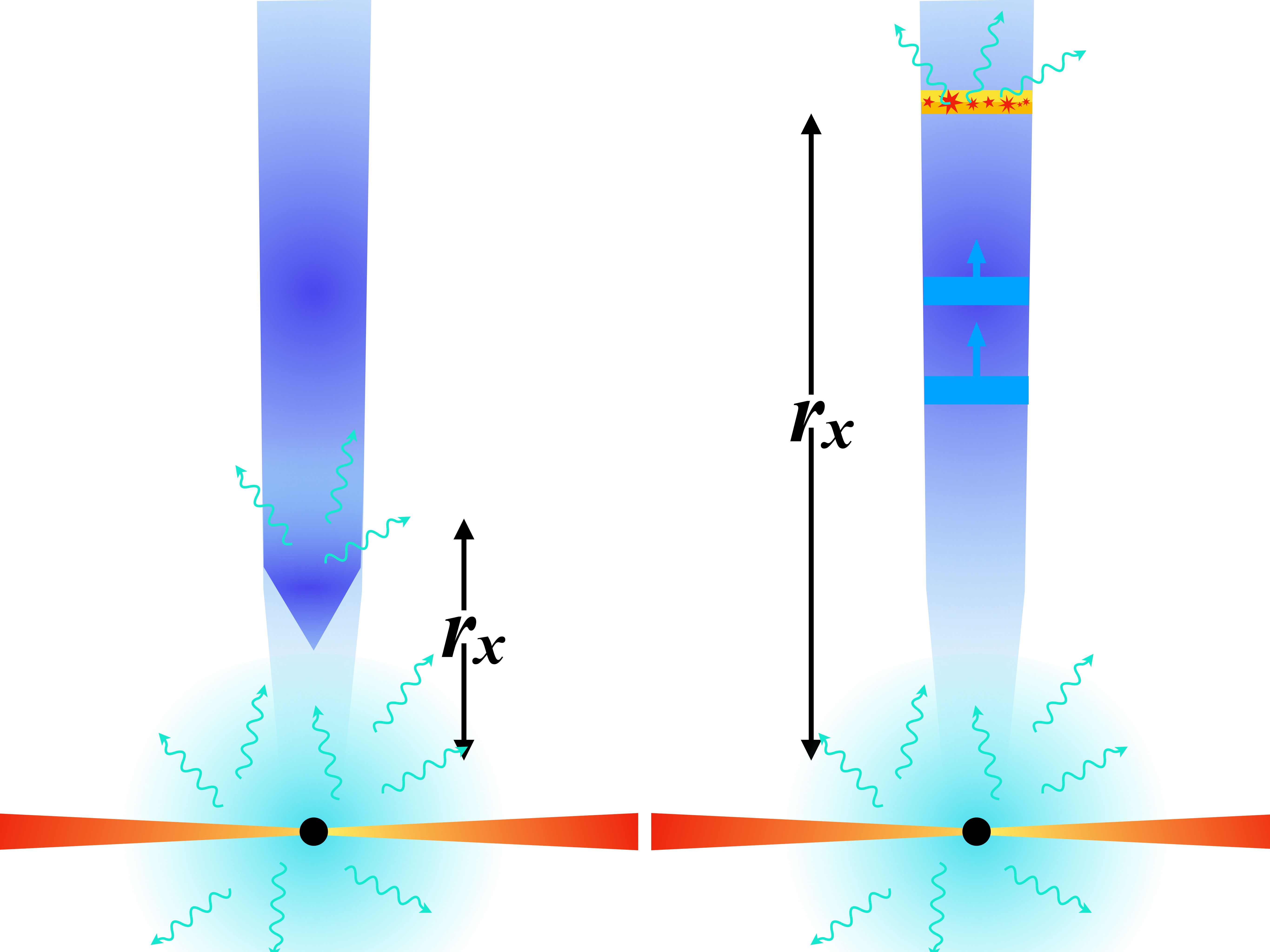
Blandford-Koenigl (Markoff)

