Active Galactic Nuclei: Blazars
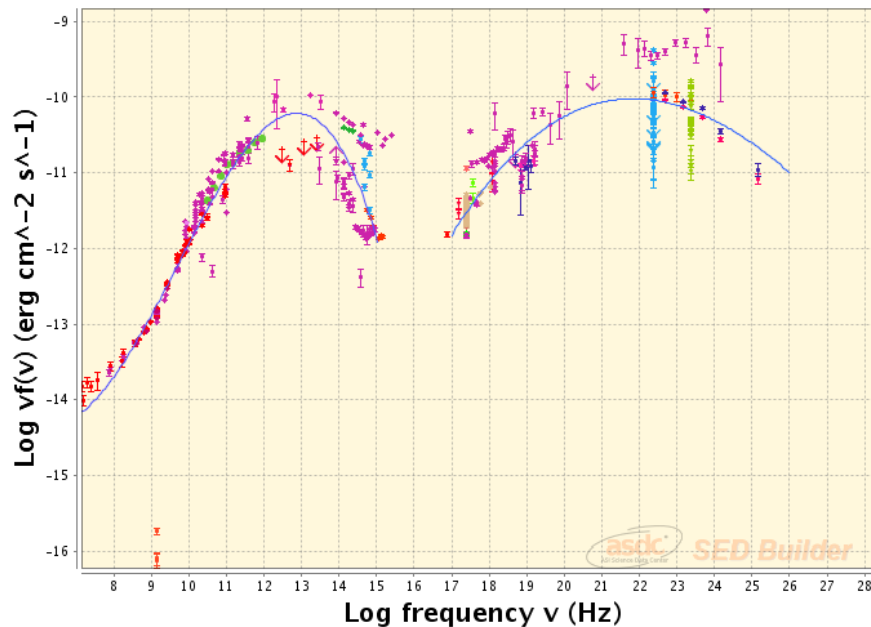
Bruno Sversut Arsioli

Supervisor: Paolo Giommi; Colaboration: Bernardo Fraga

Discovery
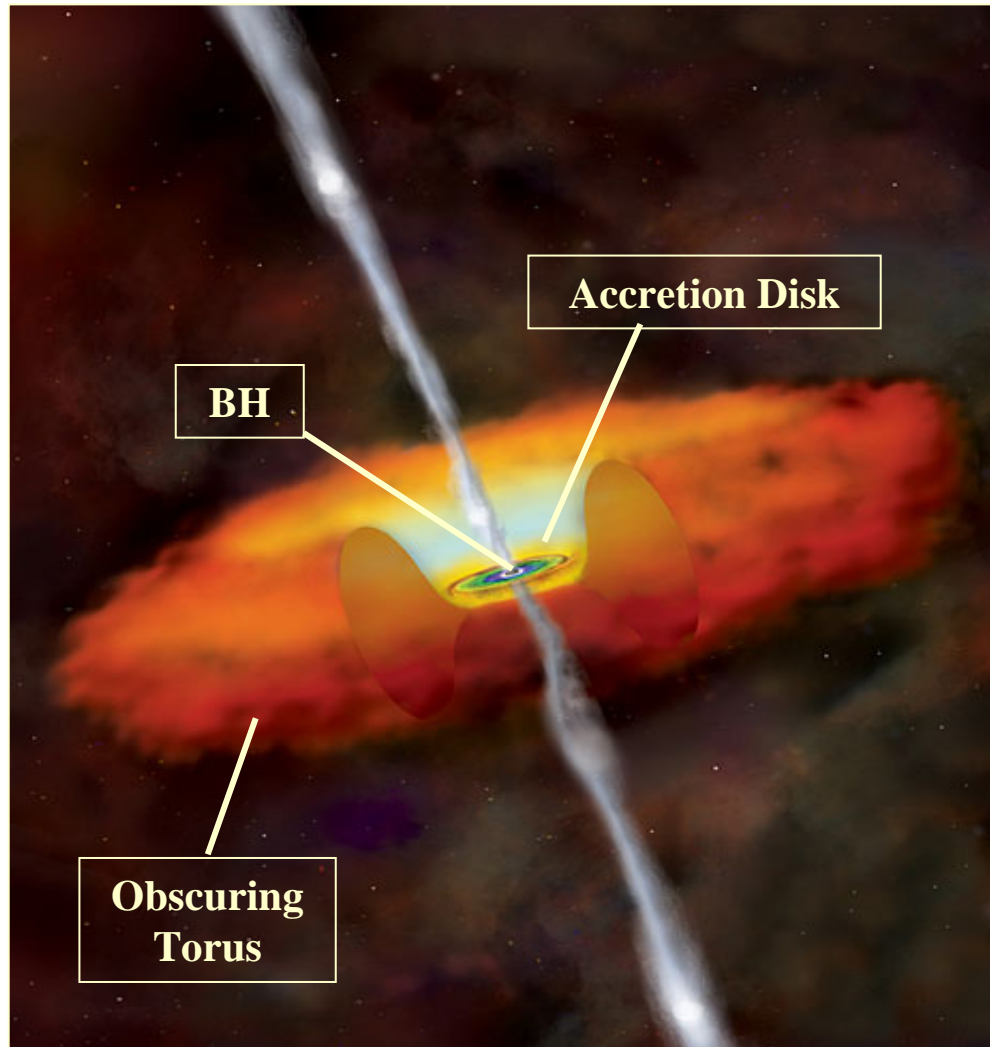
- AGN : Radio Loud Nuclei
- 1st Quasar → 1963

- FSRQ (Flat Spectra Radio Quasar) 3C273
- BL Lac → Eliptical Galaxies
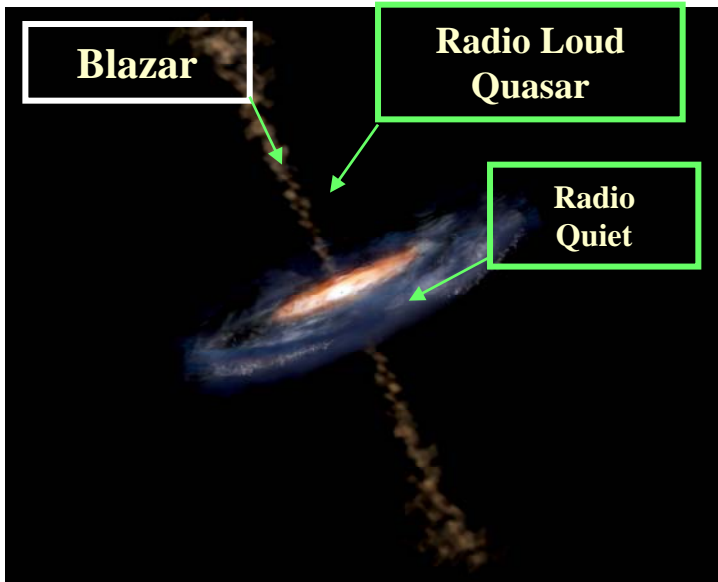
3C279 Ra=194.04625 deg Dec=-5.78917 deg (NH=2.0E20 cm^-2)

