The CSO PKS 1718-649 in gamma-rays with Fermi-LAT

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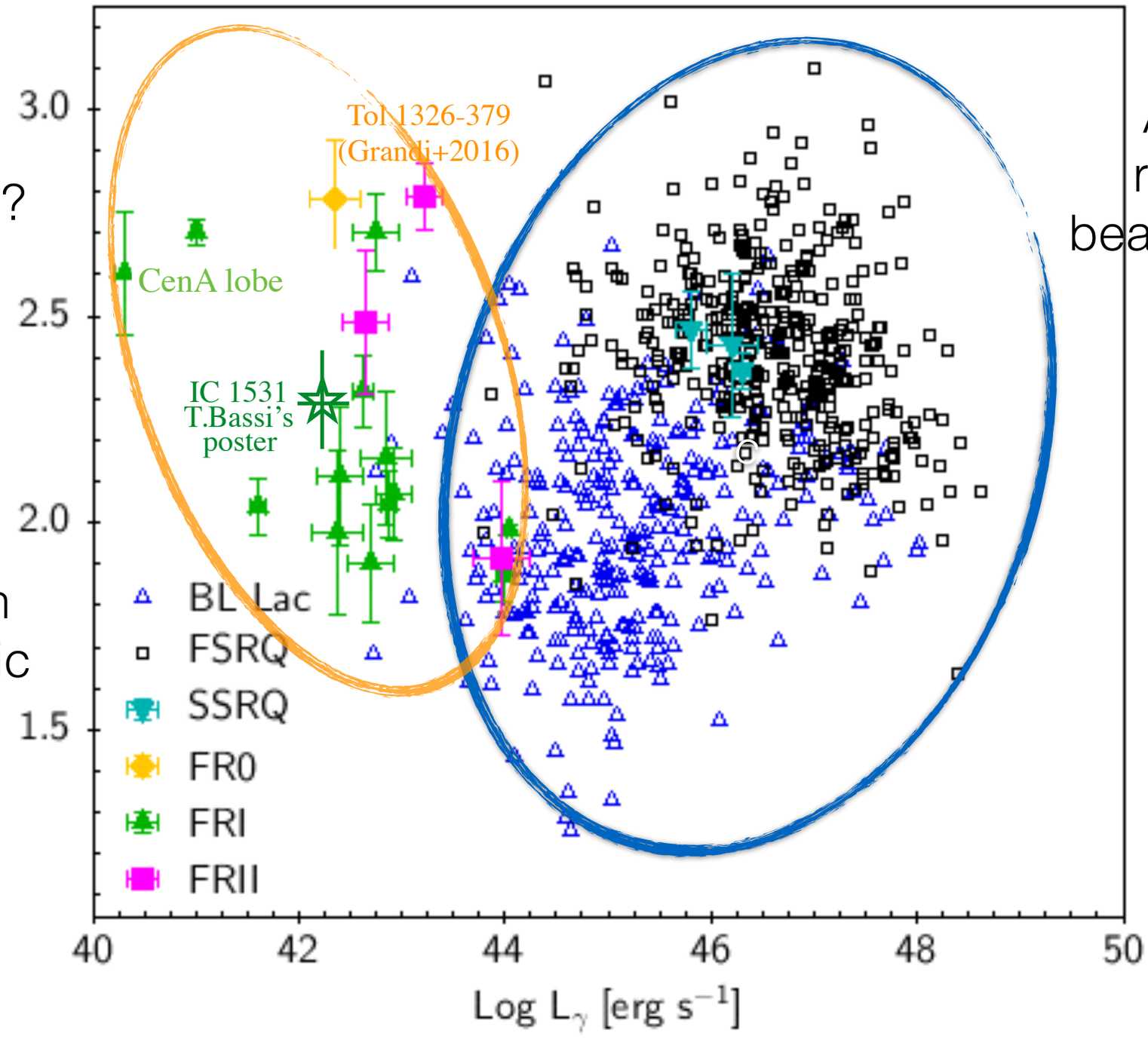
Jetted AGN in γ-rays

Misaligned jets:
beamed emission?
structured jet?

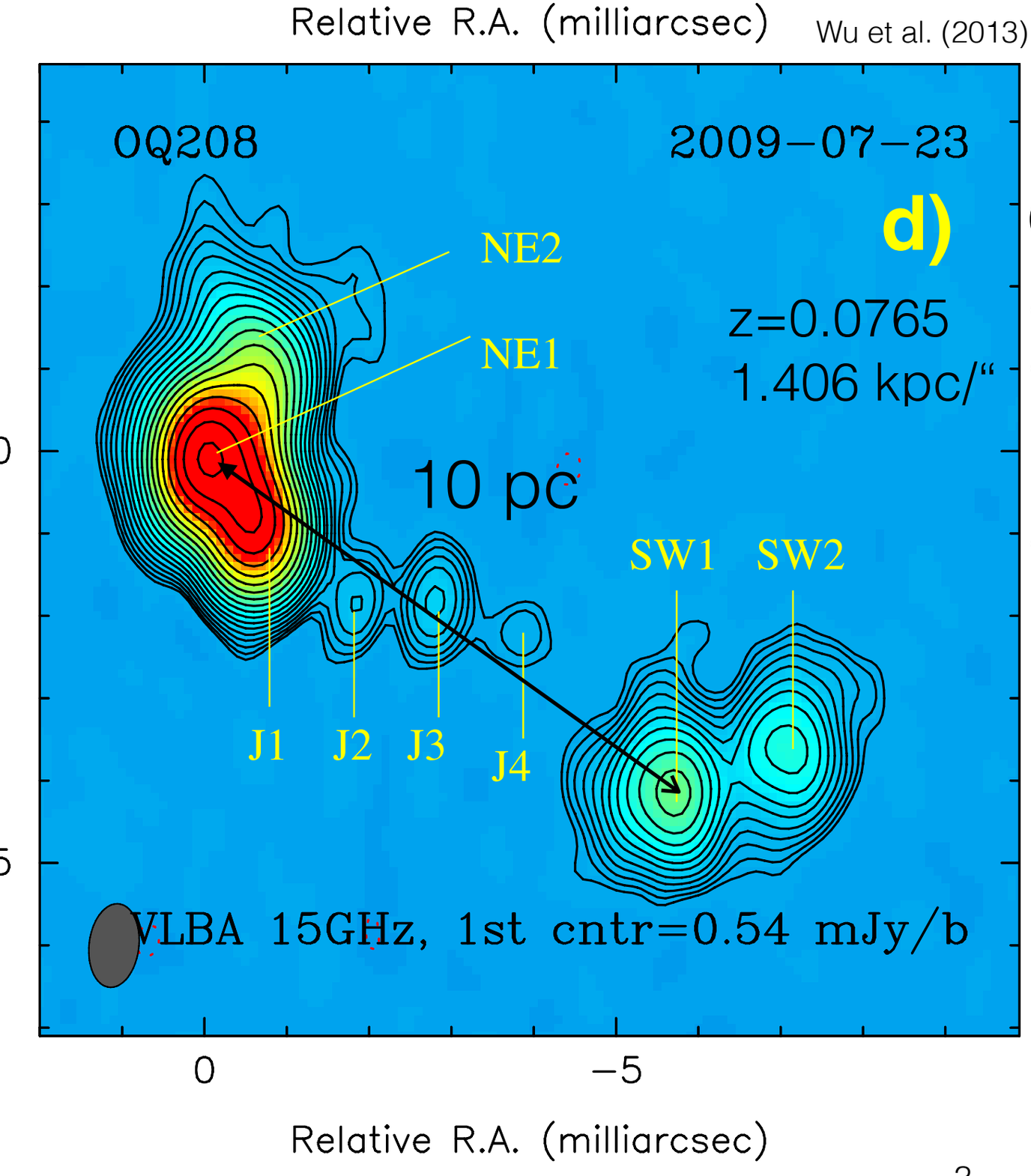
Cen A:
only RL AGN with
extended, isotropic
γ-ray emission
+
Fermi Bubbles
in the MW



