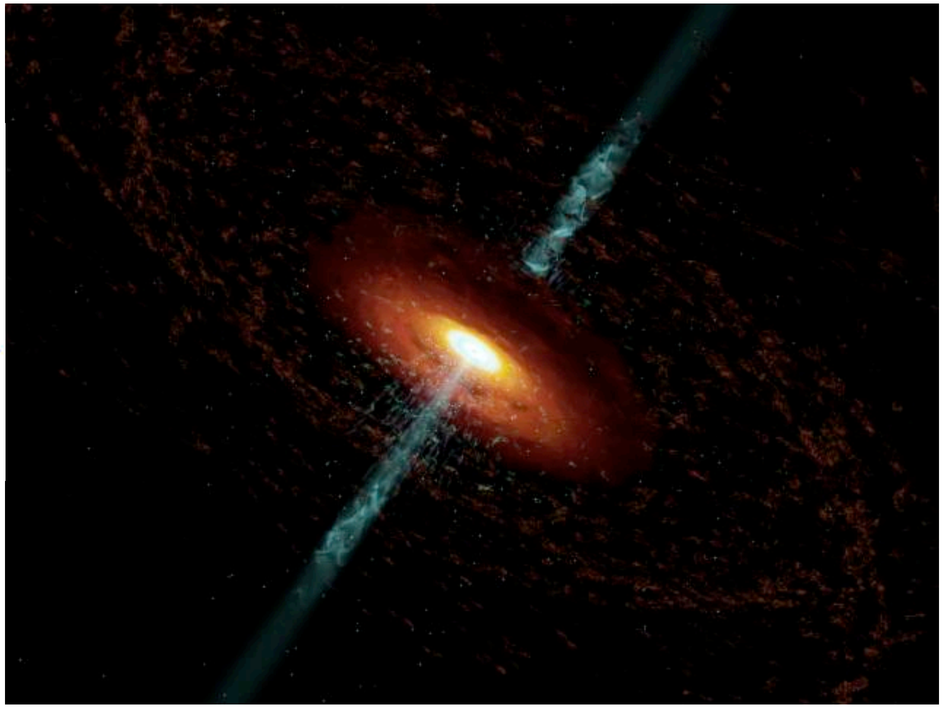


RXTE et al. Monitoring of Gamma-ray Bright Blazars

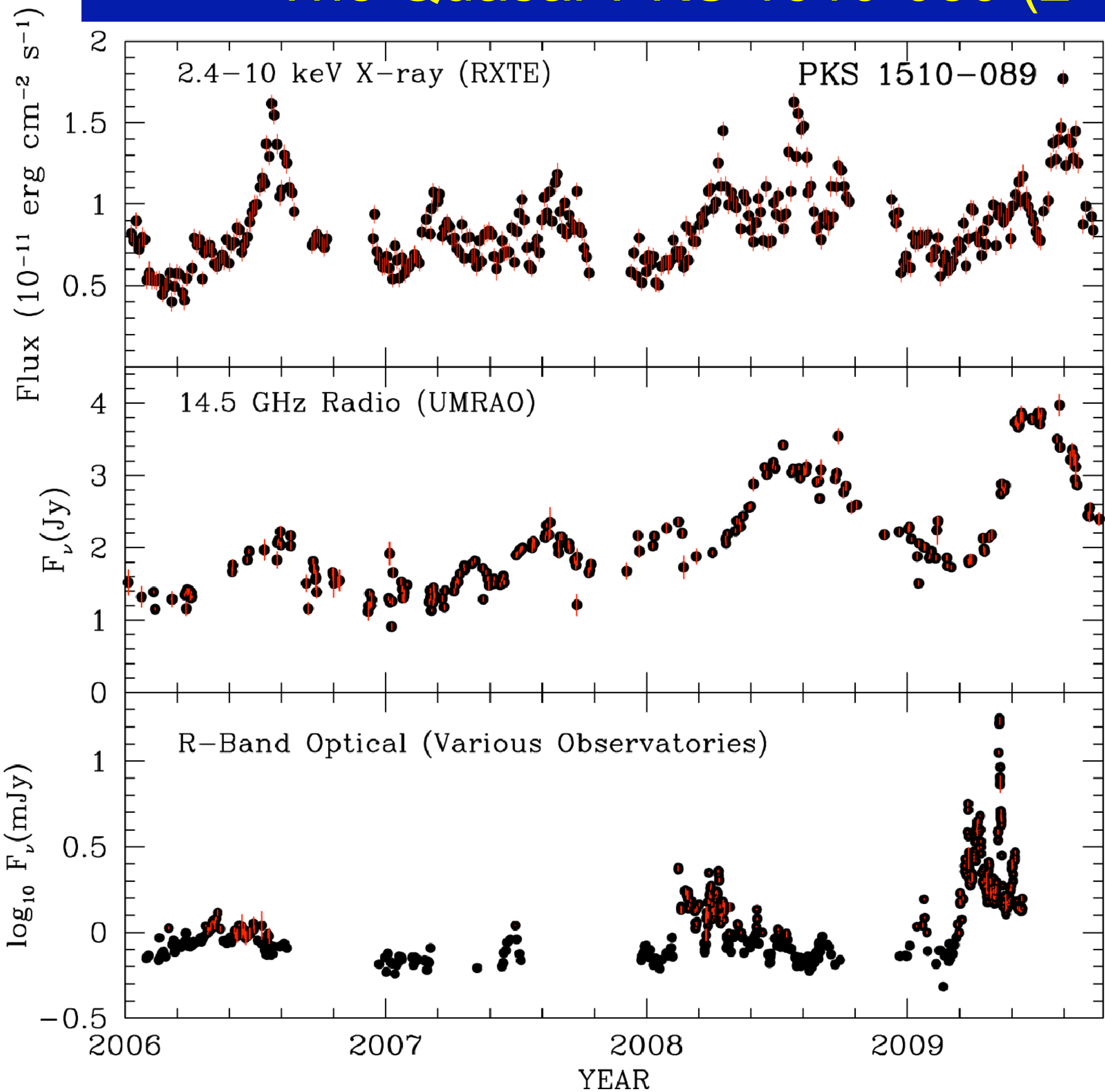
Alan Marscher

