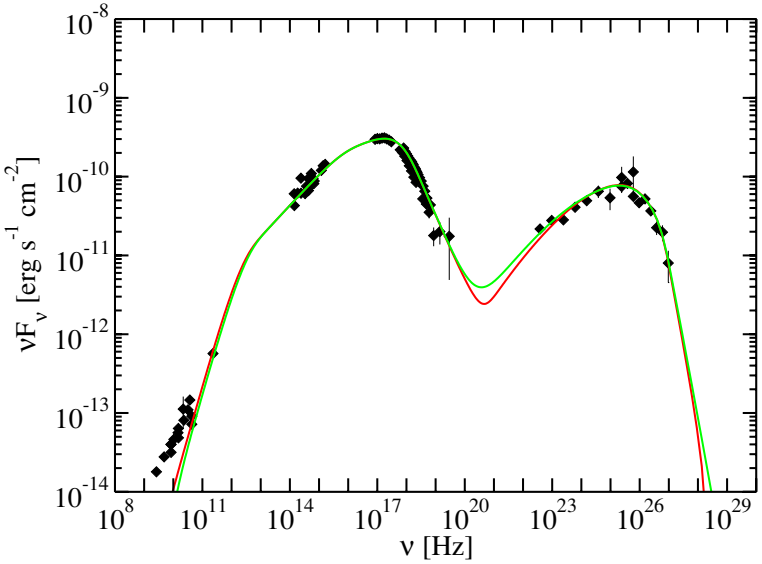
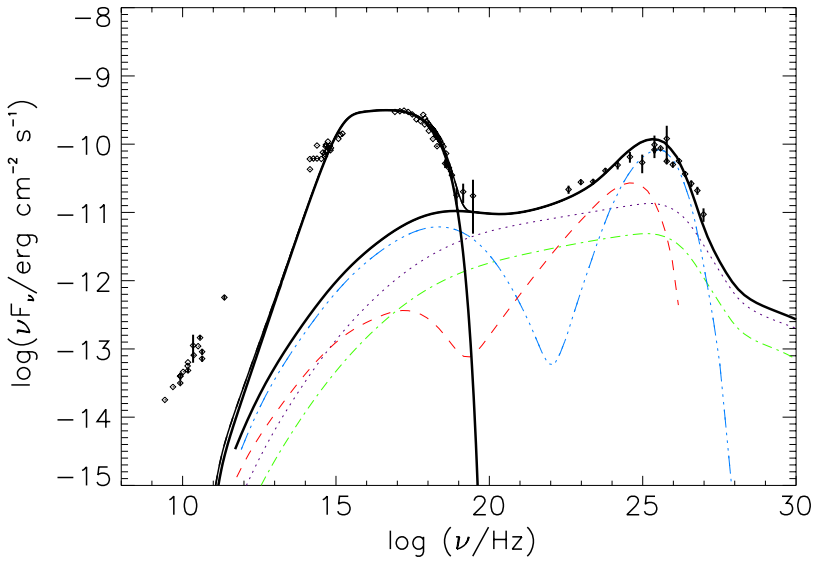
Fermi Symposium
MWL Workshop
AGN SED Modeling

November 13th, 2015

- Can we distinguish leptonic and hadronic models?

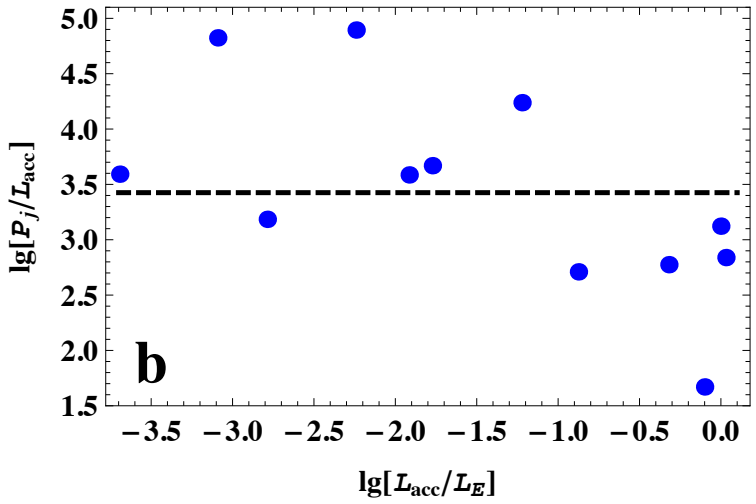


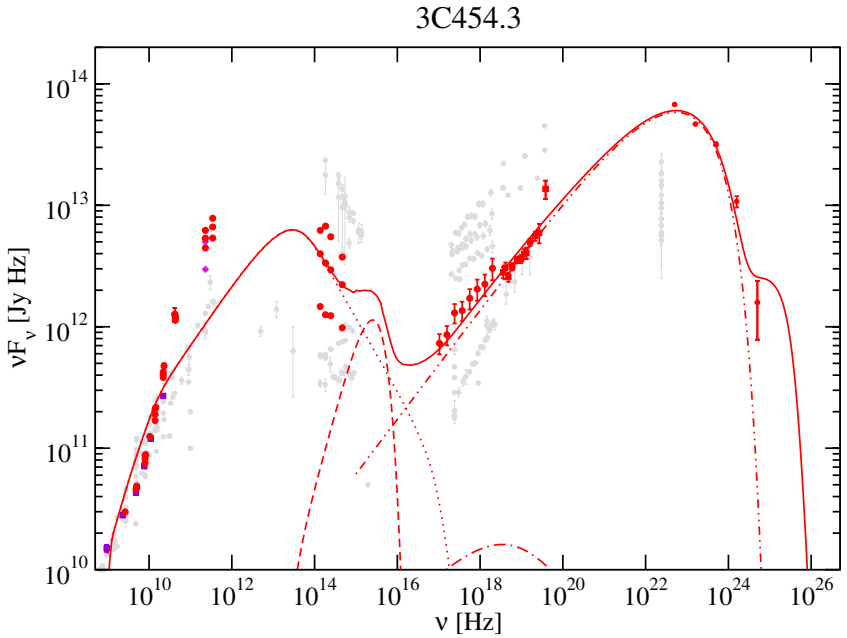


leptonic model ***hadronic model***

Mrk 421
Abdo et al. (2011), ApJ, 736, 131

- Hadronic models: ruled out for FSRQs, LSPs, and ISPs?

