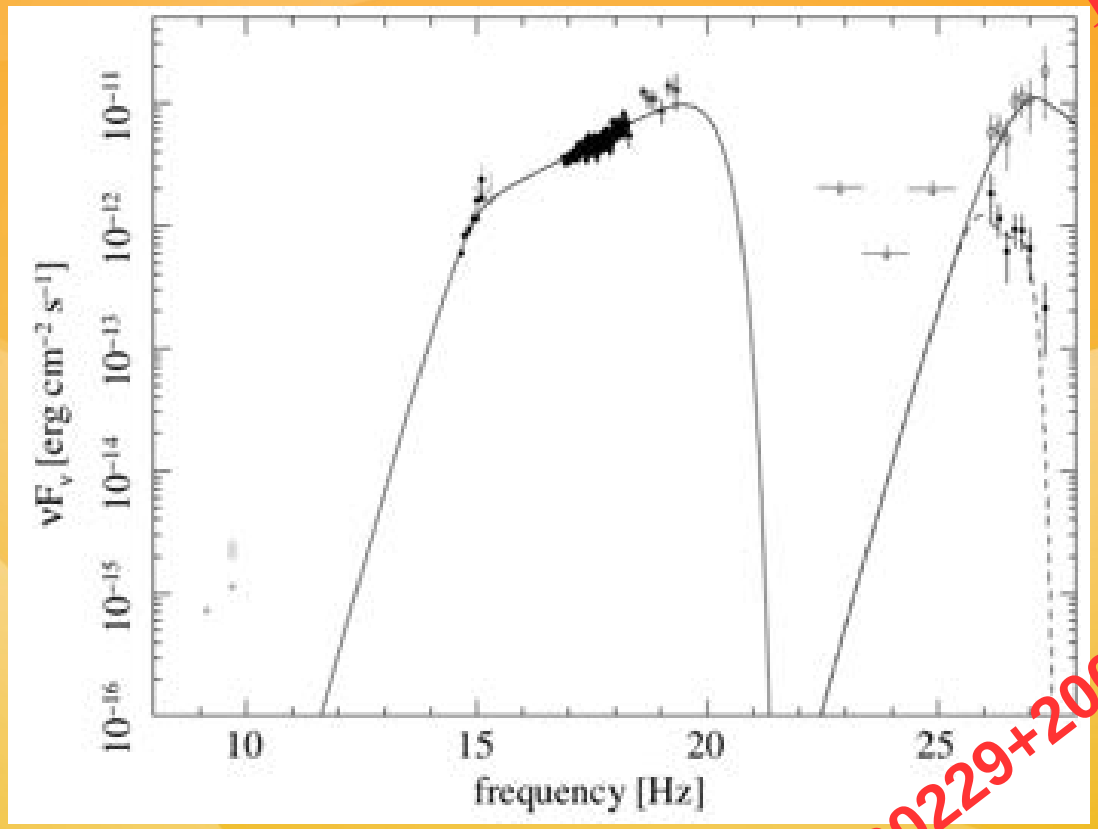
Identification of extreme blazar candidates in X-ray catalogs

Preliminary!



1ES0229+200

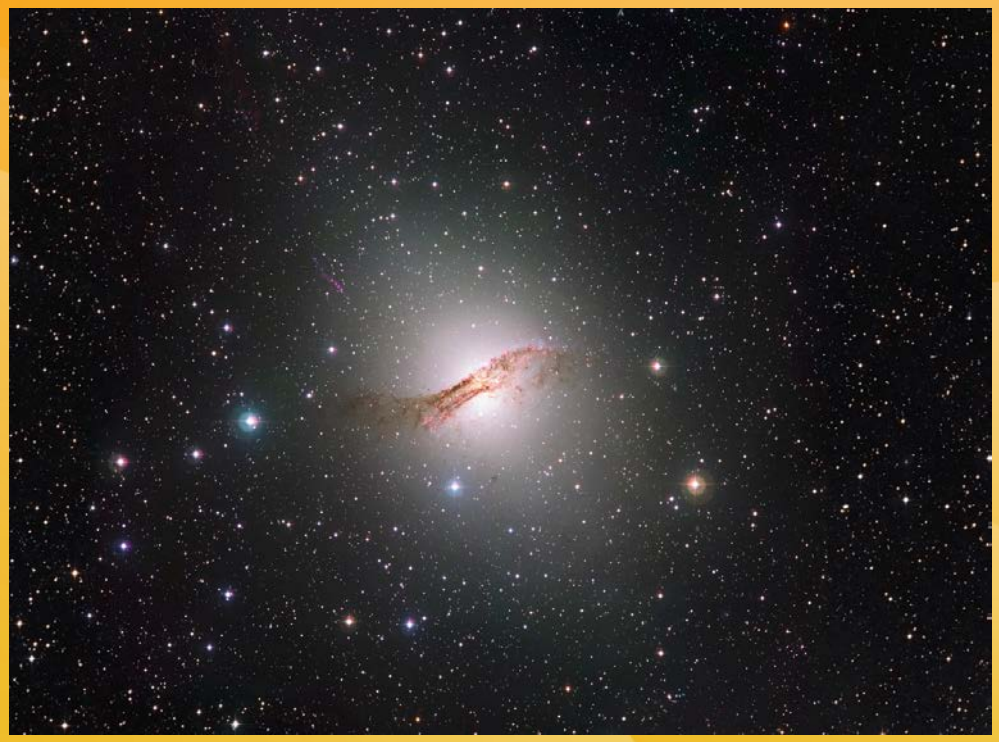
Speaker: **Luca Foffano** – PhD student
University of Padova – department of Physics and Astronomy "Galileo Galilei"