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

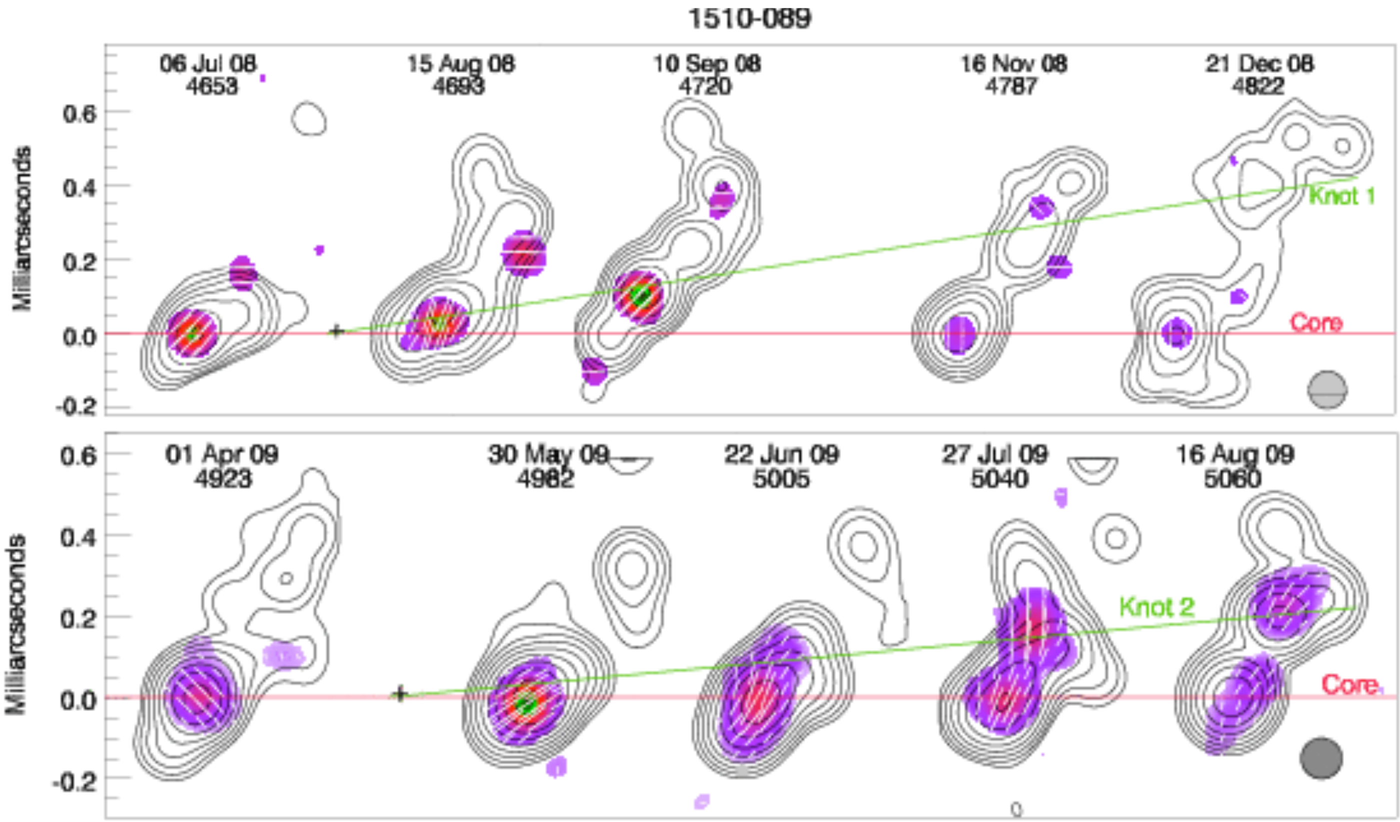
Optical flux not so well correlated with radio, X-ray

Conclusion: X-rays are mainly external Compton by low-E electrons

- supports Madejski et al. & Kataoka et al.

Marscher et al. (2009, Astrophysical Journal, submitted)