Aligned jets:
relativistically
beamed & boosted
emission

1/3 of the 3FGL sources are unidentified

Gamma-ray emitter candidates: Young Radio Sources



Wu et al. (2013)

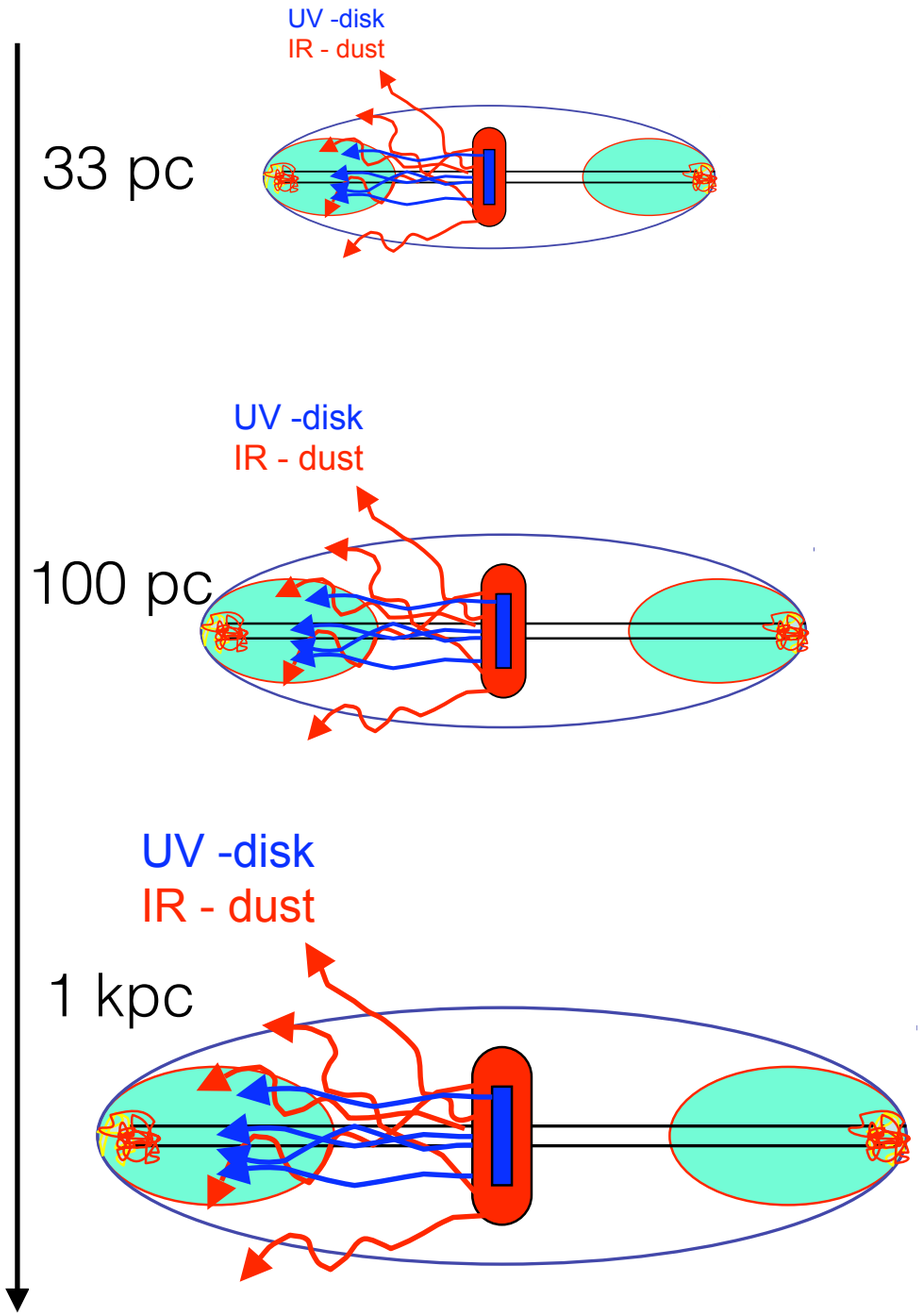
Compact Symmetric Objects (CSOs):

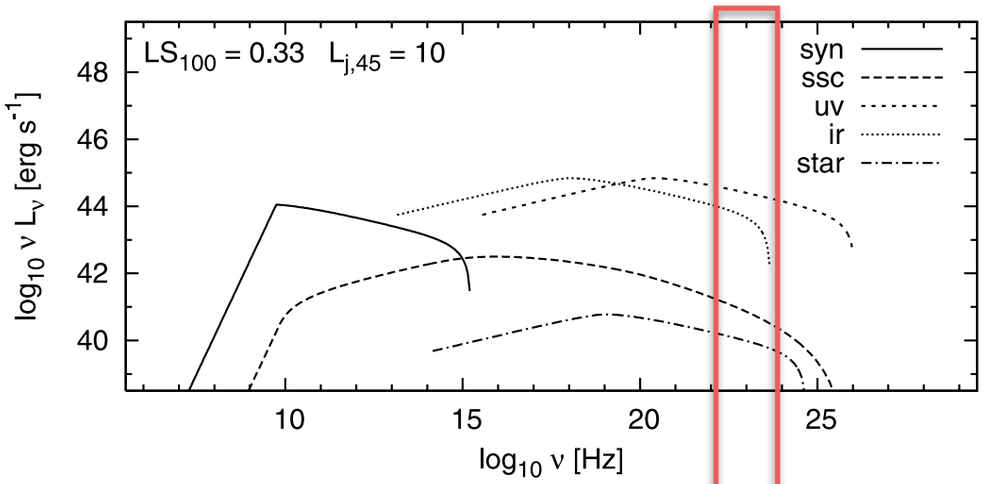
- linear size <1kpc;
- symmetric, two-sided radio morphology, dominated by mini-lobes/ hotspots;
- estimated ages from the hot spots advance velocities: $<10^3$ yrs.