Ejections

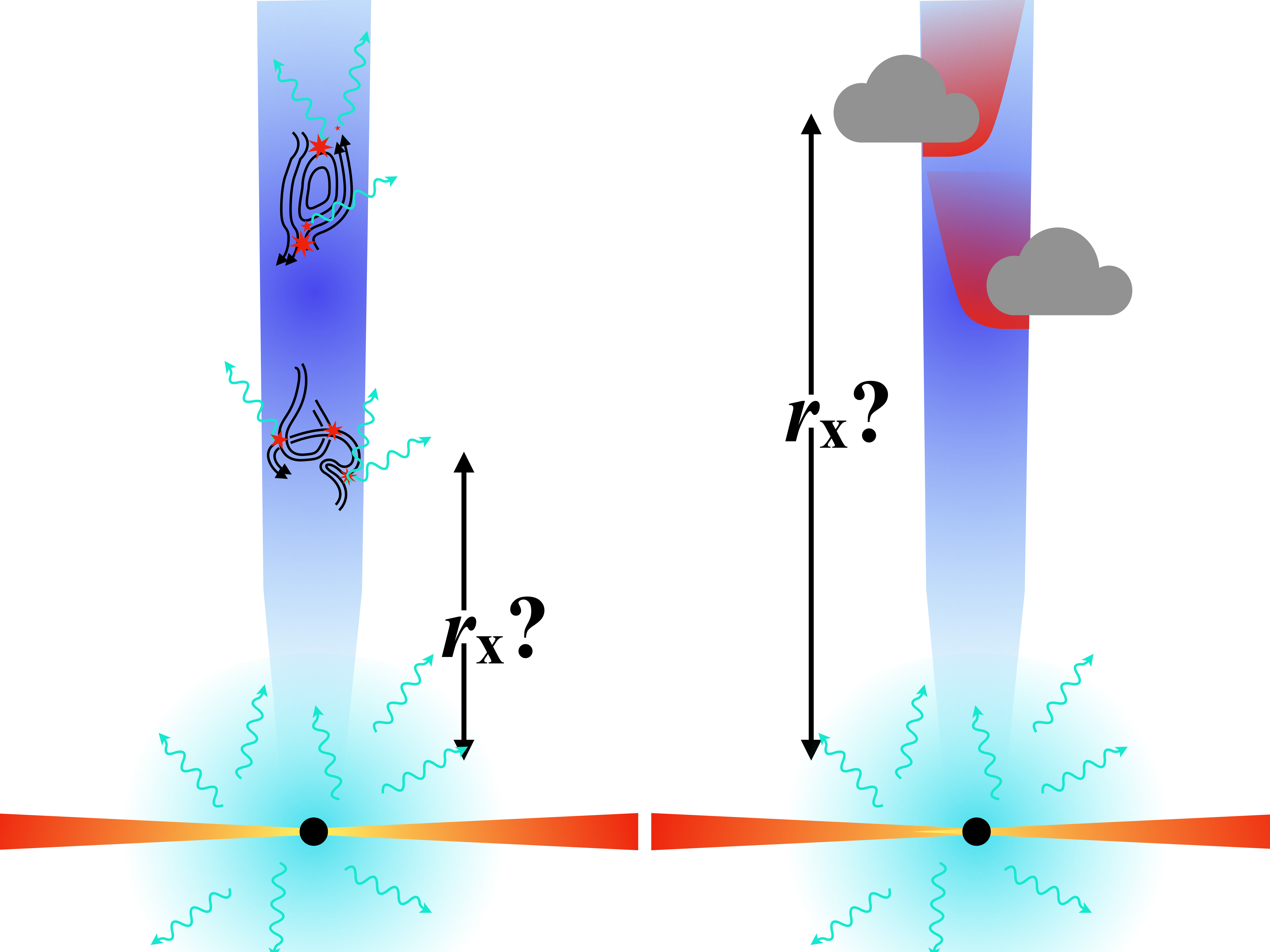


van der Laan

$$\delta t_{\rm radio} \sim \frac{D_{\tau=1}}{\beta c}$$

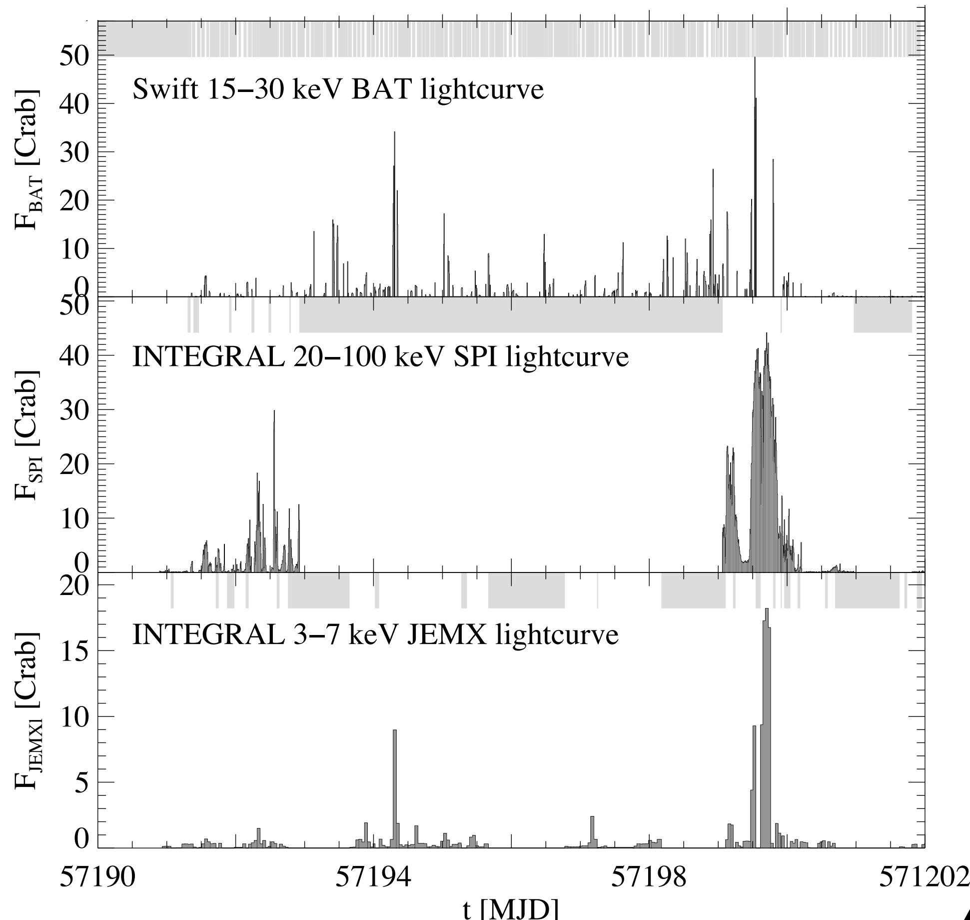


r_x
r_x

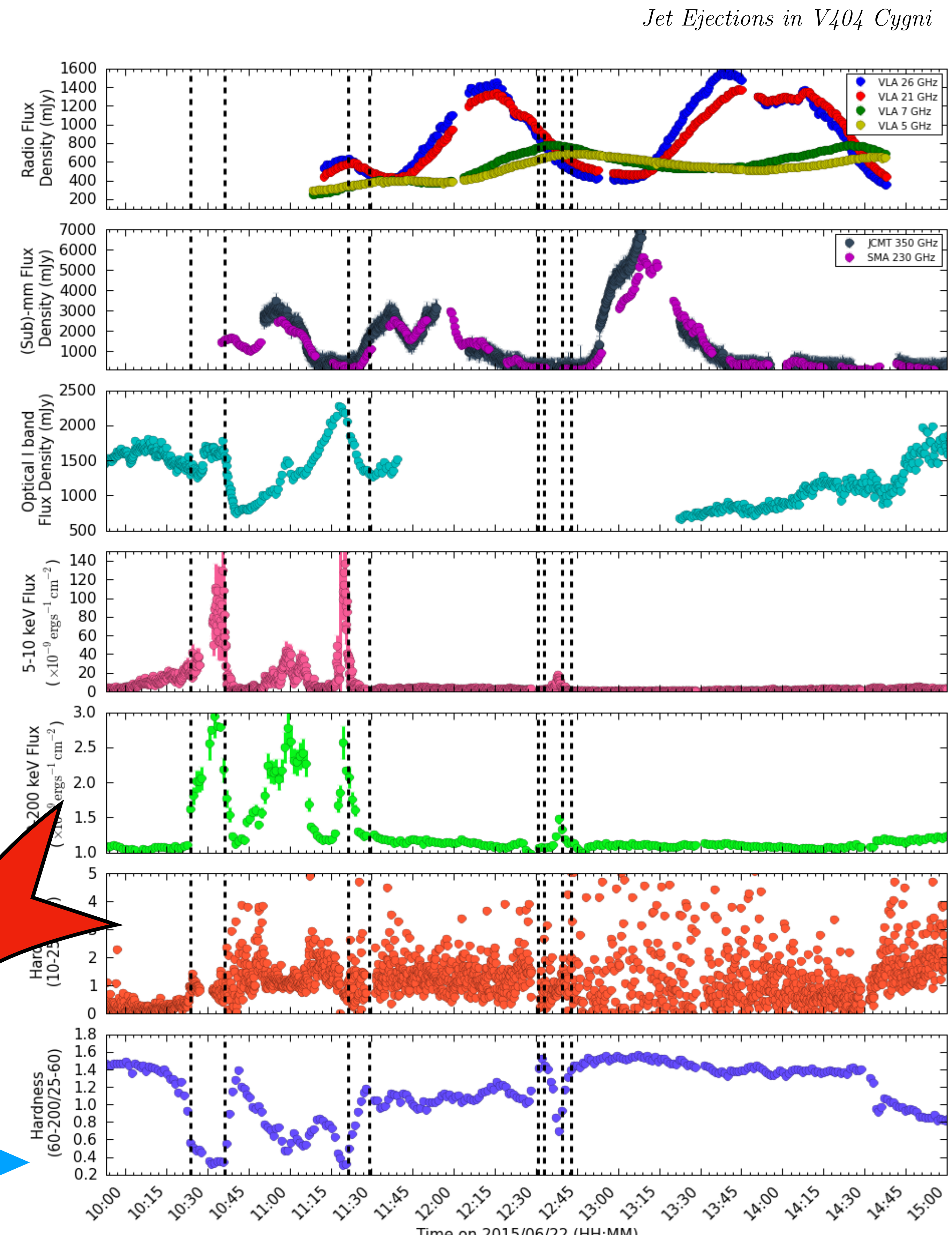


r_x?
r_x?

