

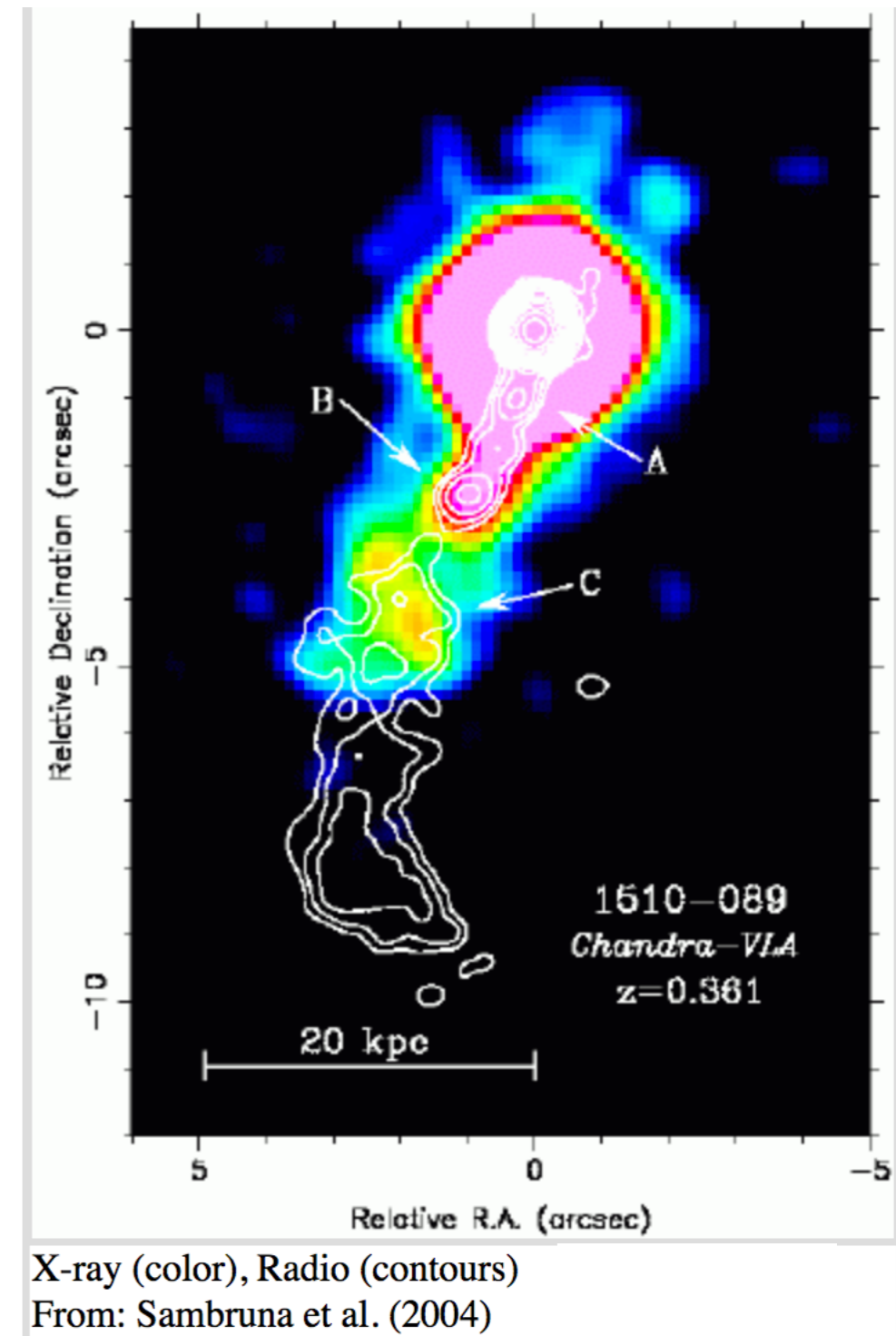
PKS 1510-089

FSRQ

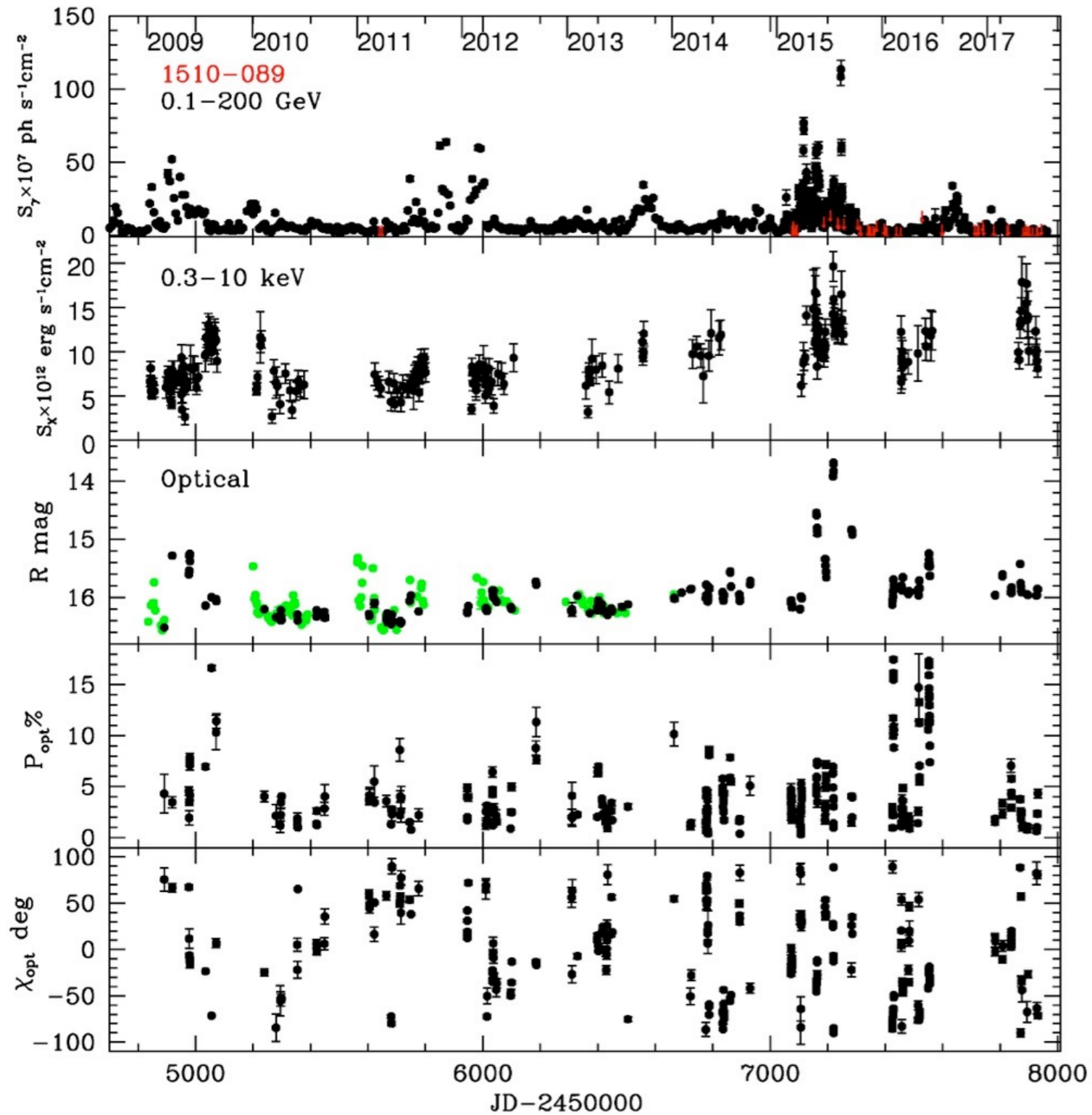
$z=0.361$

$N_{\text{H}}(\text{Gal})=6.99\text{e}20 \text{ cm}^{-2}$
