Blazars:
Probes of the Jet Launching Region

A Summary

(with apologies to nearly everybody)

SW

Thanks to speakers for providing talks
(or preliminary versions)

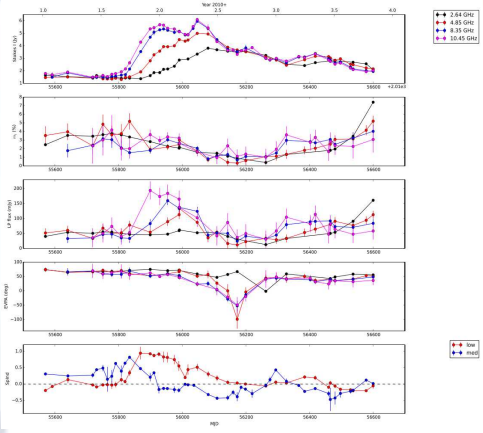
Blazars:
Probes of the Jet Launching Region

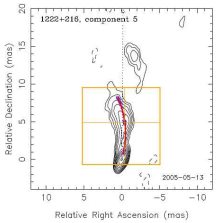
A picture is worth a thousand words....

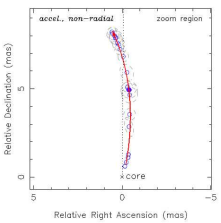
16 pictures are worth 16.000 words

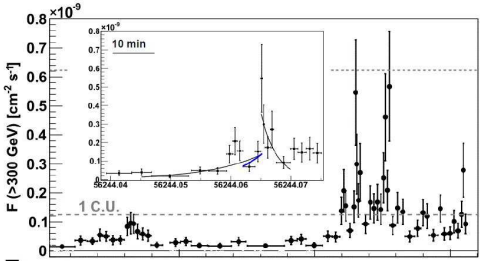
Warning: This summary is based on a highly biased choice of figures, quotes, and selection of results. Any misinterpretations and wrong assessment are the sole responsibility of the rapporteur.

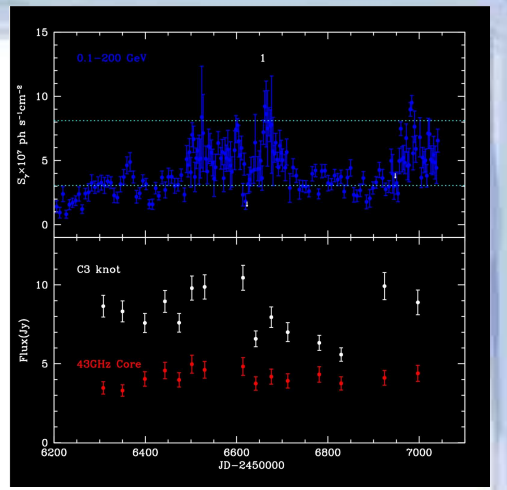
Blazars

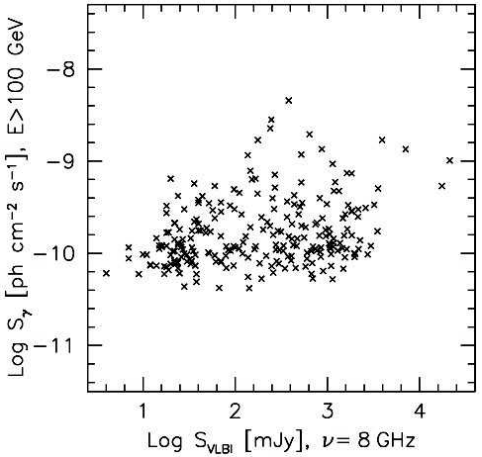


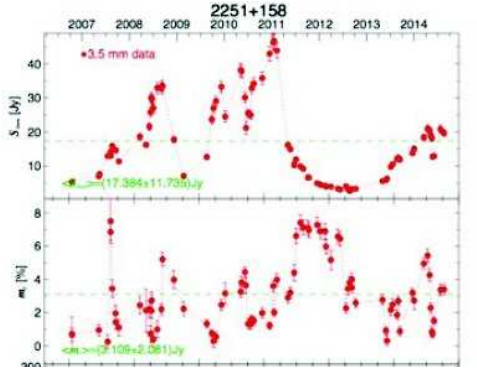

1222+216, component 5
Relative Declination (mas)
Relative Right Ascension (mas)
2005-05-13

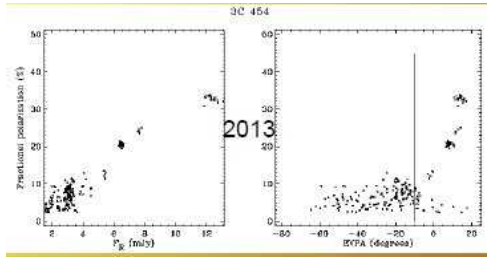

accel., non-radial
zoom region
core
Relative Declination (mas)
Relative Right Ascension (mas)

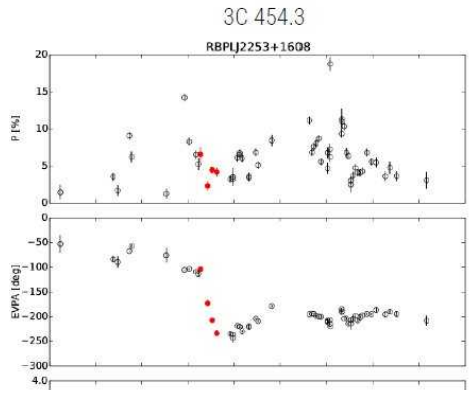

10 min
1 C.U.
F (>300 GeV) [cm^{-2} s^{-1}]

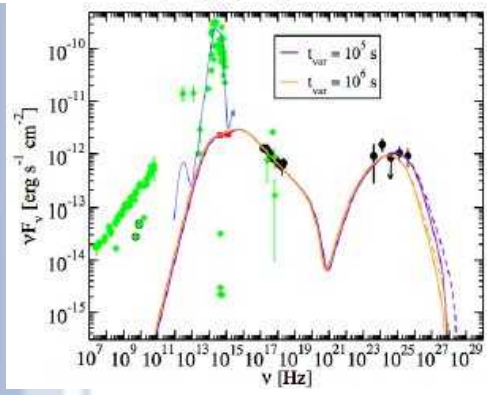

0.1−200 GeV
C3 knot
43GHz Core
Flux(Jy)
JD−2450000

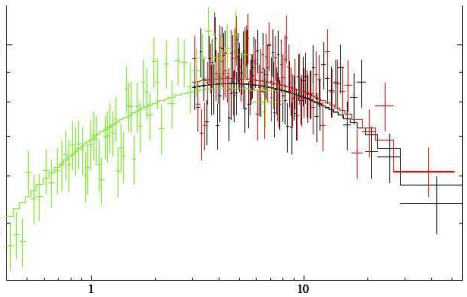

Log S$_\gamma$ [ph cm^{-2} s^{-1}], E>100 GeV
Log S$_{VLBI}$ [mJy], ν= 8 GHz

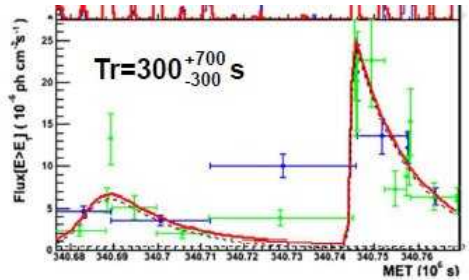

2251+158
•3.5 mm data

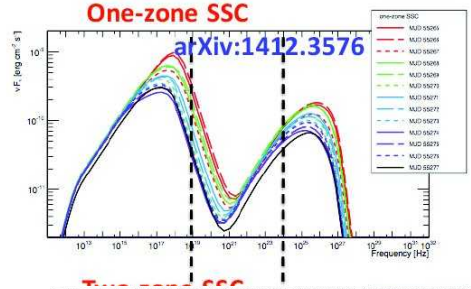

3C 454
2013
EVPA (degrees)

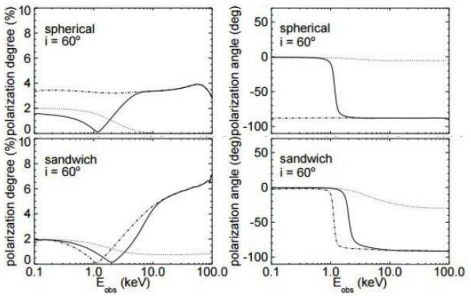

3C 454.3
RBPLJ2253+1608
EVPA [deg]

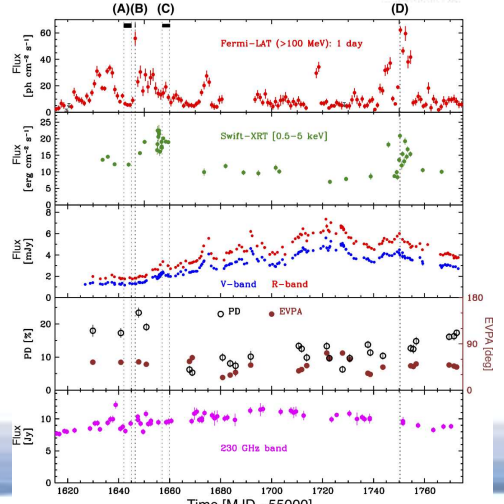

t$_{var}$ = 10^5 s
t$_{var}$ = 10^6 s
νF$_\nu$ [erg s^{-1} cm^{-2}]
ν [Hz]

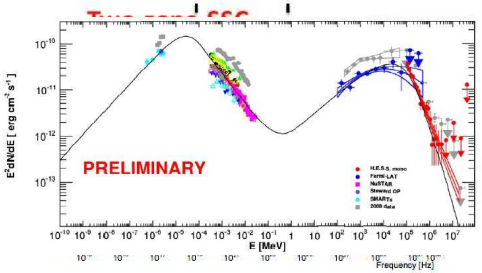


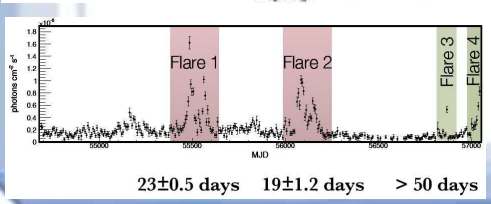

Tr=300$^{+700}_{-300}$ s
Flux[E>E$_t$] (10^{-6} ph cm^{-2} s^{-1})
MET (10^6 s)


One-zone SSC
arXiv:1412.3576
Frequency [Hz]


spherical
i = 60°
sandwich
i = 60°
polarization degree (%)
polarization angle (deg)
E$_{obs}$ (keV)


(A)(B) (C)
(D)
Fermi-LAT (>100 MeV): 1 day
Swift-XRT [0.5-5 keV]
V-band R-band
PD EVPA
230 GHz band
Time [MJD −55000]


PRELIMINARY
E^{2}dN/dE [erg cm^{-2} s^{-1}]
E [MeV]
Frequency [Hz]


