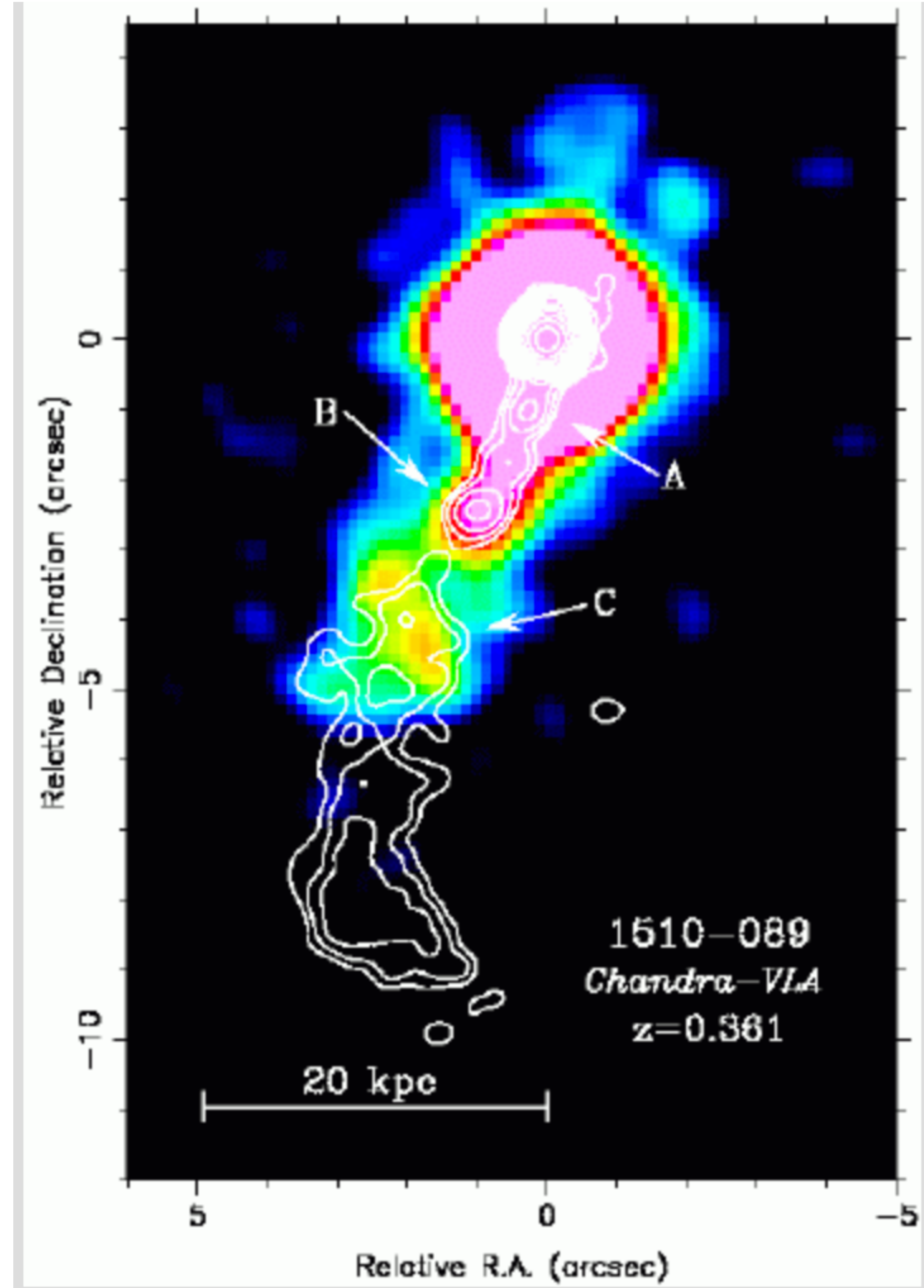
PKS 1510-089

FSRQ

z=0.361

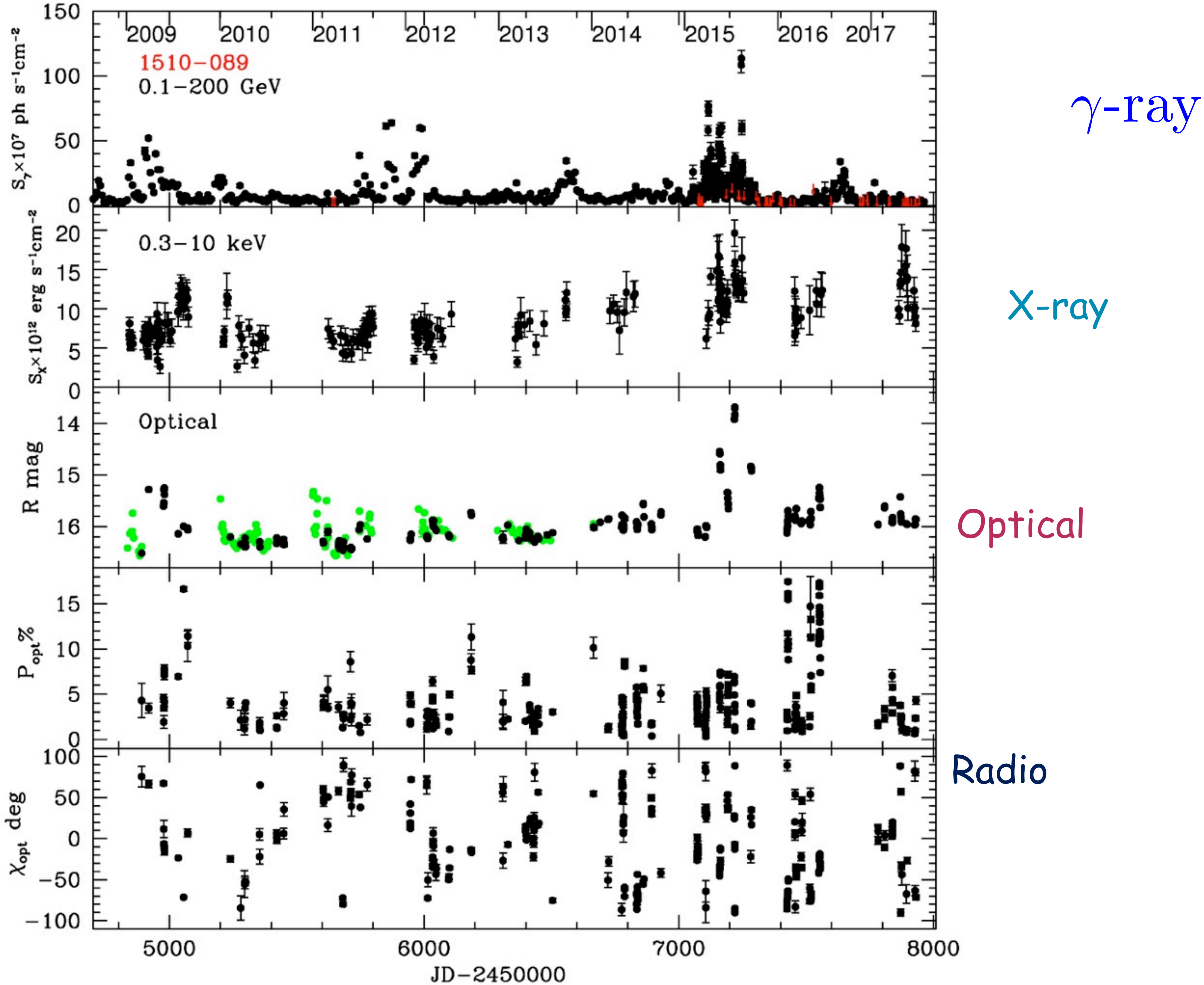
Nh(Gal)=6.99e20 cm-2
(Kalberla et al. 2005)



X-ray (color), Radio (contours)
From: Sambruna et al. (2004)

Apparent velocity: 1263 ± 27 μas/y ; 28.00 c
(Lister et al. 2013, AJ, 146, 120)

Extremely variable source



Spectral and Imaging Analysis

- Chandra: Superposition X-ray and Radio images (DS9) to individuate the entire jet and knots B, C to be analyzed;

- Chandra: extraction of the spectrum of the jet and production of rmf and arf files (CIAO). Analysis with XSPEC. Definition of the best model: parameter uncertainties, confidence (68%, 90% and 99%) contour plots, flux and luminosity;