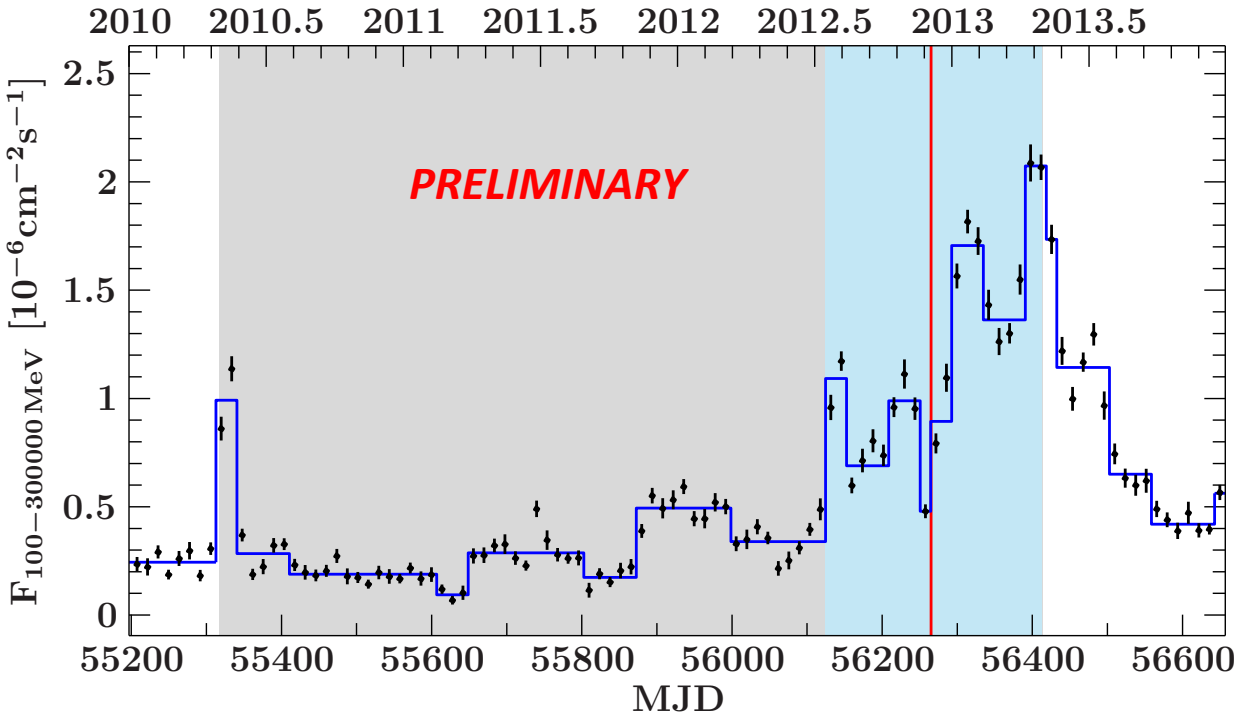




Zdziarski & Boettcher (2015), MNRAS, 450, 21
see also: Sikora et al. (2009), ApJ, 704, 38
Petropoulou & Dimitrakoudis (2015), MNRAS, 452, 1303

Boettcher et al. (2013), ApJ, 768, 54

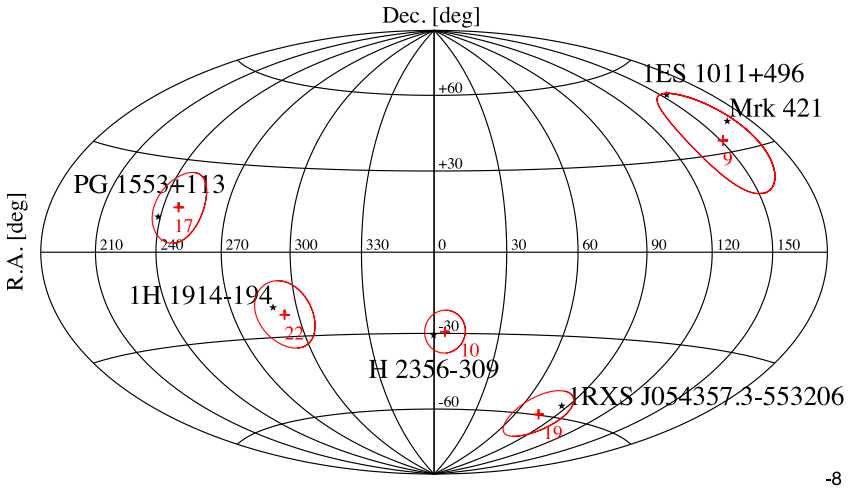
- Can neutrino detections help us distinguish leptonic and hadronic models?