(Kalberla et al. 2005)

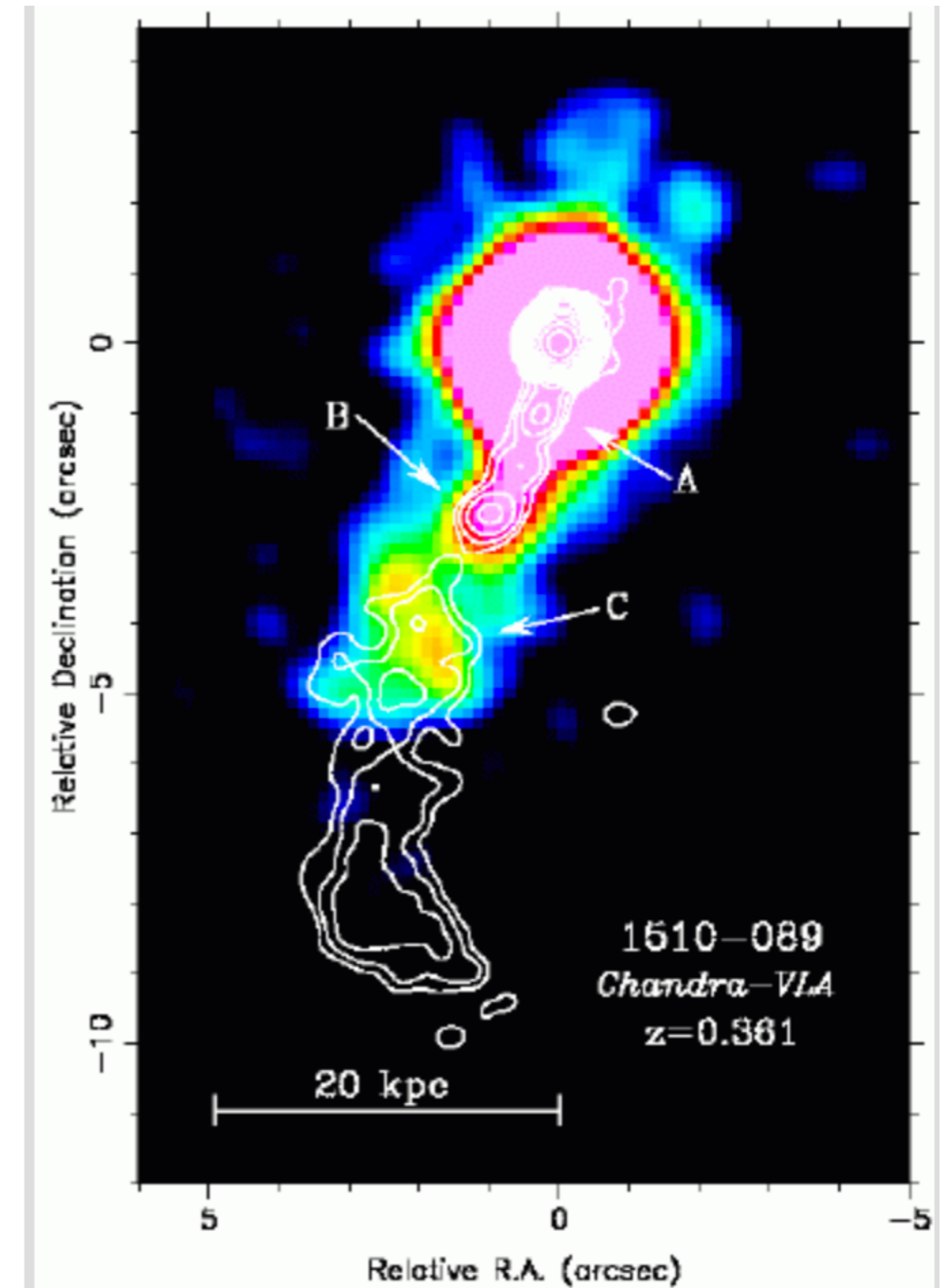
Apparent velocity: $1263 \pm 27 \mu\text{as/y}$; $28.00 c$
(Lister et al. 2013, AJ, 146, 120)



