The Signature of velocity gradients in the Gamma-Ray spectra of radio loud AGN. Some thoughts and a plan of action.

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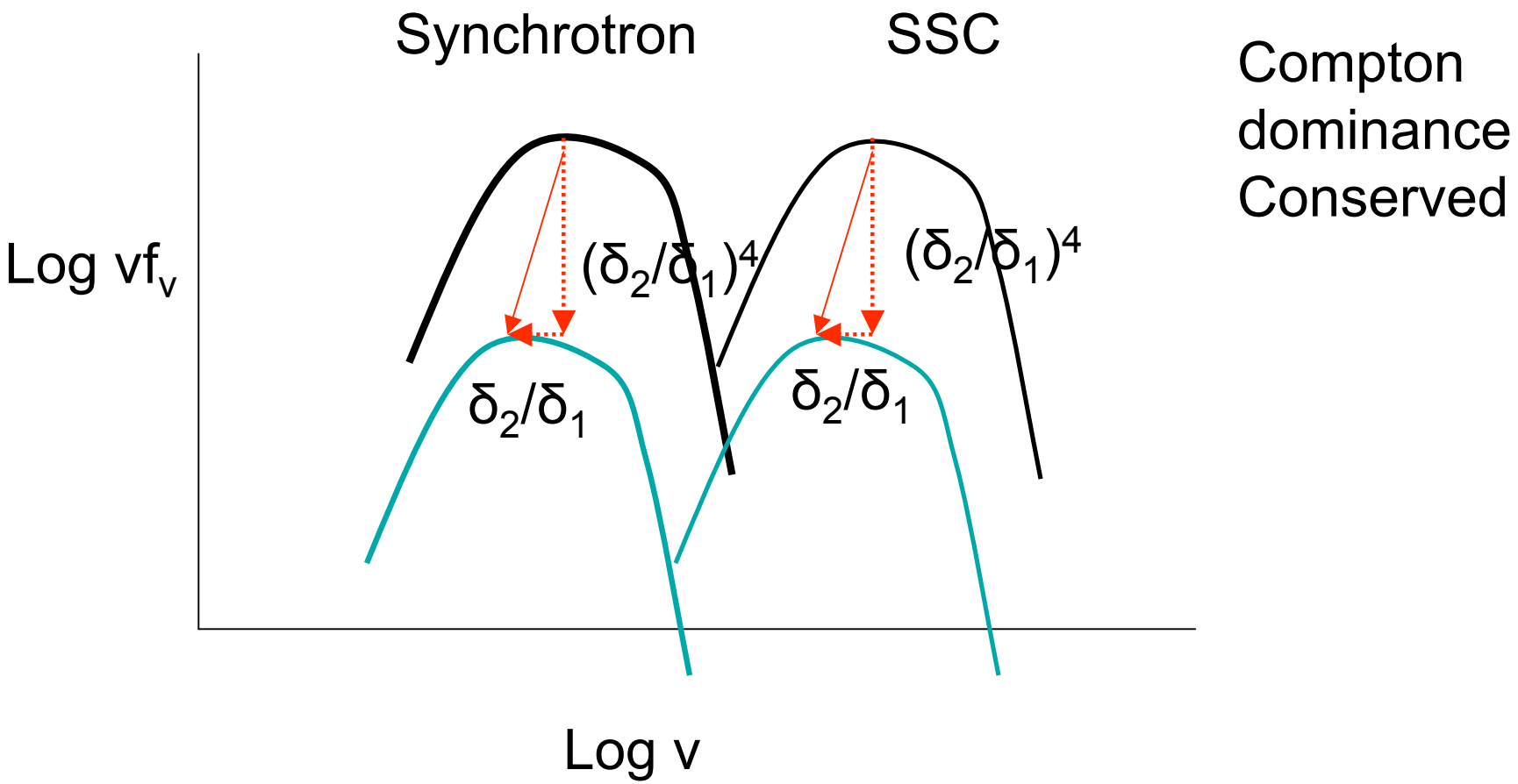
What happens when you gradually misalign a blazar?