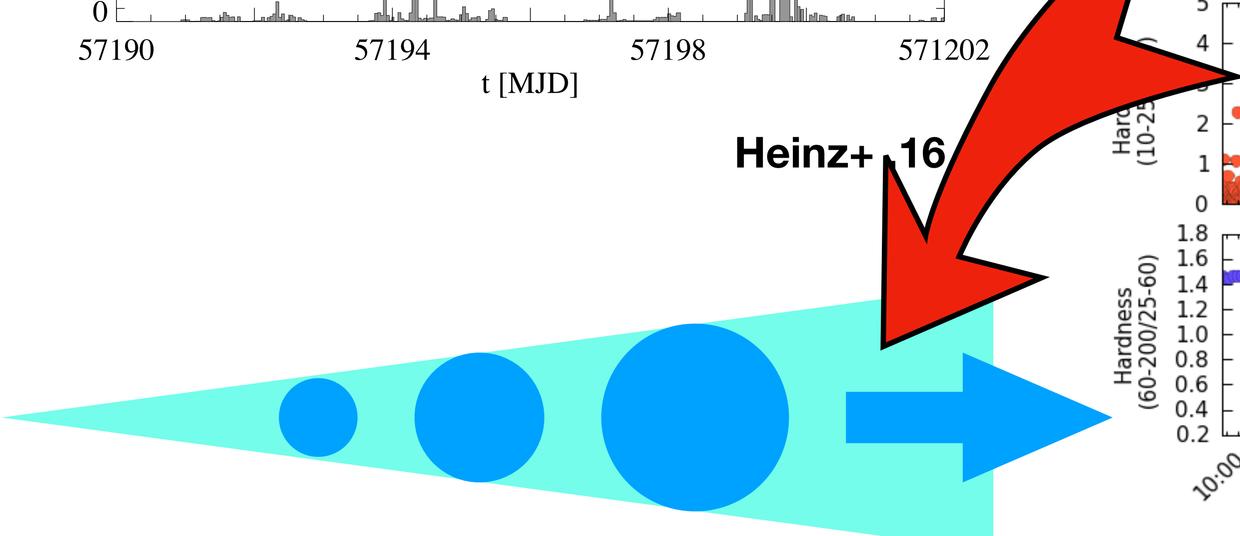
Timing



Heinz+ ,16

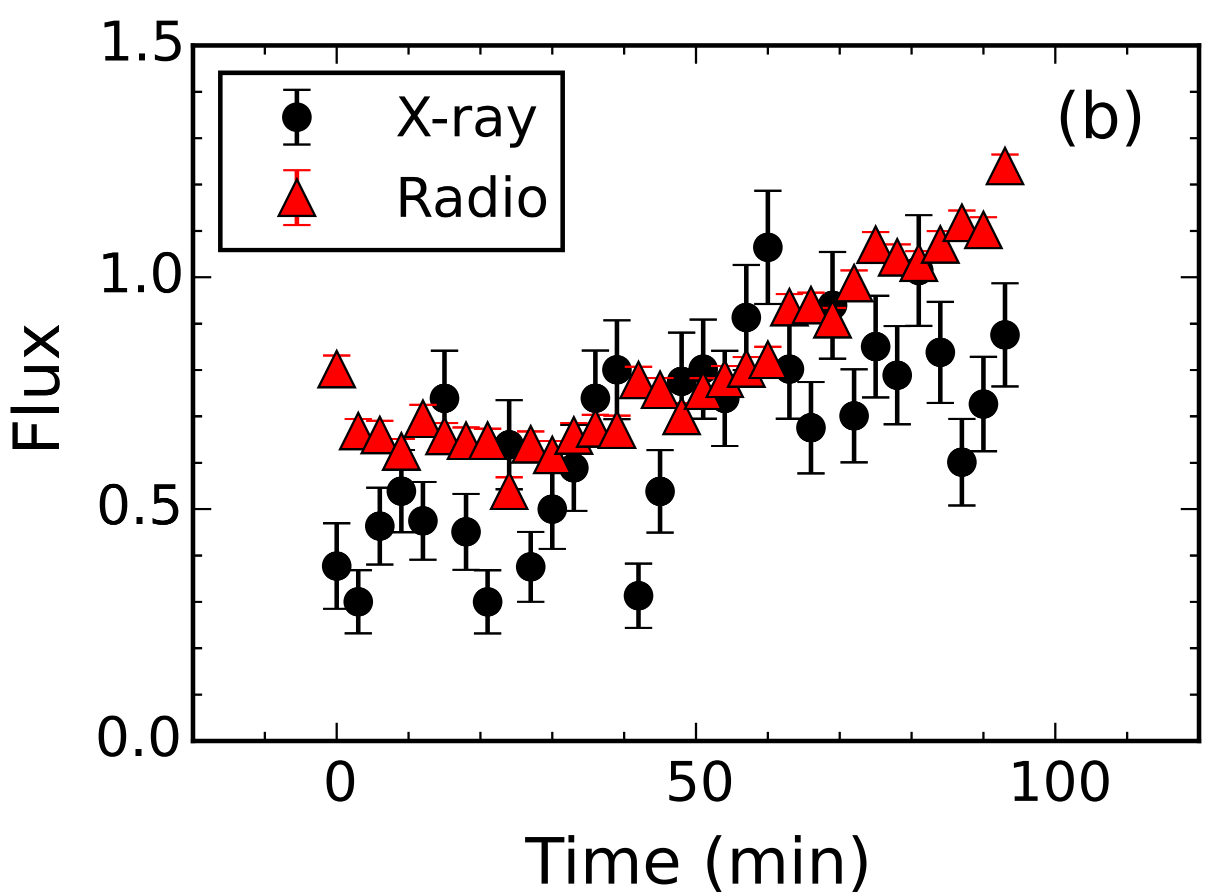


Tetarenko+ ,17