Variable



Jet resolved in X-ray



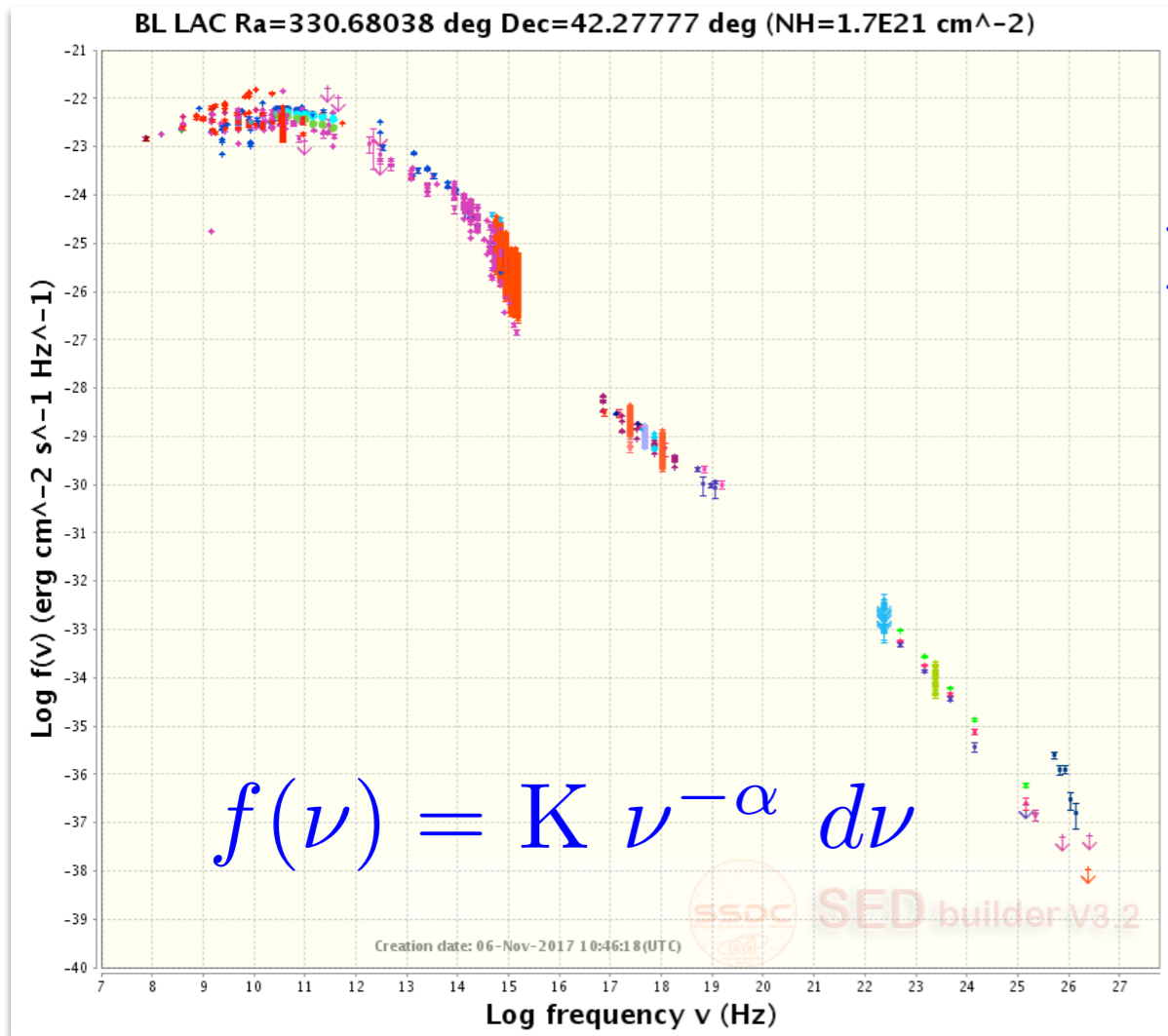
X-ray (color), Radio (contours)
From: Sambruna et al. (2004)