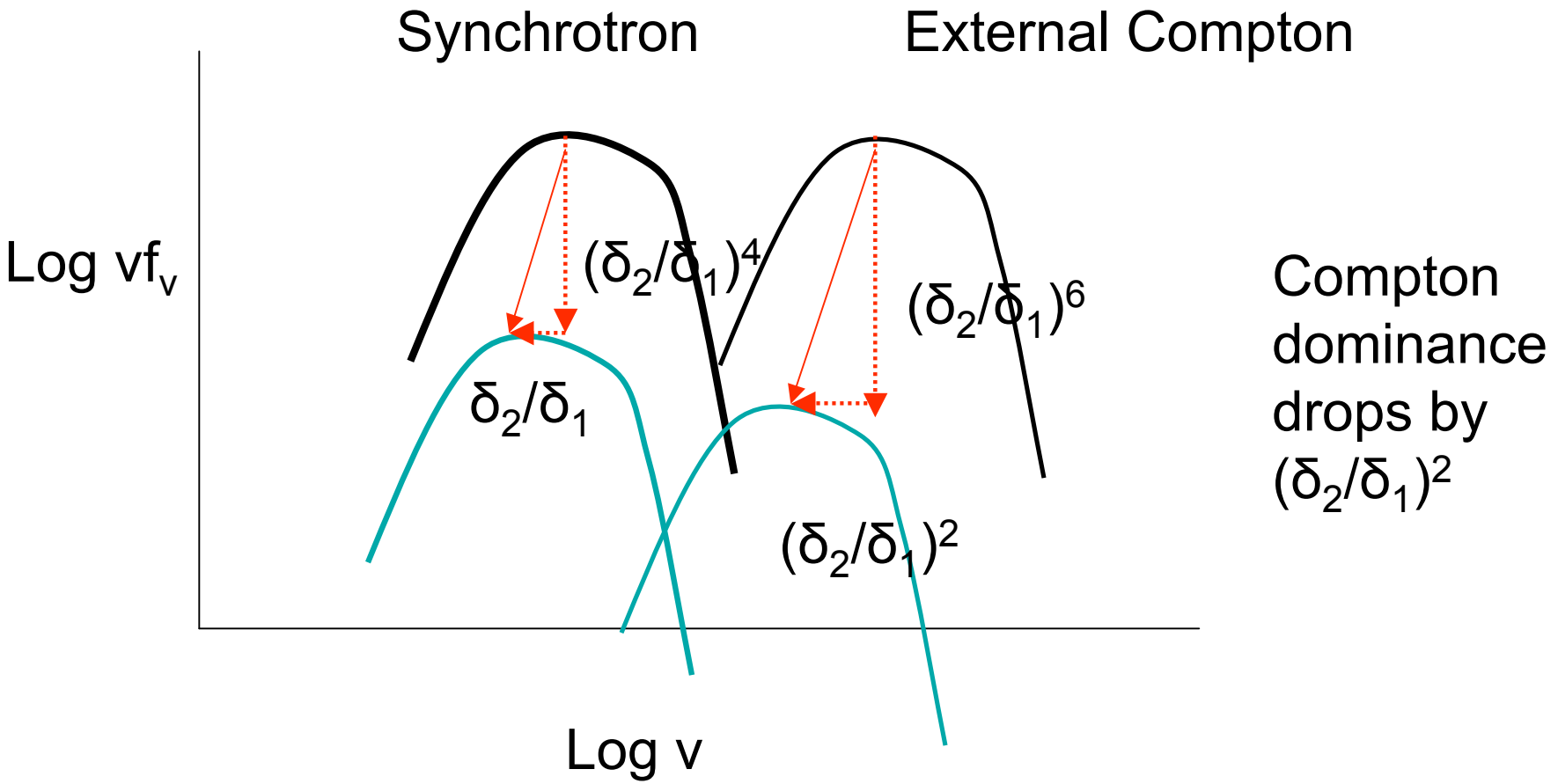
- It depends on the velocity structure in the blazar emission zone:
- If the source is characterized by a single bulk Lorentz factor Γ, then isotropic in the comoving frame emission processes (synchrotron SSC) shift their νf_ν peak by δ^4 in luminosity and by δ in frequency, where δ is the Doppler factor

$$\delta = \frac{1}{\Gamma(1 - \beta\cos\theta)}$$

No velocity gradients.
A. SSC γ-rays (BL Lacs?)