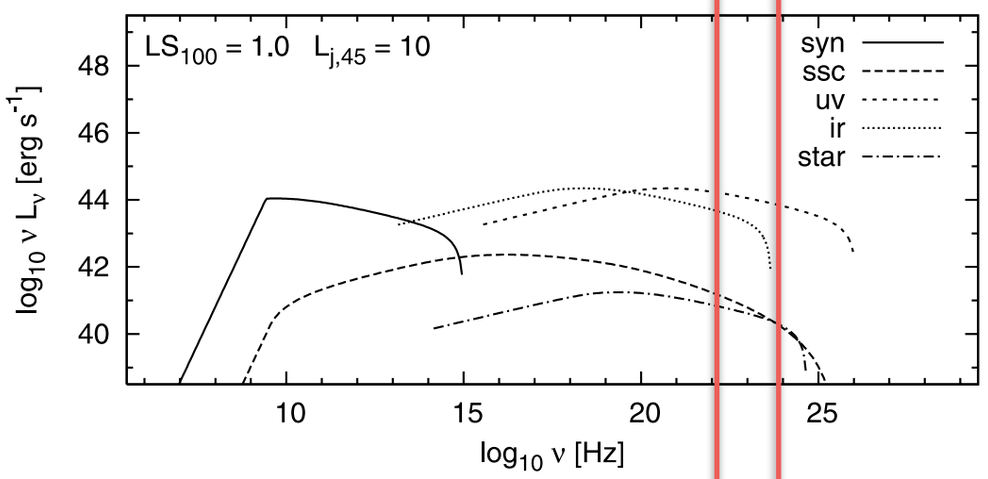
CSOs in γ-rays: theory

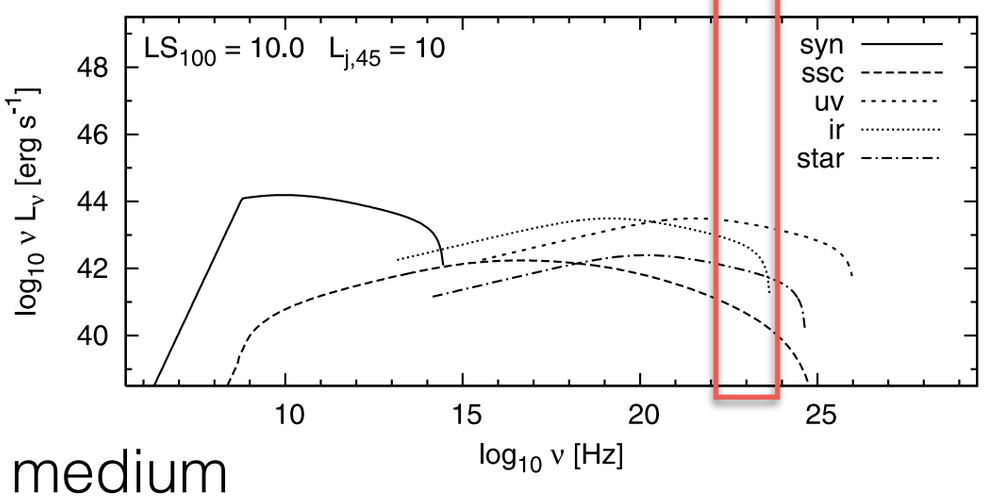
Predictions for γ-ray emission from the mini-lobes (Stawarz+2008)

LS









IC of IR and UV photons by the electrons in the lobes

Lobes expanding in a photon-rich medium

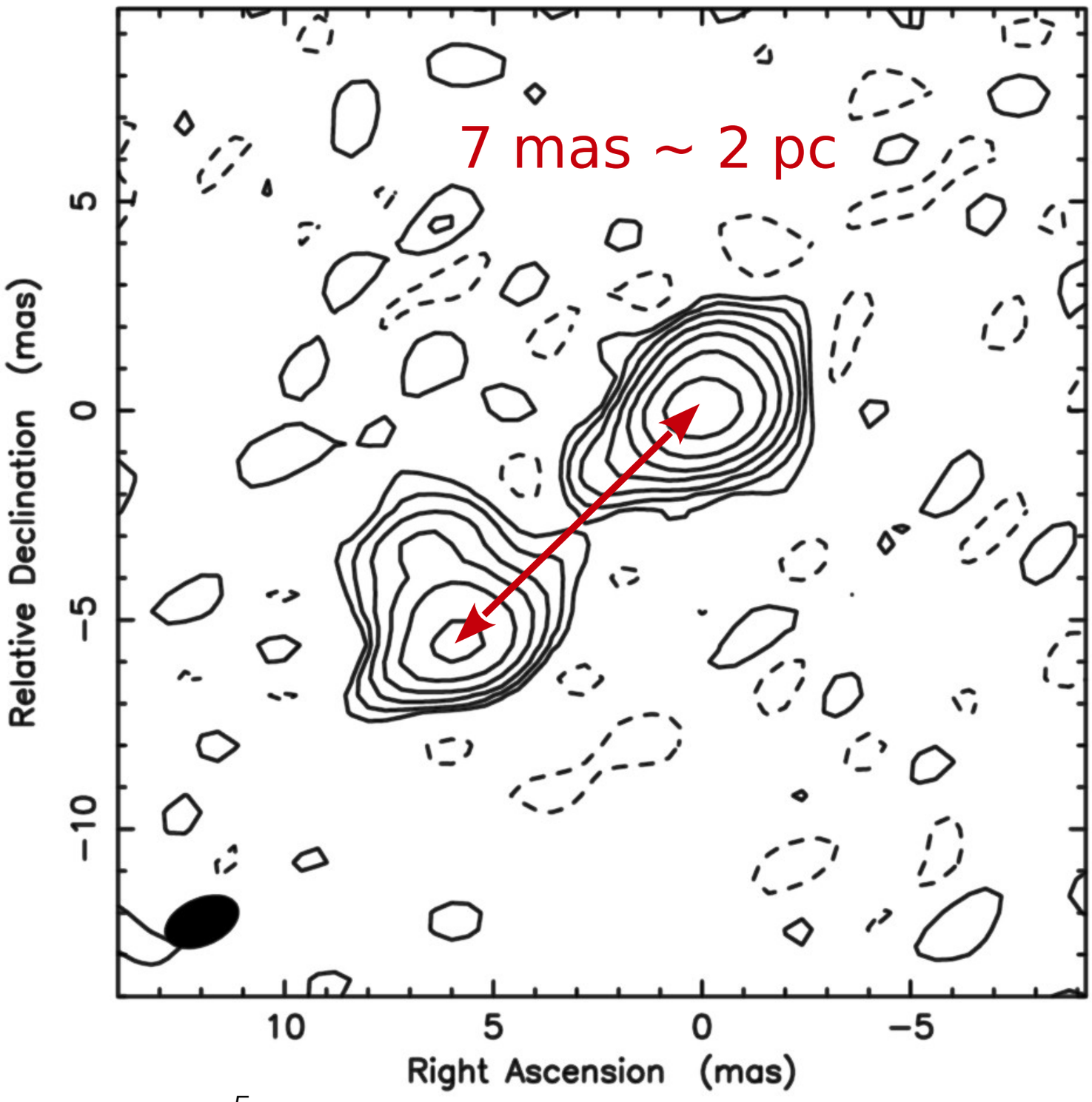
γ-ray searches in 5-yrs Fermi-LAT data of 16 X-ray selected CSOs (Migliori+2016a): no clear detections but a 4σ signal for one case.