43 GHz VLBA Images of PKS 1510-089



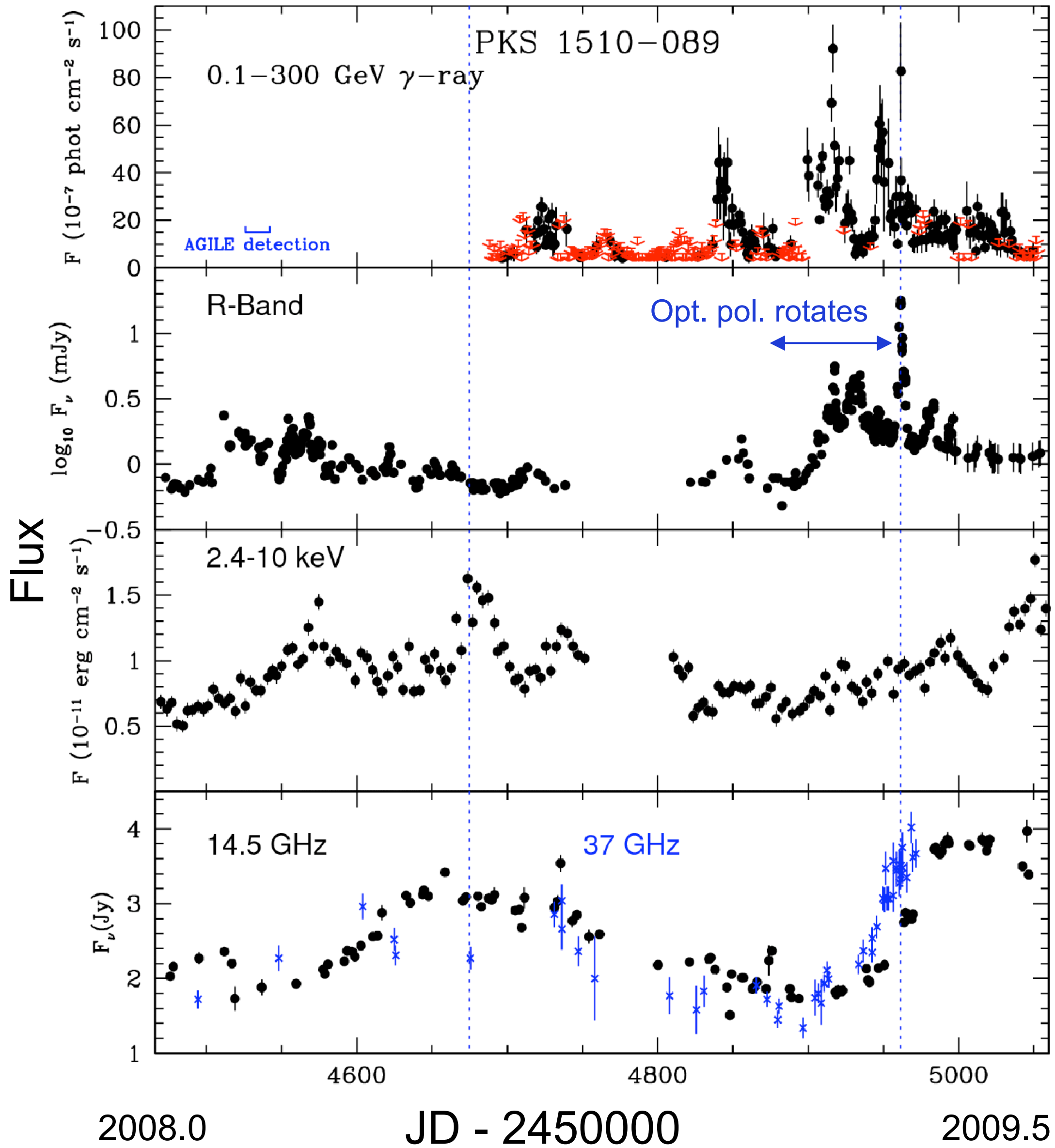
Contours: intensity
Colors: polarization

$V_{app} = 23c$

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

Marscher et al. (2009, Astrophysical Journal, submitted)