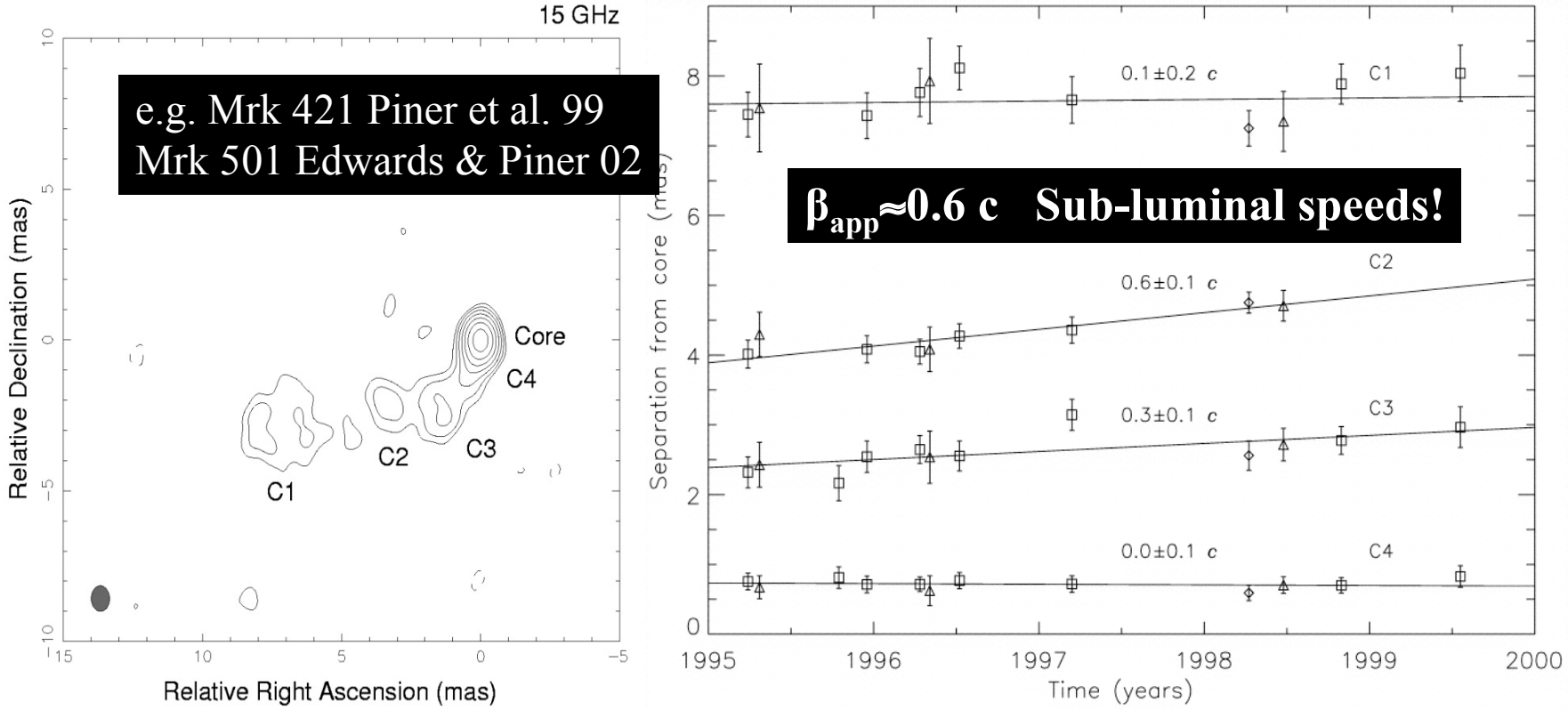
No velocity gradients
A. EC γ-rays (FSRQs?)



Do we need velocity gradients for low power jets (FR I and BL Lacs)?

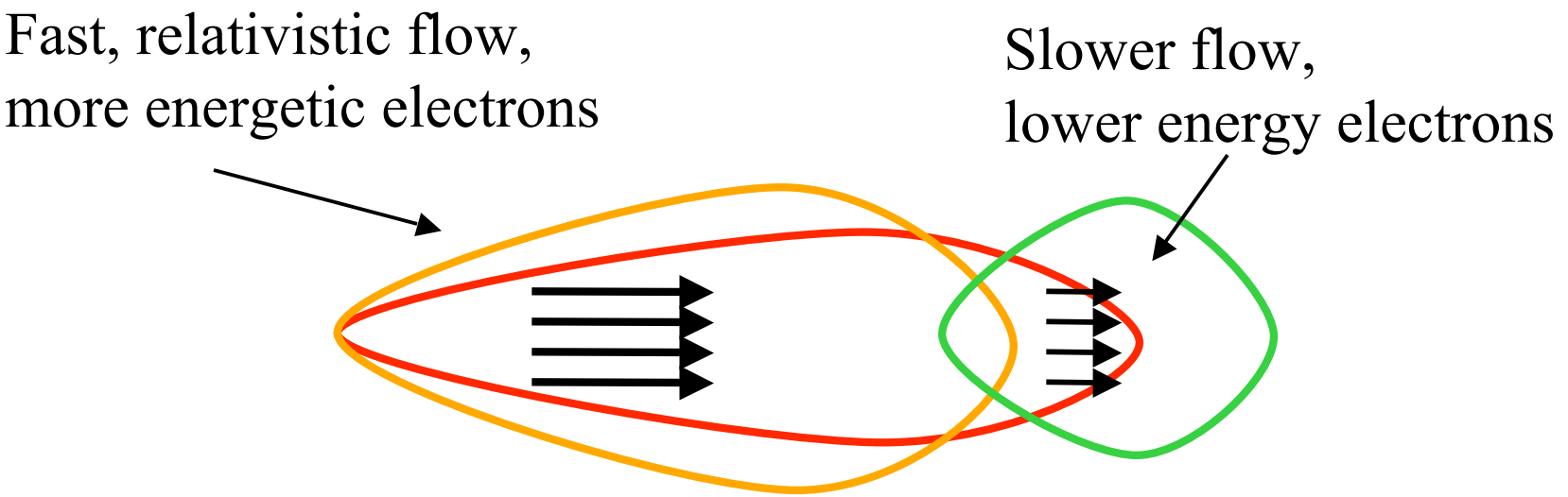
- The cores of FR I radio galaxies are much brighter than expected under the BL Lac-FR I unification (Chiaberge et al. 2000).
- This can be explained by a fast spine- slow sheath velocity profile (Ghisselini et al. 2005)
- The fast spine dominates in BLs, the slower outer layer in FR Is.