Flare 1
Flare 2
Flare 3
Flare 4
MJD
23±0.5 days
19±1.2 days
> 50 days

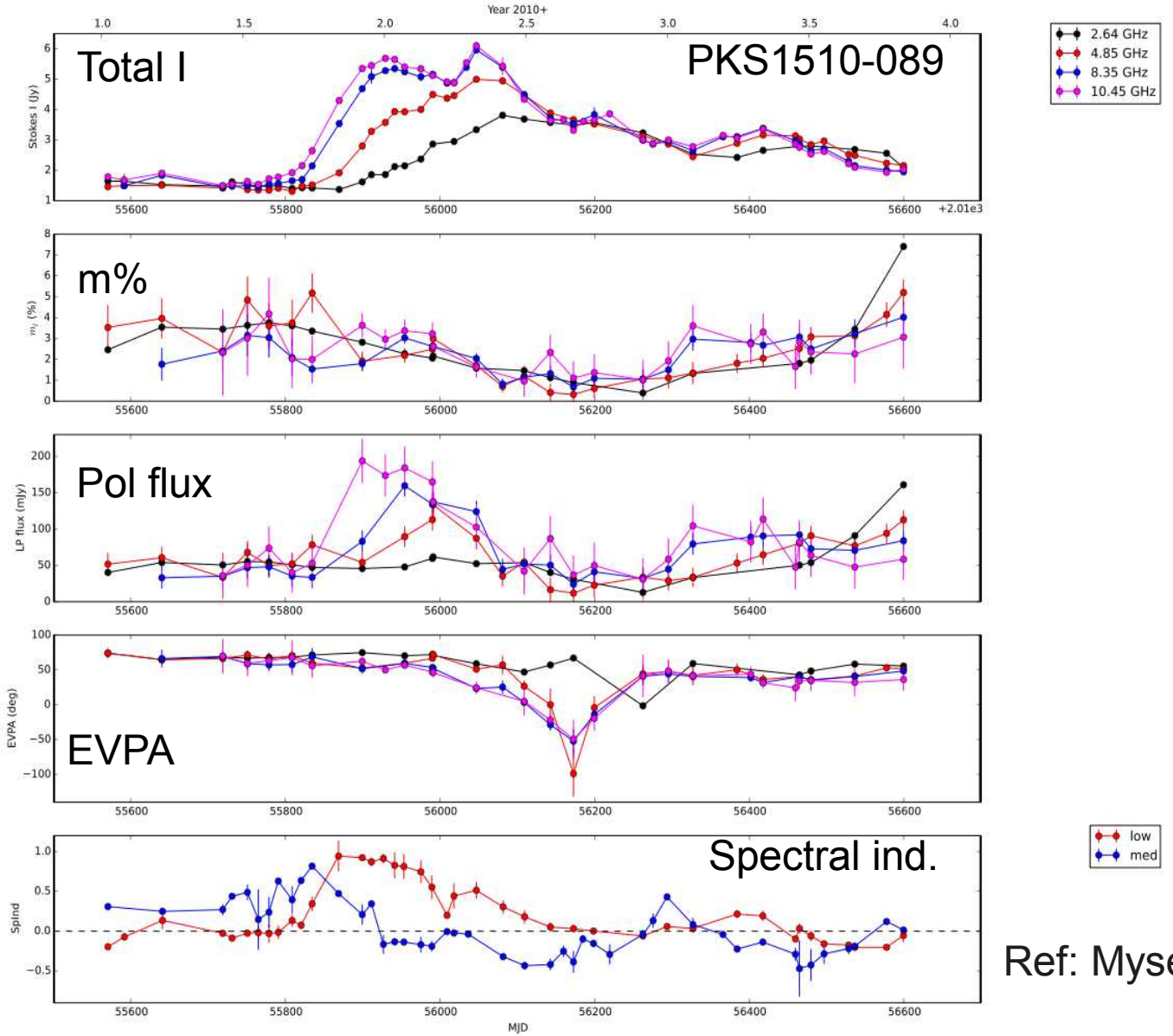
Talvikki Hovata

Variability → brightness temperature→ Doppler factor

Parameter estimates and modeling of polarimetric monitoring data

Worry about transparency

Where?



Ref: Myserlis, et al., 2014

Matt Lister

MOJAVE

High-resolution radio monitoring

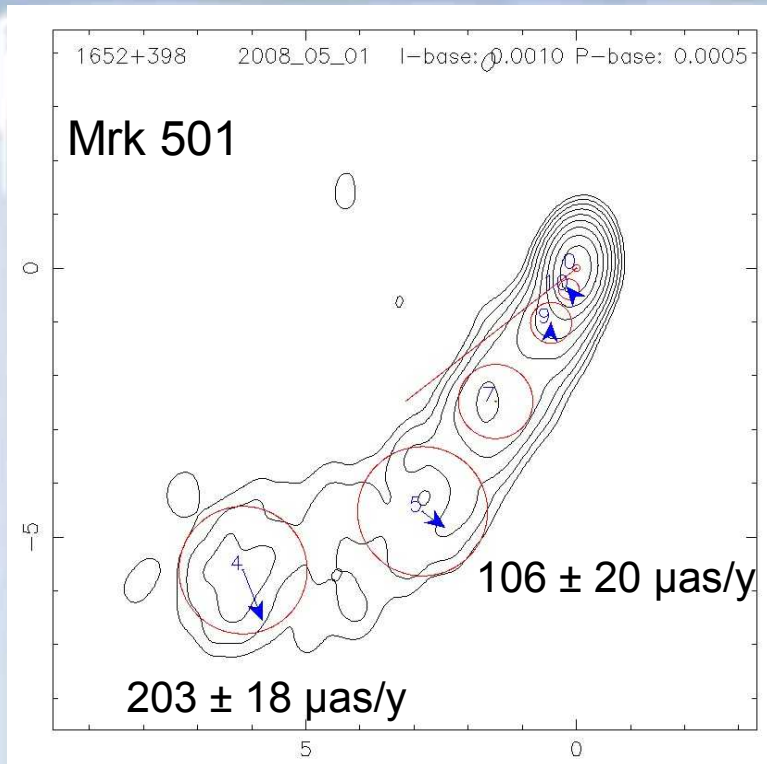
Curved trajectories
→ small angles
filling-in wide time-averages cones

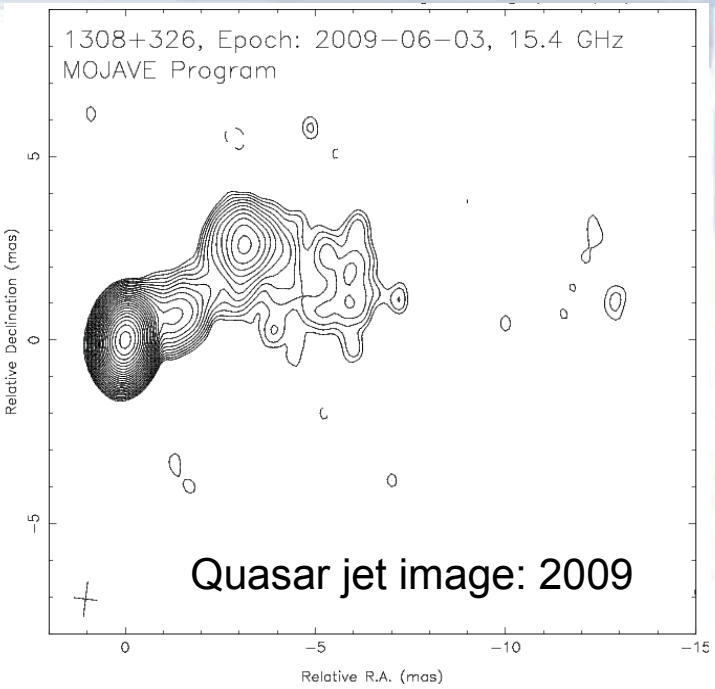
Many low velocities, but any knot may differ significantly from average

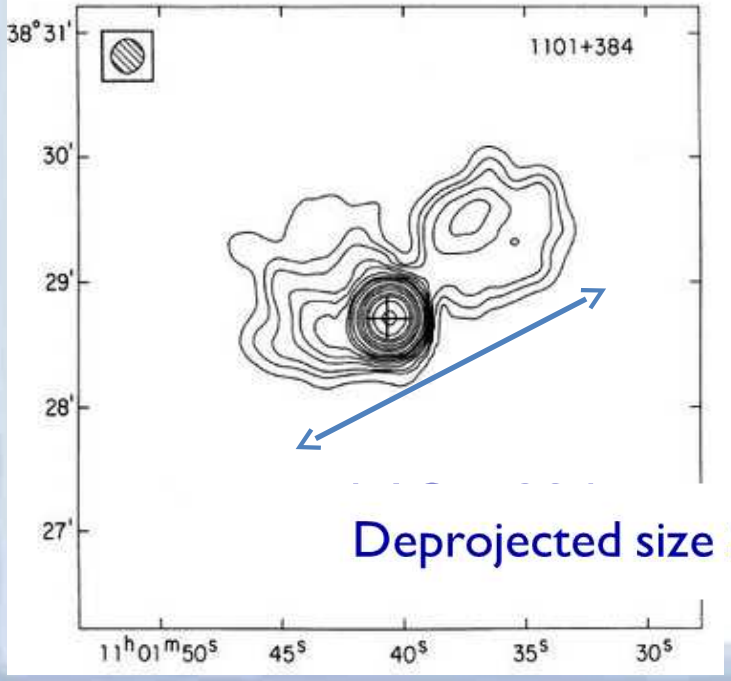
LONG jets

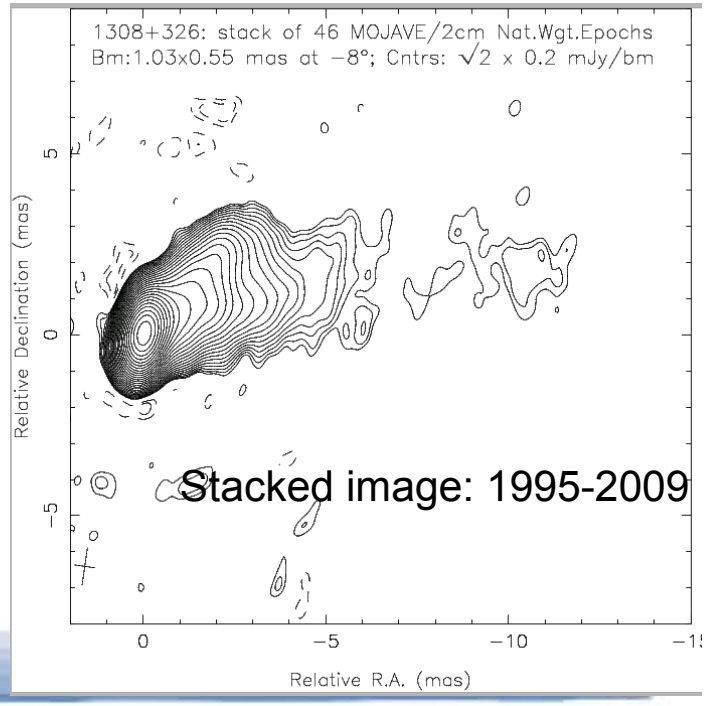
Deprojected size $\geq 900 \left(\frac{\delta}{10}\right)$ kpc !