Spectral and Imaging Analysis

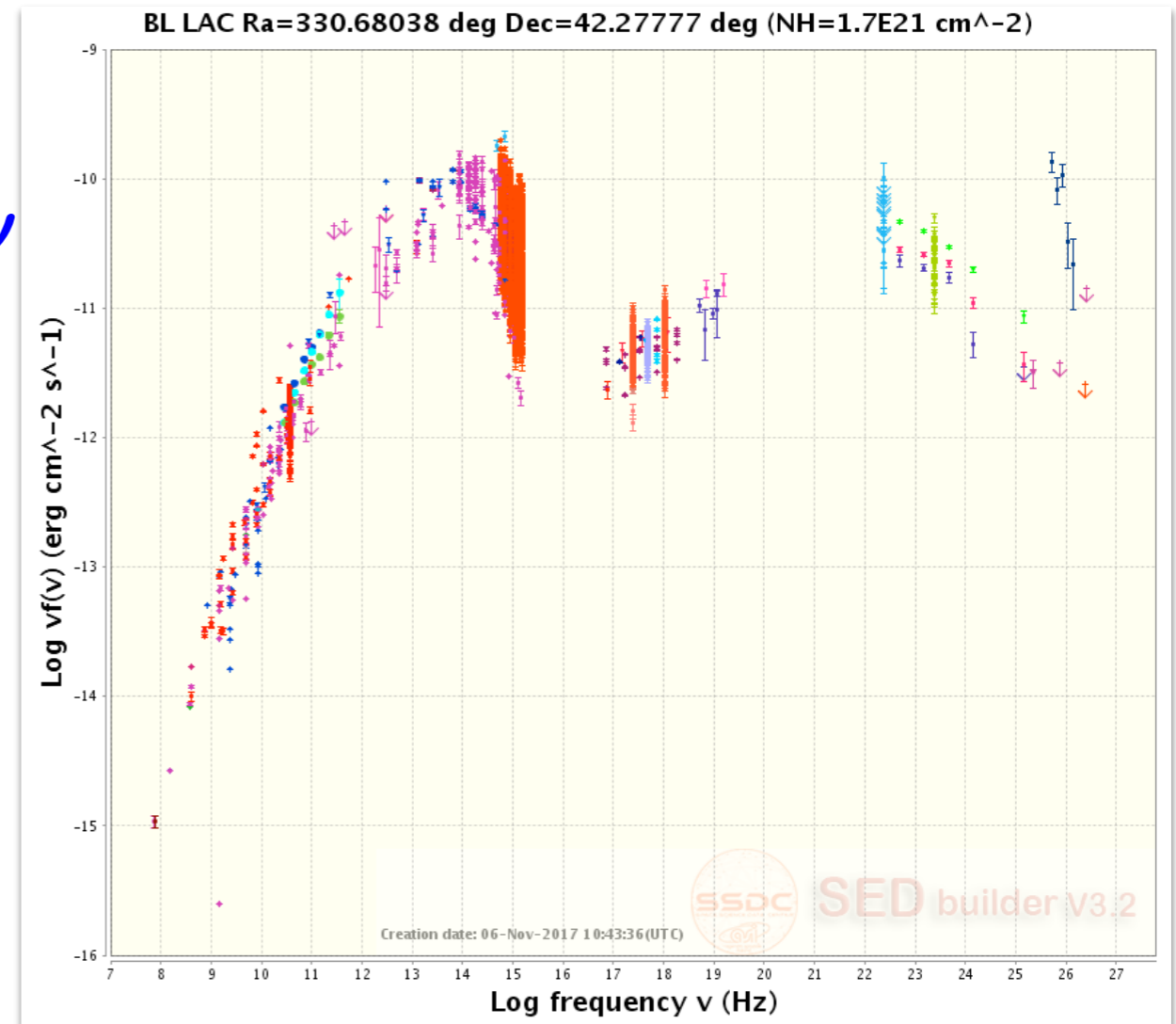
- Chandra: Superposition X-ray and Radio images (DS9) to individuate the regions to be analyzed in the jet
- Chandra: Knot B and C - extraction of the spectra and production of rmf and arf files(CIAO). Analysis with XSPEC. Definition of the best model: parameter uncertainties, confidence (68%, 90% and 99%) contour plots, flux and luminosity
- Chandra: Nucleus - extraction of the spectrum using a circle. Extraction of a new spectrum using an annulus. Check for possible pile up effects.
- Swift/XRT- Spectral analysis of the nucleus with XSPEC Definition of the best model: parameter uncertainties, confidence (68%, 90% and 99%) contour plots, flux and luminosity.
- Construction of the Spectral Energy Distribution
- Optional: AGILE: Spectral analysis (spectral slope and flux); time variability of the gamma-ray counterpart of PKS1510-089

Construction of the Spectral Energy Distribution

Why a SED?