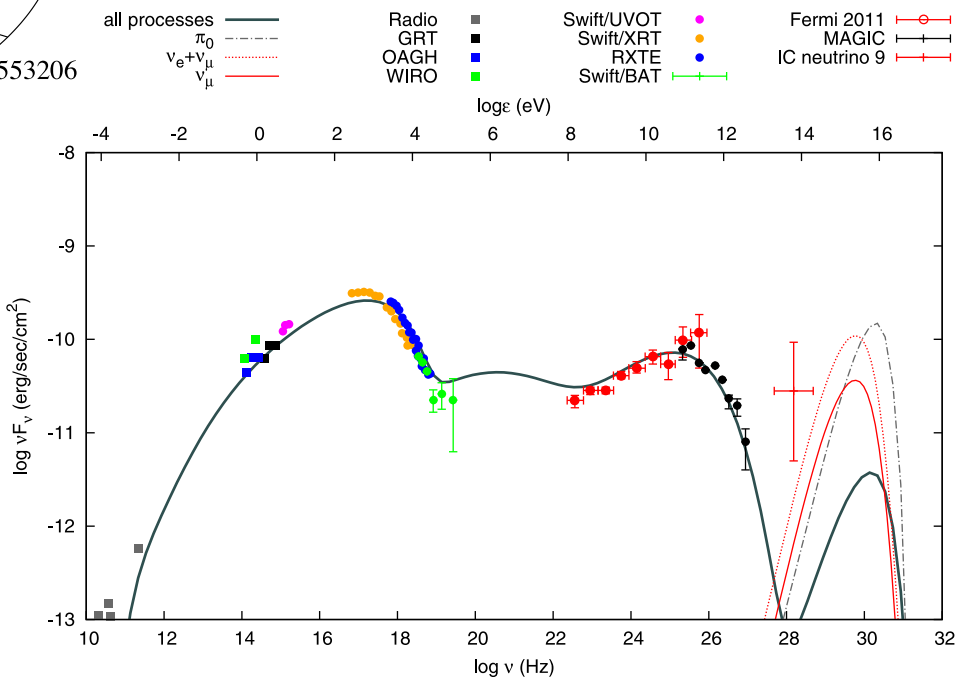


Kadler et al., submitted

2σ significance that it is not a chance coincidence

hadronic models and neutrinos





Petropoulou et al. (2015), MNRAS, 448, 2412

- Are there any “emerging trends” from AGN modeling?

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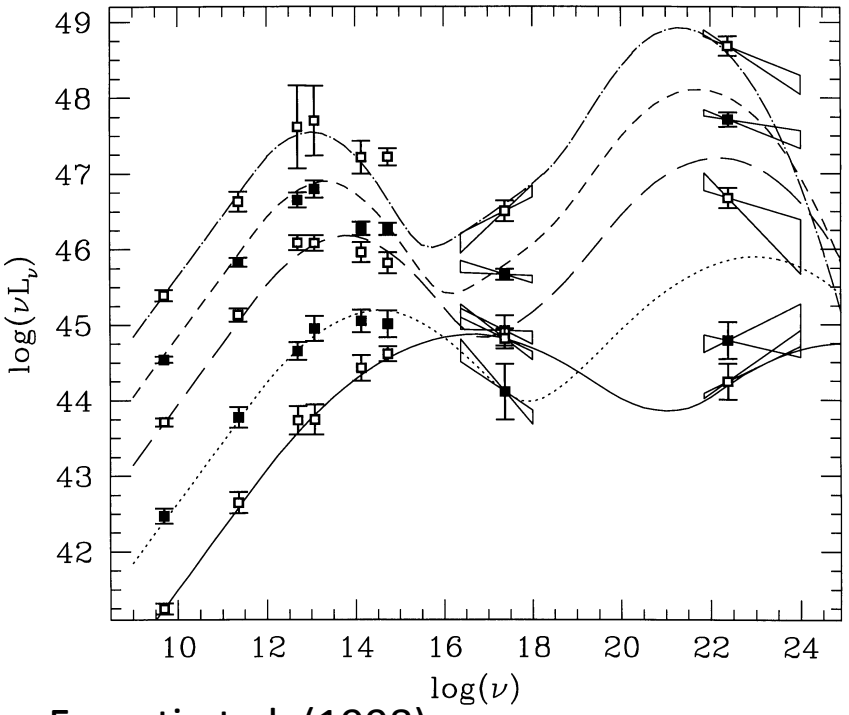
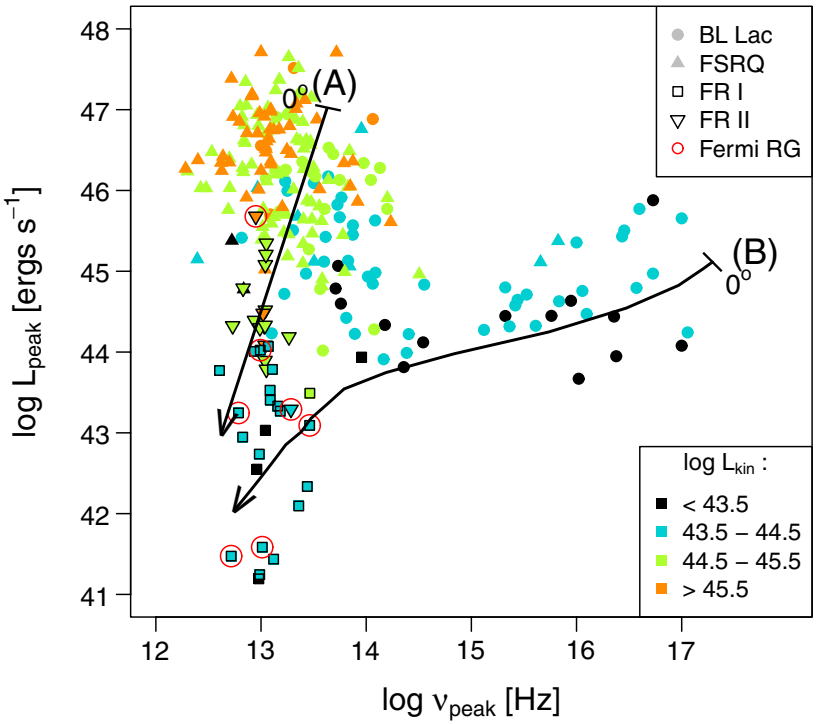