Beaming







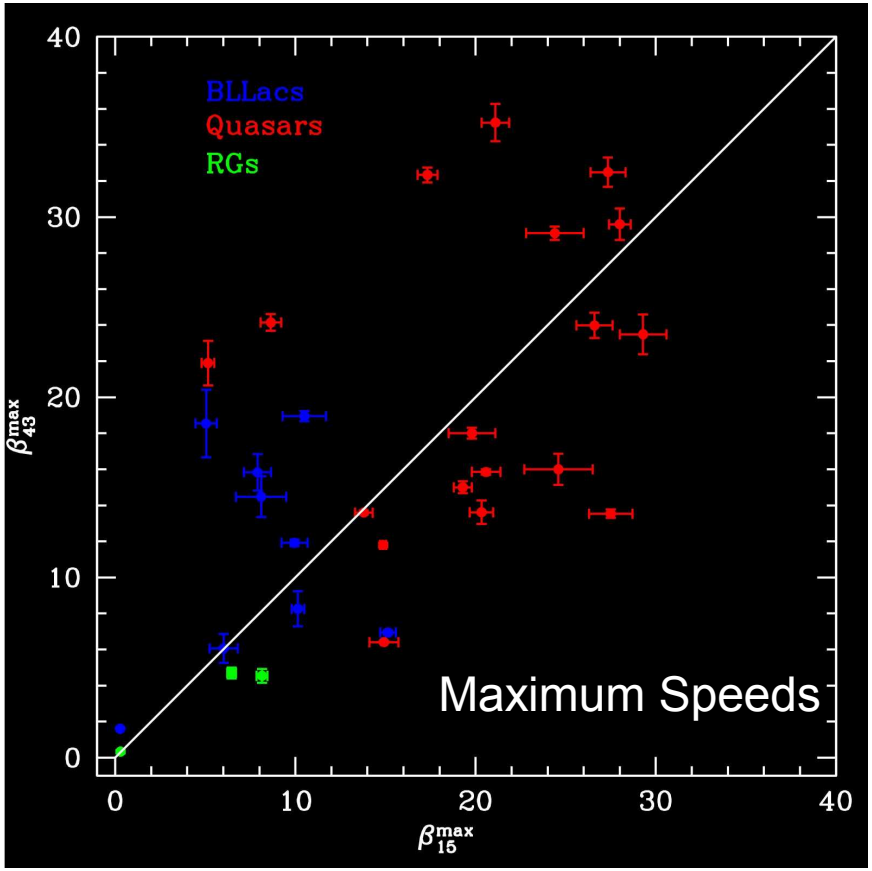


Svetlana Jorstad

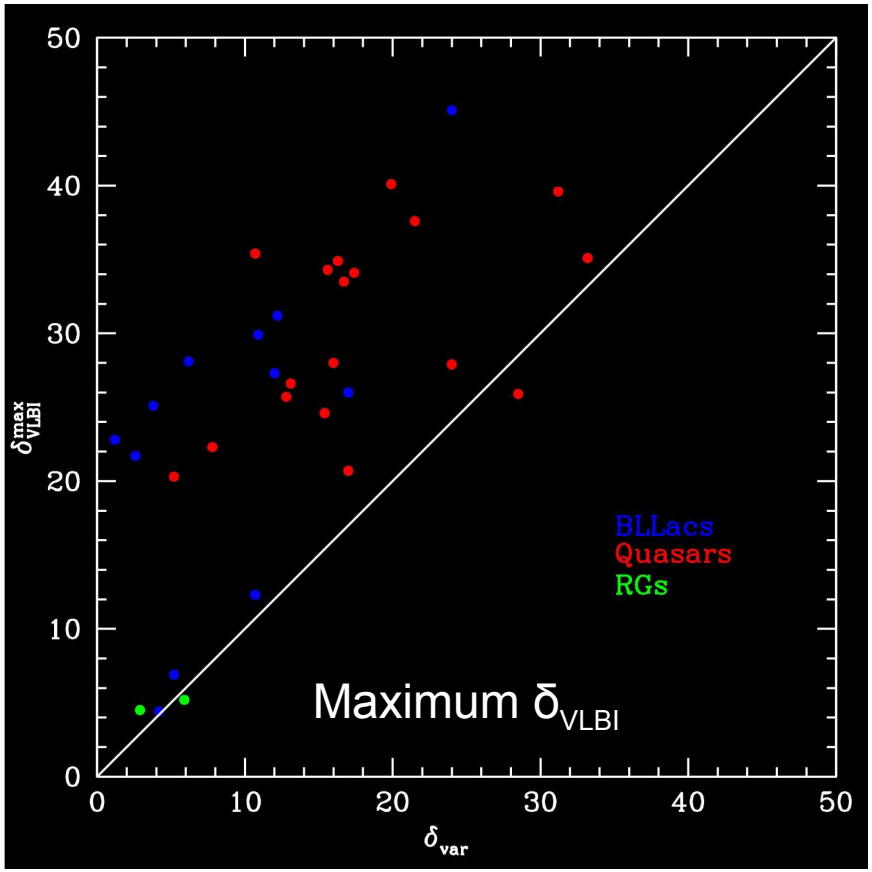
Where ?

BU program: localizing flaring regions within the jet.

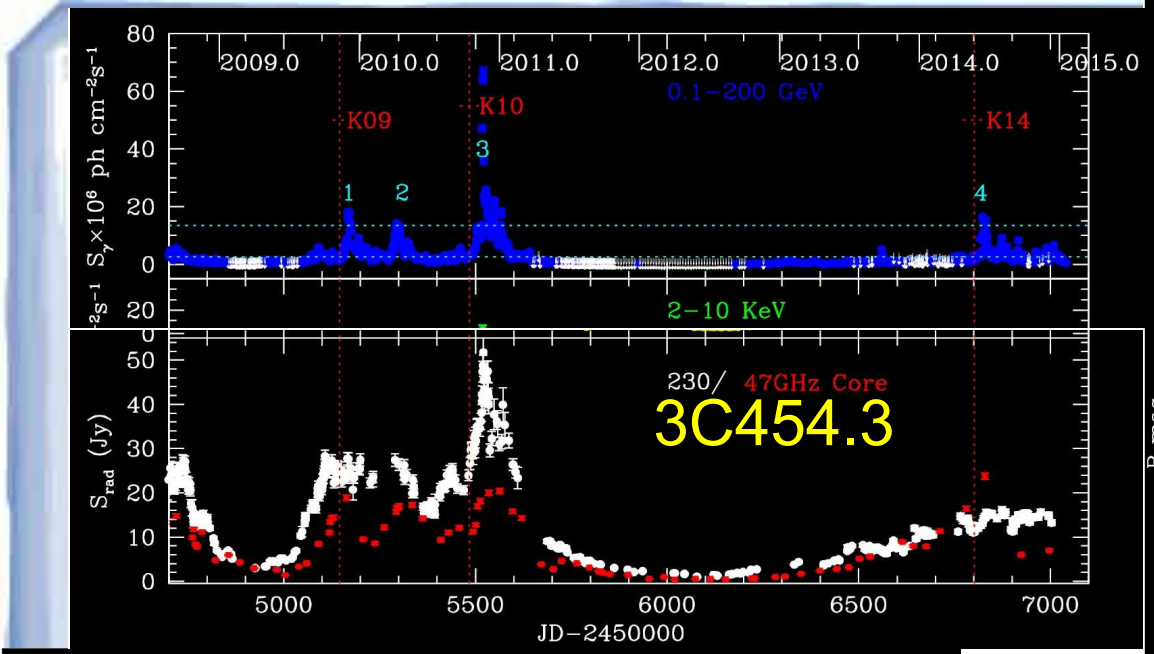
Doppler speeds, scatter (cf MOJAVE), and systematics (offsets).

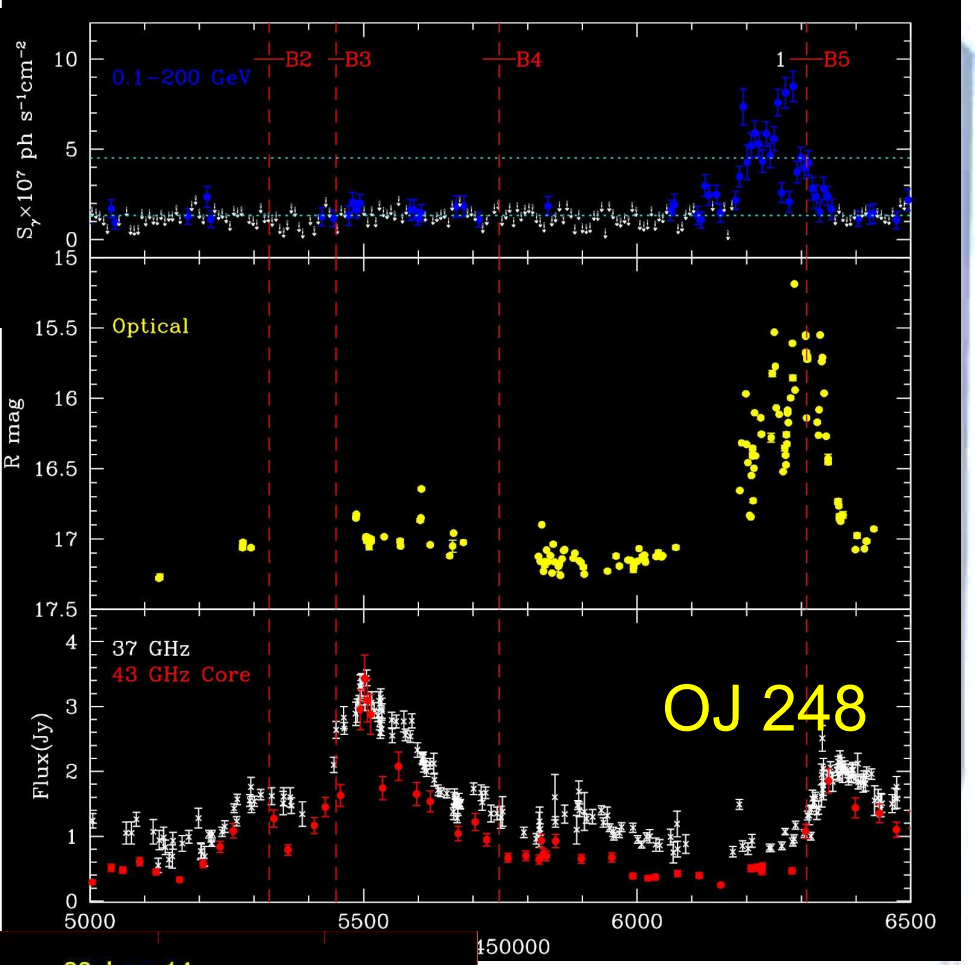


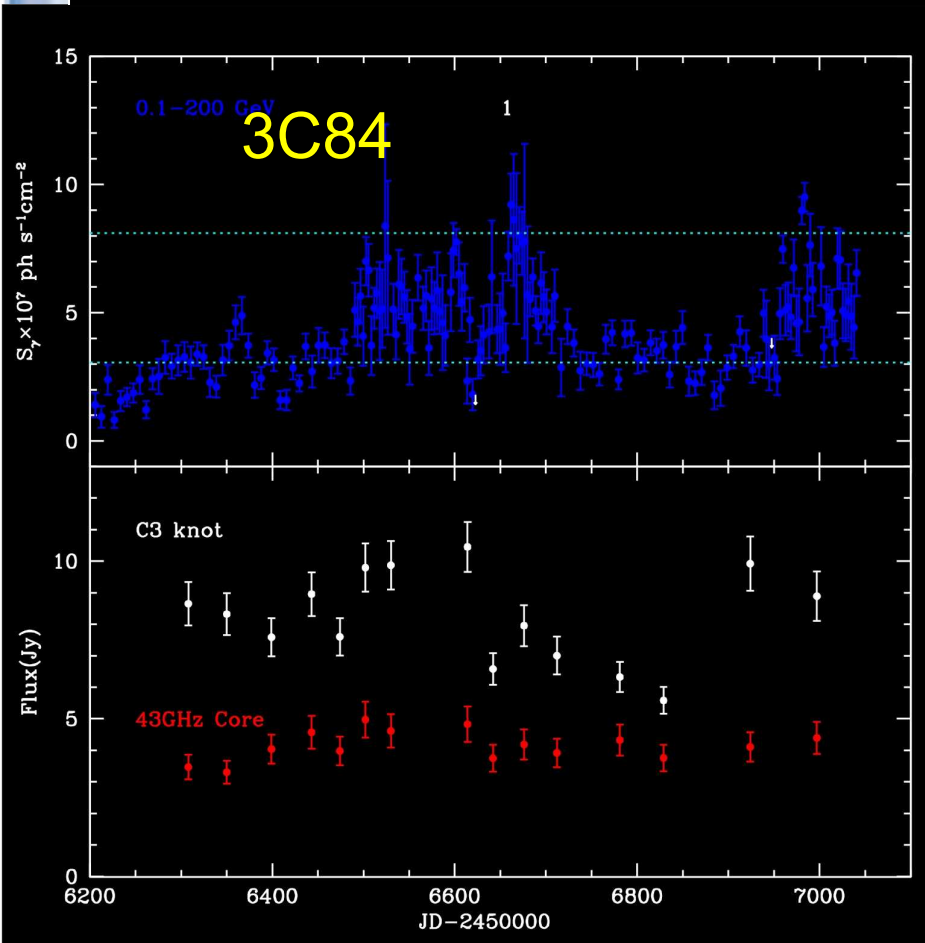
BU – MOJAVE (distance effect?)

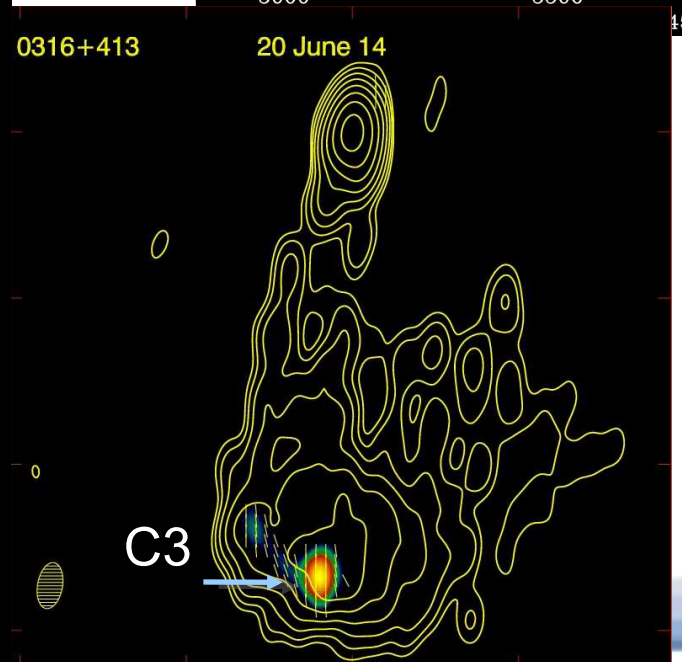


BU – Variability (systematics?)