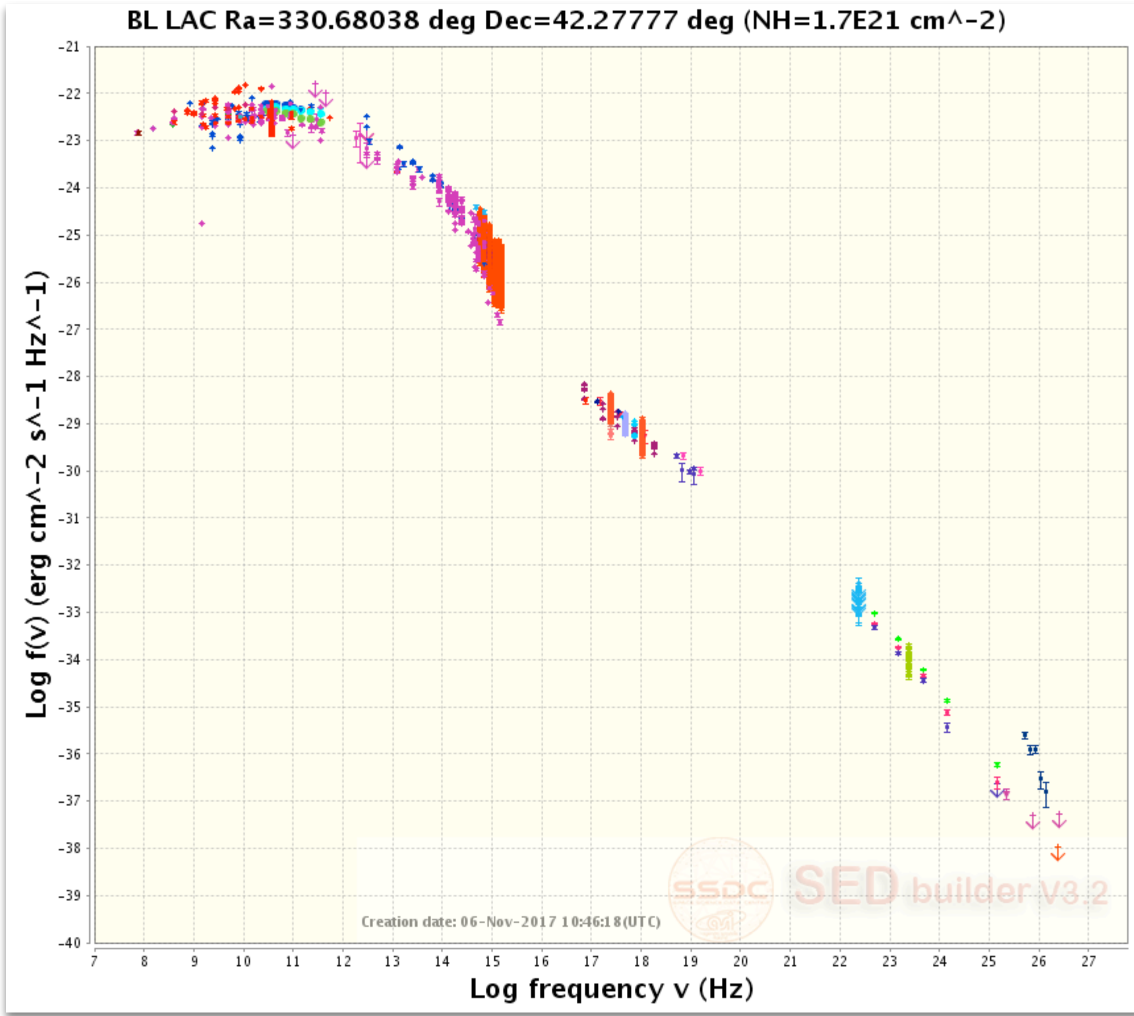
- Chandra: extraction of the spectra of knots B, C and production of rmf and arf files (CIAO). Analysis with XSPEC (see above);

- Chandra: Nucleus - extraction of the spectrum using a circle and spectral analysis;