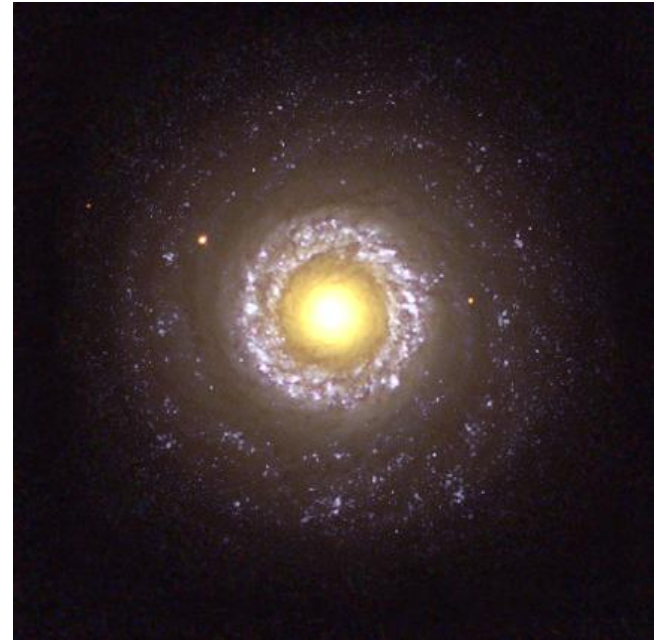Bright across the spectra - Radio to TeV photons

Standard View

Superluminal Motion → Relativistic Jet + Angle

AGN – Unified Schemes
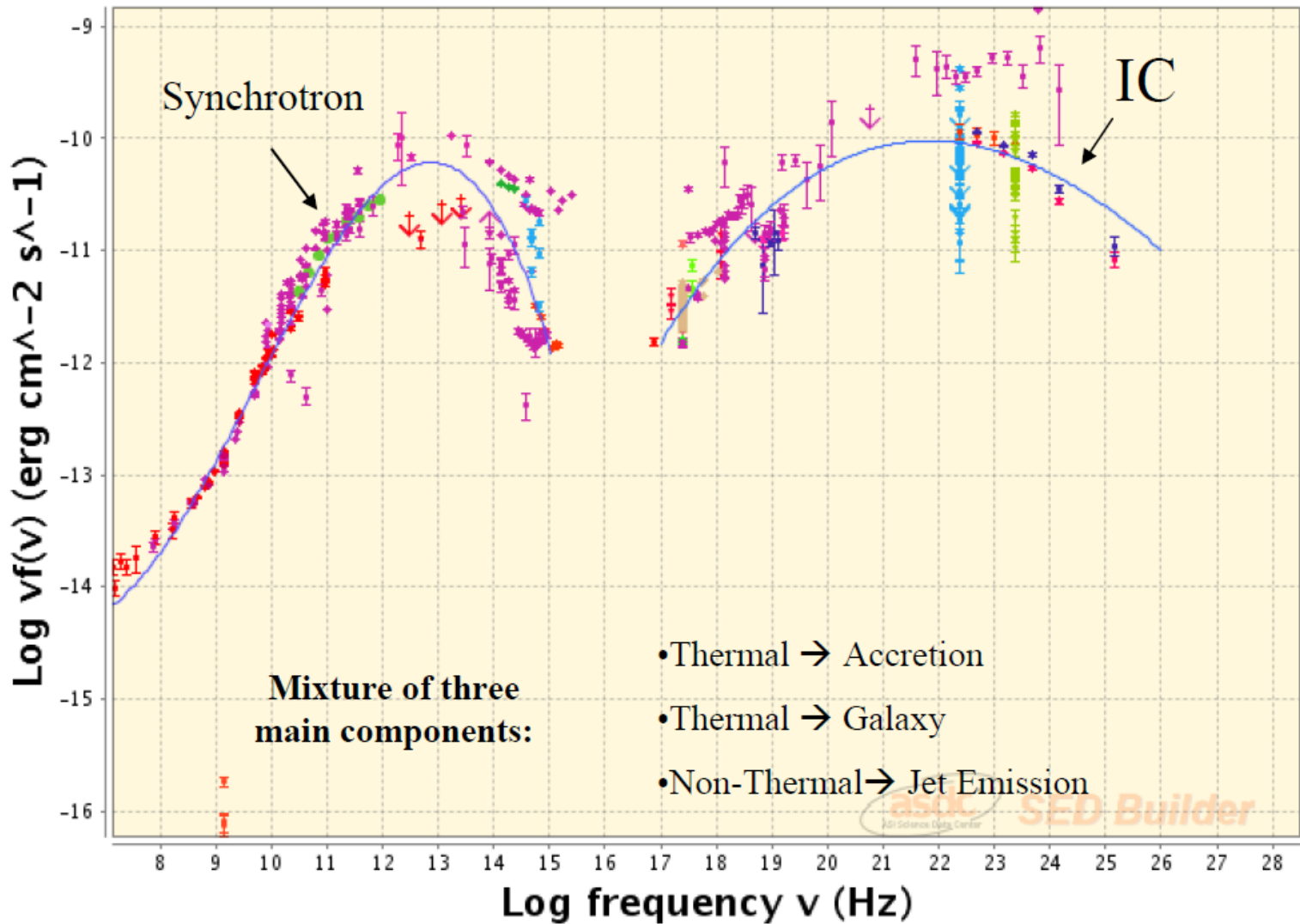

Blazar

Radio Loud Quasar

Radio Quiet

•Jets Pointing to us : Blazar

•Structure can have many different orientation

Spectral Emission

3C279 Ra=194.04625 deg Dec=−5.78917 deg (NH=2.0E20 cm^−2)