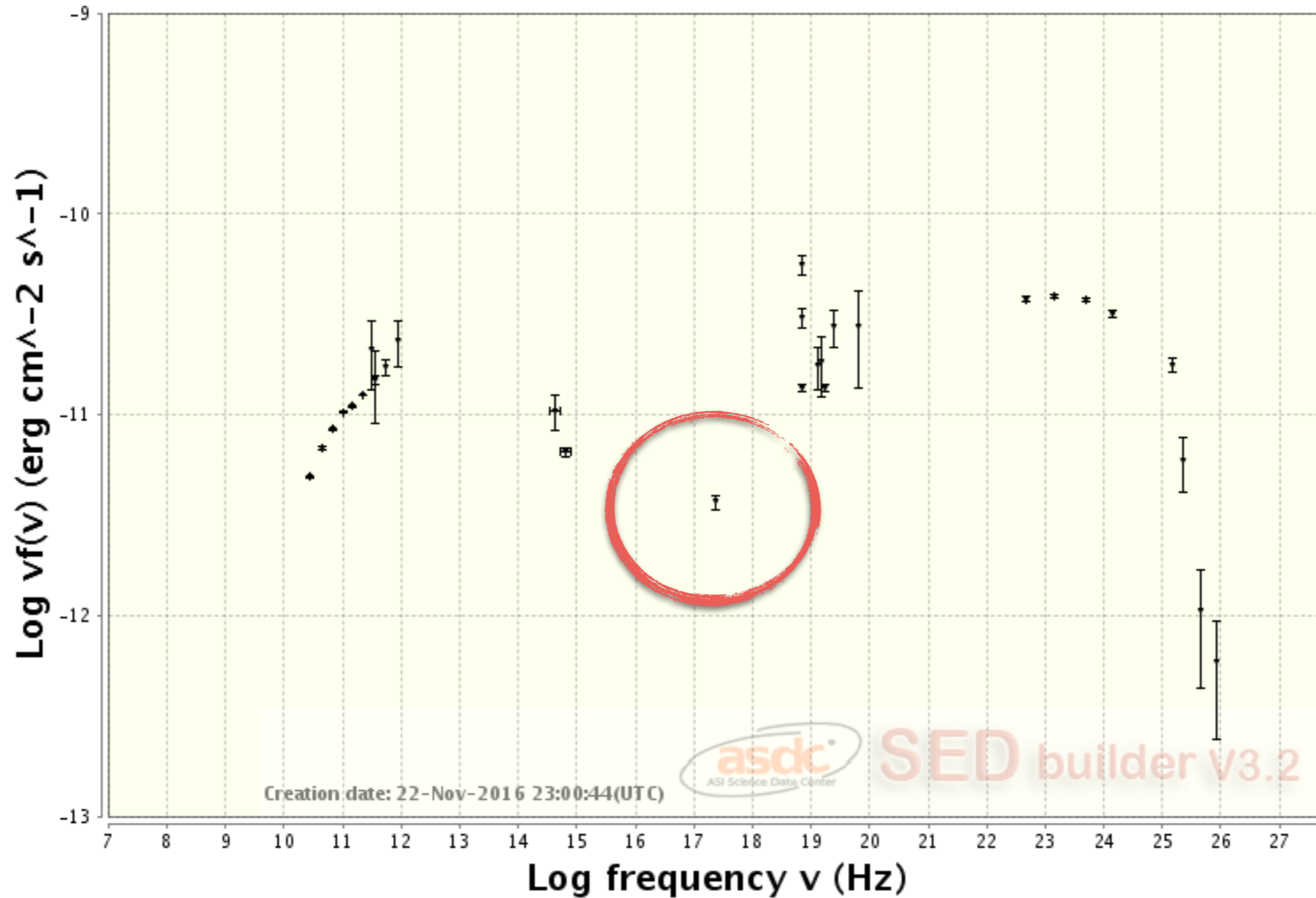


(erg cm⁻² s⁻¹ Hz⁻¹)



(erg cm⁻² s⁻¹)

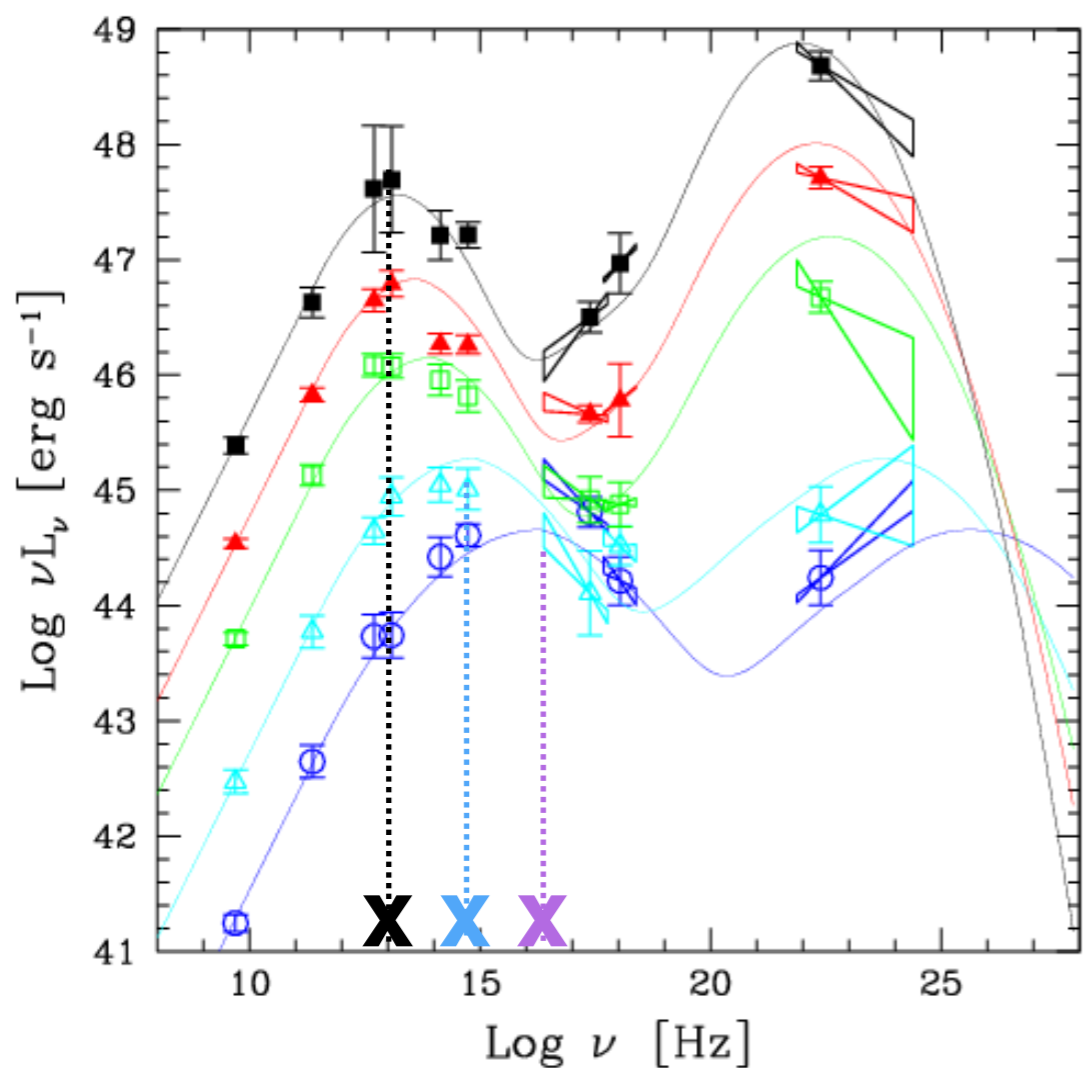
NGC1275 Ra=49.95083 deg Dec=41.51167 deg (NH=1.4E21 cm⁻²)