Radio-X-ray-Timing

V404 Cyg 2015



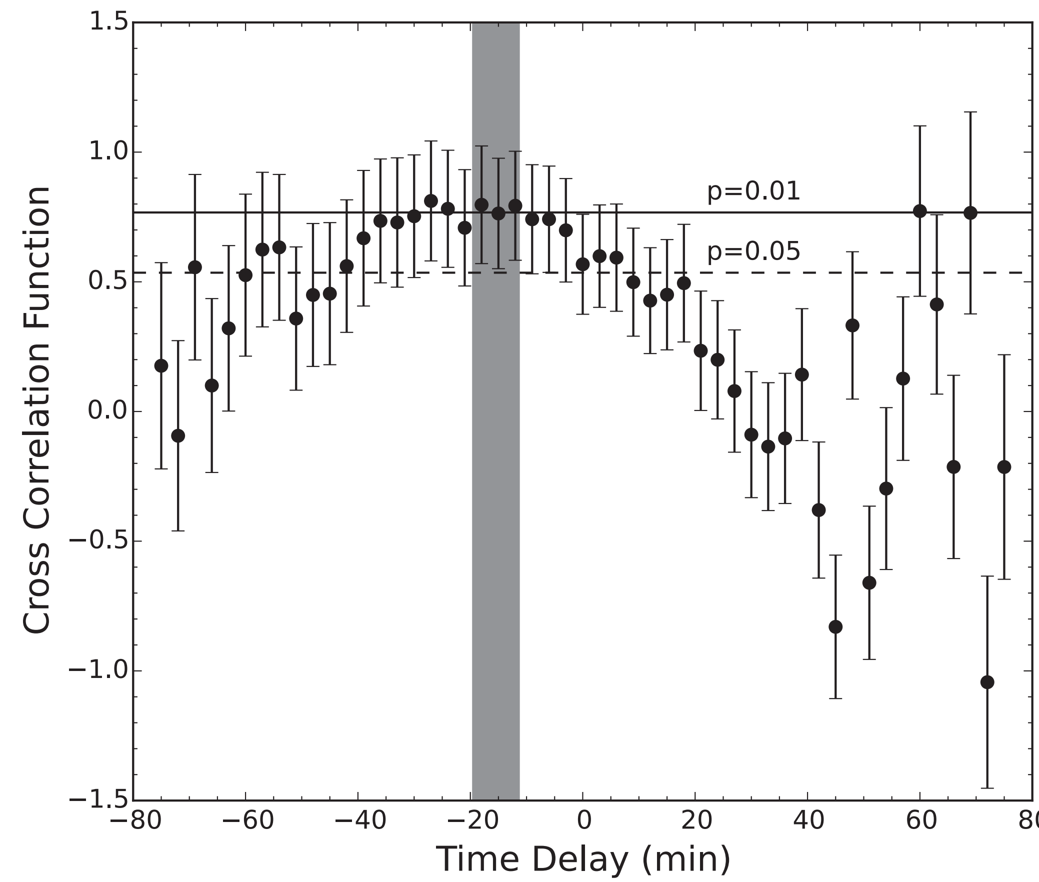
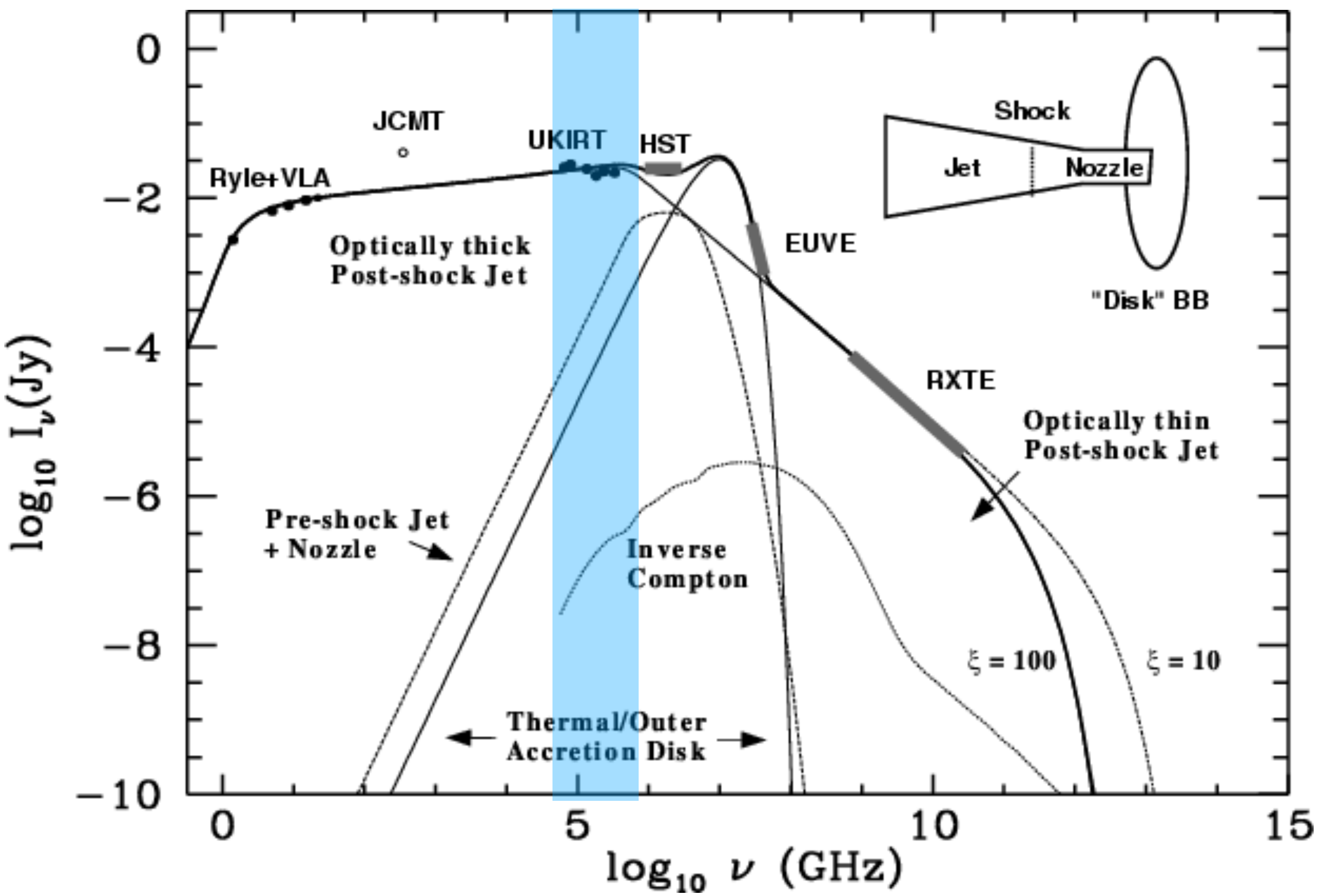