PKS 1510-089 in 2008-09



Simultaneous γ-ray & optical flares

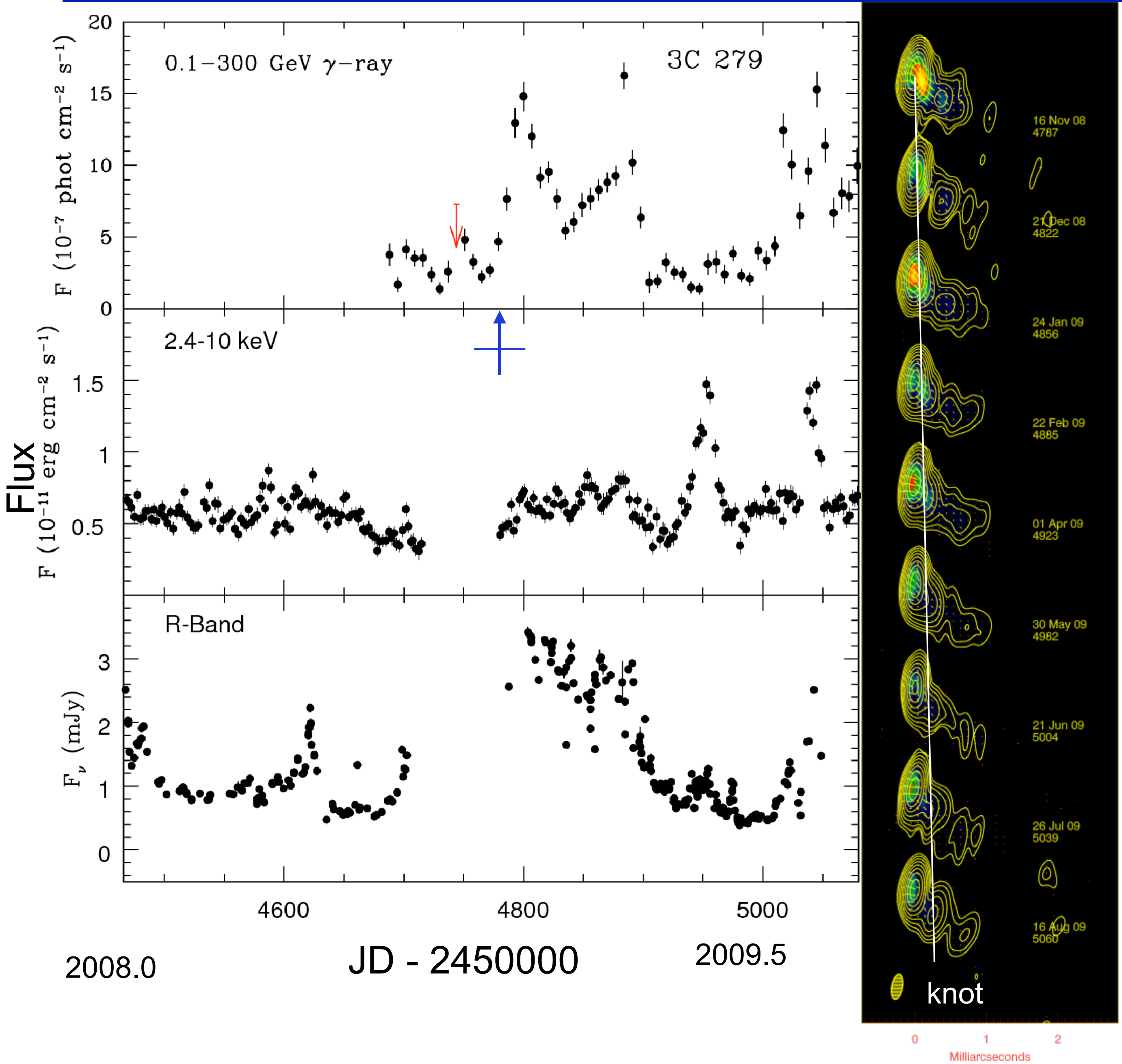
X-ray & radio outbursts can be delayed by months

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

→ Max. electron energy varies among knots

Marscher et al. (2009, Astrophysical Journal, submitted)