PKS 1718-649:

- closest known CSO (z=0.014);
- kinematically estimated age: ~100 yrs (Giroletti & Polatidis 2009);
- very compact radio structure

ideal candidate for a gamma-ray detection

Tingay, de Kool (2003), 22 GHz VLBI radio imaging



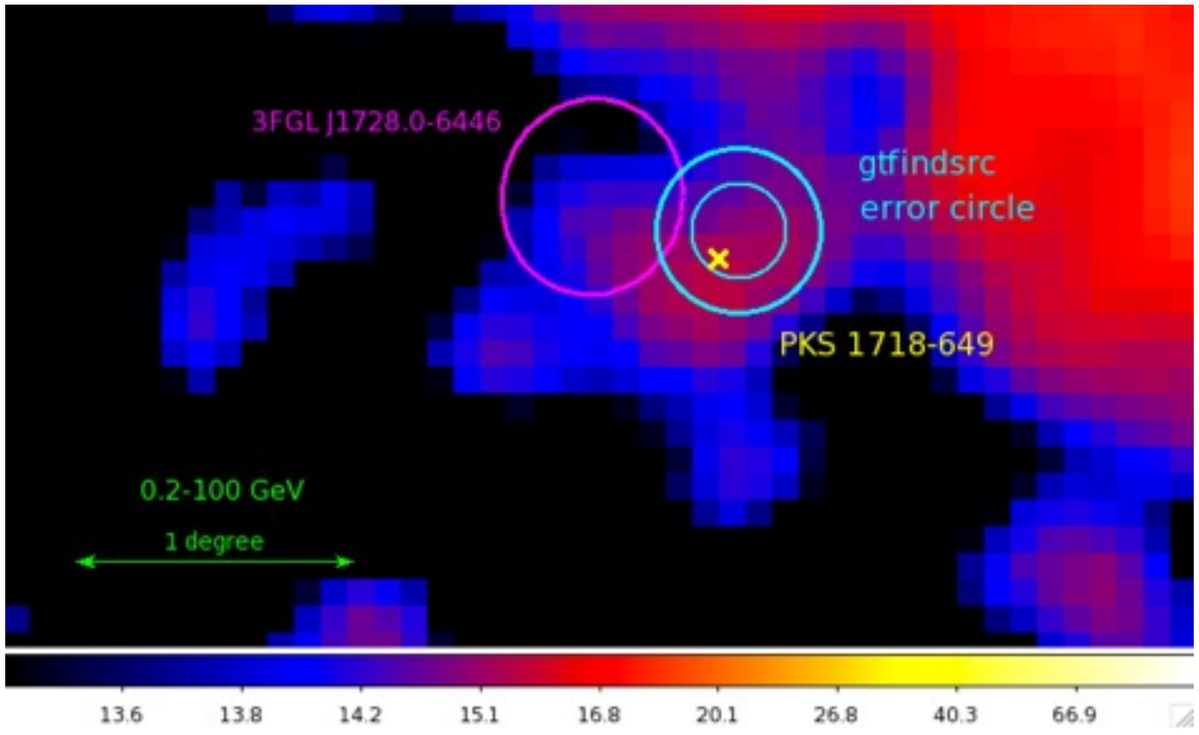
PKS 1718-649: 7 years of Fermi data

3-step analysis (binned likelihood, Pass 8 DR):

1. confirmation of the γ-ray detection:
   - *>5σ detection @ >100 MeV*
   - *Γ=2.9±0.3;*
   - *F(>100MeV)=(11.5±0.3)×10^{-9} phot^{-1} cm^{-2} s^{-1}.*

2. γ-ray source localization & association:
   - *PKS 1718-649 within the r_{68}=0.18° of the gtfindsrc best fit position;*
   - *no other candidates in catalogs of extragalactic radio sources.*