Synchrotron

IC

Log νf(ν) (erg cm^−2 s^−1)

Log frequency ν (Hz)

Mixture of three main components:

- Thermal → Accretion
- Thermal → Galaxy
- Non-Thermal → Jet Emission

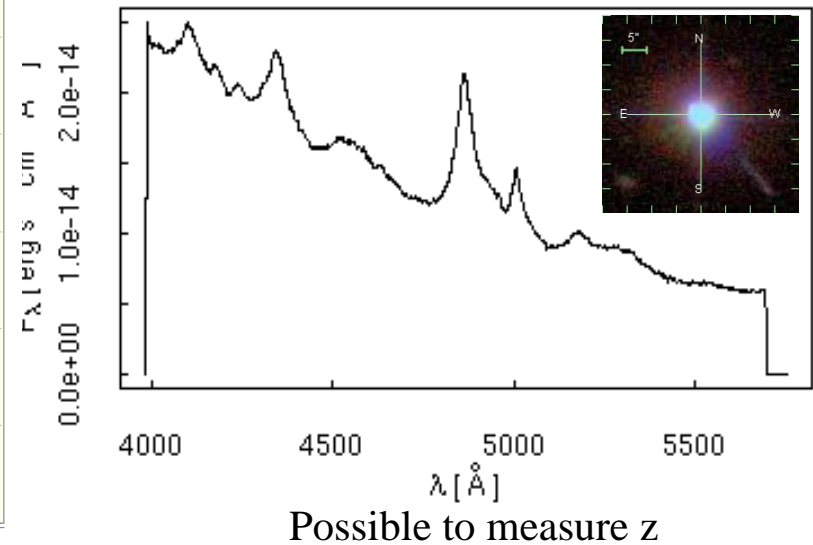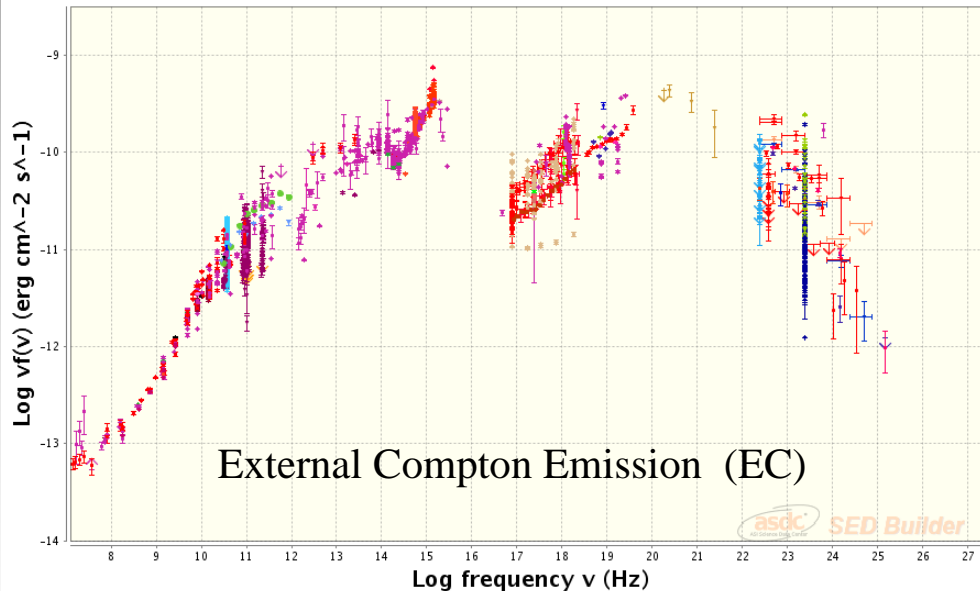# Object types: Flat Spectrum Radio Quasars

• FSRQ: Strong spectral lines → Strong thermal component
           Accretion Disk must be present – High efficiency   FRII

   Typically found at redshift: $1 < z < 5.5$

3C273.0 Ra=187.27792 deg Dec=2.05222 deg (NH=1.7E20 cm^-2)

External Compton Emission (EC)

Possible to measure z

Photons from the accretion disk as seeds for the IC

Object types:

- BL Lacs: Sync. Component is to strong

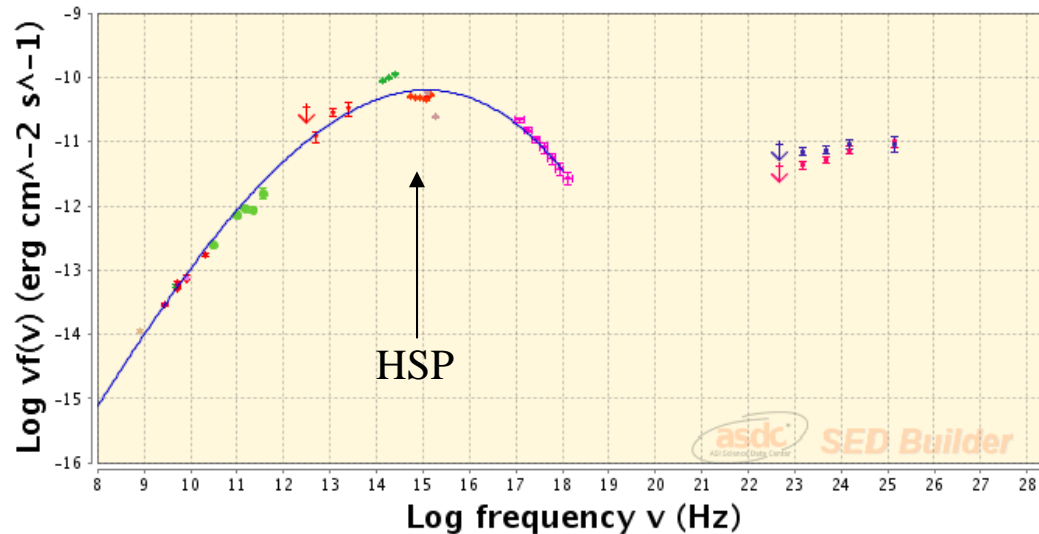 Swamped galaxy light → No Z (z<0,6)

  Low efficiency accretion disk: FRI

sed-2009m4849 Ra=302.35542 deg Dec=-48.83150 deg (NH=3.9E20 cm^-2)