1. black point are already in a file in the work directory
2. points inside the red circles (swift and agile) provided by your direct data analysis

SED Physical Interpretation

- Synchrotron peak position: ν_S



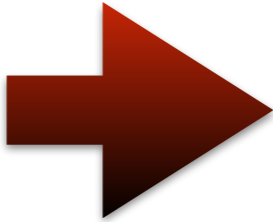
High synchrotron-peaked (HSP) blazars: $\nu_S > 10^{15}$ Hz

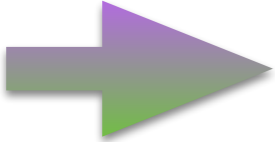
Intermediate synchrotron-peaked (ISP): $10^{14} < \nu_S < 10^{15}$ Hz

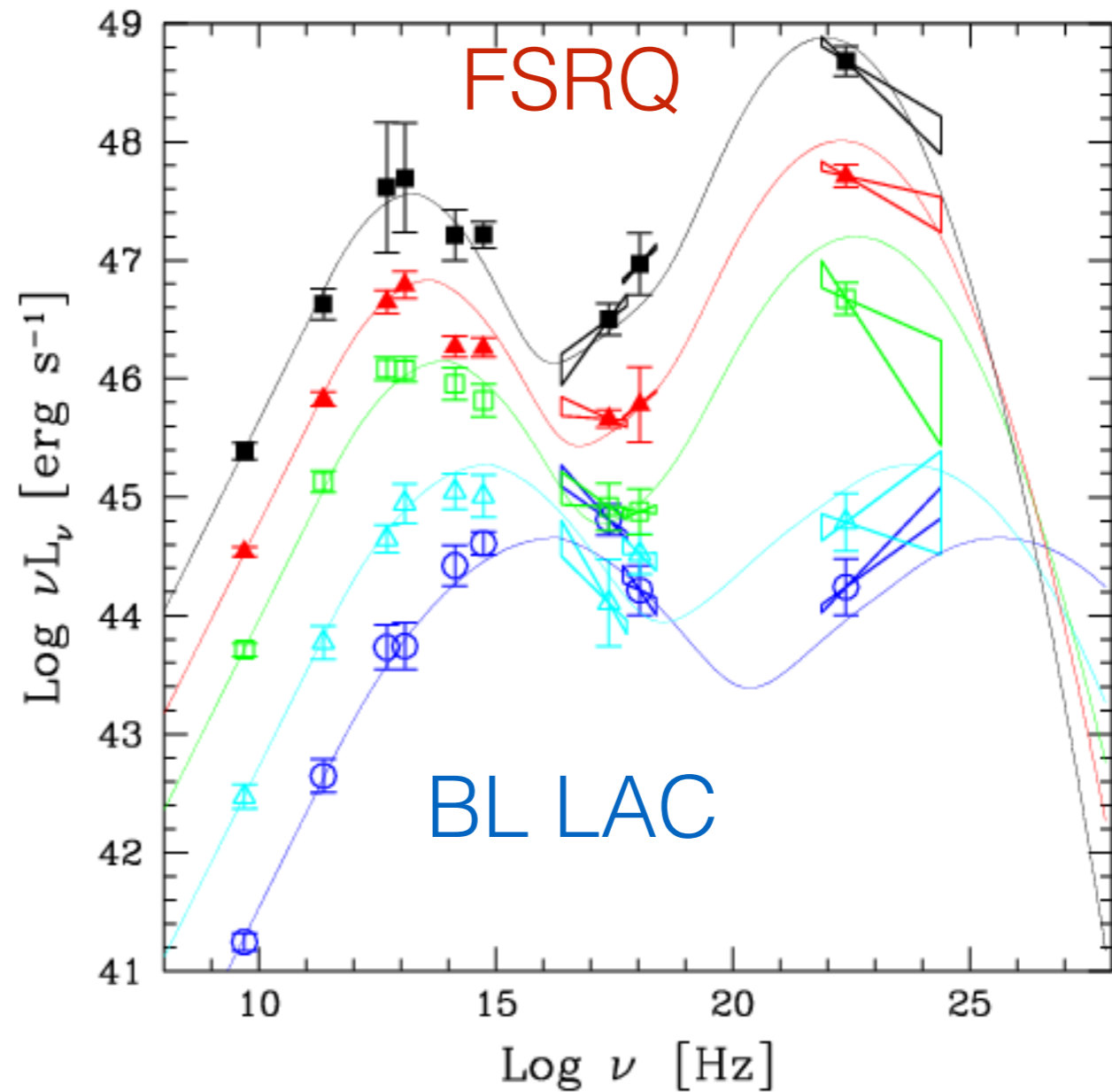
Low synchrotron-peaked (LSP) blazars : $\nu_S < 10^{14}$ Hz