No fast flow is detected in VLBI observations of TeV blazars.



- Marscher 99: The flow must decelerate from the high energy to the radio emitting region.

Radiation beaming patterns for a relativistic and decelerating flow.

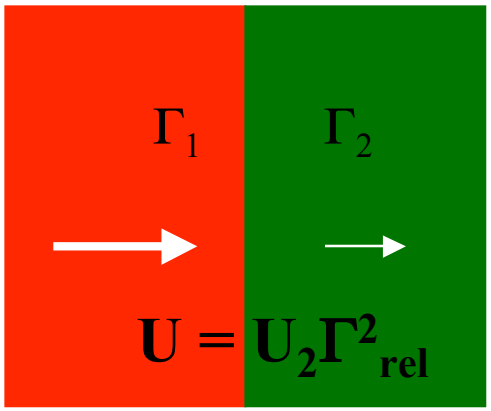


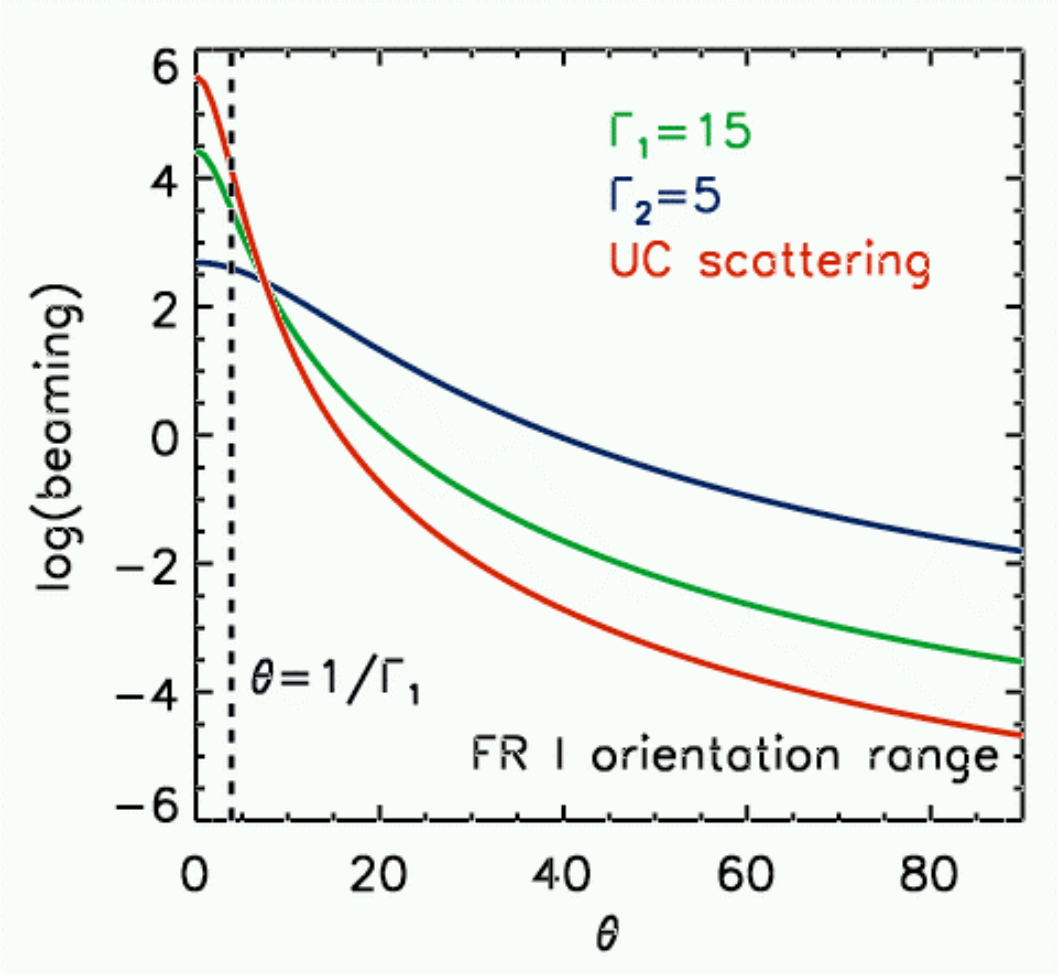