Synchrotron Self Compton (SSC)
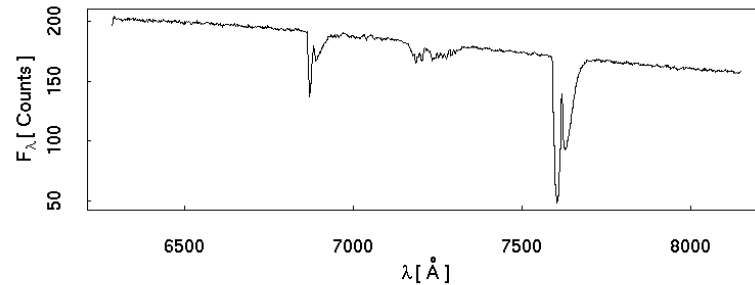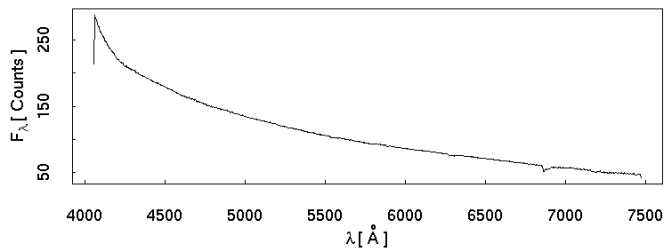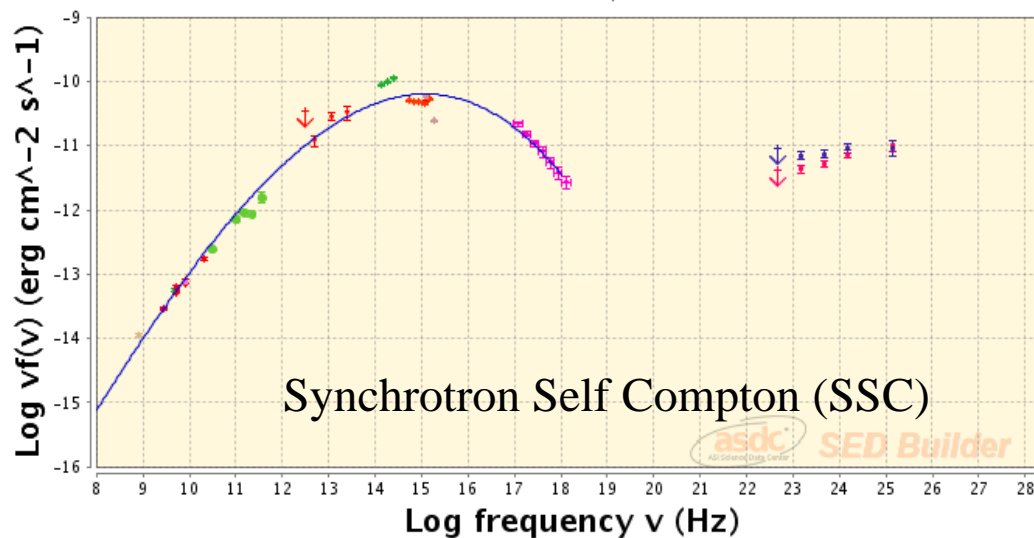
BL Lac Classification:

- HSP (High Spectral Peak) $v > 10^{15}$ Hz
- LSP (Low Spectral Peak) $v < 10^{14}$ Hz

sed-2009m4849 Ra=302.35542 deg Dec=-48.83150 deg (NH=3.9E20 cm^-2)

HSP

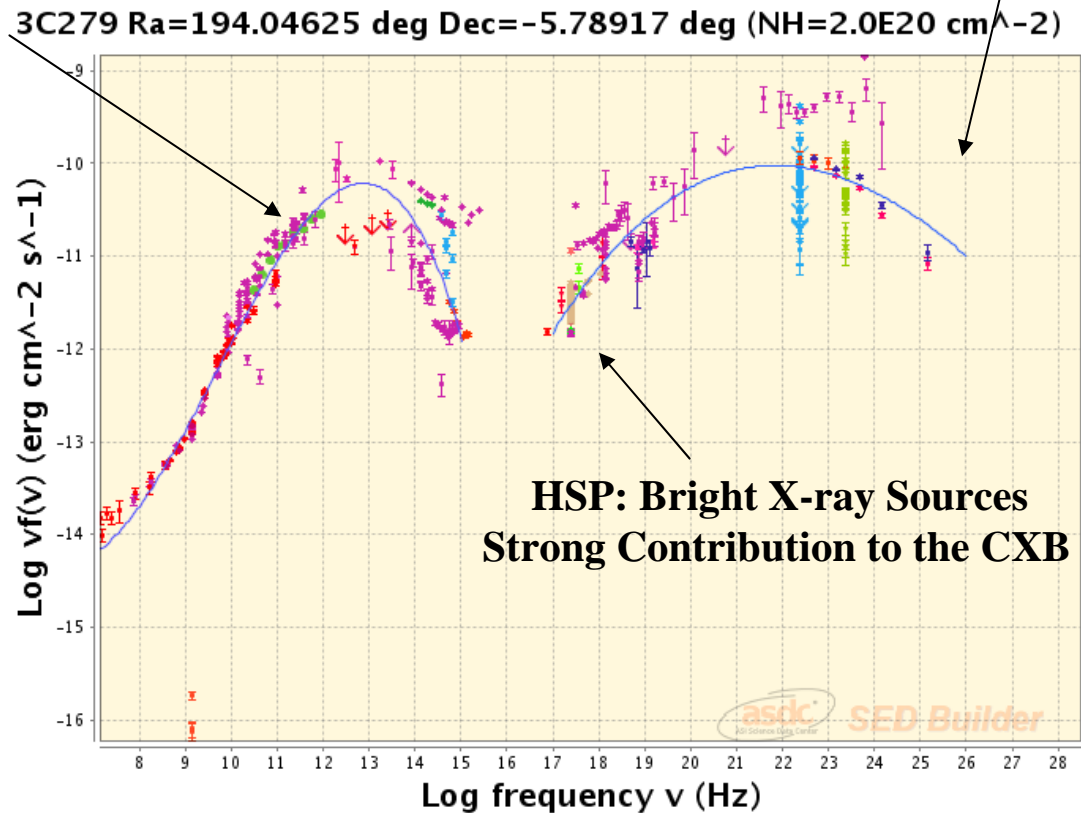Same electron distribution generating Synchr. and IC bumps.