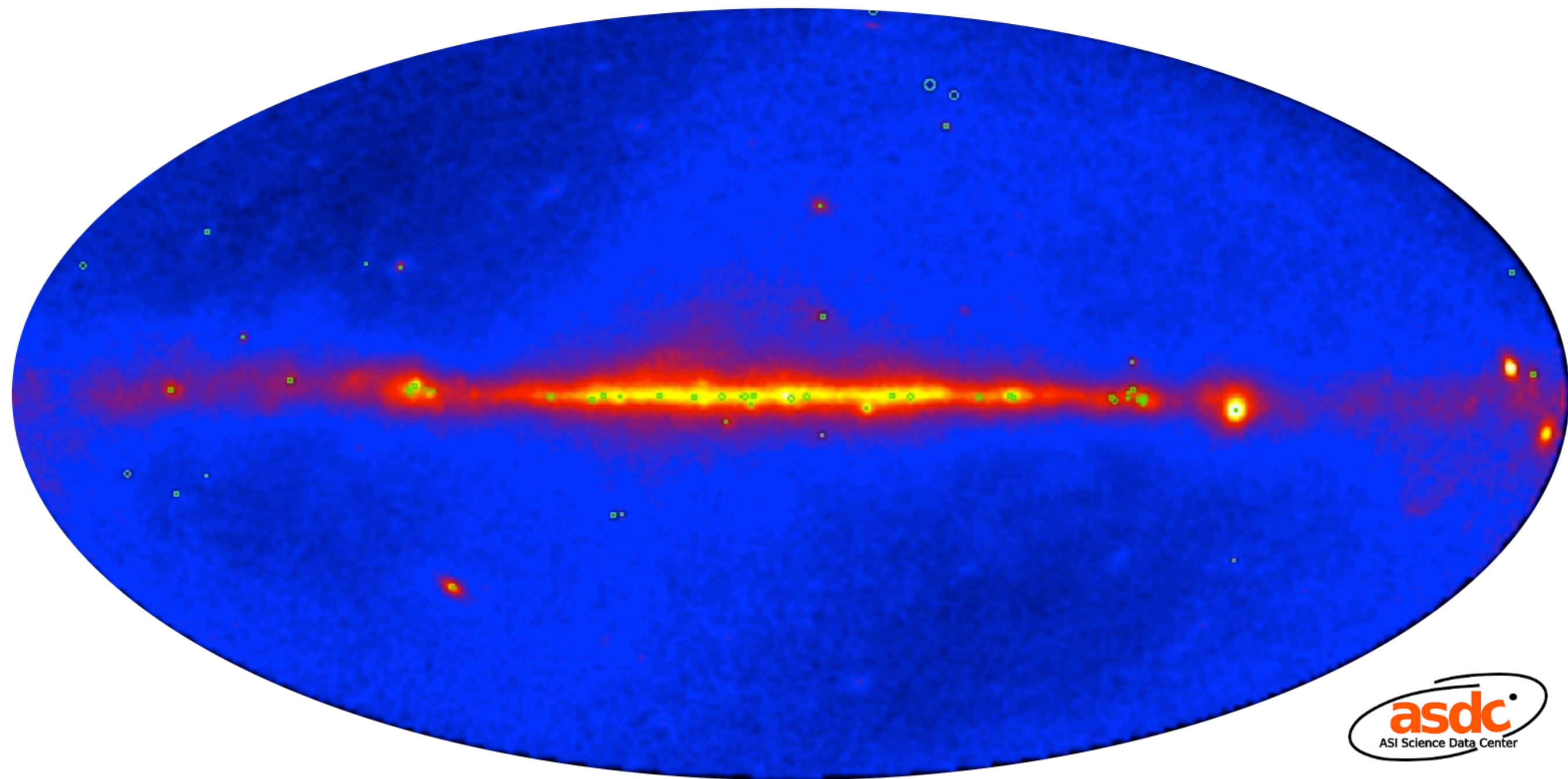
- Compton Dominance (CD): $CD = \frac{L_{IC}}{L_S}$