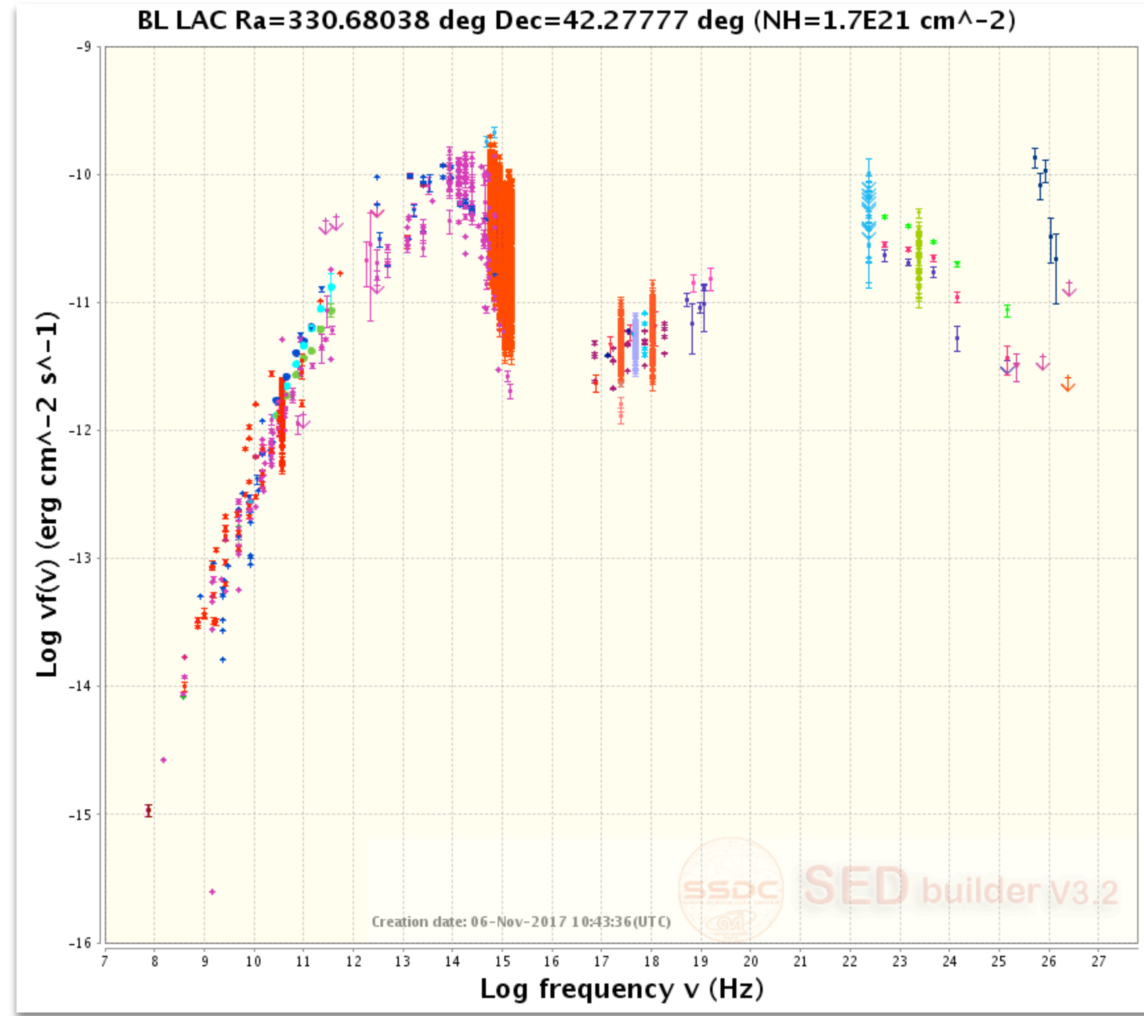
- Swift/XRT- Spectral analysis of the (already extracted) nuclear spectrum with XSPEC and comparison with the Chandra spectral parameters;

Optional:

- Construction of the Spectral Energy Distribution and estimate of the core dominance (see below);
- Optional: Spectral analysis (spectral slope and flux); time variability of the gamma-ray counterpart of PKS1510-089; TS map;
- Instrumental Lab (IV floor).



$$\times \nu$$



$$f(\nu) = \mathrm{K}\ \nu^{-\alpha}\ d\nu$$

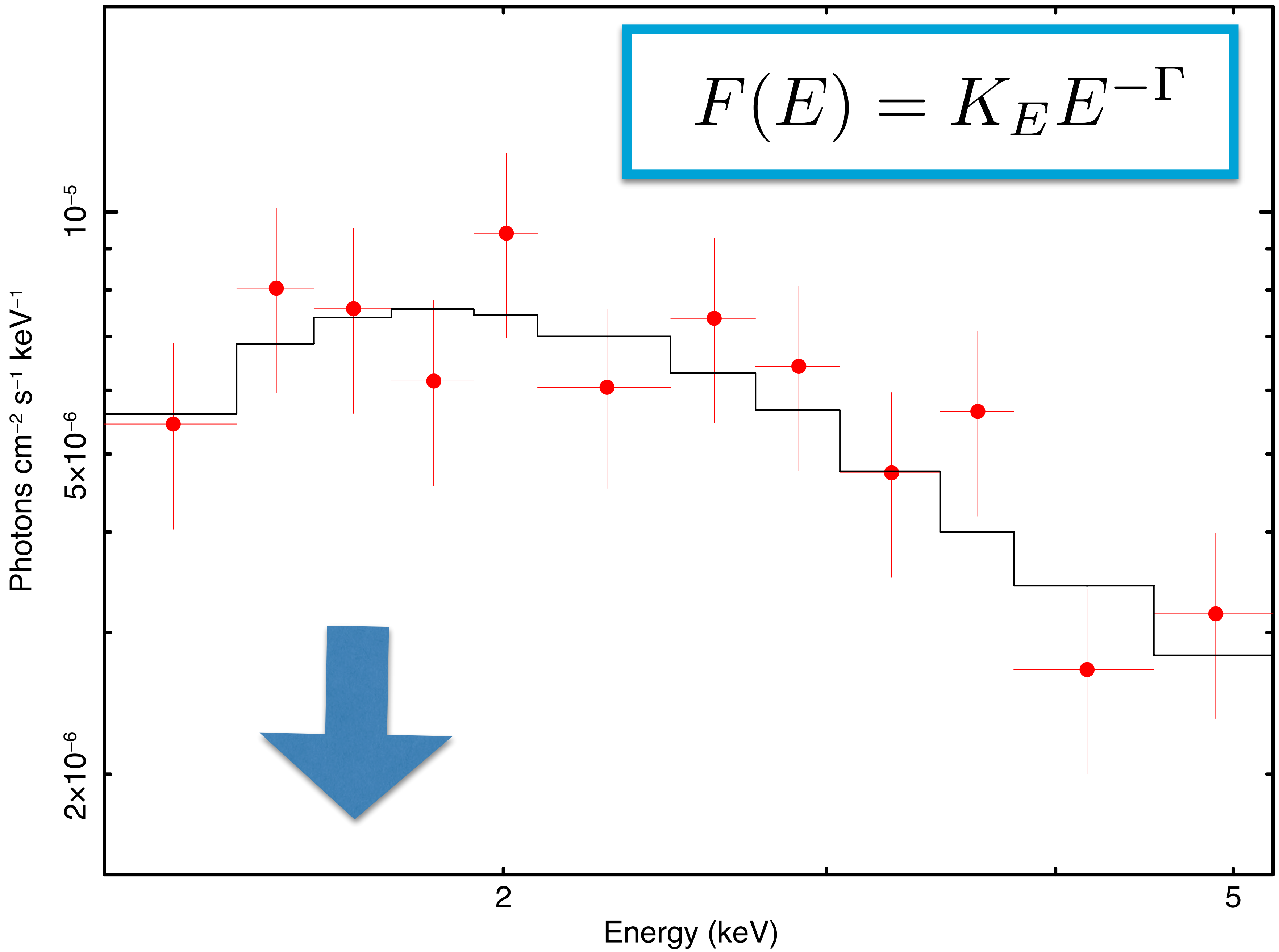
$$(\mathrm{erg\ cm^{-2}\ s^{-1}\ Hz^{-1}})$$