Fossati et al. (1998)



Meyer et al. (2011)

- The TeV blazar bulk Lorentz factor crisis: what is the resolution?
- Decelerating jet (Georganopoulos et al. 2003)?
- Spine/Sheath model (Ghisellini et al. 2005)?
- Any way to distinguish these options? Are there other options?

Piner & Edwards (2014), ApJ, 797, 25

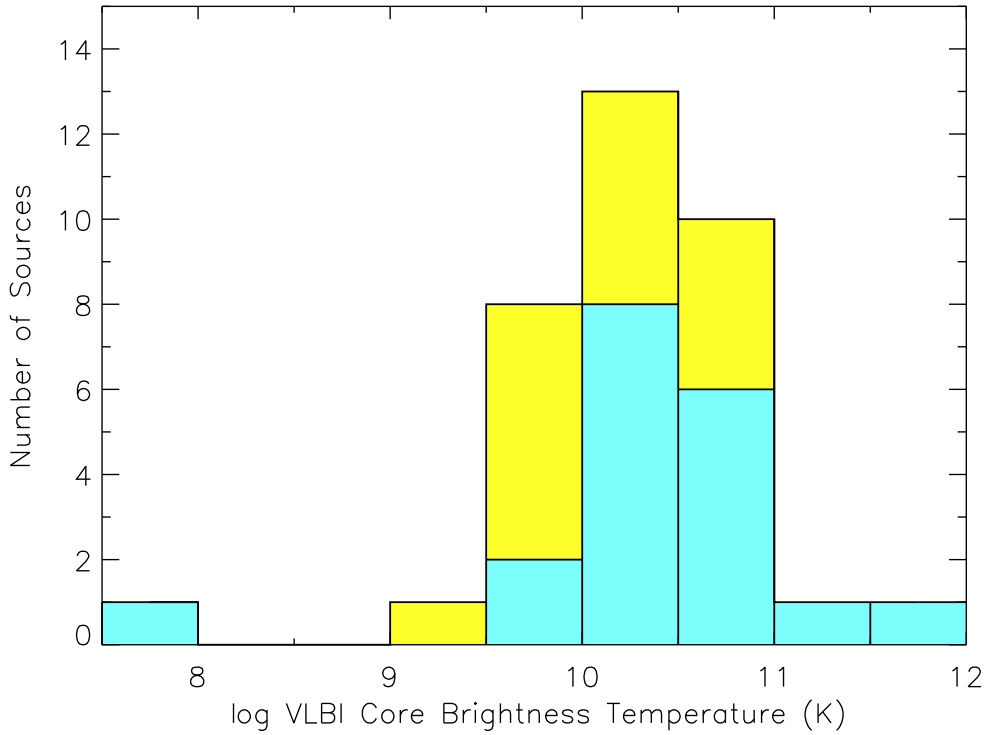
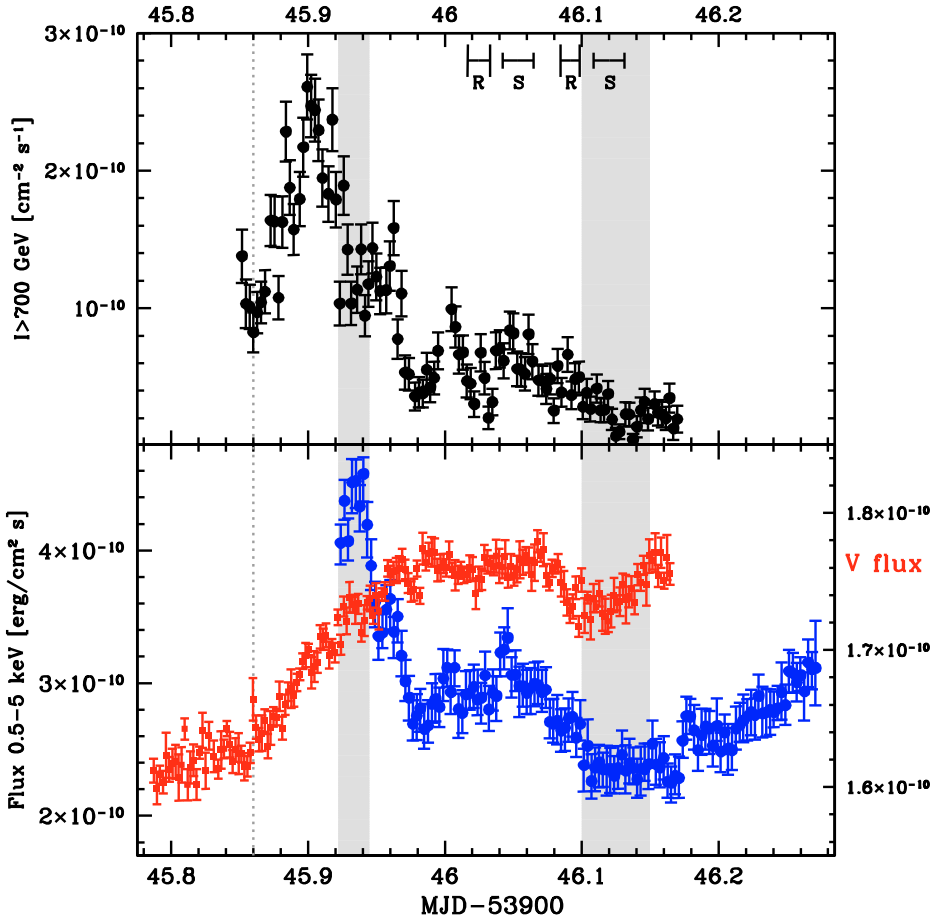