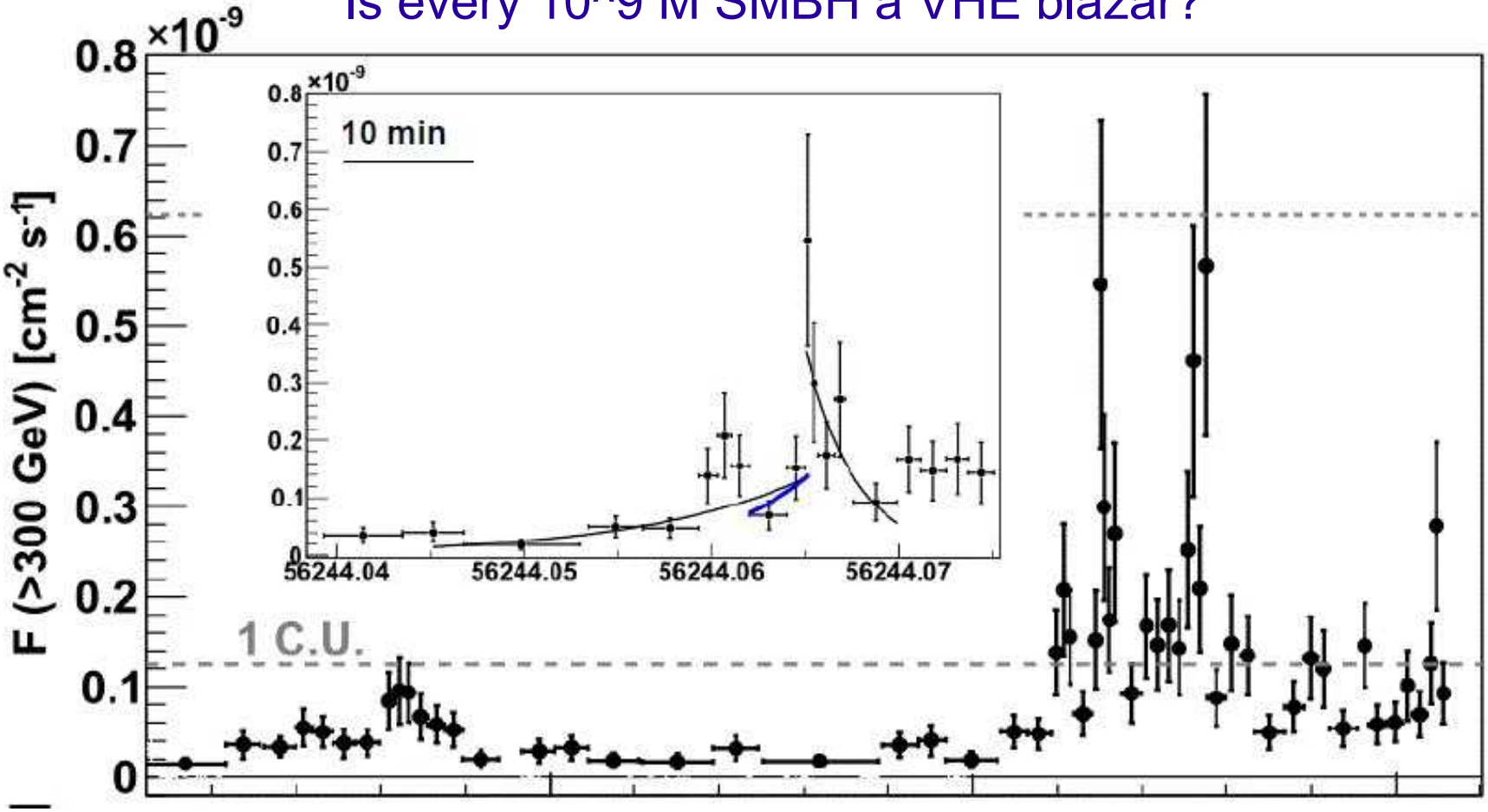


Flares and 43 GHz VLBI core matches: Close (3C454.3), yes/no (OJ 248), No (3C84) **BUT Match with C3?**

Dorit Glawion

Beaming

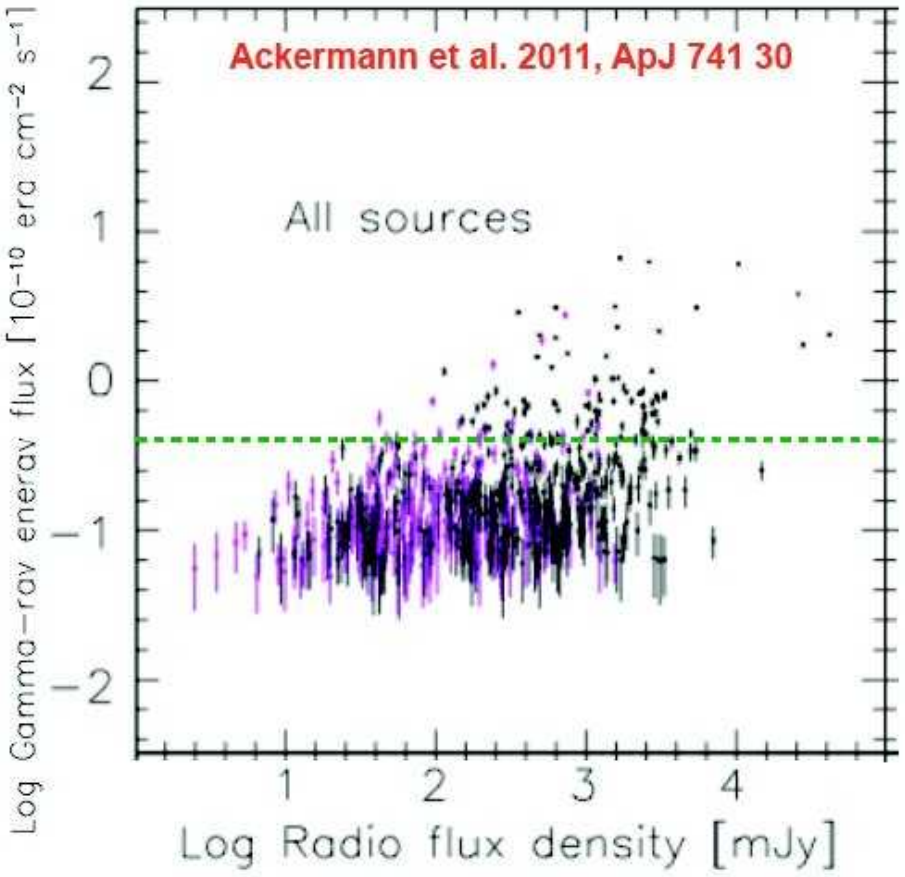
High Doppler factors → population statistics.
Is every 10^9 M SMBH a VHE blazar?



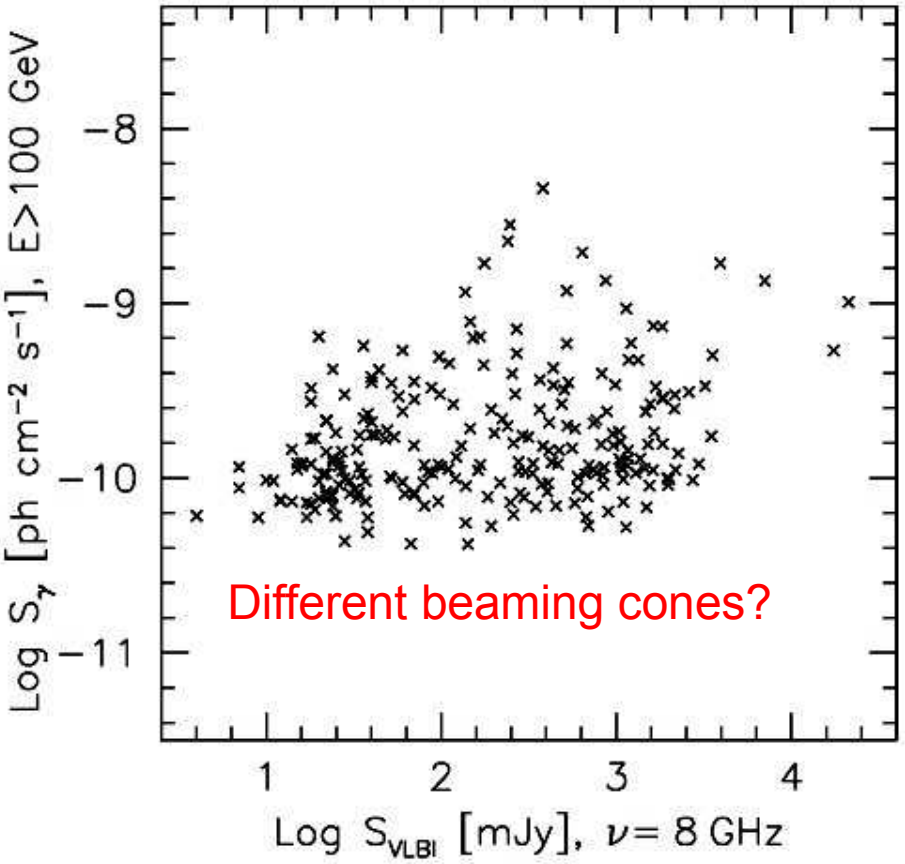
Rapid variations in inconspicuous radio galaxy IC 310
(chance detection of VHE nature, variability)

Marcello Giroletti

Correlation radio – GeV/VHE (skewed!) r=.47 → r=.29
(Fermi long-term less affected by flaring episodes)



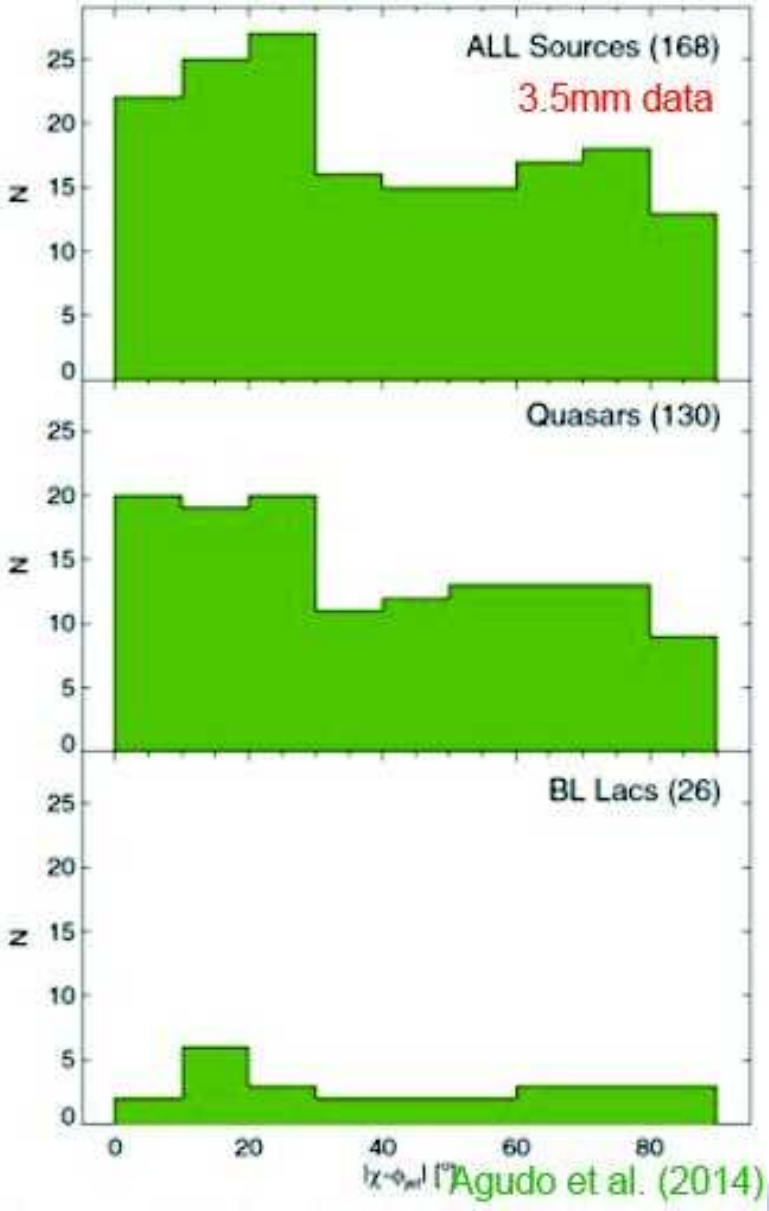
1FHL sources (E>100 GeV)