$$P(\nu_1, \nu_2) = \int_{\nu_1}^{\nu_2} \mathrm{K}\ \nu^{-\alpha}\ d\nu =$$

$$(\mathrm{erg\ cm^{-2}\ s^{-1}})$$

$$= \frac{K}{1-\alpha}(\nu_2^{1-\alpha} - \nu_2^{1-\alpha})\ (\alpha \neq 1)$$

$$= K In(\frac{\nu_2}{\nu_1})\ (\alpha = 1)$$



$$F(E) = K_E E^{-\Gamma}$$

K_E (phot $cm^{-2} s^{-1} keV^{-1}$)

@ 1keV

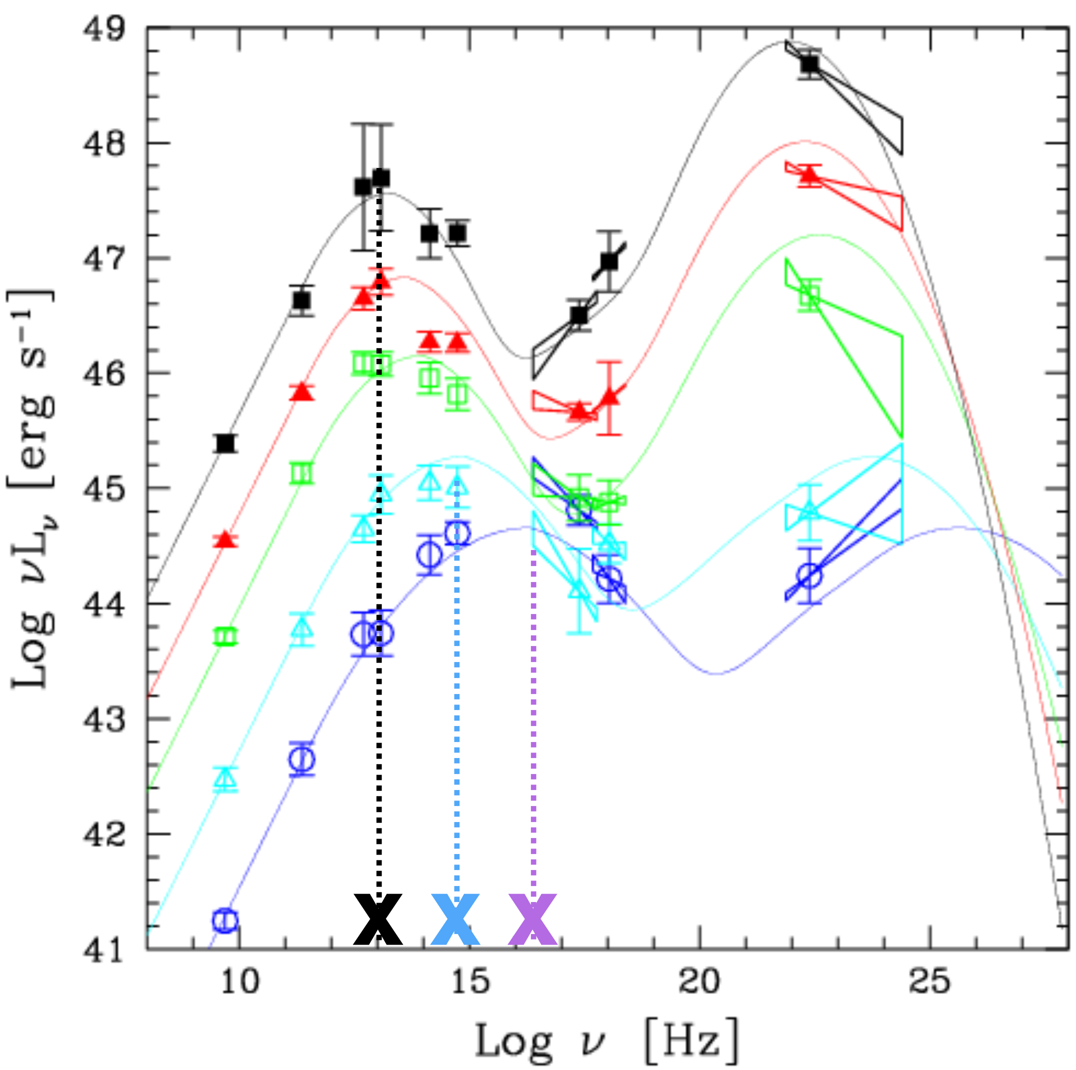
$$F(\nu) = K_\nu \nu^{-\alpha}$$

K_ν (erg $cm^{-2} s^{-1} Hz^{-1}$)

SED

SED Physical Interpretation

- Synchrotron peak position: ν_S



High synchrotron-peaked (HSP) blazars: ν_S >10^{15} Hz

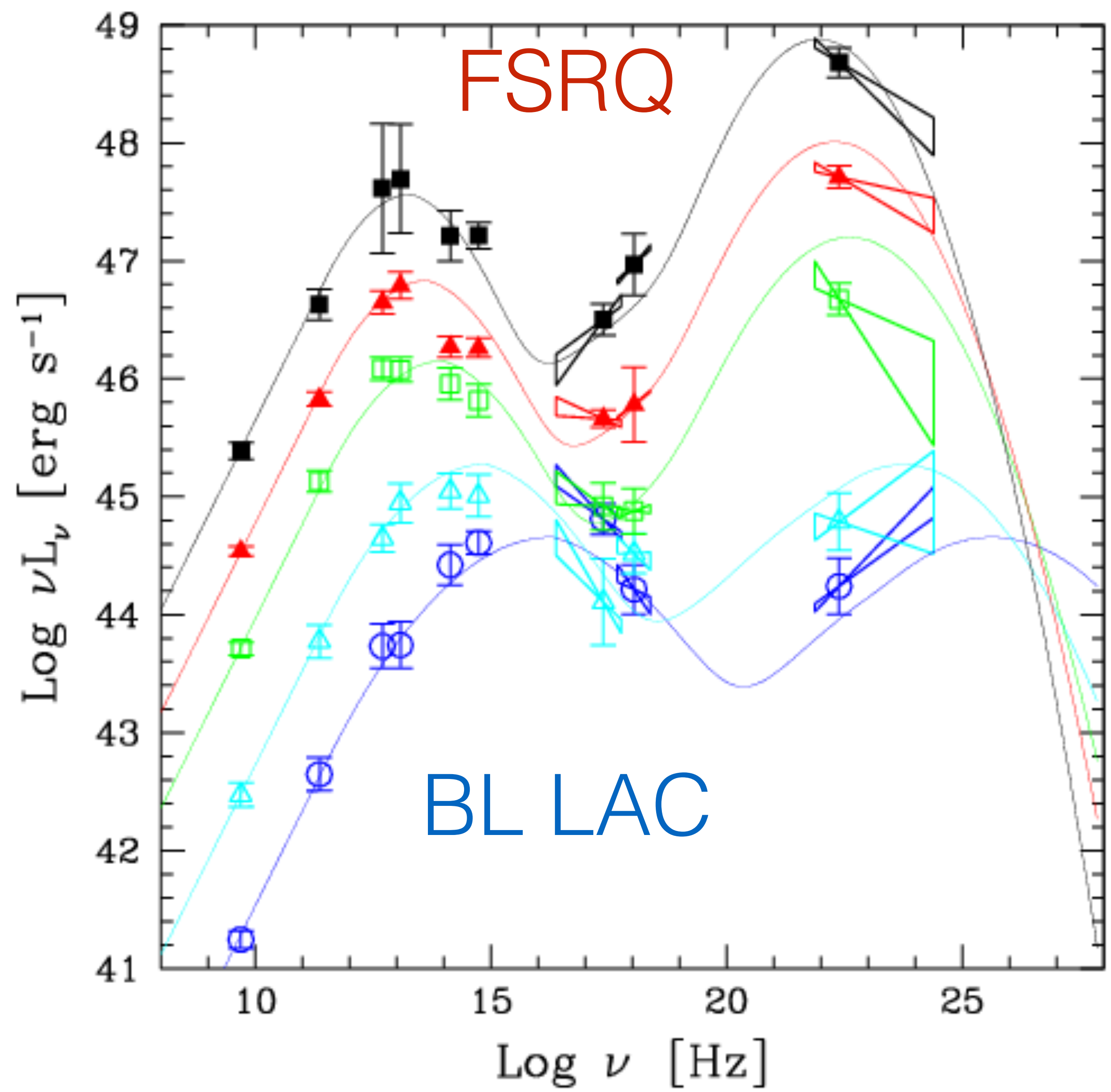
Intermediate synchrotron-peaked (ISP): 10^{14} < ν_S <10^{15} Hz