Georganopoulos & Kazanas 2003

UC emission: Synchrotron seed photons from the slow part of the flow are scattered by the upstream energetic electrons of the fast part of the flow.

Upstream Compton (UC) Scattering.

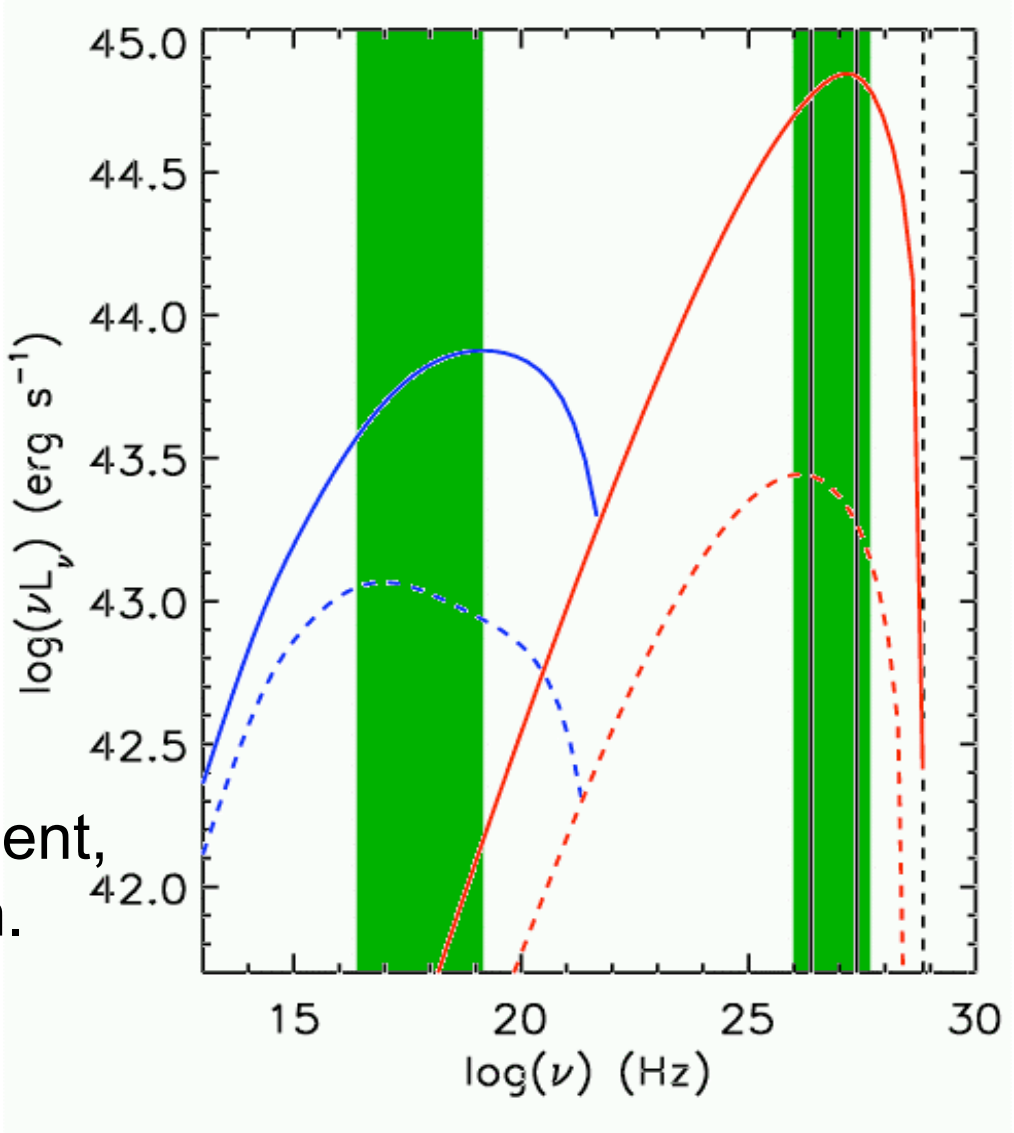
Higher seed photon energy density
Tighter beaming pattern