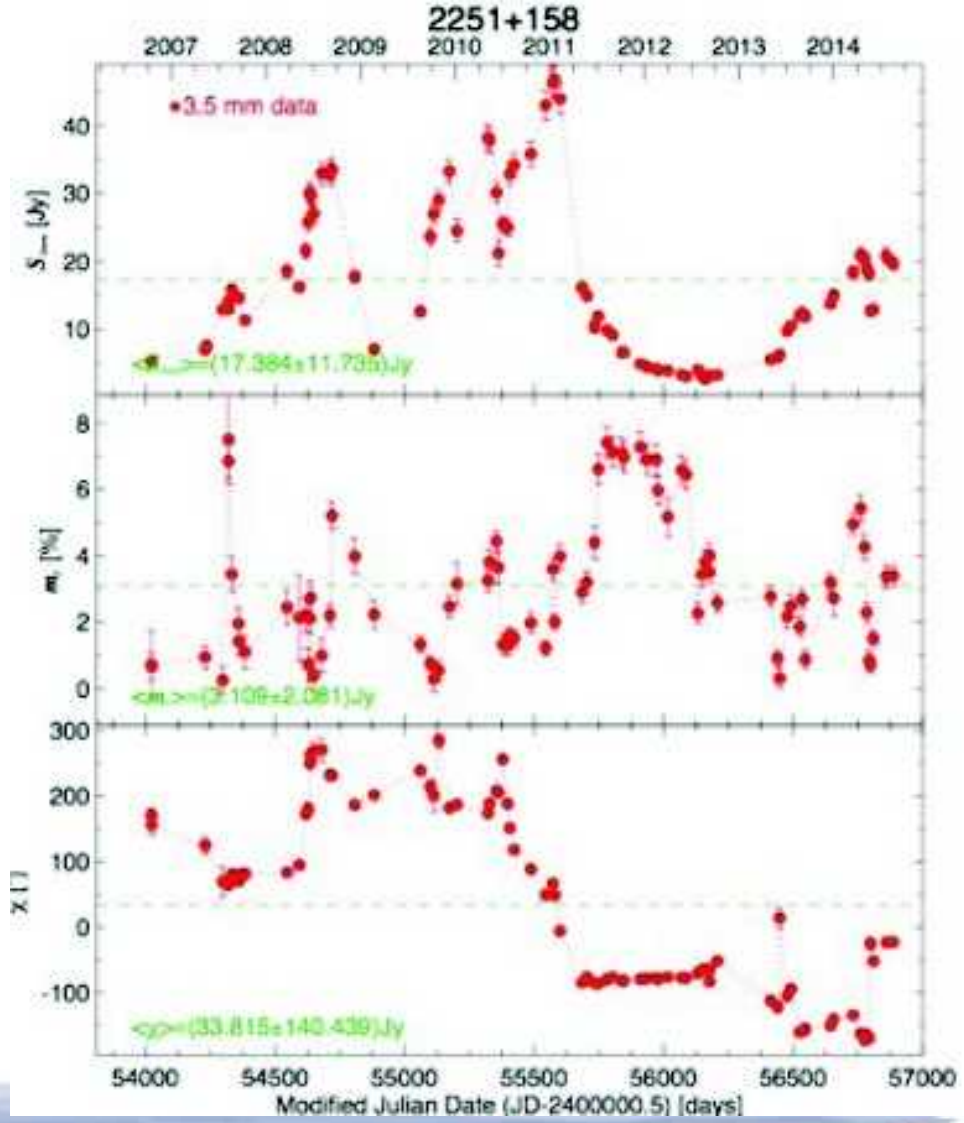


Ivan Agudo

No axisymmetry?

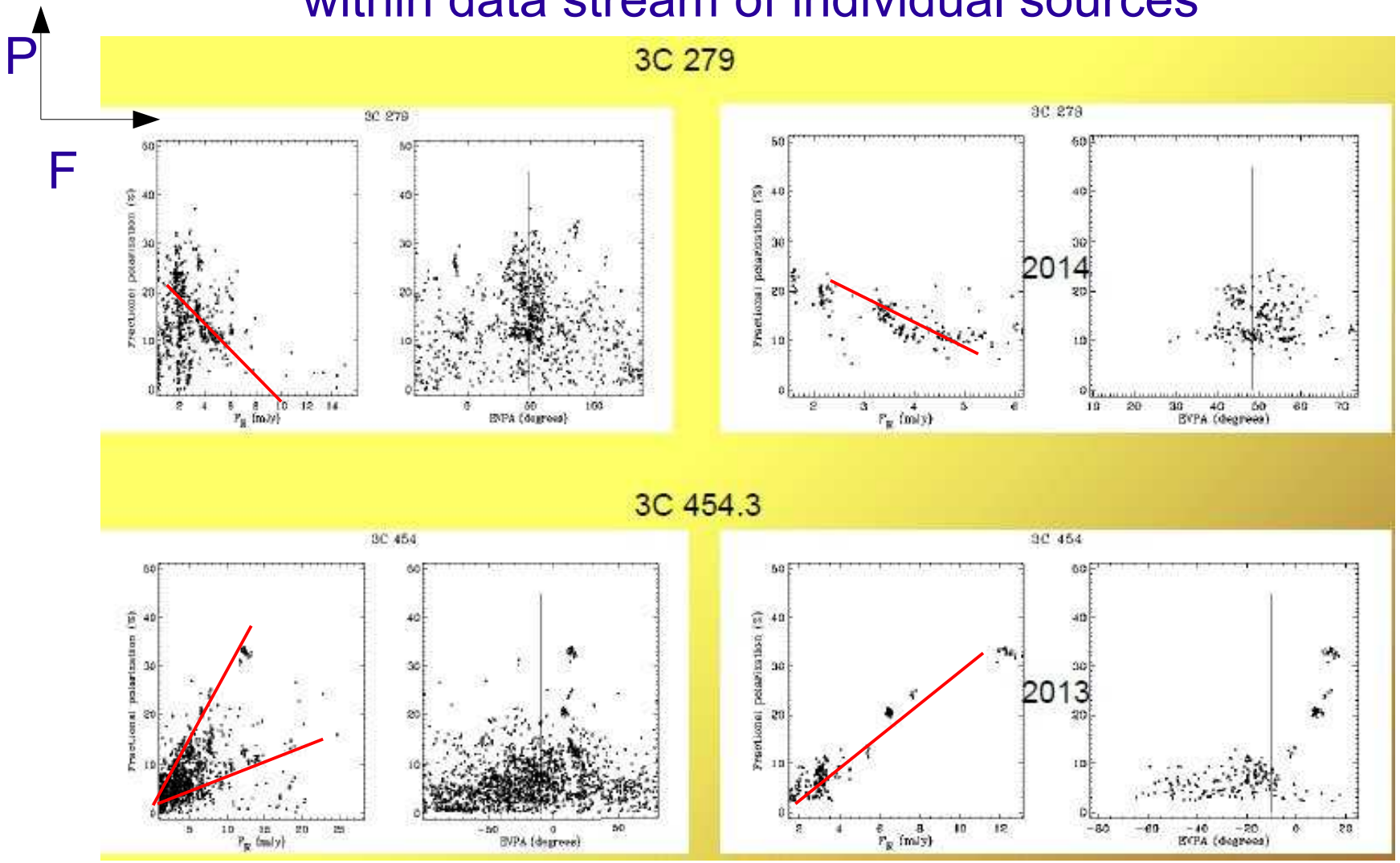
Weak (no) correlation of (hard-to-define) average polarisation angles and jet axis {beware of short data trains}.





Valeri Larinov

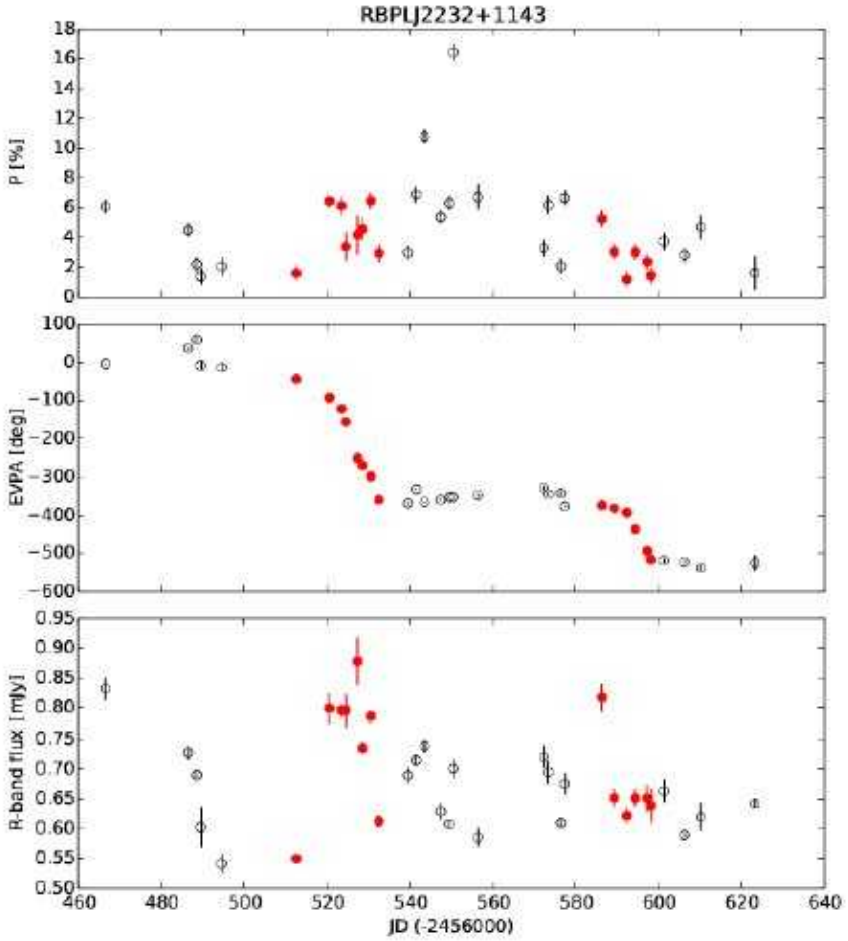
Wide range of polarimetric behaviour across sample and within data stream of individual sources



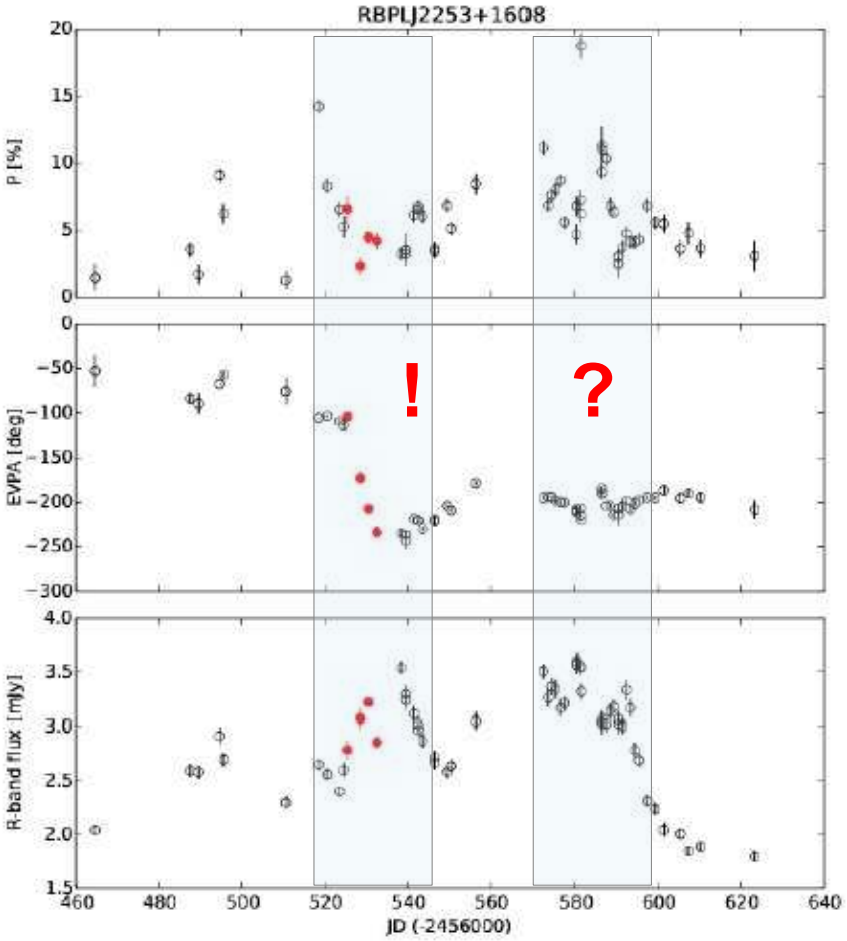
Dmitry Blinov

Occasional matches between EVPA swings and flares.
Random walk in Stokes Plane turns into EVPA swings more frequently in sources with low average P (Gamma-bright sources).