Figure 4. Histogram of observer-frame Gaussian core brightness temperatures of TeV HBLs from Table 7, for sources whose best-fit core size is not zero. New sources with VLBI data from this paper are shown in yellow (16 sources). Sources with data taken from elsewhere are shown in blue (19 sources). The outlier is HESS J1943+213 (see text).

Are multi-zone models viable?

- And do they have too many free parameters?

Are multi-zone models viable?



Aharonian et al. (2009), A&A, 502, 749

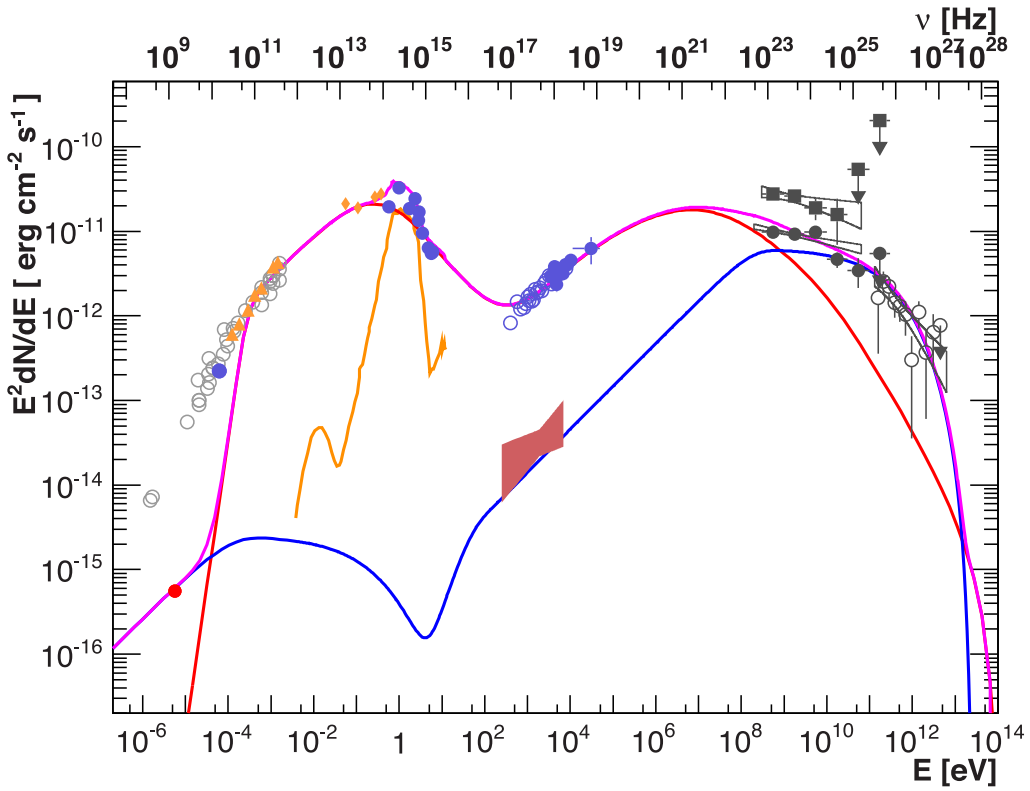
See also:

Petropoulou (2014), A&A, 571, 83

Aleksic et al. (2015), A&A, 578, A22 (Mrk 421)

Potter & Cotter (2012, 2013a, 2013b, 2013c) MNRAS

Are multi-zone models viable?