Low synchrotron-peaked (LSP) blazars : ν_S < 10^{14} Hz

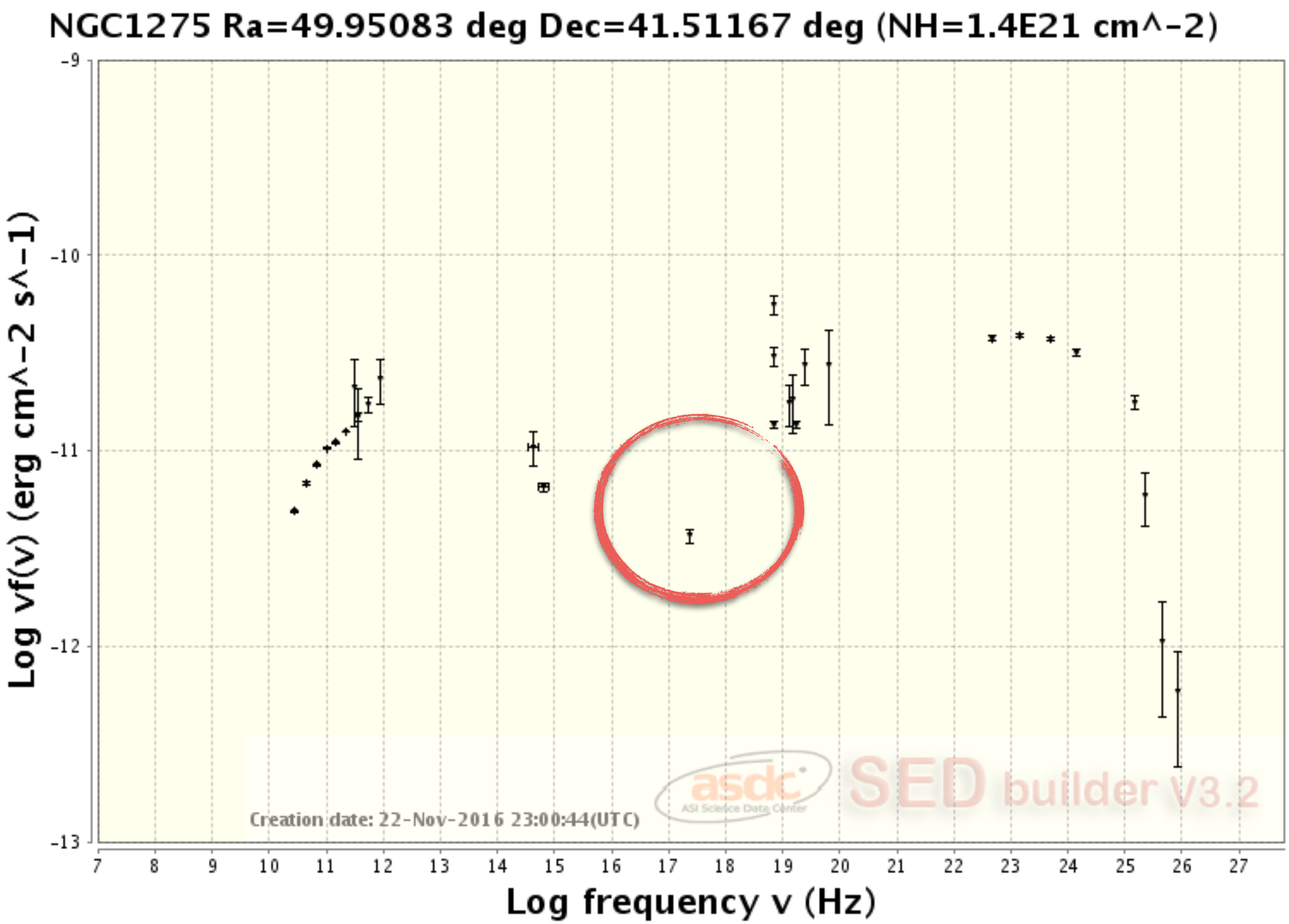
- Compton Dominance (CD): $\mathrm{CD} = \frac{L_{IC}}{L_S}$