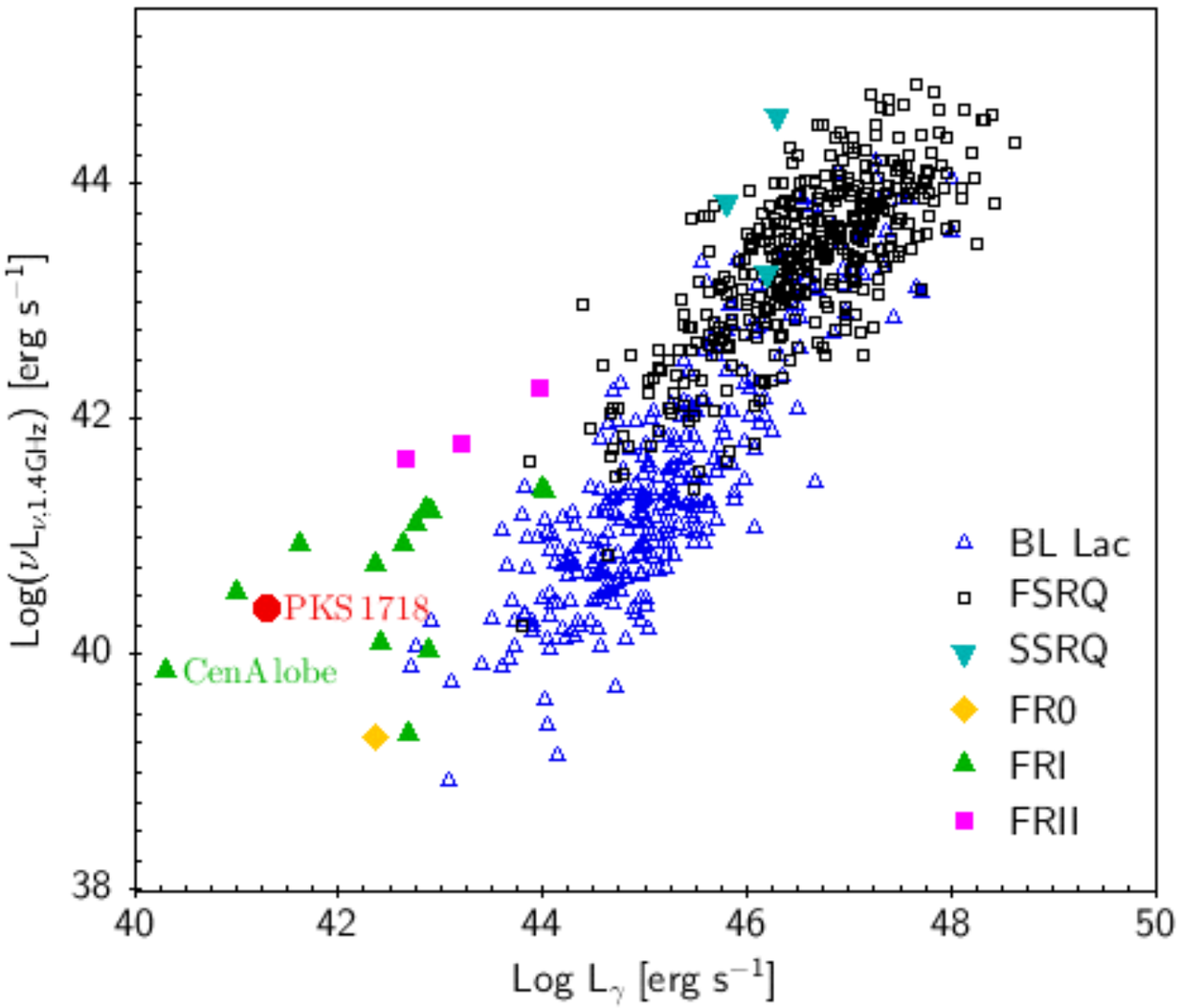
3. temporal analysis:
   - *no evidence of flux variability;*
   - *faint and steady emission with an incrementally increasing significance.*