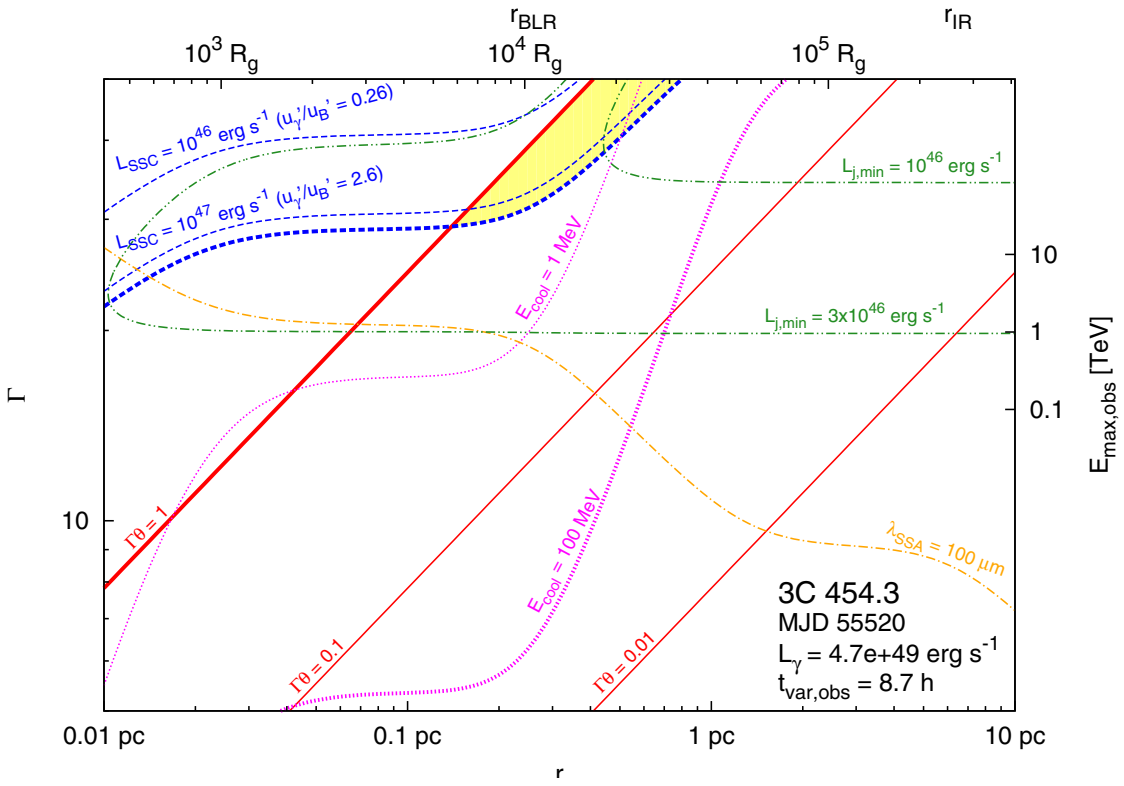


γ-rays from extended jet?

Sanchez et al. (2015), MNRAS, 454, 3229
See also: Hevet et al. (2015), A&A, 578, A69

- Can SED modeling constrain the location of the γ-ray emitting region?

location of the γ-ray emitting region?



Region must be at least at outer part of BLR to not overproduce observed X-rays

Nalewajko et al. (2014), ApJ, 789, 161
See also Dermer et al. (2014), ApJ, 782, 82

- Timescales and the γ-ray emitting region

BLR:

$$\Delta t = 3.3 \times 10^4 \, R_{BLR,17} \, \delta_1^{-2} \, (\delta/\Gamma) \, (1+z) \ \mathrm{s}$$

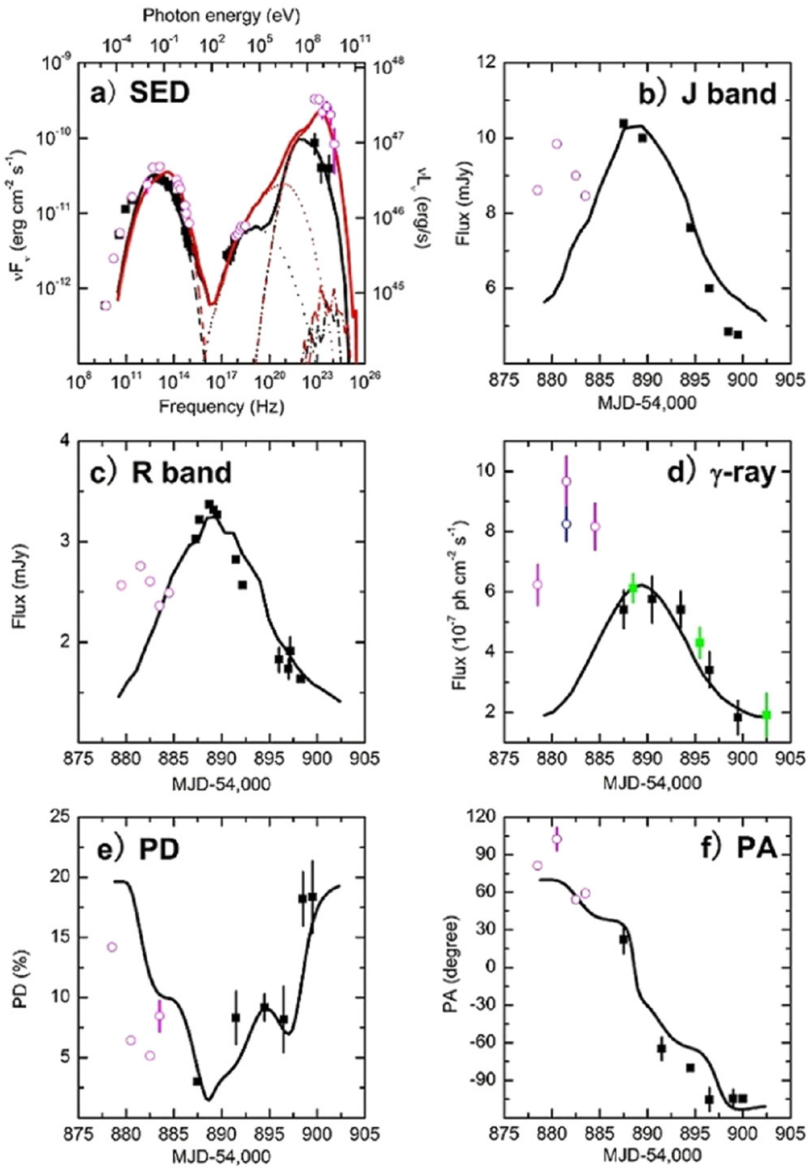
$$t_{cool} = 4400 \, u_{ext,-2}^{-1} \, \delta_1^{-2} \, (\delta/\Gamma)^2 \, E_{0,Ly\alpha}^{1/2} \, E_{\mathrm{obs,GeV}}^{-1/2} \, (1+z)^{1/2} \ \mathrm{s}$$

Dust torus:

$$\Delta t = 13 \, \delta_1^{-2} \, (\delta/\gamma) \, L_{disk,45}^{1/2} \, T_3^{-2.6} \, (1+z) \ \mathrm{day}$$

$$t_{cool} = 3.5 \, \xi_{-1}^{-1} \, T_3^{-4.7} \delta_1^{-2} \, (\delta/\Gamma)^2 \, E_{\mathrm{obs,GeV}}^{-1/2} (1+z)^{1/2} \ \mathrm{day}$$

Can we model polarization angle swings?