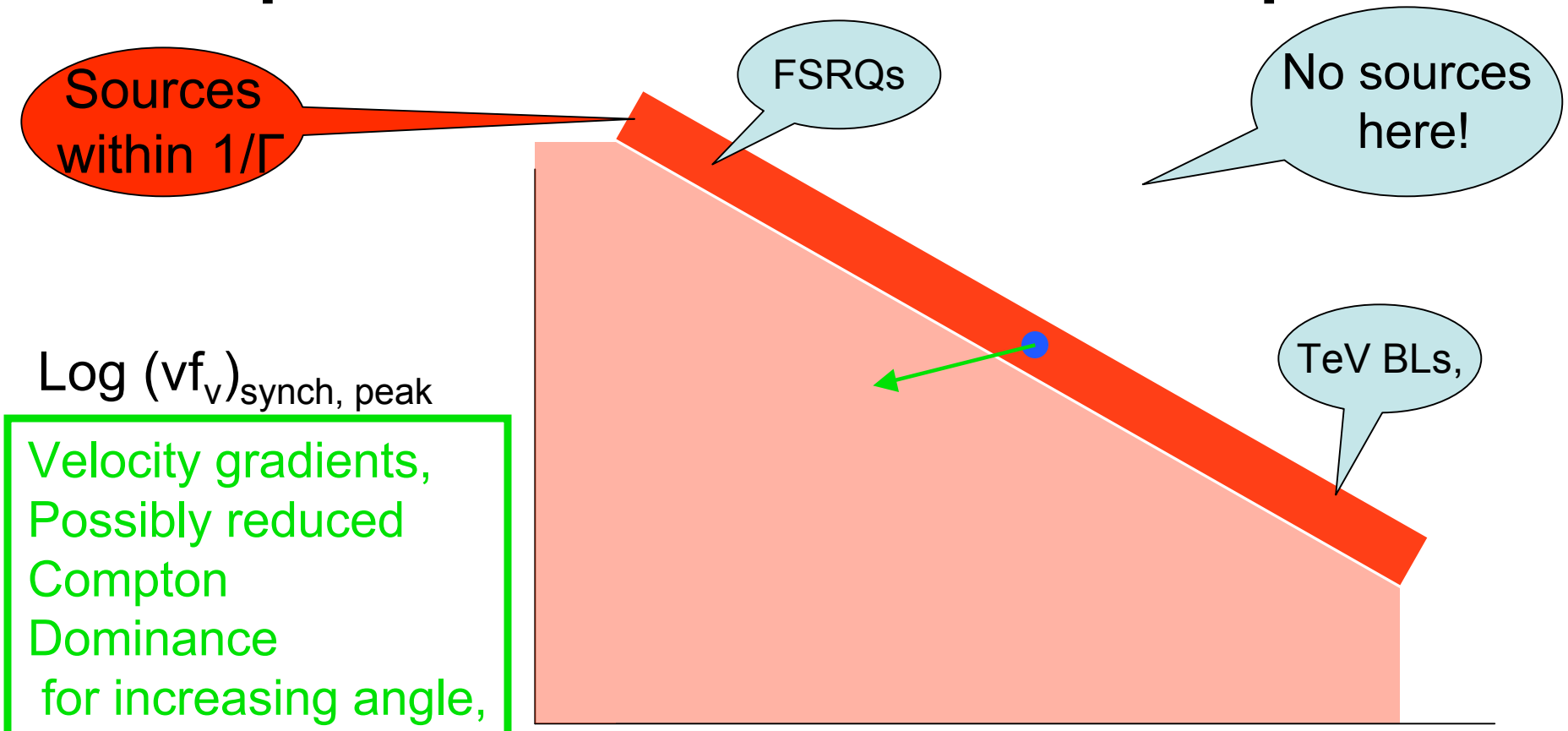
Emission from a decelerating relativistic flow

- Flow decelerates from Γ=15 to Γ=4,
  $R=10^{16}$ cm
- $\gamma_{max}=10^7$, B=0.1 G
- $\theta_1=3^o$, $\theta_2=6^o$