FSRQ  $CD > 1$

BL LAC  $CD \sim 1$



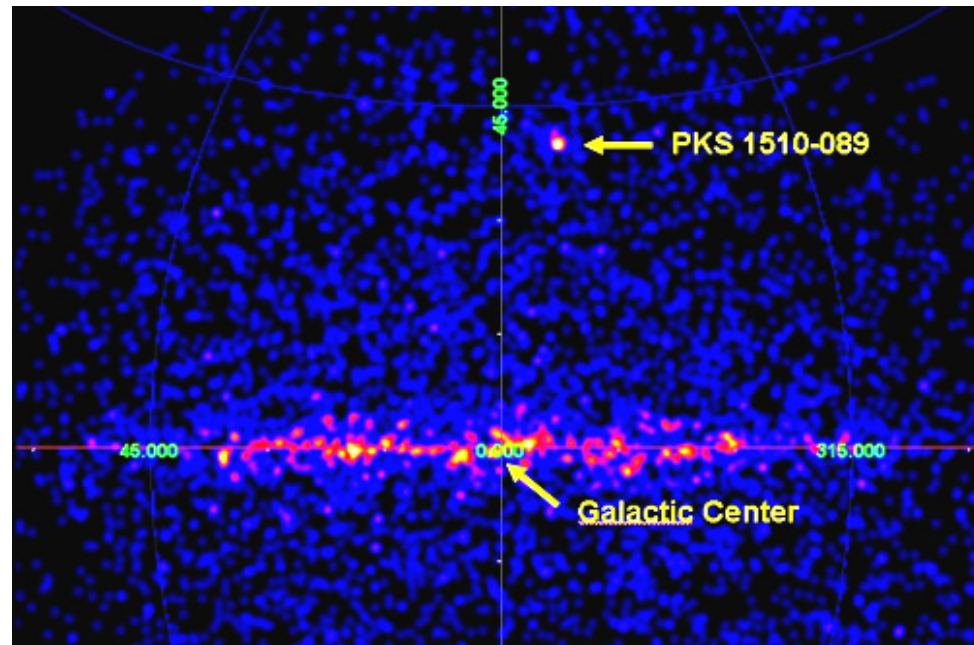
Optional: AGILE analysis



PKS 1510-089 - AGILE

The blazar PKS 1510-089 in Gamma-rays

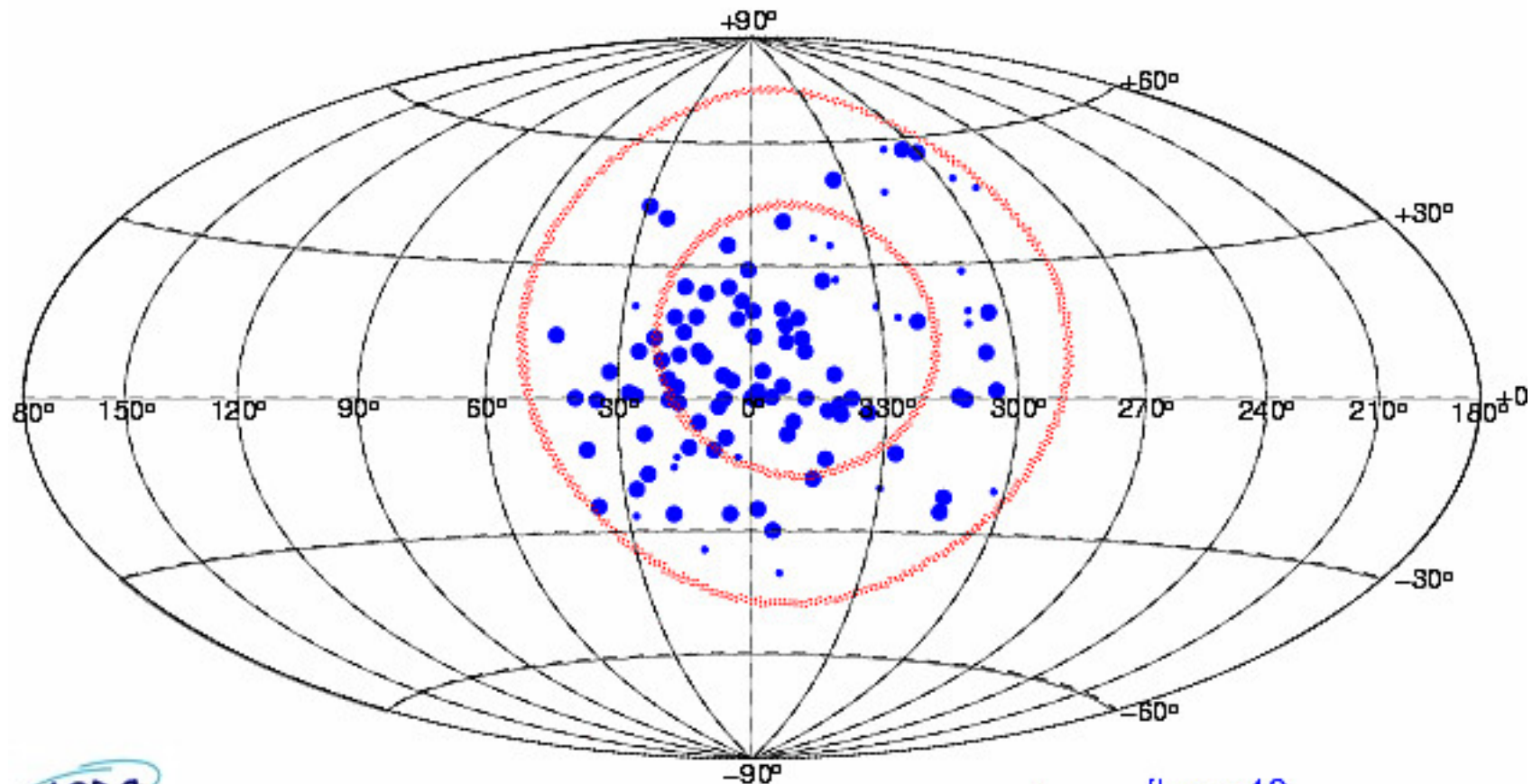
- Blazars characterized by strong non-thermal emission across the entire electromagnetic spectrum (from radio to Gamma-ray energies)
- PKS 1510-089 characterized by very intense and variable Gamma-ray emission detected by AGILE and Fermi satellites
- **In March 2009, an extraordinary Gamma-ray activity 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/2

AGILE observation:

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



Marker size prop to EGRET Flux
Units of e^{-8} ph/cm²/s ($E > 100$ MeV)

- flux < 40
- 40 < flux < 400
- flux > 400

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

.... 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)

The blazar PKS 1510-089 in Gamma-rays/4

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