What we can do:

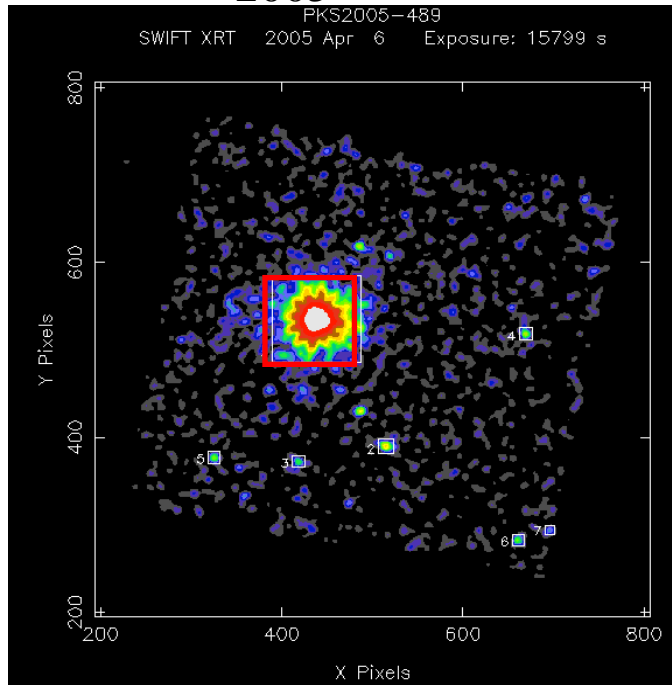**MicroWave Band: LSP – Very Bright MicroWave Sources**

WMAP Correctionsto to the meassurements of CMB Primordial Fluctuations

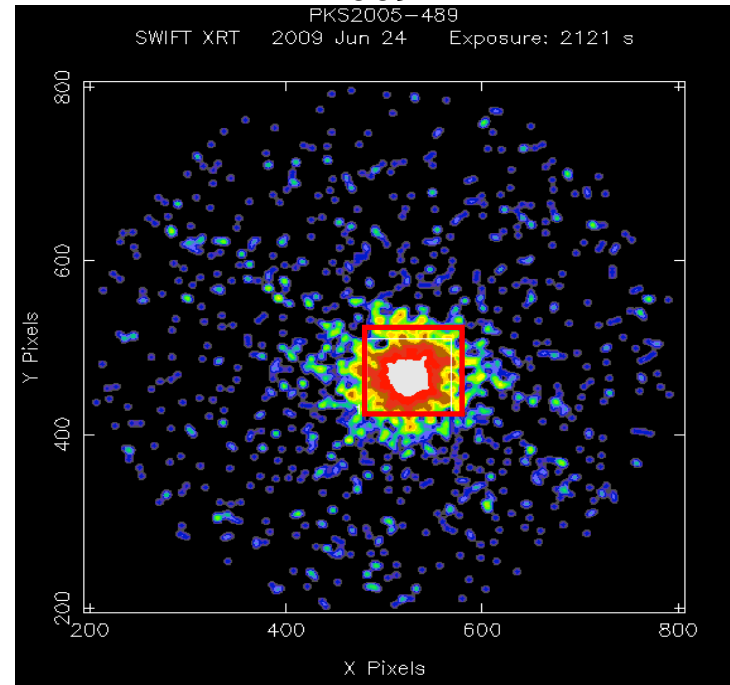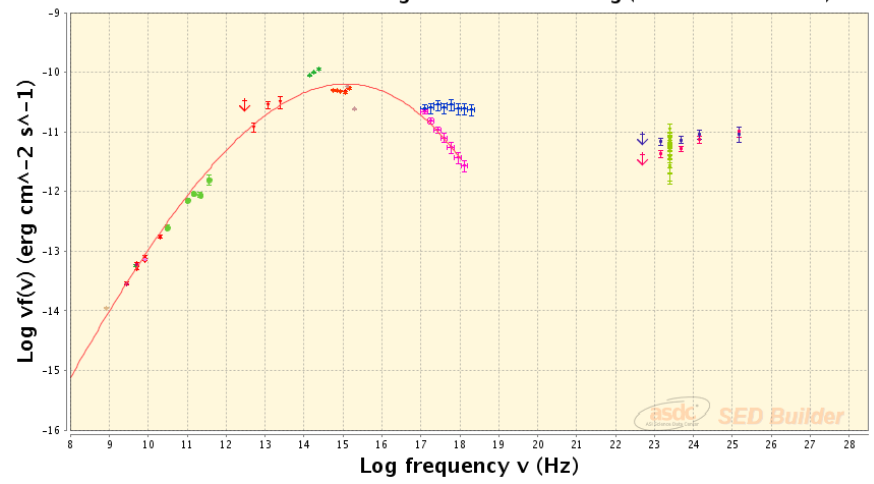**High Energy band: HSP Sources Identification of TeV photons**

3C279 Ra=194.04625 deg Dec=-5.78917 deg (NH=2.0E20 cm^-2)

Log vf(v) (erg cm^-2 s^-1)

Log frequency v (Hz)