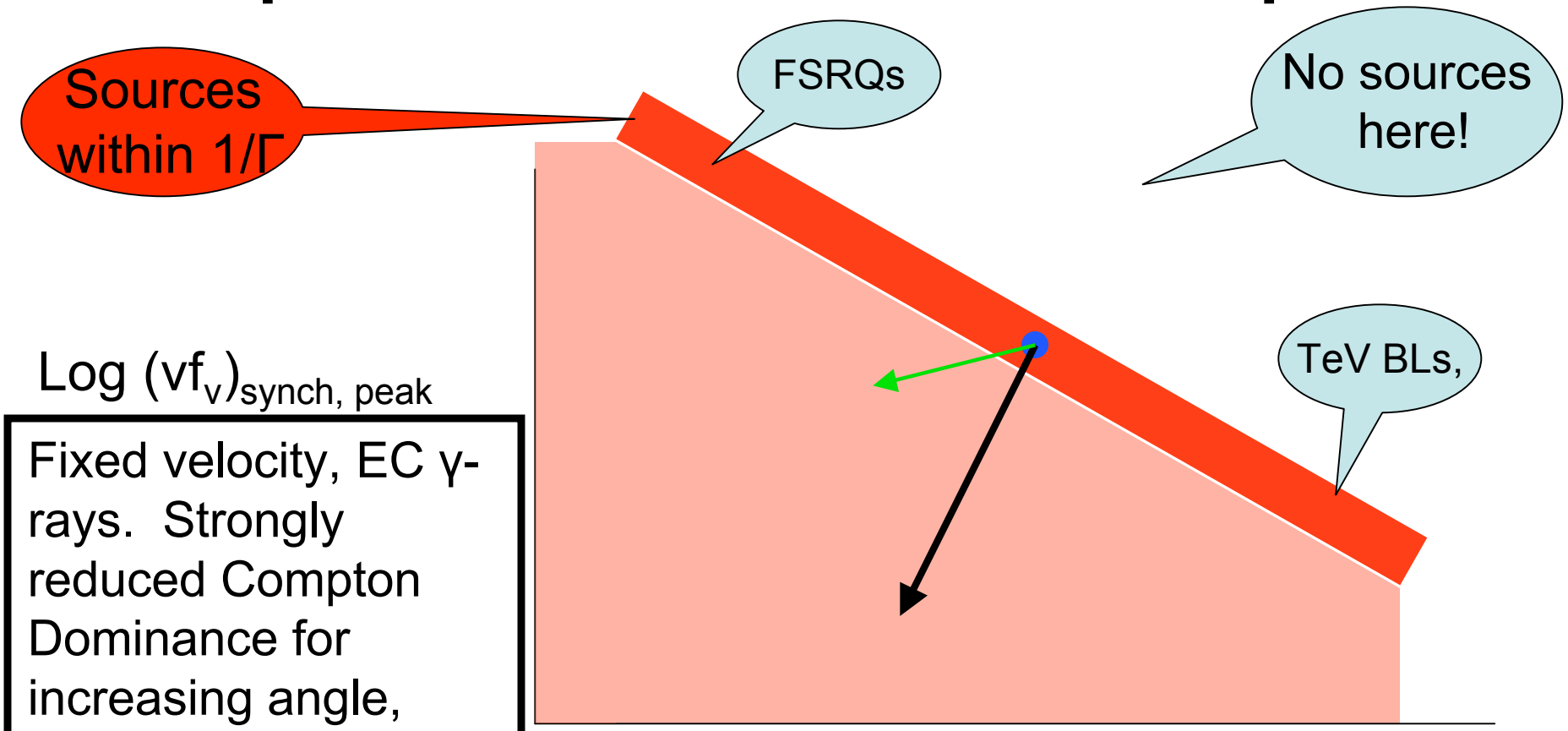
Compton dominance decreases with misalignment, even without EC emission.

Effects on the blazar sequence: Misaligned sources should turn the sequence in into a blazar envelope.