FSRQ → CD >1

BL LAC → CD~ 1



Example:

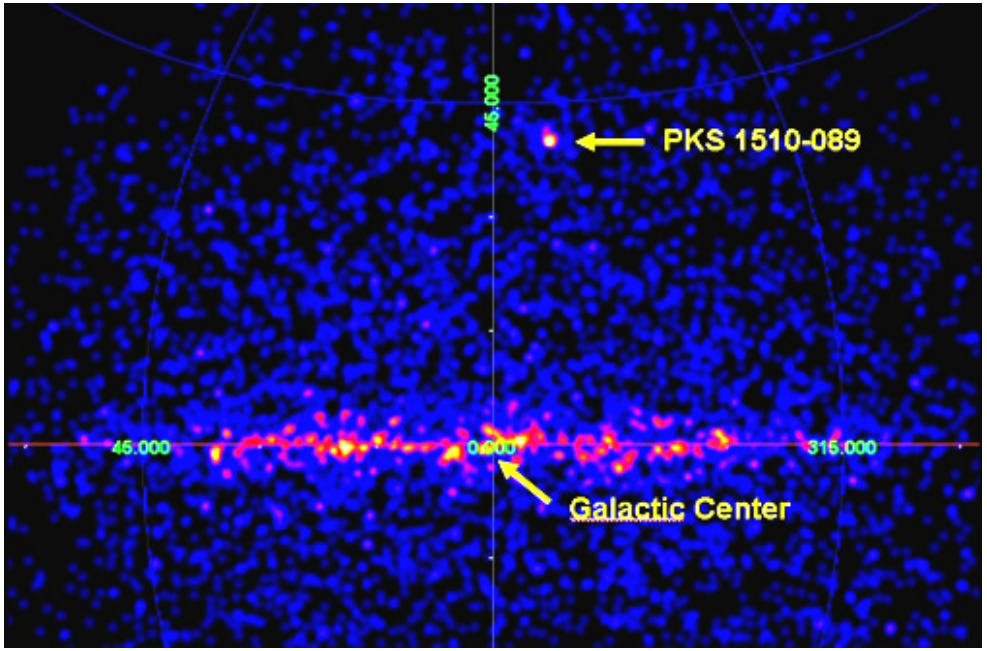


1. black point are already in a file in the work directory
2. point inside the red circle provided by your direct analysis of Swift data

PKS 1510-089 - AGILE

The blazar PKS 1510-089 in Gamma-rays

- Blazars characterized by strong non-thermal emission across the entire electromagnetic spectrum (from radio to Gamma-ray energies)
- PKS 1510-089 characterized by very intense and variable Gamma-ray emission detected by AGILE and Fermi satellites
- **In March 2009, an extraordinary Gamma-ray activity was detected by AGILE: a science alert was immediately sent to the Astronomical community (ATel 1957) triggering 15 Swift Target of Opportunity (ToOs) observations (see P. Grandi tutorial)**
- Today we analyze the AGILE observation of PKS 1510-089 in March 2009



The blazar PKS 1510-089 in Gamma-rays/3

References for PKS 1510-089:

- Pucella et al., 2008, A&A, 491, L21
- Dammando et al, 2009, A&A, 508, 181
- Dammando et al, 2011, A&A, 529, A145

Links:

- AGILE at ASI/ASDC: http://agile.asdc.asi.it
- **AGILE App (AGILEScience**

Interested in AGILE data analysis? See the list of proposed thesis or ask A. Bulgarelli

AGILE observation: OP06800
2009-02-28T12:00:00 (54894.50)   2009-03-31T12:00:00 (54921.50)

…. After the X-ray analysis:

1) Use all the data (MJD 54894.50-54921.50) to

1.1) calculate flux, best position and spectral index (fixflag=7 energybin=3)
- use calculated spectral index for light curve 2)

1.2) generate counts map in the energy range 100-50000 MeV (energybin=0)
- display the map (ds9)
- open reg file to check positioning

2) Light curve (energybin=0)
- generate maps with a temporal bin of 4 days (at least 4 bins starting from 54894.50)
    - change tstart, tstop
- analyze maps with fixflag=3.
    - check position
    - save sqrt(TS), flux and flux error, start time of the temporal bin
- plot the light curve

3) Compute the dimension (upper limit) of the emitting region from the flux variability (see x-ray analysis slides)

4) Calculate flux for each energy bin (see 1))

5) Make SED with Swift analysis results (OPTIONAL)