Figure 6. Cross-correlation function (CCF) for the strictly simultaneous X-ray and radio light curves on August 5. Negative time delays mean that the radio emission lags the X-ray emission. The CCF shows marginal evidence for the radio emission lagging the X-ray by 15 $\pm$ 4 minutes (the shaded region illustrates the $\pm 1\sigma$ confidence interval on the time delay). The solid and dashed horizontal lines mark the $p = 0.01$ and $p = 0.05$ probabilities, respectively, that the CCF peak is due to random fluctuations and/or uncorrelated variability (see Section 3.2.1).

Plotkin et al. 2017

Optical-X-ray-Timing



Markoff+'01

Timing: Internal Shocks

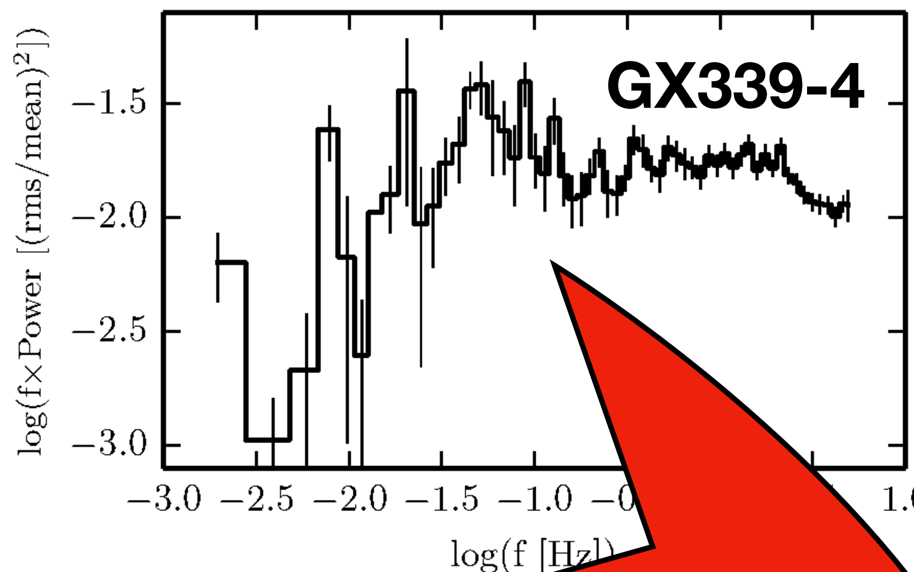
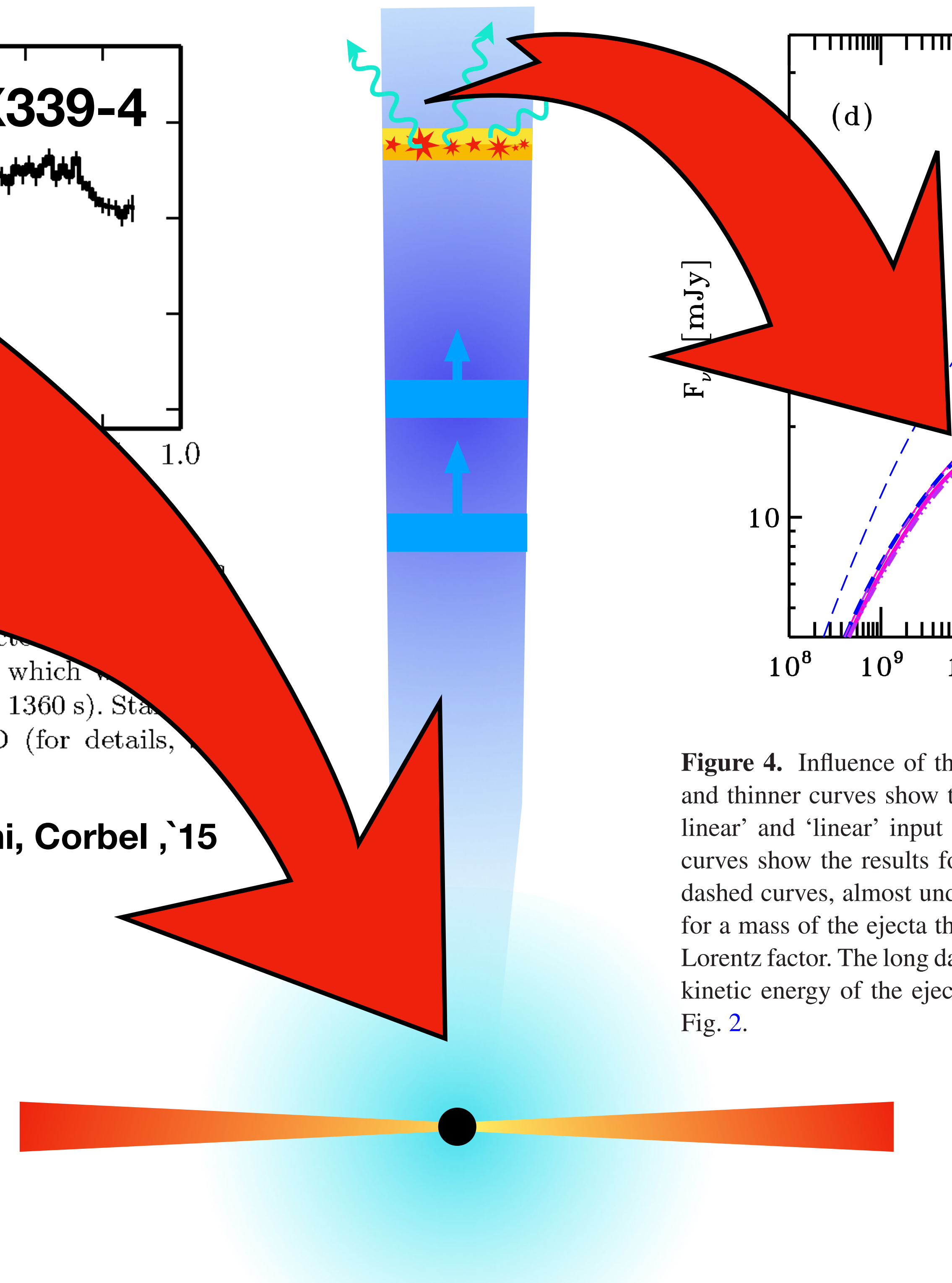


Figure 1. X-ray power spe… the 3-20 keV band, used to constrain th… Lorentz factor of the ejecta. The PSD was extract… PCA observations with ObsId 95409-01-09-03 which w… simultaneous with WISE (goodtime exposure ∼ 1360 s). Sta… procedures were used for computing the PSD (for details, … section 4.2 of Gandhi et al. (2010)).