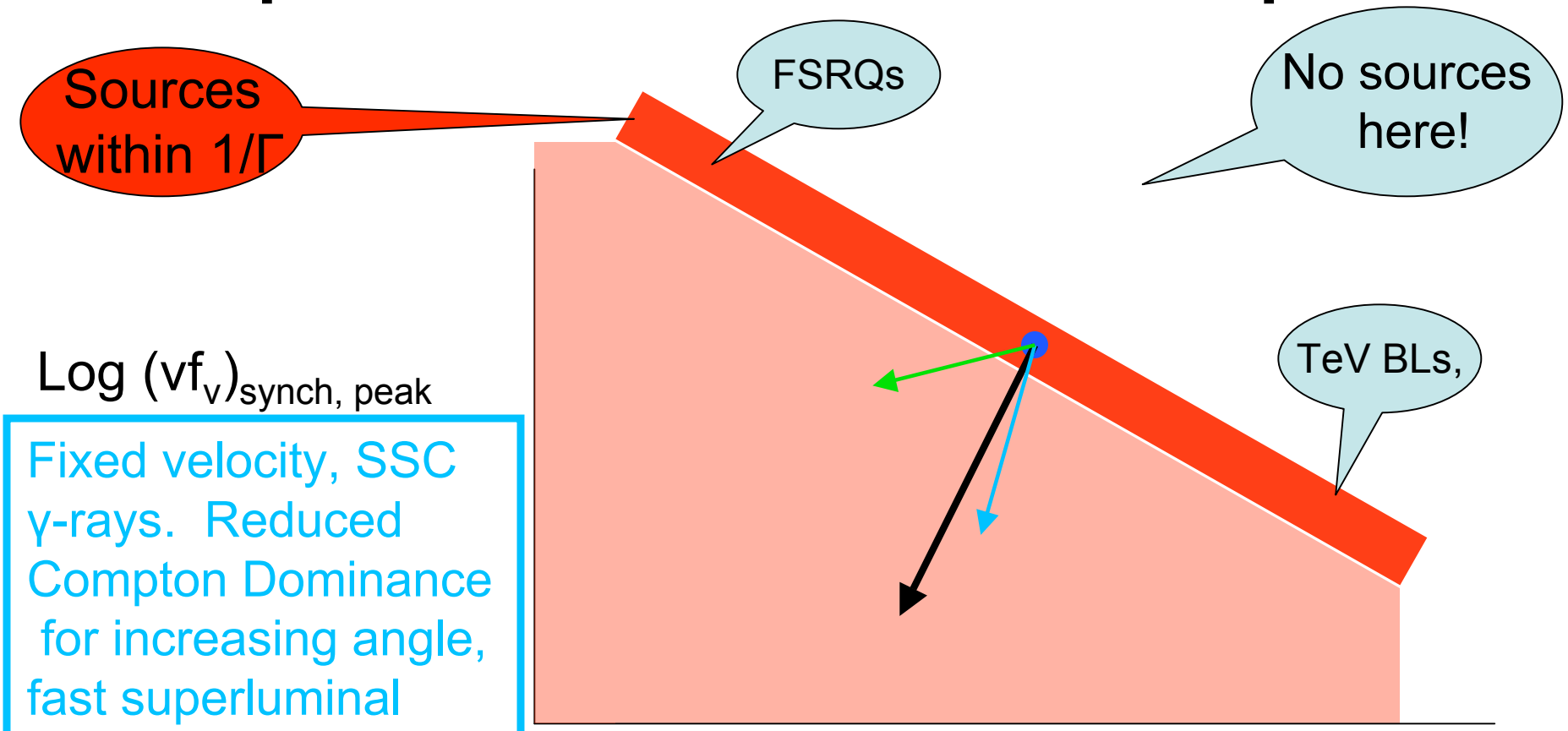
Velocity gradients, Possibly reduced Compton Dominance for increasing angle, no fast superluminal motions, regardless of angle.

Effects on the blazar sequence: Misaligned sources should turn the sequence in into a blazar envelope.



Fixed velocity, EC γ-rays. Strongly reduced Compton Dominance for increasing angle, fast superluminal motions for aligned jets only.

Effects on the blazar sequence: Misaligned sources should turn the sequence in into a blazar envelope.



Interesting connections:

- Sources in the Mojave catalog that were expected to be LAT-detected and are not are usually of low superluminal velocity (Lister et. al. 2010 Hawaii HEAD meeting)
- There are many sources that, according to the blazar sequence, although expected to be detected by LAT are not detected (Meyer & Fossati 2010 Hawaii HEAD meeting)
- Can these simply be misaligned sources with a Compton dominance that decreases with increasing misalignment?
- This can be accommodated either by EC or velocity gradients.

How can we probe velocity gradients from sample studies?

- Develop parametric models for blazars, and run Monte-Carlo simulations to produce complete synthetic samples.
- Compare these results to the observed samples.
- How deep into the envelope can we see?
- How large is the intrinsic range of the $1/\Gamma$ strip.
- Is deceleration relevant for powerful sources
- What are the preferred emission mechanism for the γ-rays as a function of source power?
- Is there a connection between jet power and speed?