CTA 102

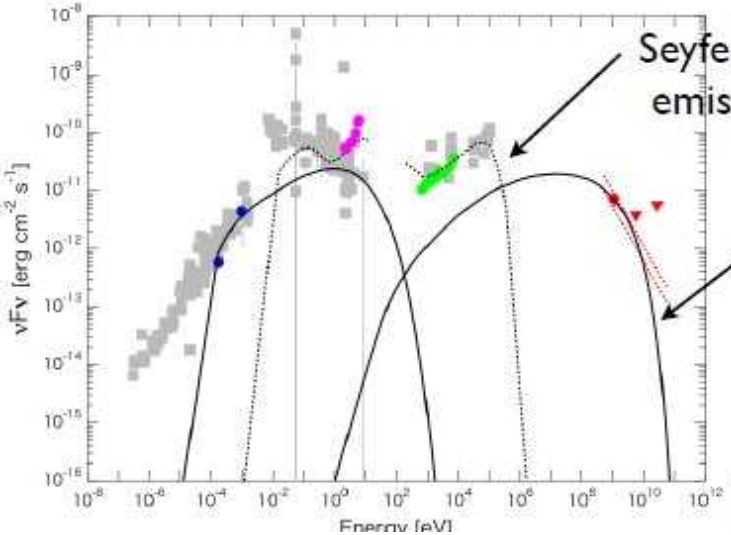


3C 454.3



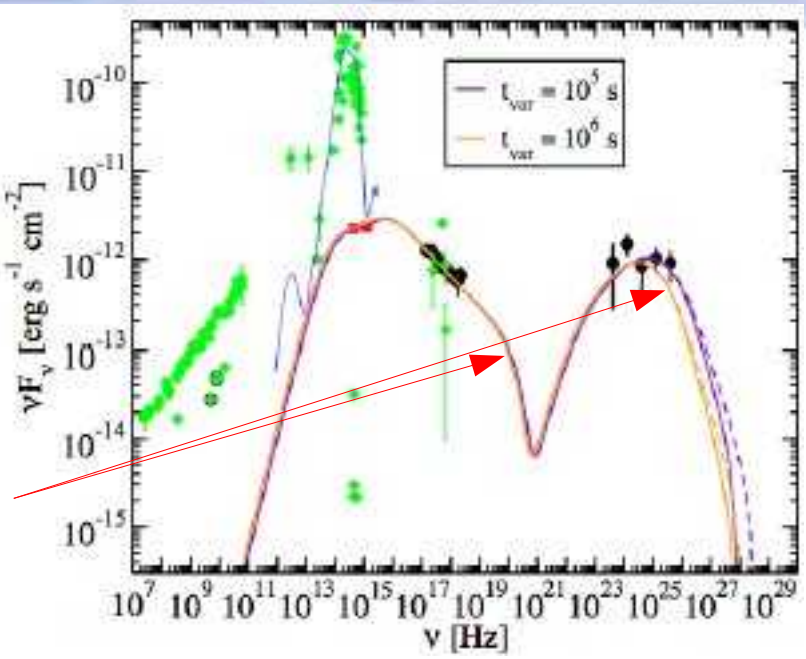
Yasuyuki Tanaka

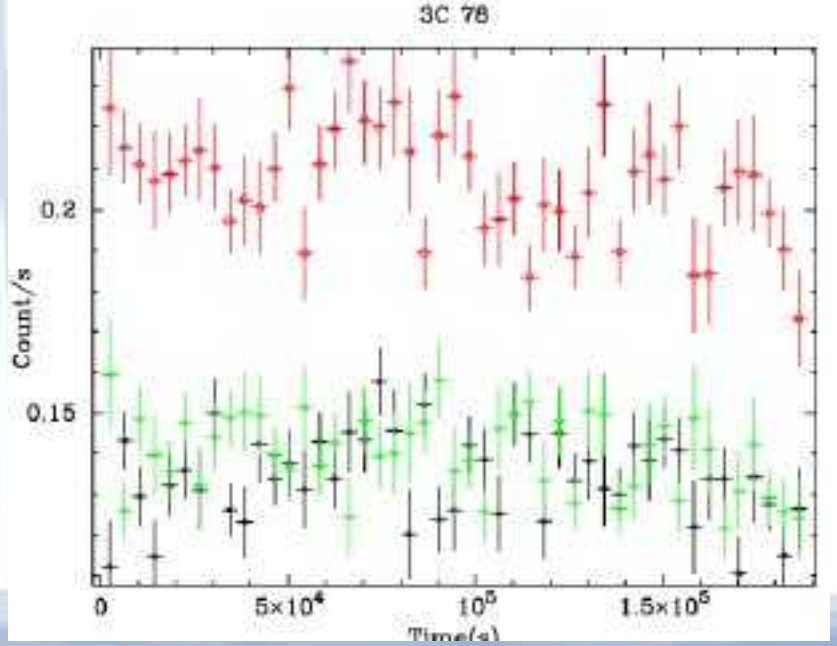
3C 120 SEDRG as Gamma-Ray sources

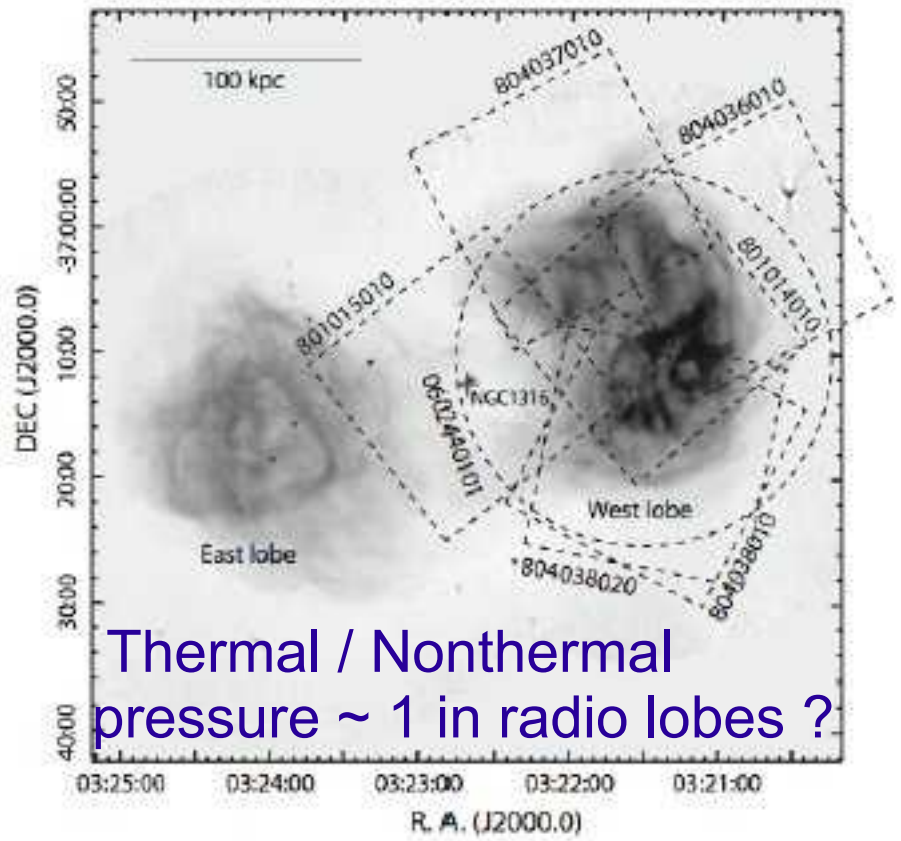


Tanaka+15,

high γ_{max}

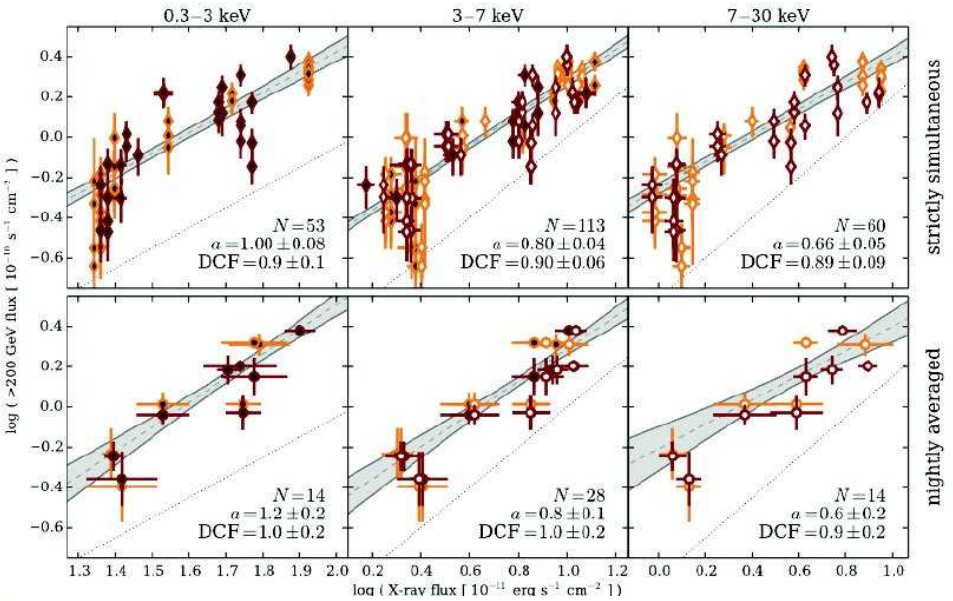


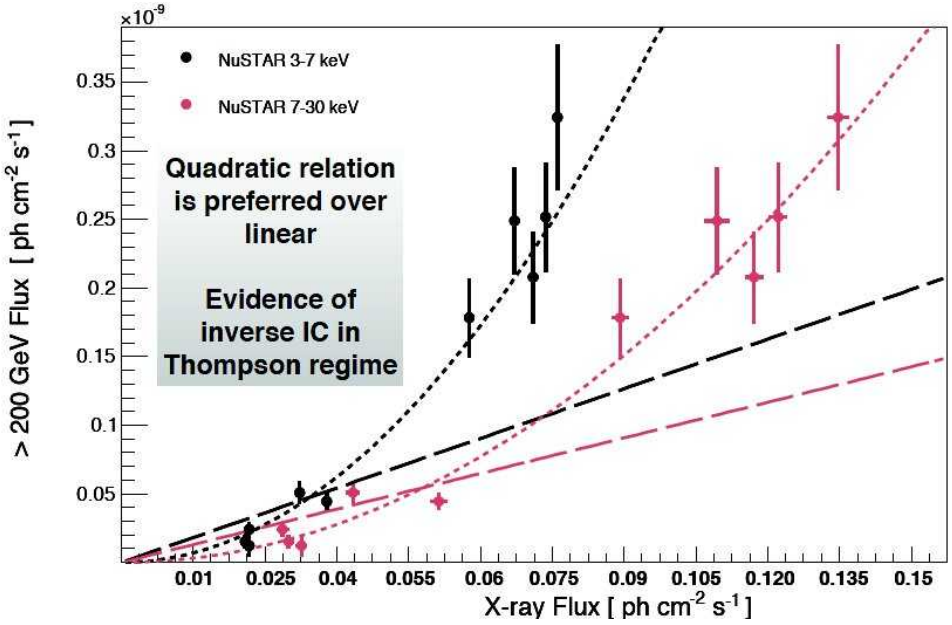




Thermal / Nonthermal pressure ~ 1 in radio lobes ?