Drappeau, Malzac, Belmont, Gandhi, Corbel ,`15



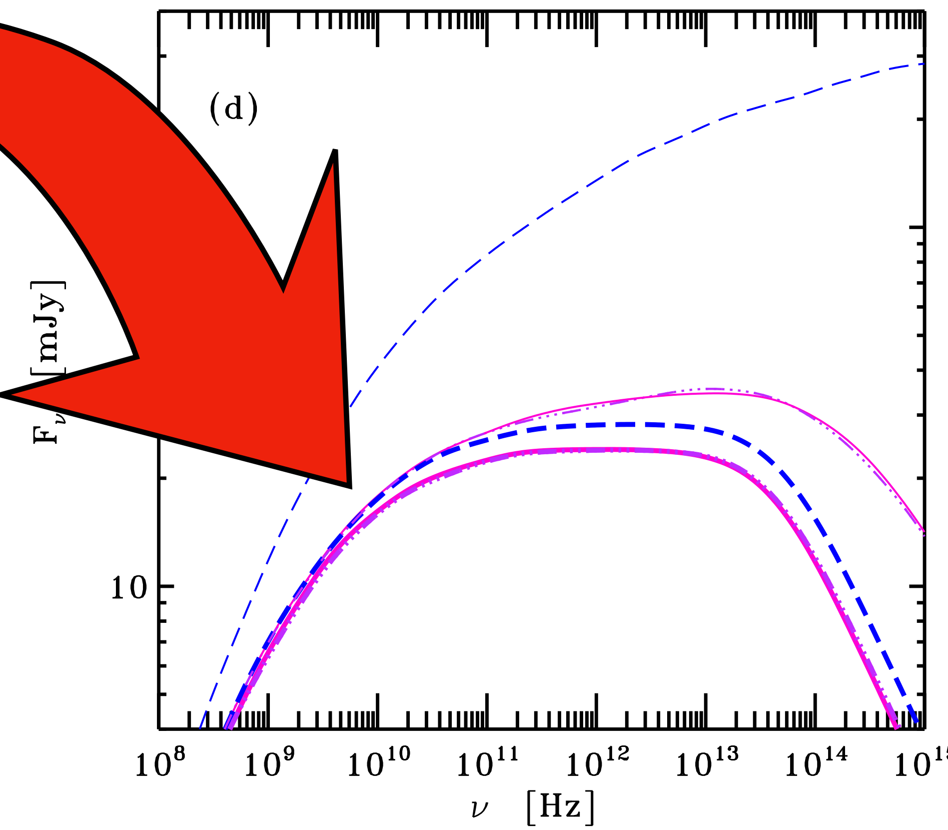
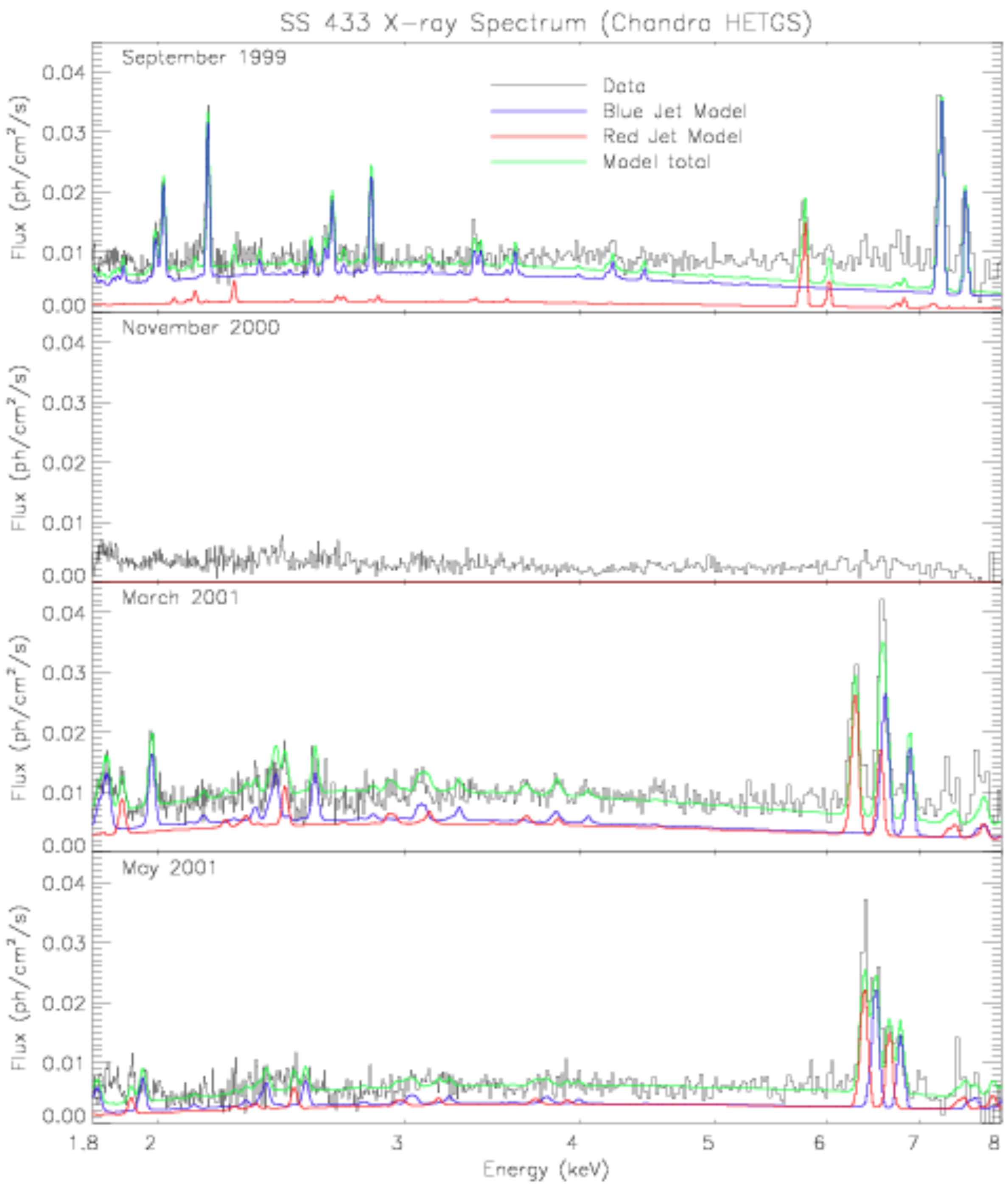


Figure 4. Influence of the modelling of the input fluctuations. The thick and thinner curves show the result of simulations obtained with the 'non-linear' and 'linear' input fluctuations, respectively (see the text). The full curves show the results for a constant mass of the ejecta. The triple-dot–dashed curves, almost undistinguishable from the full curves, are obtained for a mass of the ejecta that is varying randomly and independently of the Lorentz factor. The long dash curves show the results obtained for a constant kinetic energy of the ejecta. The other parameters are identical to that of Fig. 2.