Can it tell us something about Jet structure?

Zhang et al. (2015), ApJ, 804, 58
See also talk by Ioannis Myserlis

Important polarization instruments:
RoboPol (talk by Angelakis)
Kanata (talk by Itoh)
Astro-H

FSRQ Flare types

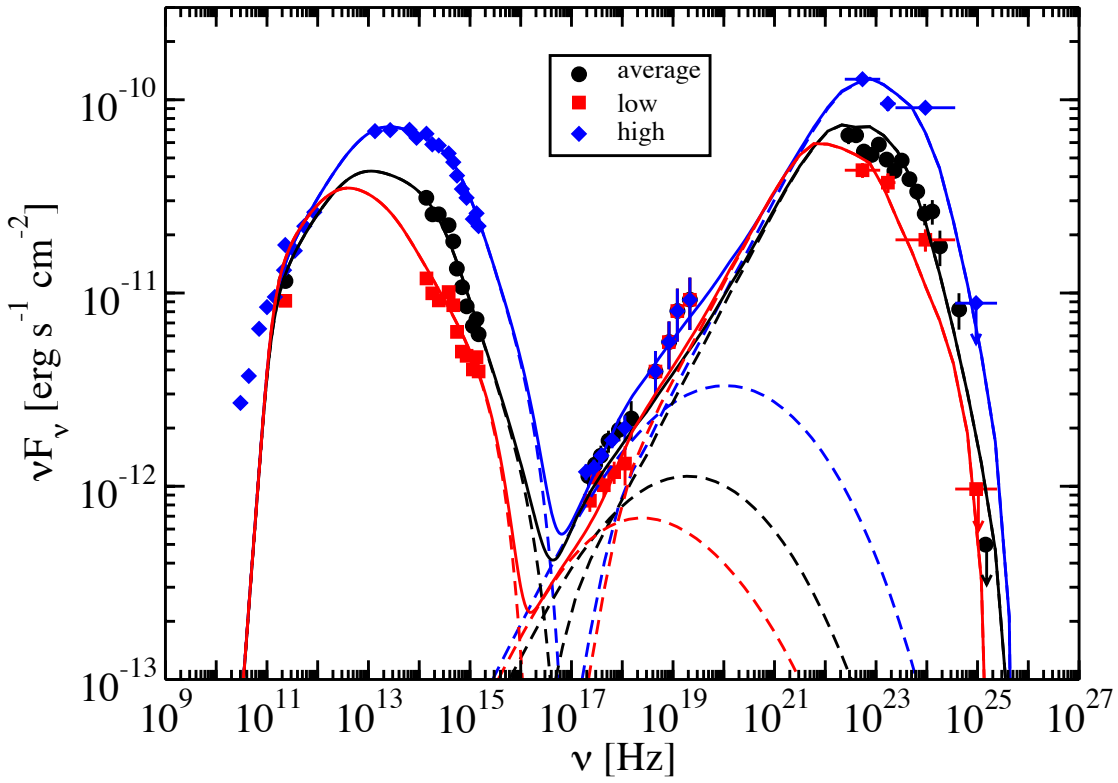
- Type I: Only change in electron distribution needed to explain SED

- Type II: Change in electron distribution not sufficient to explain SED

- Is this a useful classification?