Amy Furniss

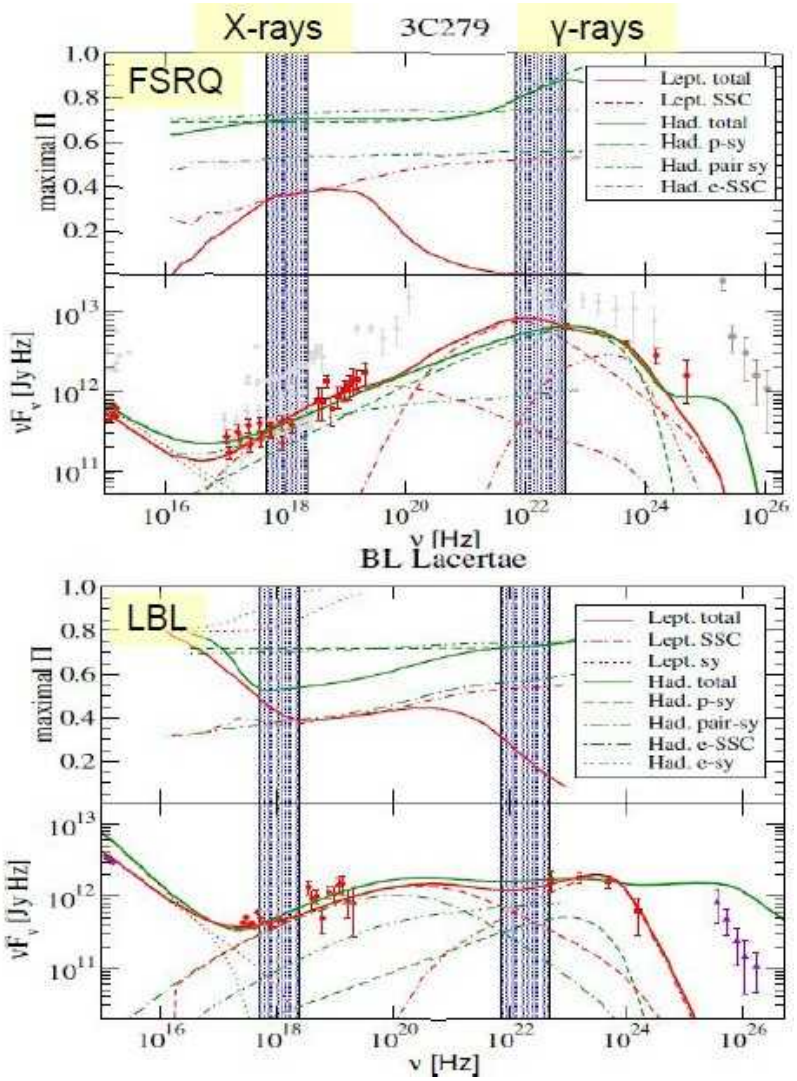




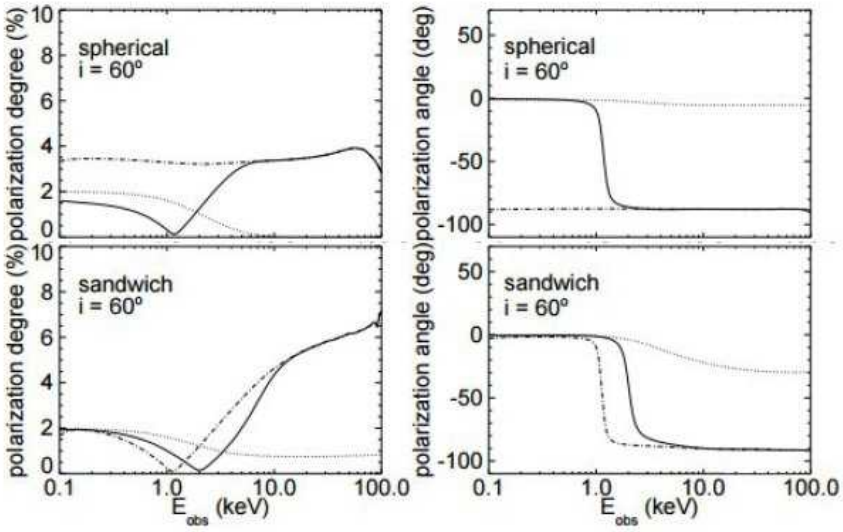
Gamma-flux / X-ray flux throughout campaigns with significant dynamic range follow linear and quadratic trends, respectively, suggesting SSC in Klein-Nishina and Thompson regimes.

Is this a feature of the source or of the event?

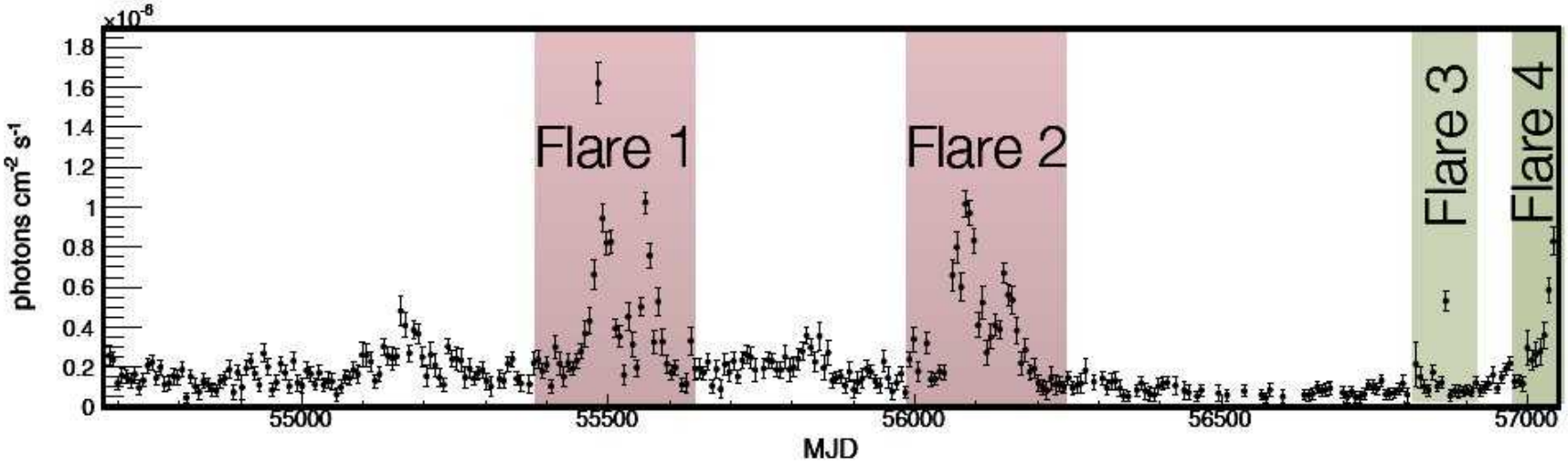
Anna Zajczyk



X-ray Polarimetry on the horizon.
X-Calibur, Astro-H
and further proposed instruments
may utilize this for further tests.



Anna Barnacka

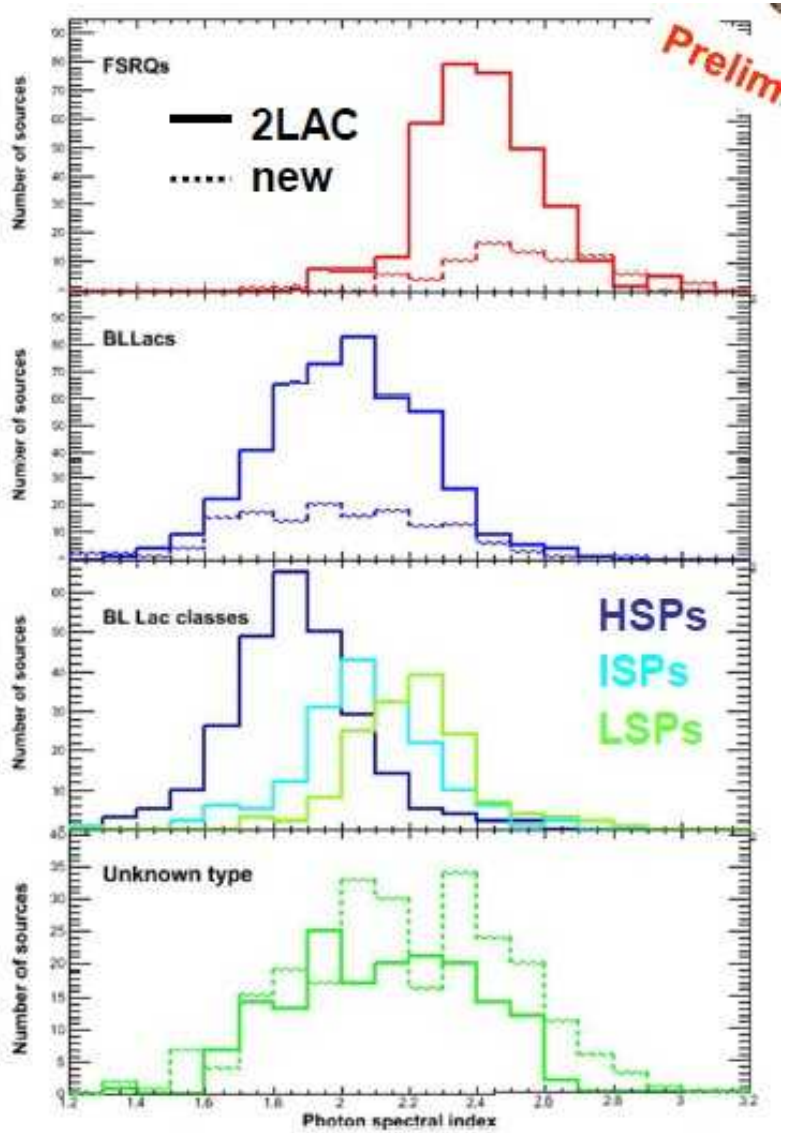


23±0.5 days 19±1.2 days > 50 days

Gravitationally lensed PKS 1830-211 observed
with Fermi during multiple flares,
effectively improving angular resolution to 0.02”.

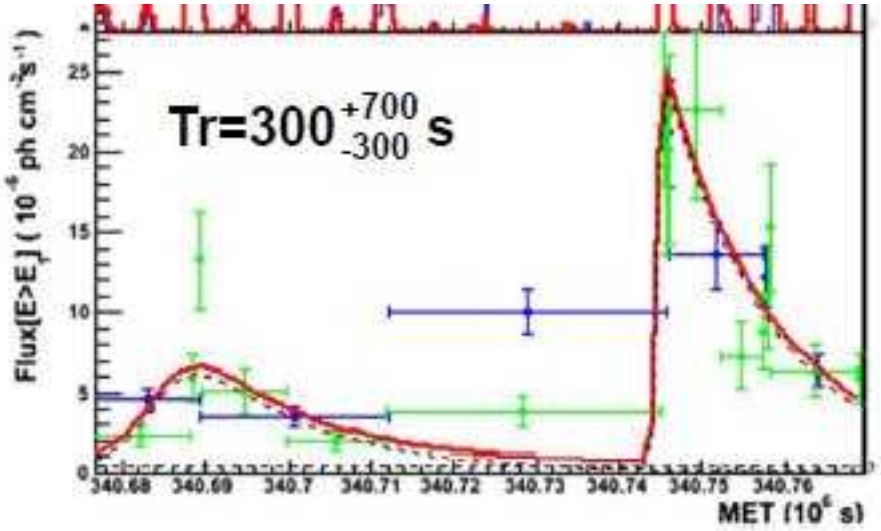
Modeling suggests flares 1 and 2 to have been produced
within 100 pc of the centre of the core,
while flares 3 and 4 originated > 1.5 kpc from the core.

Benoit Lott

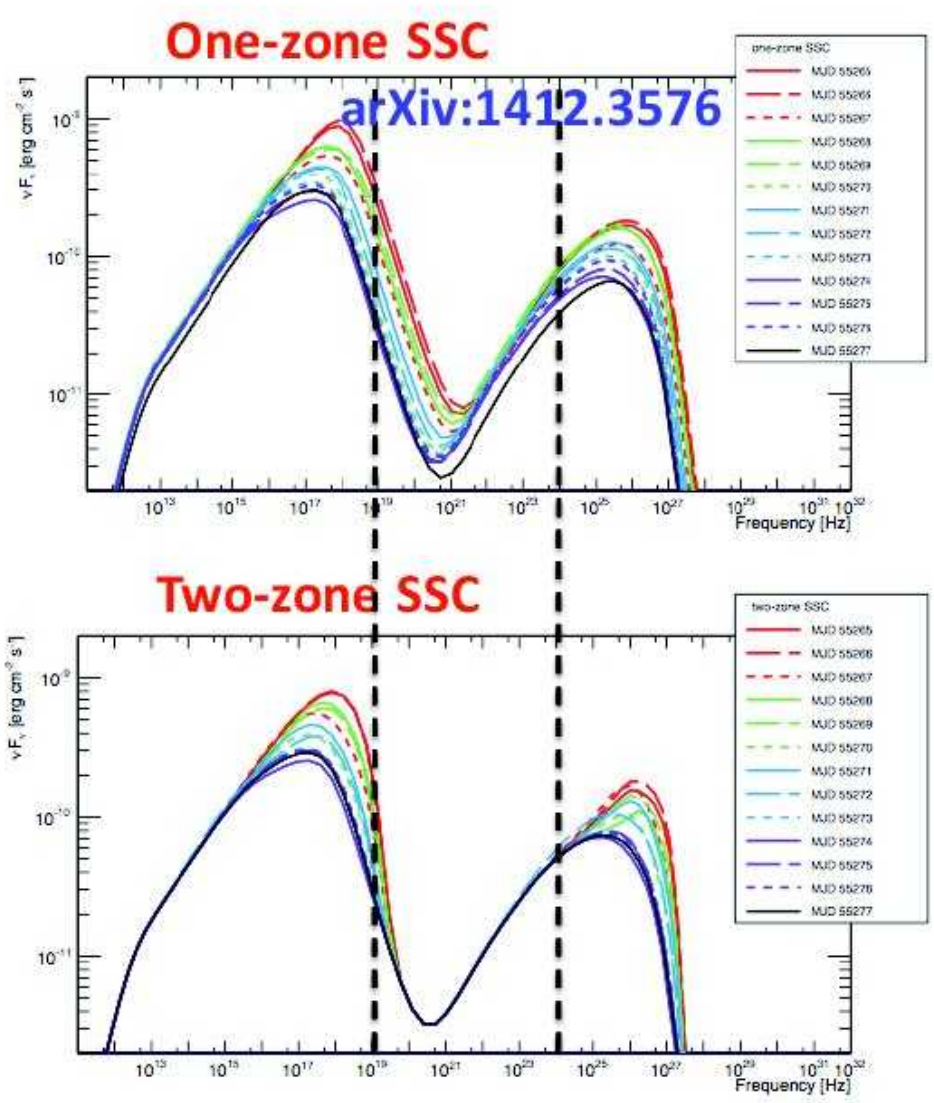


3LAC is out, 2FHL is coming
Dissecting Blazars (SEDs)
(gradual FSRQ curvature
Suggesting curved electron spectra?)