Malzac ,14

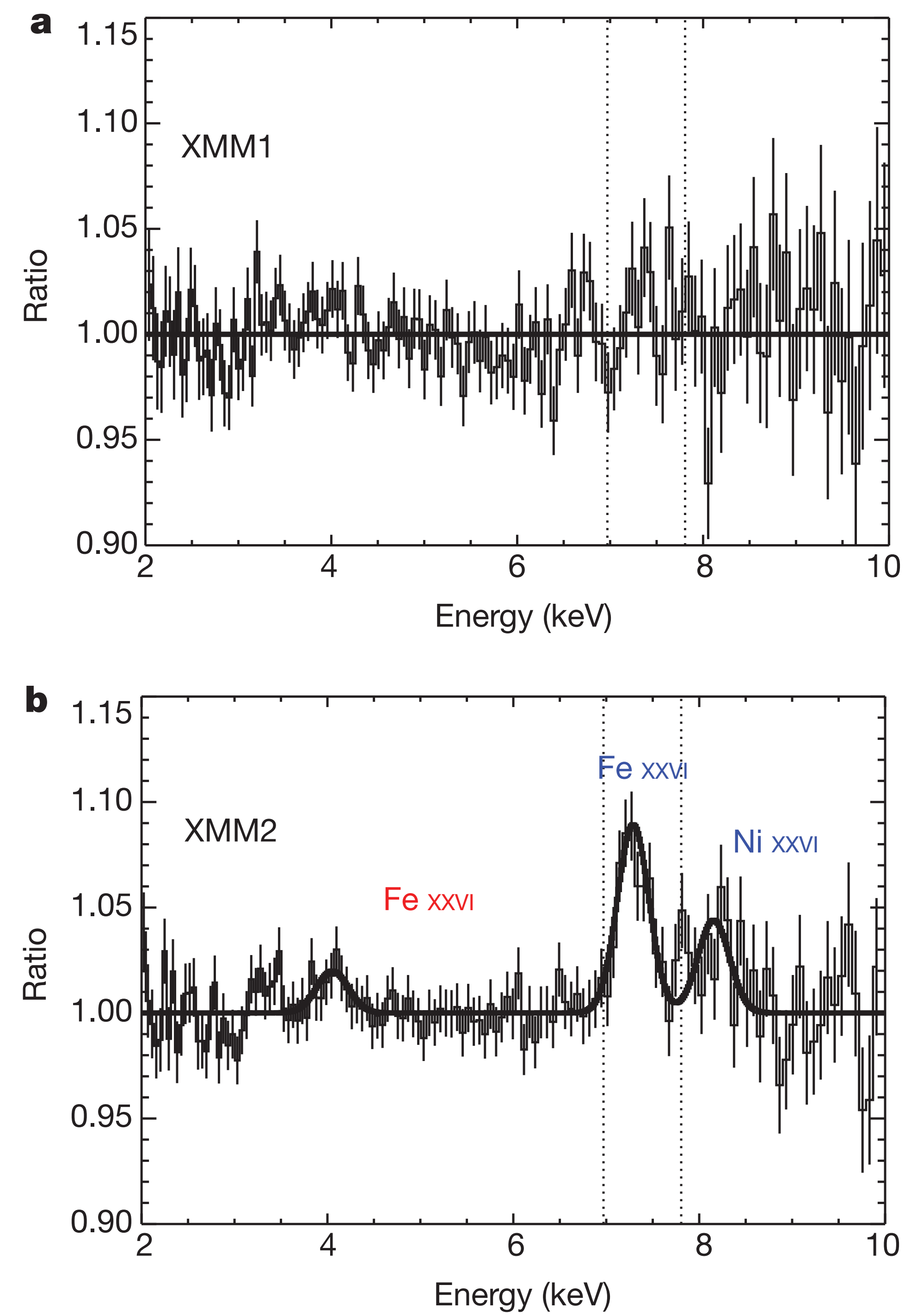
Emission Line Diagnostics

SS433



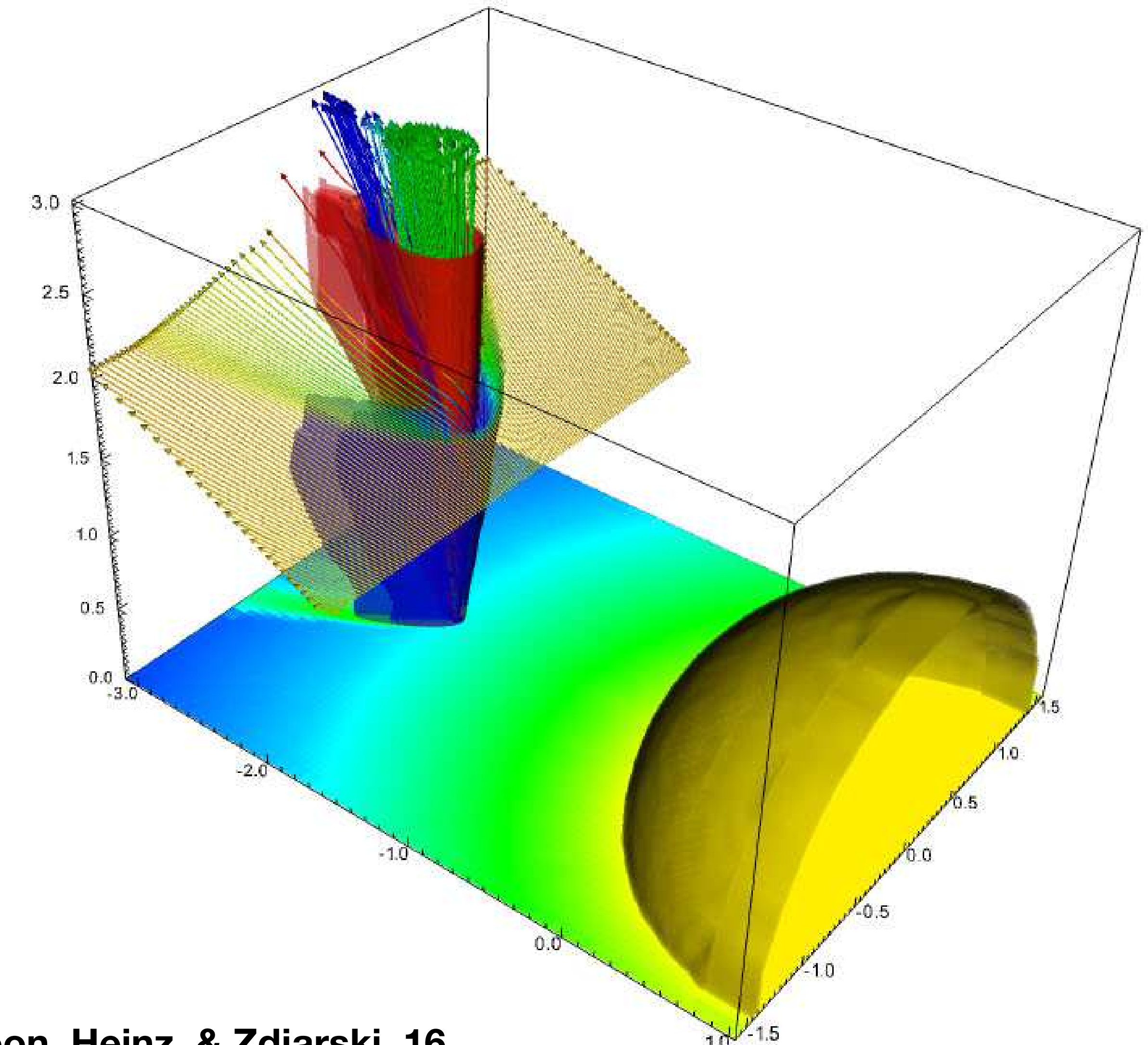
Marshall+ '13

4U 1630-47

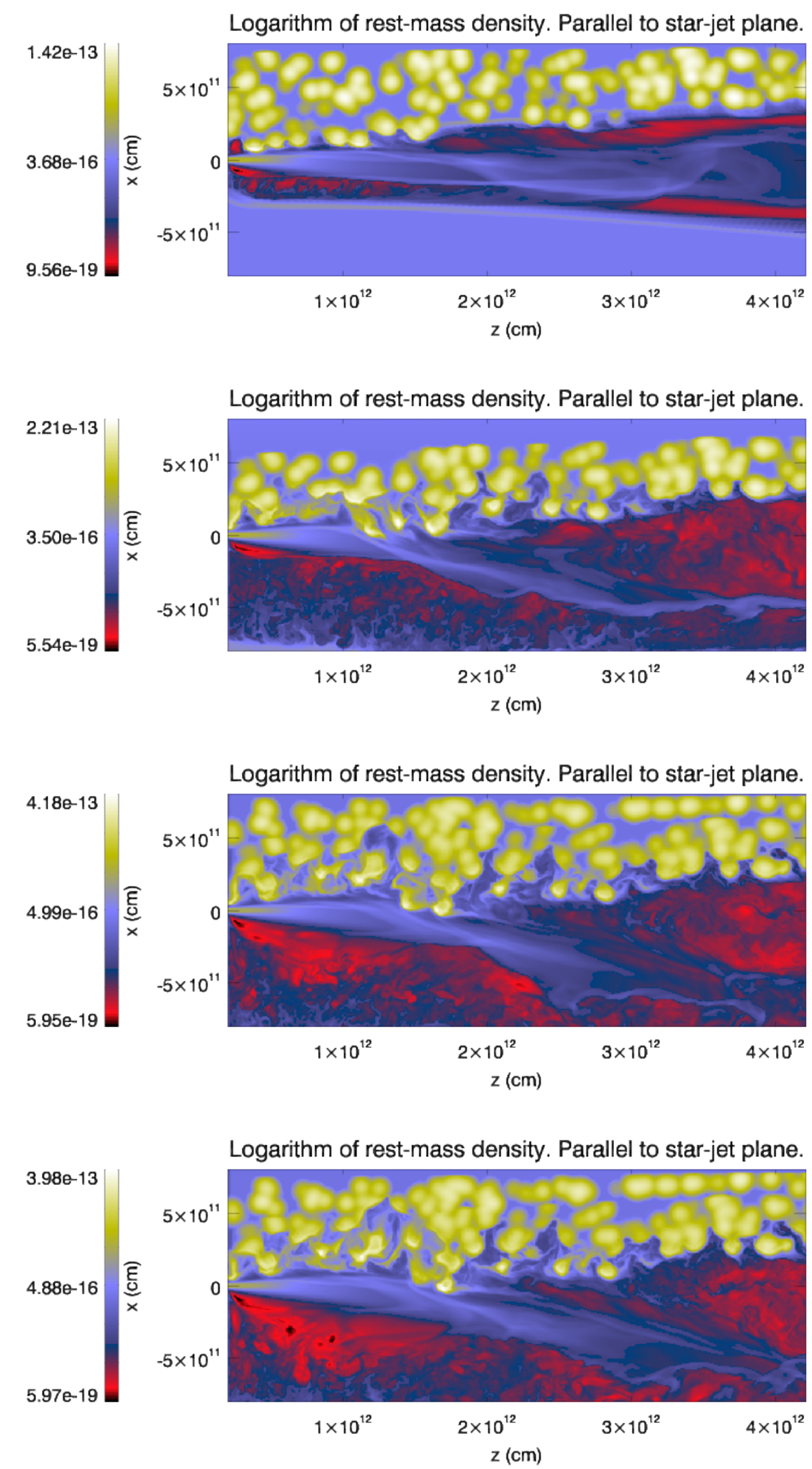


Diaz Trigo, Miller-Jones, Migliari, Broderick, Tzioumis '13

Winds & Clumps



Yoon, Heinz, & Zdjarski ,16



Perucho+'12

$$\delta t_{\rm cross} \sim \frac{\phi_{\rm jet} a}{v_{\rm wind}} \sim 100\,{\rm s}\,\frac{a}{3\times10^{12}\,{\rm cm}}\,\frac{\phi_{\rm jet}}{5^\circ}\,\frac{2000\,{\rm km\,s^{-1}}}{v_{\rm wind}}$$

Wish List

- Emission lines:
  - <5% resolution spectroscopy
  - large area
  - high dynamics range
- Constrain jet emission region:
  - long time series
  - easy coordination with other observatories
- Micro-blazar?
  - look for >kHz variability