3C 279 in 2008-09



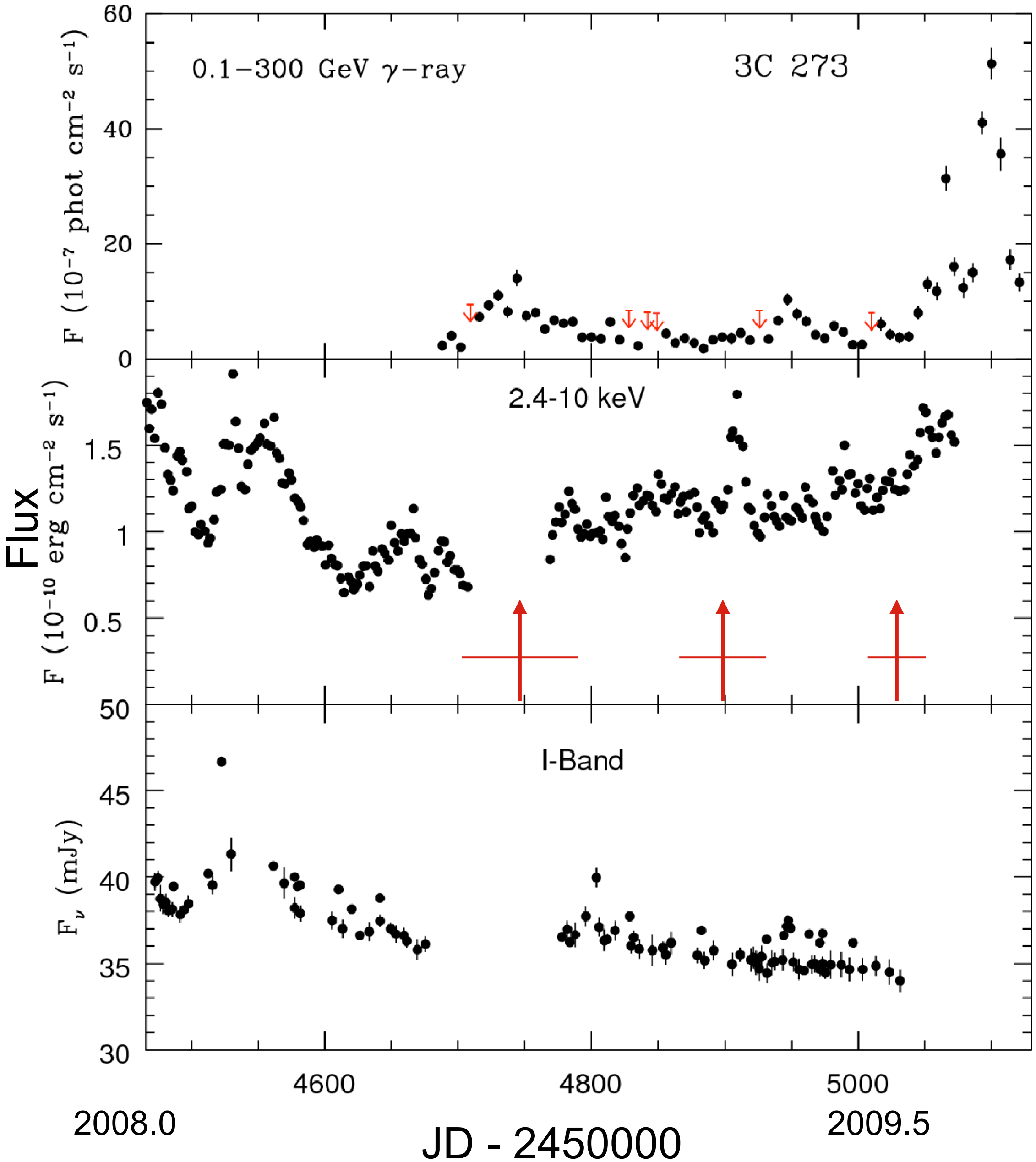
Simultaneous γ-ray, optical, & X-ray outbursts

Superluminal radio knot appeared as outburst started

X-ray dominant flare

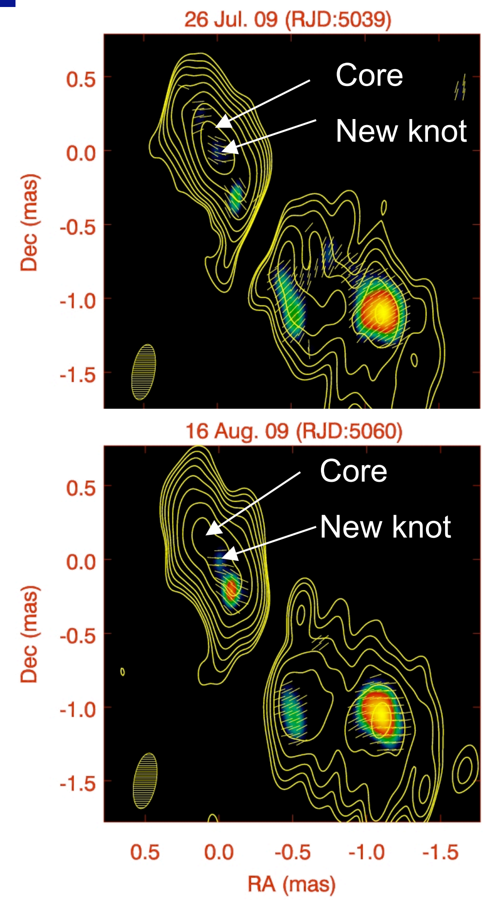
Major flare at all 3 wavebands as 3C 279 faded into the sunset . . .