Dutka et al. (2013), ApJ, 779, 174
Dutka et al. (2016), ApJ, in preparation

FSRQ Flare types

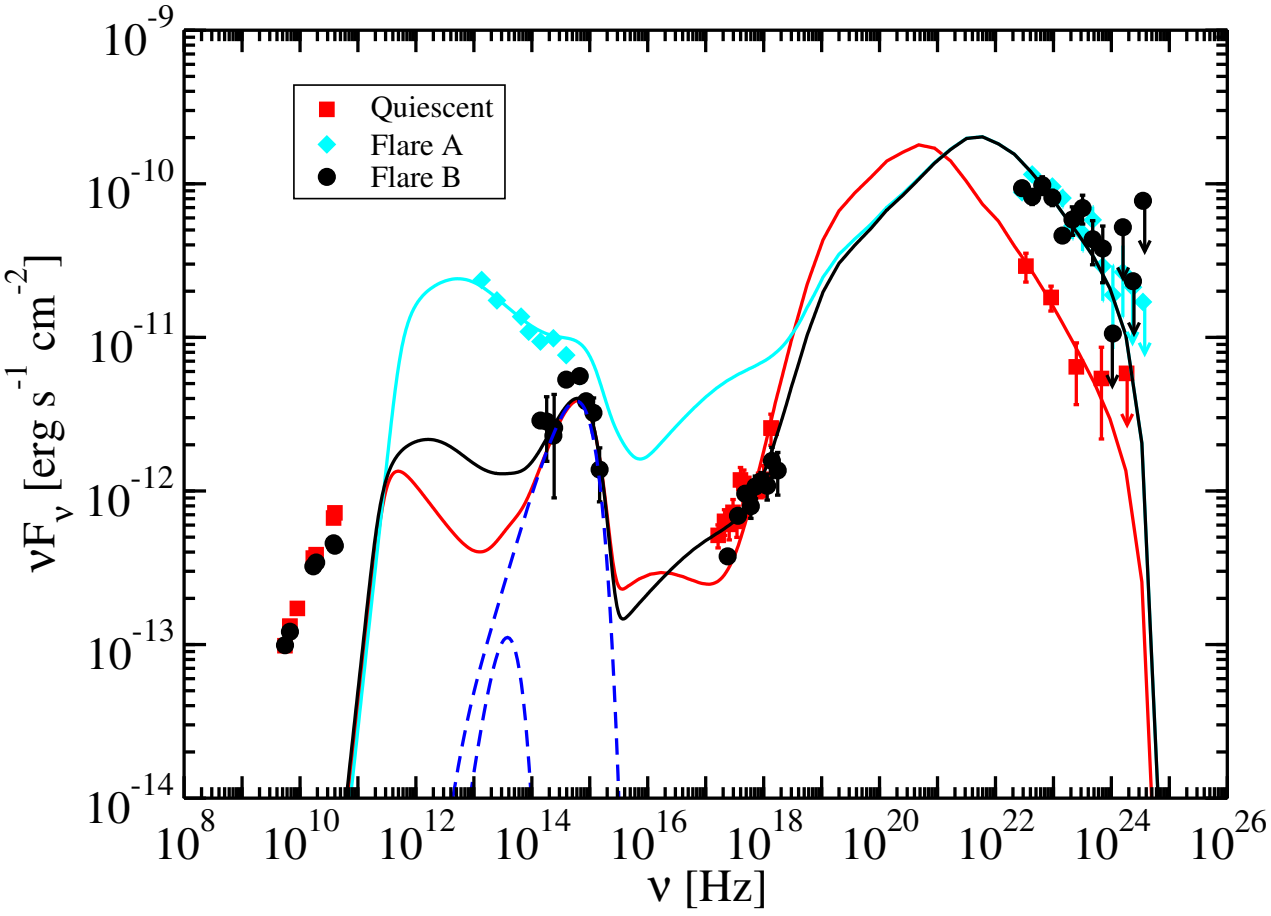


Type I Flare

PKS 0537-441

D'Ammando et al. (2013), MNRAS, 431, 2481

FSRQ Flare types



Dutka et al. (2013), ApJ, 779, 174

Two different flares from this source

Flare A: Type II

Flare B: Type I

But could be due to a lack of spectral coverage in the IR

FSRQ Flare types

- Type I: Only change in electron distribution needed to explain SED
  - Type Ia: optical and γ-ray flare. Optical dominated by non-thermal jet emission.
  - Type Ib: weak or absent optical flare with γ-ray flare. Optical dominated by disk emission during flare. Could be "hidden" type II flares.

- Type II: Change in electron distribution not sufficient to explain SED
  - Type IIa: weak or absent X-ray flare with γ-ray and optical flare. Change in B-field and size of emitting region?
  - Type IIb: strong X-ray flare with γ-ray and optical flare. Change in B-field only? Do these types of flares exist?

Particle Acceleration

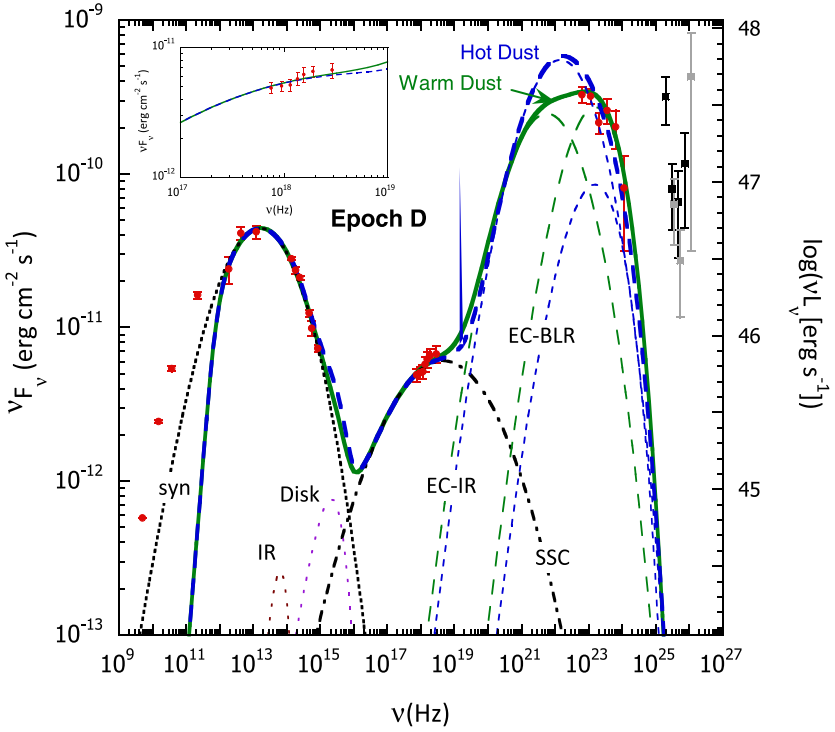


Figure 6. Equipartition blazar model fits to the SEDs of 3C 279 (Hayashida et al. 2012) for Epochs C (upper panel) and D (lower panel), with spectral components and inset graphs as described in Figure 5. The upper panel shows a warm dust, hot dust, and long variability time, $t_{\rm var} = 10^5$ s, solution. The lower panel for the Epoch D fit shows both warm-dust and hot-dust Compton scattering components. Non-simultaneous VHE MAGIC data for 3C 279 are shown in the lower panel for comparison with the Epoch D *Fermi* LAT γ-ray data.

Narrow electron distribution needed for modeling FSRQs

Dermer et al. (2014), ApJ, 782, 82

- How important are simultaneous observations?