RXTE et al. Monitoring of Gamma-ray Bright Blazars

Alan Marscher
Boston University
Co-I’s: S. Jorstad, M. Aller, I. McHardy
Research Web Page: www.bu.edu/blazars
The Quasar PKS 1510-089 (z=0.361)

- Long-term connection between X-ray & radio
- Optical flux not so well correlated with radio, X-ray

Conclusion: X-rays are mainly external Compton by low-E electrons
- supports Madejski et al. & Kataoka et al.

Two bright superluminal blobs emerged during the outbursts in brightness during the 2nd half of 2008 & the 1st half of 2009

Simultaneous $\gamma$-ray & optical flares

X-ray & radio outbursts can be delayed by months

New superluminal knots cause one or more flares at some or all wavebands

$\rightarrow$ Max. electron energy varies among knots

3C 279 in 2008-09

Simultaneous γ-ray, optical, & X-ray outbursts

Superluminal radio knot appeared as outburst started

X-ray dominant flare

Major flare at all 3 wavebands as 3C 279 faded into the sunset . . .
1-2 wavebands appear to participate in each flare, never all 3

Superluminal radio knots passing through 43 GHz core coincide with γ-ray and/or X-ray flares

3C 273 in 2008-09: γ-ray, X-ray, & I-band
Conclusions

- $\gamma$-ray and X-ray flares in jets are caused by superluminal knots ("blobs") that move down the jet, as seen in VLBA images.
- High-E photon emission in the jet occurs in multiple zones.
- High-E flares occur when electrons are energized: $\gamma > 1000$ needed for $\gamma$-ray flare; sometimes this is not achieved $\rightarrow$ only X-ray monitoring can detect these blobs before they reach the 43 GHz “core”.
- High-E flares can also occur from inverse Compton scattering of local sources of seed photons (e.g., in slower sheath of jet) even if electron energies remain $\sim$ same.
- Combination of RXTE & Fermi monitoring + VLBA imaging + multi-waveband flux & polarization monitoring is a powerful probe of inner jets of blazars.
**PKS 1510-089: Flare in Aug-Sep 2008**

**Time delays of peaks:**
- Optical first
- $\gamma$-ray 1 week later
- X-ray & radio 10 days after $\gamma$-ray

Superluminal knot (red arrow) passed through core before this flare

AGILE detection early in 2008 during optical flaring activity, at start of X-ray/radio rise

---