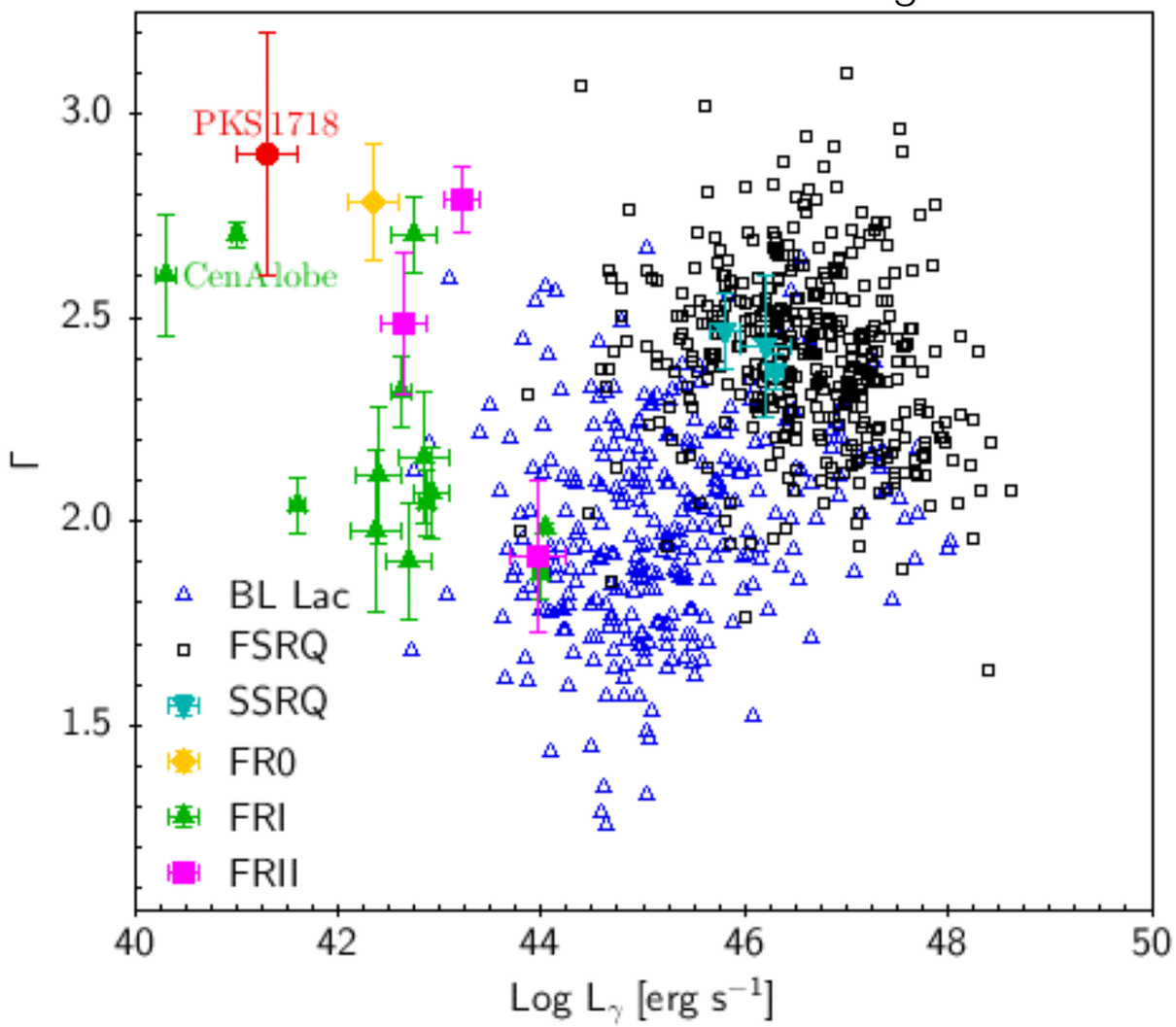


Migliori+2016b

PKS 1718-648: γ-ray properties

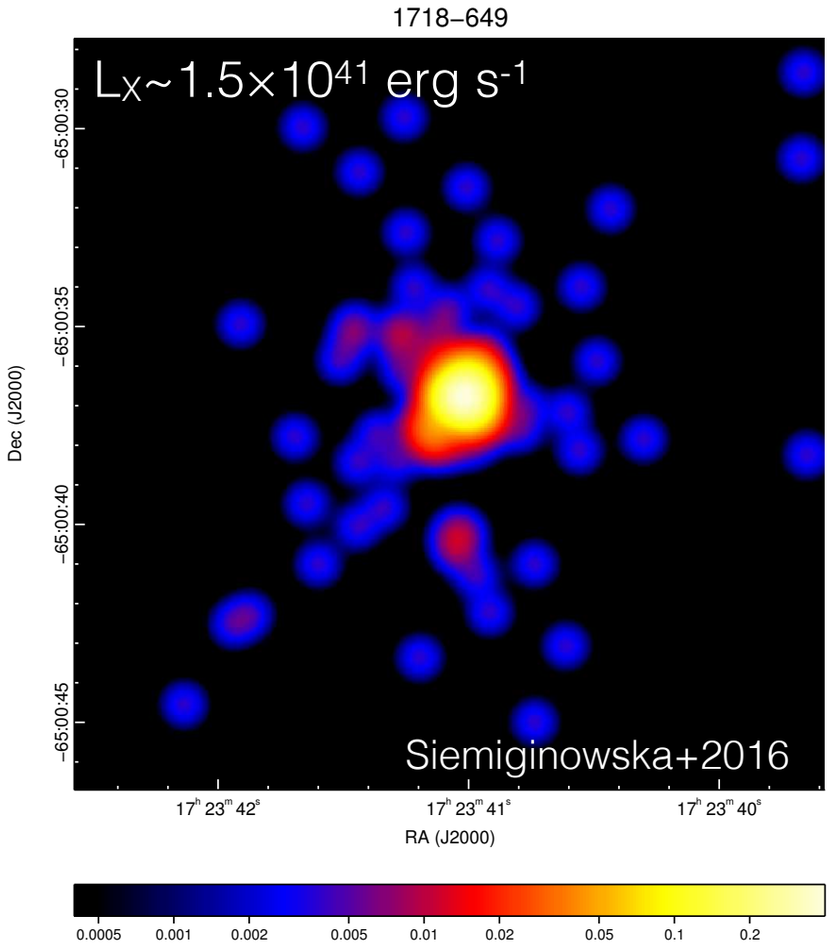
Migliori+2016b

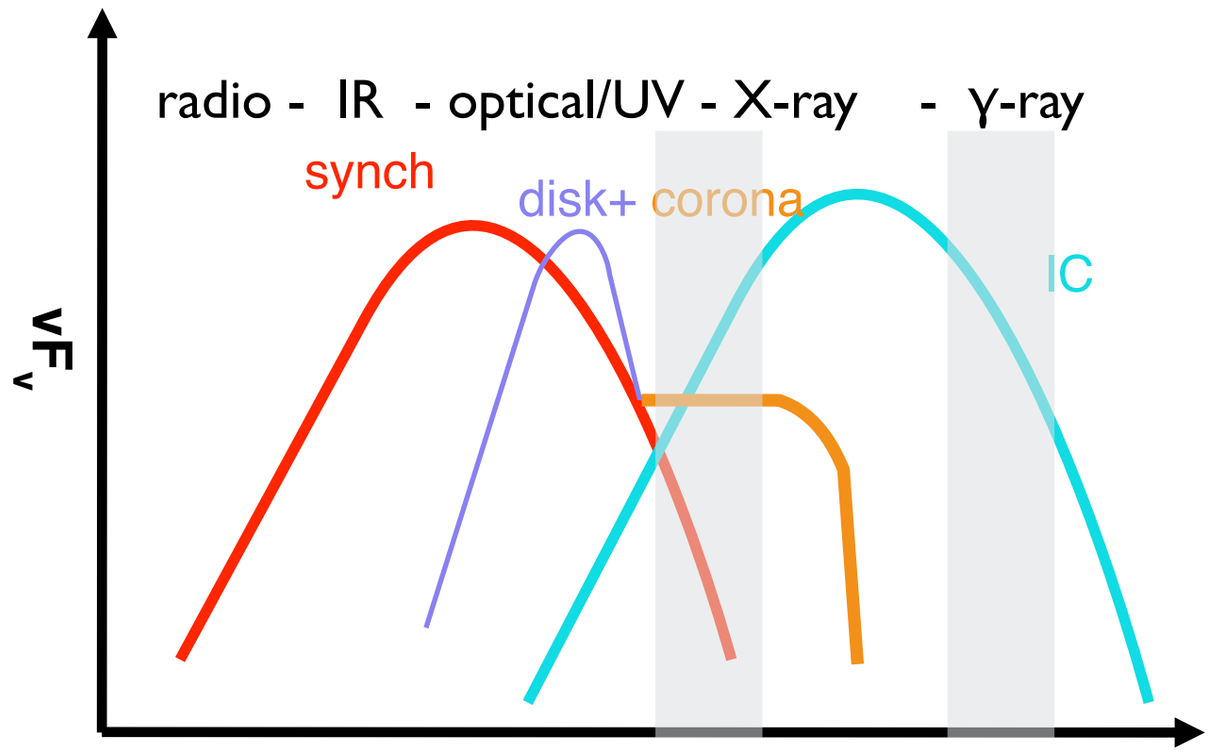




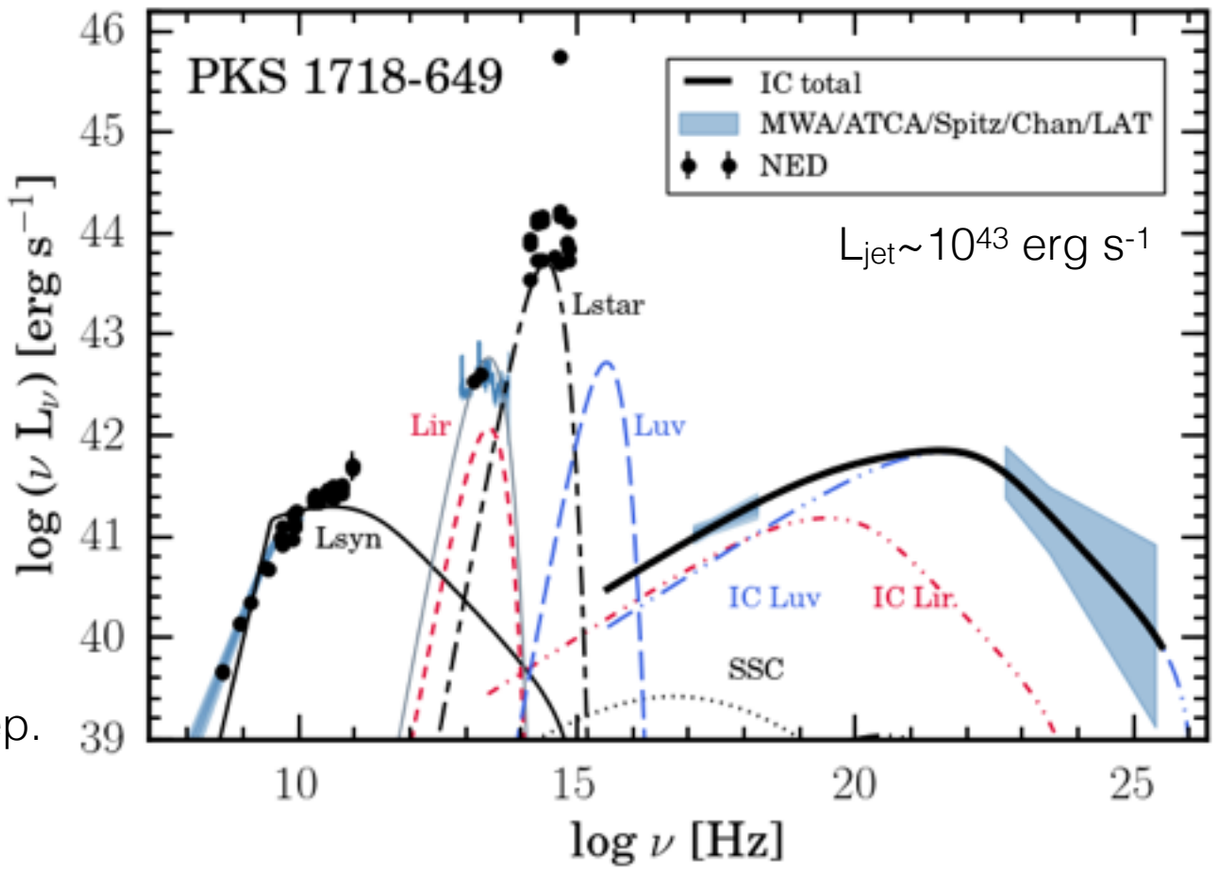
The position of PKS 1718-649 in the diagnostic plots is separated from blazars and common to MAGN + no extreme variability+ symmetric morphology: is the gamma-ray emission produced in the compact lobes?