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



1-2 wavebands appear to participate in each flare, never all 3

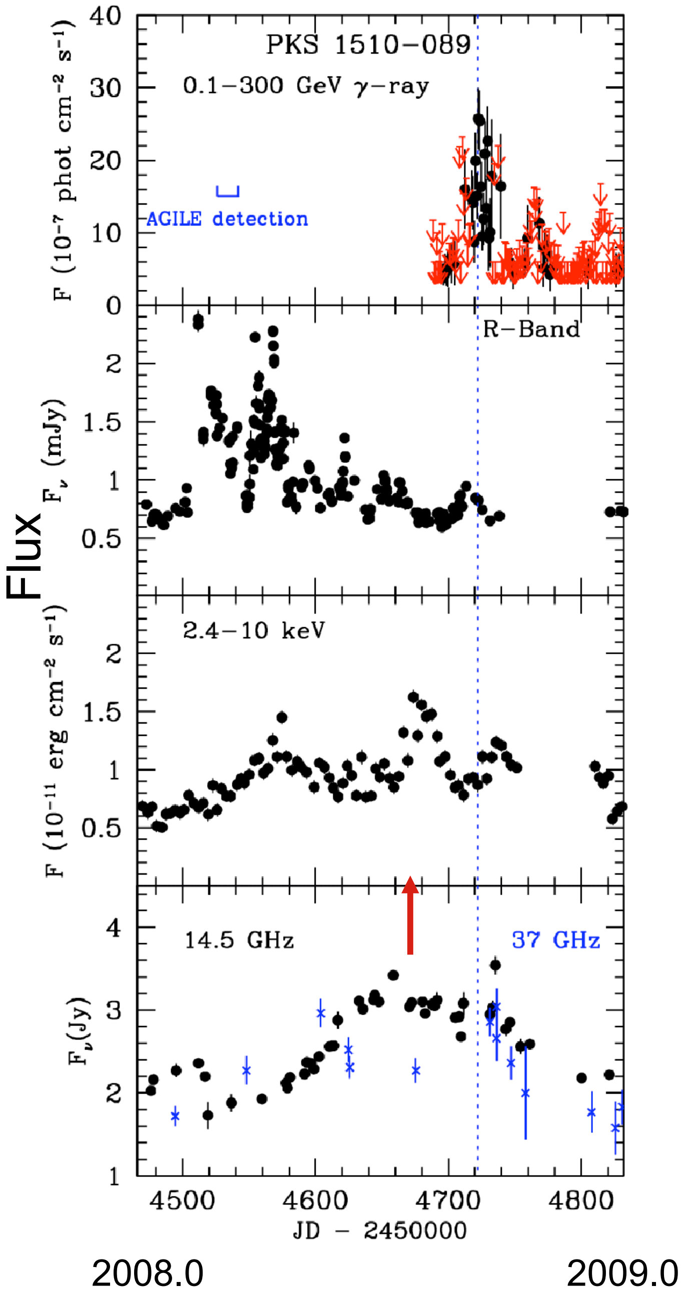
Superluminal radio knots passing through 43 GHz core coincide with γ-ray and/or X-ray flares



Conclusions

- **γ-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 γ-ray flare; sometimes this is not achieved → 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 ~ 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

γ-ray 1 week later

X-ray & radio 10 days after γ-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

Marscher et al. (2009, Astrophysical Journal, submitted)