HSP: Bright X-ray Sources Strong Contribution to the CXB

Variability

Identifying Blazars

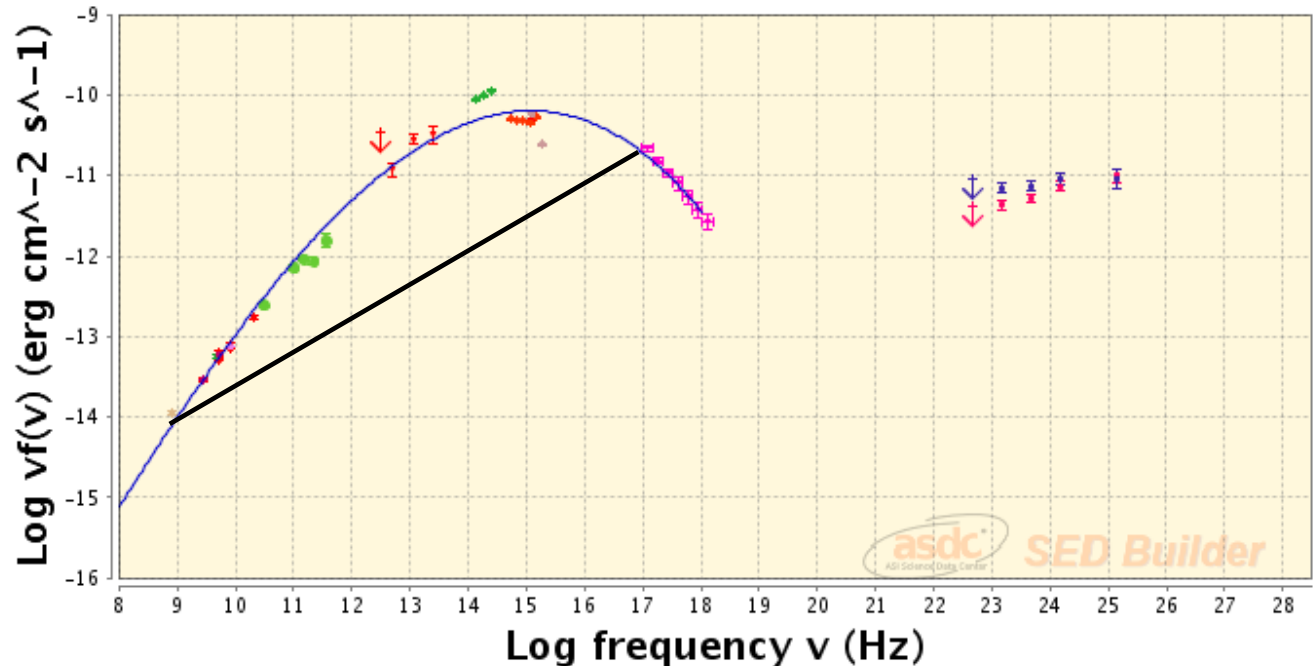WISE All Sky Survey → Tool for identifying unknown sources
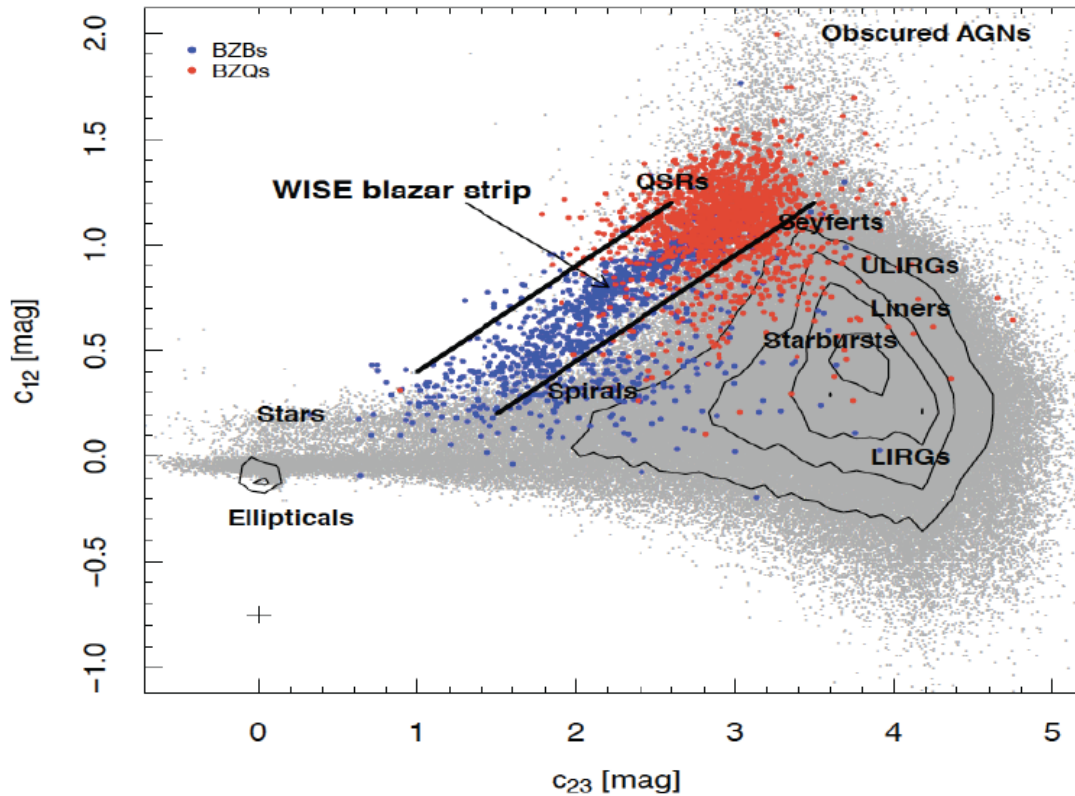
Color-Color Diagrams[R. D'Abrusco]

$[3.4]-[4.6]-[12]\mu m$

HSP (High Spectral Peak)

sed-2009m4849 Ra=302.35542 deg Dec=-48.83150 deg (NH=3.9E20 cm^-2)

$$f_{x\text{-ray}}/f_R > 1000$$

Use the sloop between chanels to identify HSP

HSP → Powerfull Synch. source : Bright in the X-ray and TeV bands.

HSP – LSP Catalog

- Bulding up complete catalog
- Many Unknown objects
- More reliable Statistical Information LogN x LogS$_{(5GHz)}$ (Contribution to CB: MicroWave, X-ray, Gamma-ray)
- Study Light curves

Overview Open Questions:

- How do Jets form and propagate?

- What are the fundamental parameters governing the Central Engine?

- BH Mass, Spining

- Are they powered by SMBH?

References

- [1] P. Giommi, P. Padovani; A Simplified view of blazars: clearing the fog around long-standing selection effects

- [2] R. D'Abrusco; Infrared Colors of The Gamma-Ray Detected Blazars

- [3]P. Giommi, S. Colafrancesco; Non-Thermal Cosmic Background from Blazars: the contribution to the CMB, X-ray and Gamma-ray Backgrounds

Thank you!