PKS 1718-649: nature of the high-energy emission





A detection in γ-ray provides clues on the nature of the unresolved X-ray emission.



Sobolewska+ in prep.

Fate of a Radio Source

SED modeling: estimates of the **jet power**

+

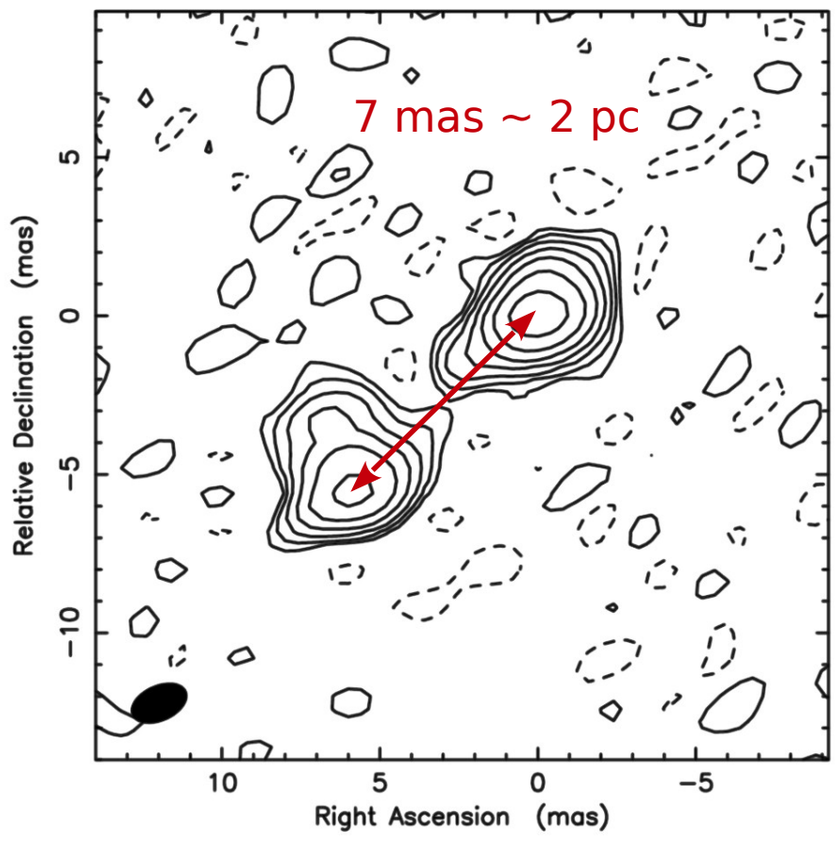
multi-λ observations

(Tingay+2003, Maccagni+2014,2016):

ISM densities & kinematics

clues on the **radio source's evolution**

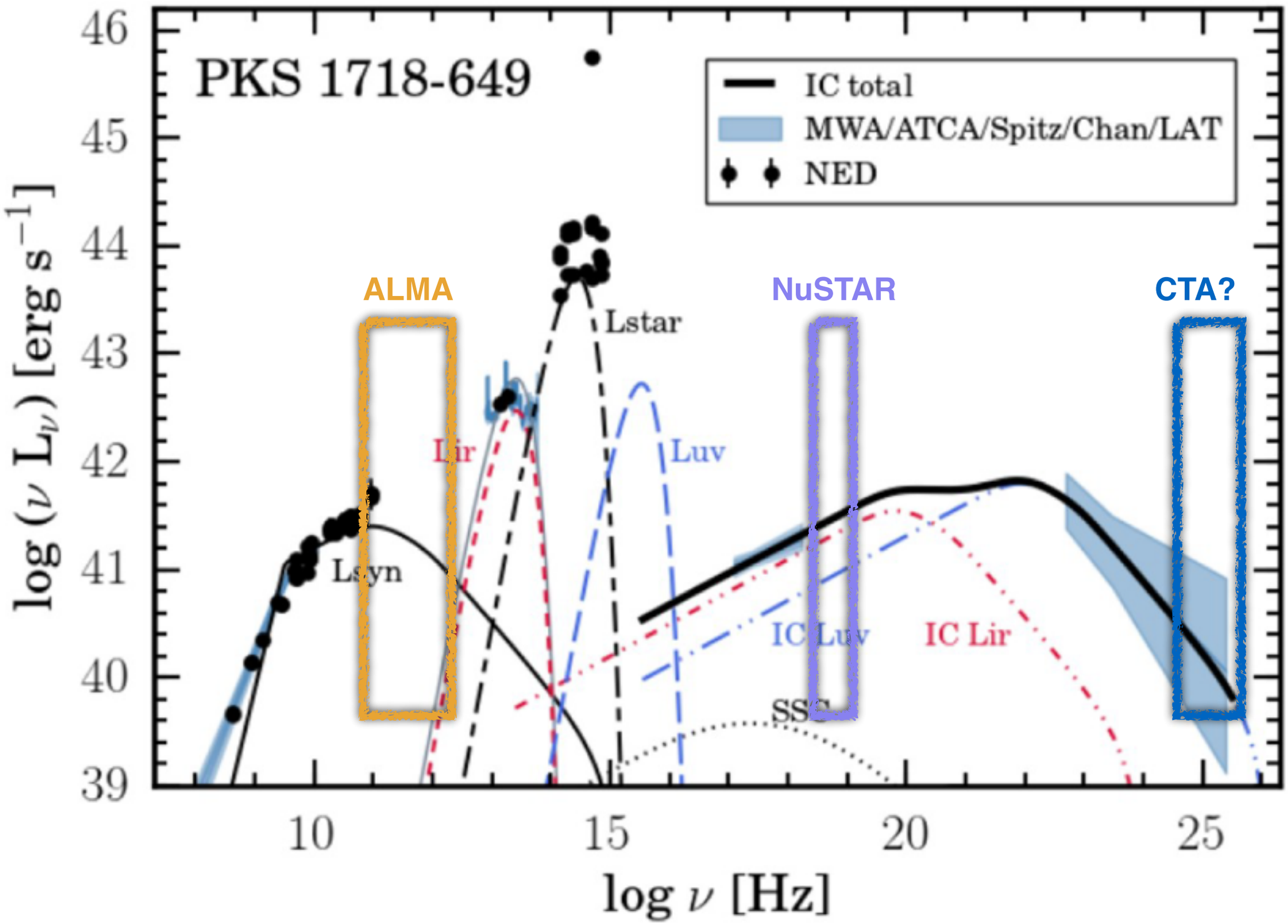
Tingay, de Kool (2003), 22 GHz VLBI radio imaging