Variability traced down to <1 day
(Worries about asymmetry)



David Paneque

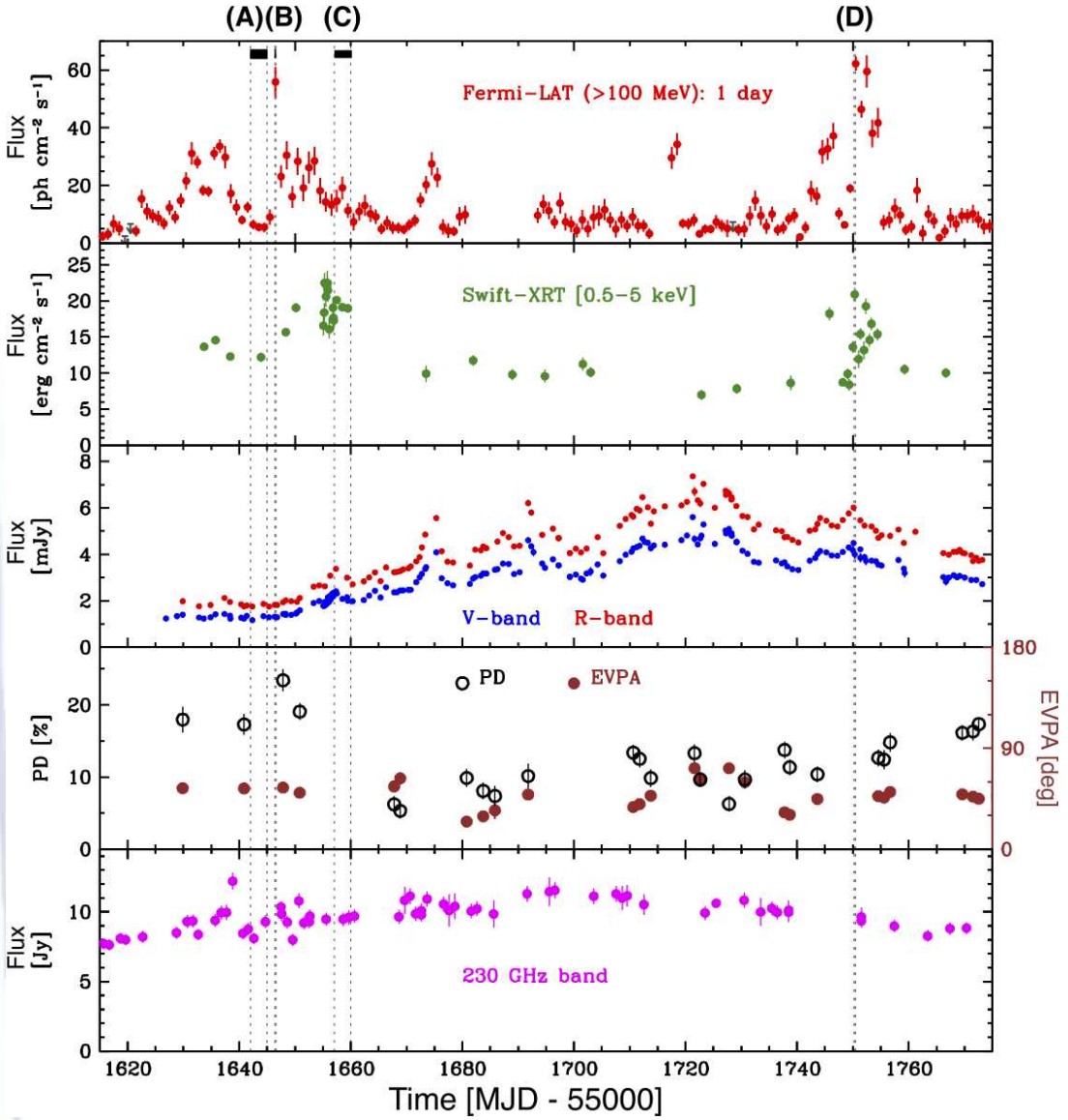


Enormous effort to conduct campaigns on HBL objects Mrk 421 and Mrk 501.

Modeling in terms of one zone and two zone models suggest patterns to result from evolution of electron distributions dominated by cooling.

Robustness / Uniqueness ?

Masaaki Hayashida



Period (B):
no flare in other bands
"orphan" γ-ray flare

(A), (C)
NuSTAR observations

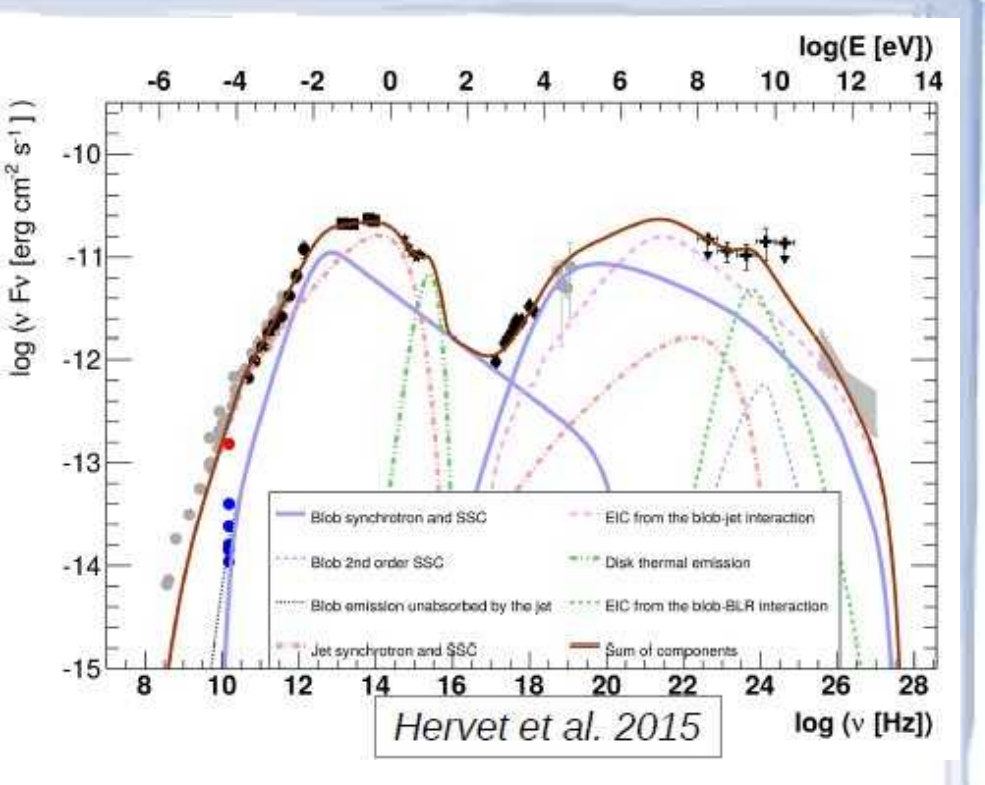
3C279:
Well documented 'Orphan Flare'

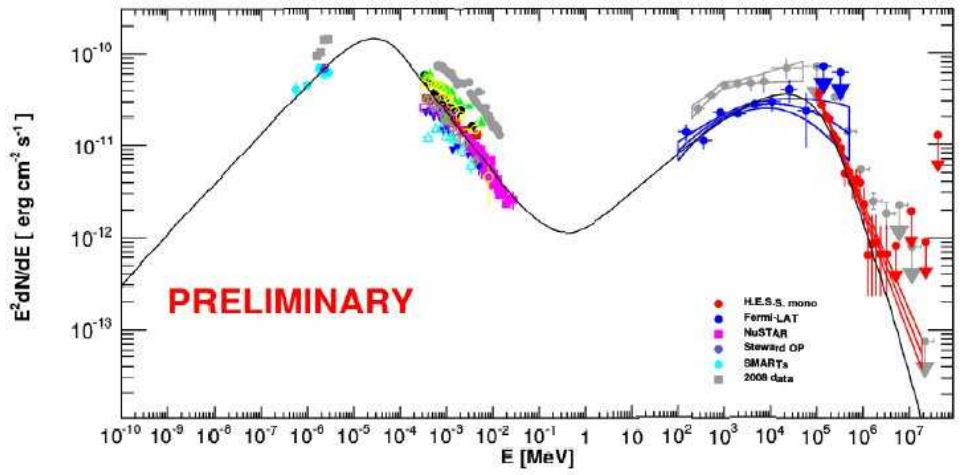
Individual Flares located inside and/or outside of BLR (not a very luminous BLR).

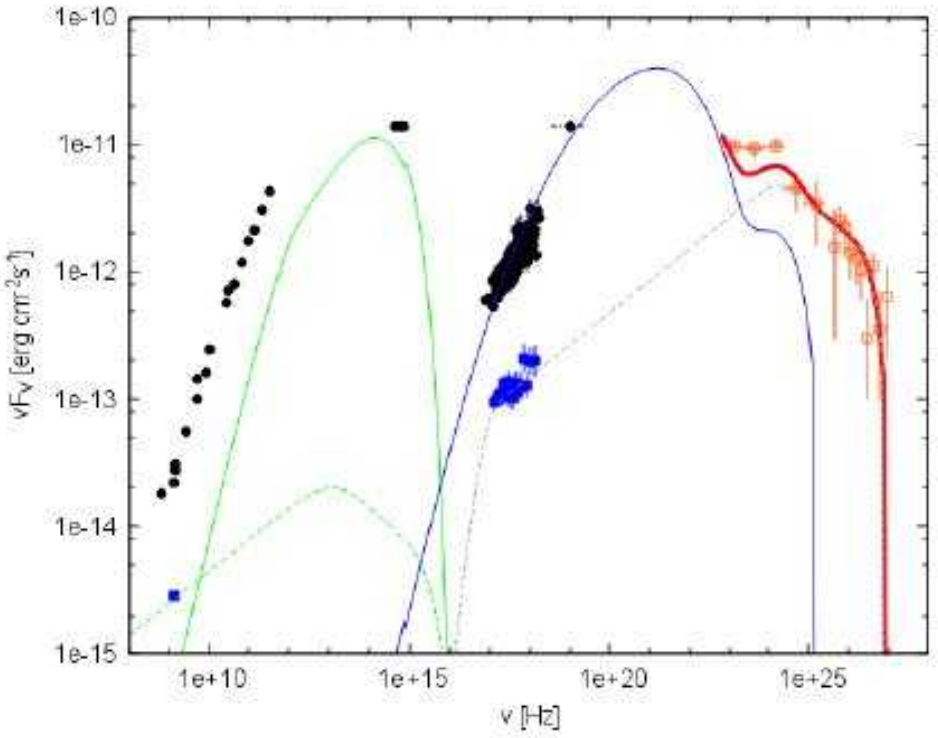
Unique set of parameters for different flares?

Olivier Hervet

Blazar physics:
AP Lib with broad gamma peak
Reproduced using different models (Hervet et al., arxiv, 2015, Zacharias (Posters upstairs))







Blazars:
Probes of the Jet Launching Region

All talks discuss variability.
All variations infer diameters of 0.01 pc or less.
Regions of this size may appear as bright as any source on average.
Doppler corrections are uncertain by factor of 10.
Smallest scales not always resolved.
Relevant for numerical simulations (turbulent plasma).

Diversity (observations(flares) – weather; models – climate?)

Many good sample studies
(UMRAO, Metsahovi, MOJAVE, BU, …., …., Fermi)
Many more sources, epochs, cadence.
Easier to assess selection biases.

Turbulence – many zones – polarimetry suffers from superposition.

A small set of issues

Do we need to worry about high Doppler factors?

Should we worry about changes in polarisation
in cases of P<~40%? (single vs. multiple zones contributing)

Gamma-flares without simultaneous flares in cores:
Gamma_min before cooling brings electrons down?

Gamma-rays: t_var ~ t_acc,t_cool vs. t_cross
Too naïve a question?

Acceleration/cooling timescales very short (models)?

Turbulence relevant down to very small scales (simulations).