HSP-LSP Catalog

- ## Statistical Info: LogN – Log S$_{(5GHz)}$
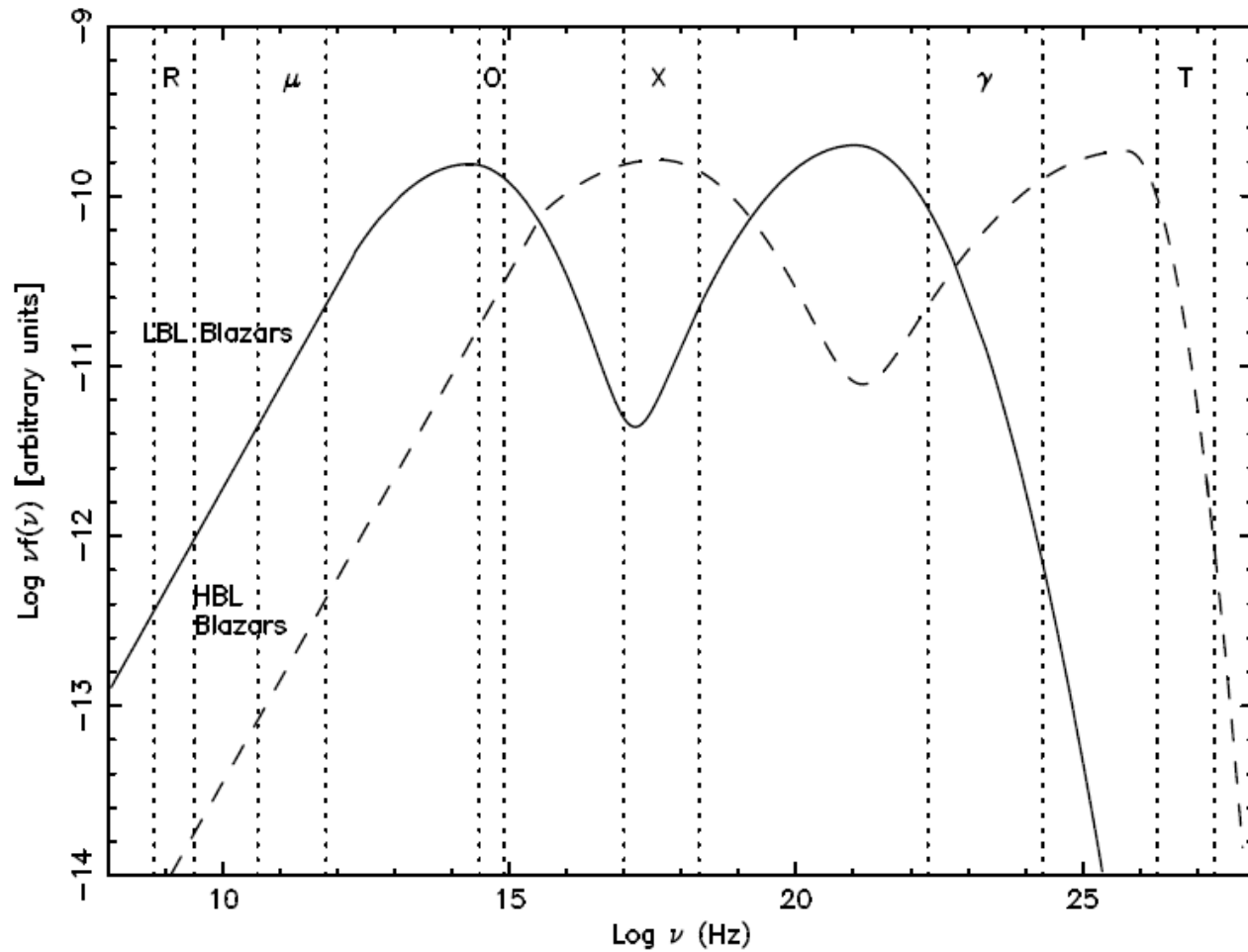
  Blazar contribution: X-ray, Gamma/TeV CB
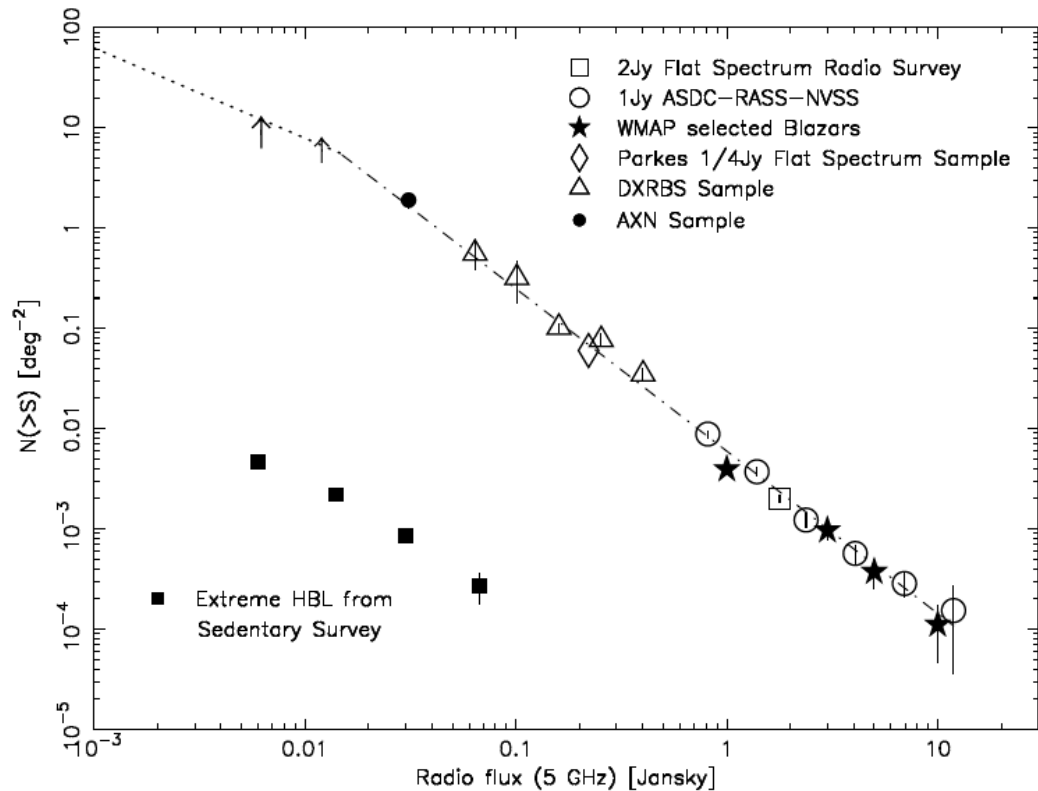
Ref.[3]