expanding radio source

SED modeling & multi-λ observations

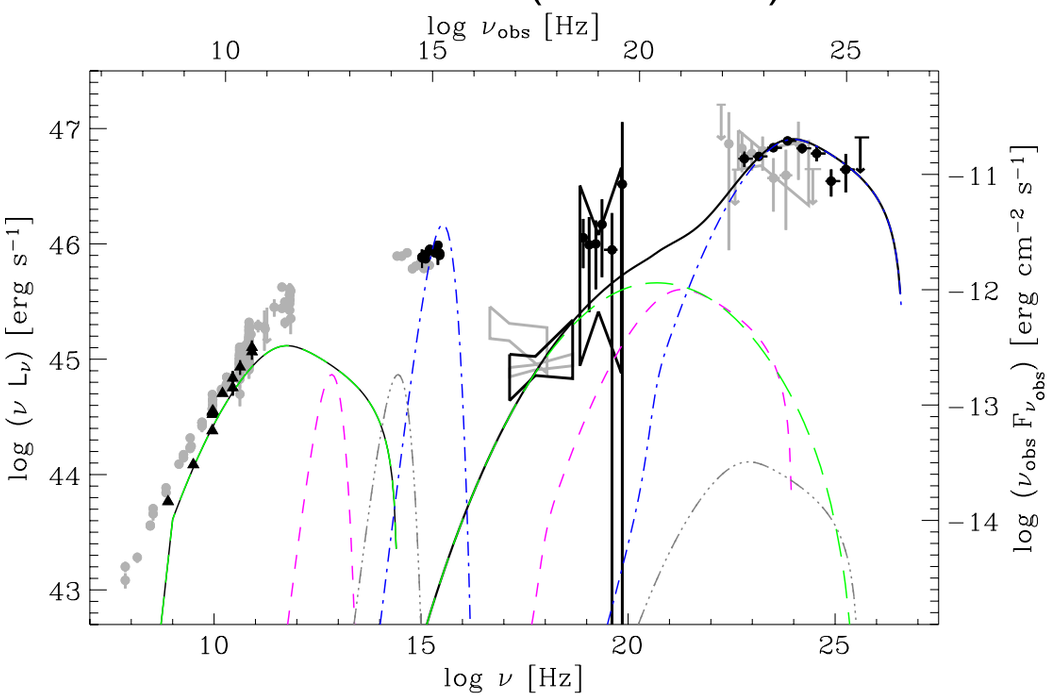
Sobolewska+ in prep.



PKS 1718-649: an isolated case?

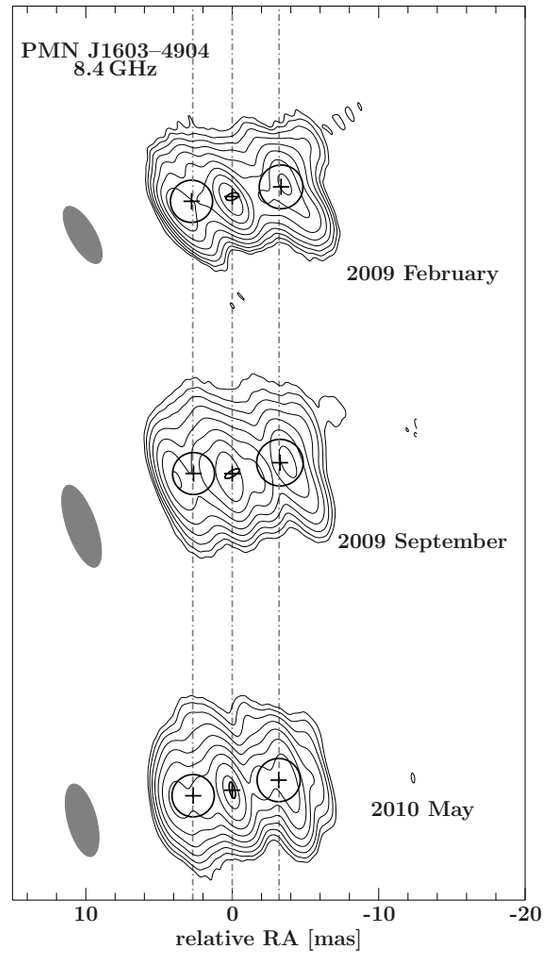
- no other clear detections of CSO classified sources in Fermi-LAT data (Migliori+2016a, D'Ammando+2016): selection criteria?
- Fermi-LAT sources with a CSO-like small scale structure:

4C +55.17 (z=0.896):



McConville+2011

PMN J1603-4904 (z=0.18):



Müller+2014,2015

- γ-ray bright and hard spectrum;
- no short term, extreme variability;
- mas symmetric radio structure;
- located at larger z.

Is the γ-ray emission produced in the mini-lobes?

Conclusions & Future Work

- The analysis of 7 yrs of LAT data (Pass 8 DR) confirms the detection (>5σ) of a γ-ray source associated with the CSO PKS 1718-649;
- the absence of extreme flux variability and the source location in the diagnostic plots are compatible with the gamma-ray emission being produced in the lobes;
- modeling of the SED of PKS 1718-649 (Sobolewska+in prep.) will give clues on the nature of the X-ray emission and its evolution (new Chandra observations, PI: Siemiginowska);
- CSO searches in γ-rays: how can we find other CSOs among unidentified LAT sources? selection criterium?