$$I_{Blazars} = \int_{0.1mJy}^{1Jy} S \, \frac{dN}{dS} \, dS$$

$$(\Delta T)_{Blazar} = [(2\pi)^{-1} C_\ell \ell(\ell+1)]^{1/2}$$

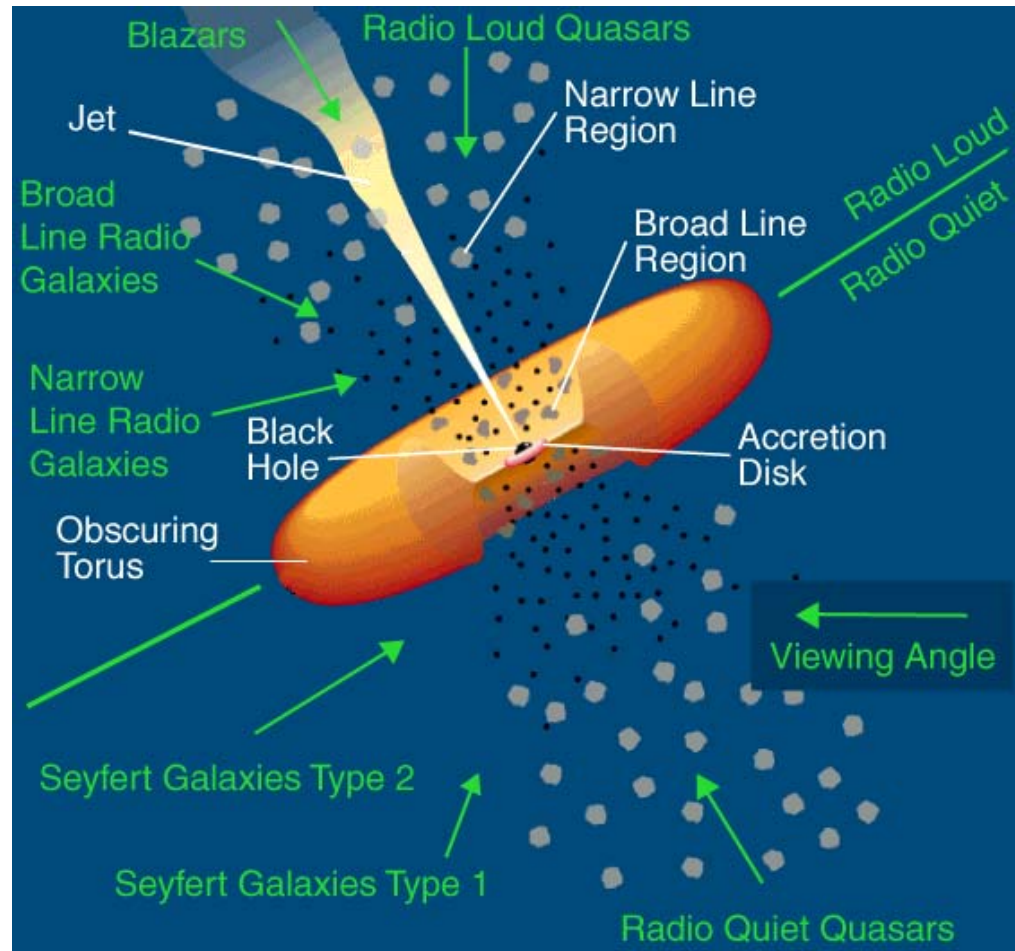$$C_{\ell,\text{Blazar}} = \int_{S_{\min}}^{S_{\max}} dS \, \frac{dN}{dS} \, S^2$$
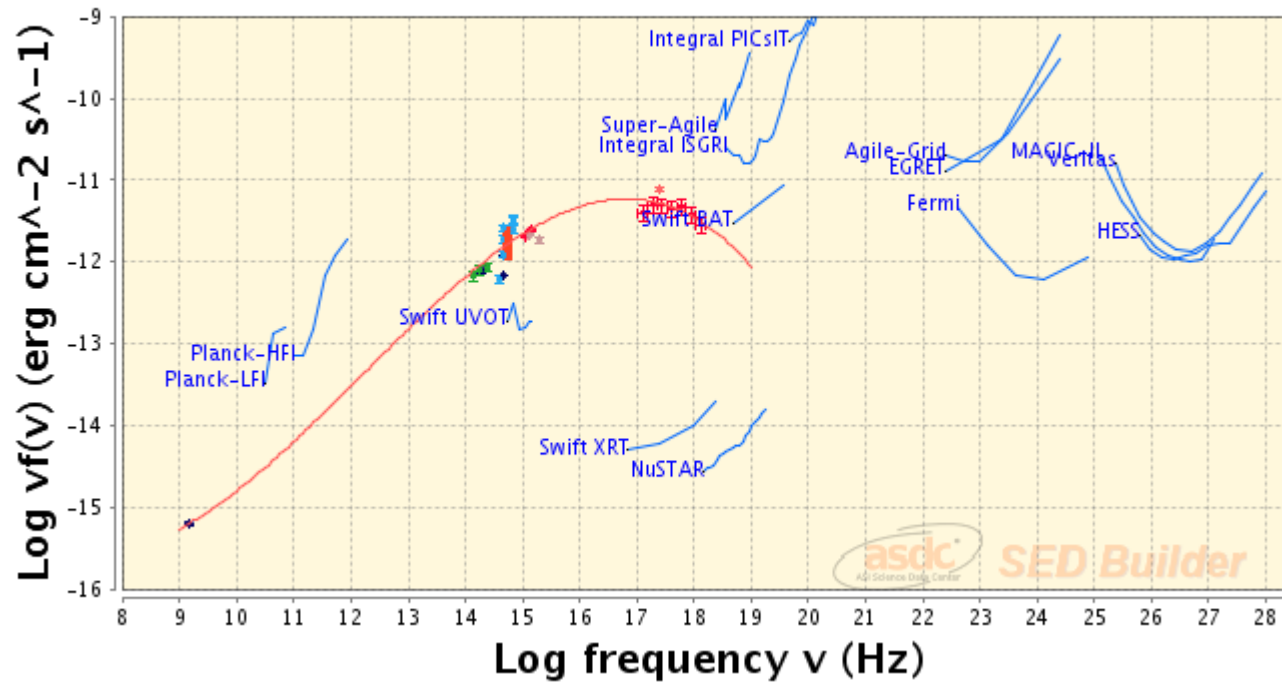
Flux Ratio: HSP - LSP

Ref. [3]: P. Giommi

Broad – Narrow Line Regions

Sensitivity

sed-2357m1718 Ra=359.37417 deg Dec=-17.30108 deg (NH=1.9E20 cm^-2)

Example: FSRQ