Outline

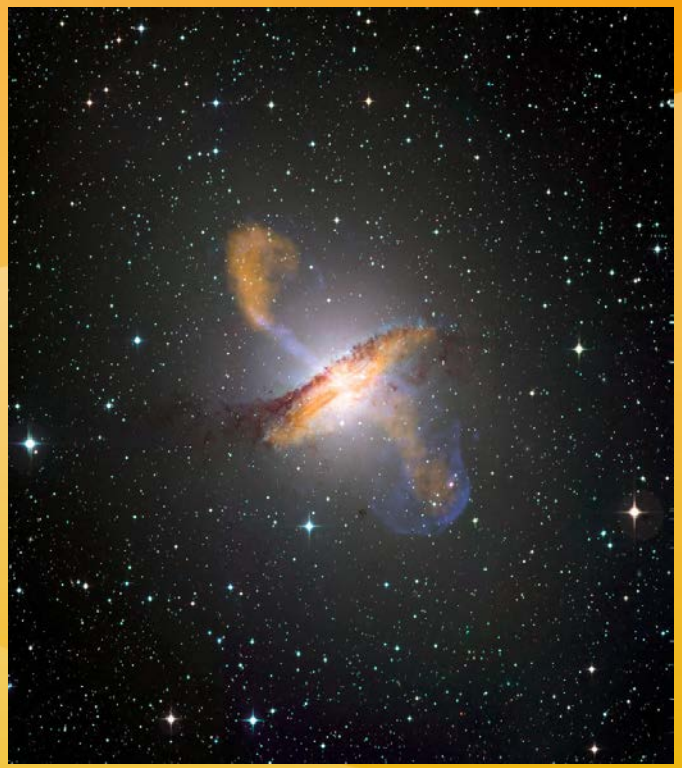
- What are AGNs?
- What is a blazar?
- What is an extreme blazar?
- What is our research strategy?

Active Galactic Nuclei

A famous AGN: Centaurus A



In optical...



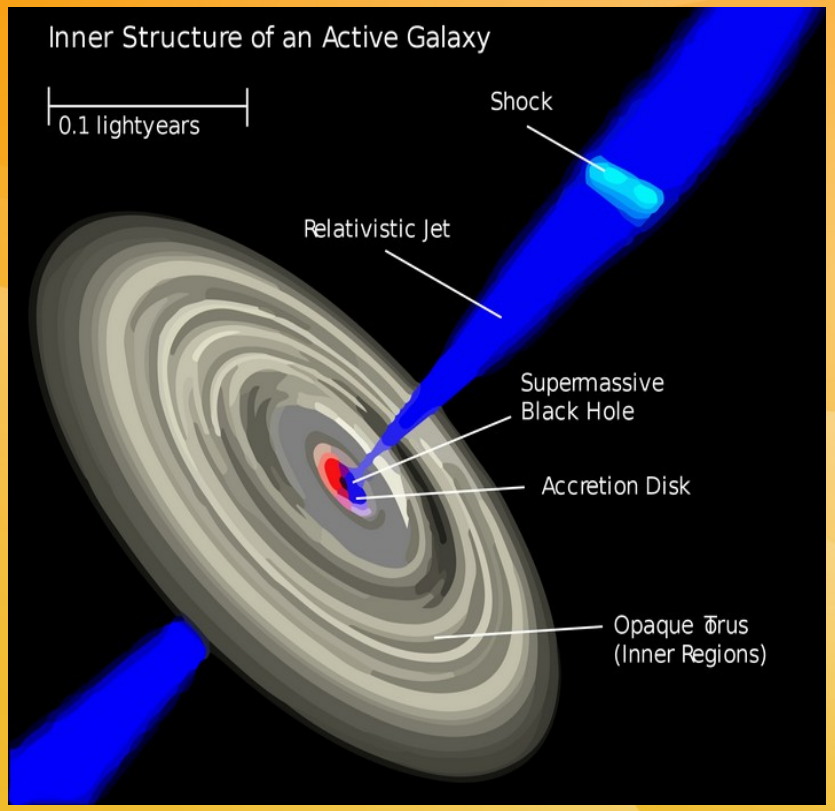
…and infrared!

Active Galactic Nuclei

Suppose you are looking at the Virgo Cluster in the sky...

A spectacular AGN: M87

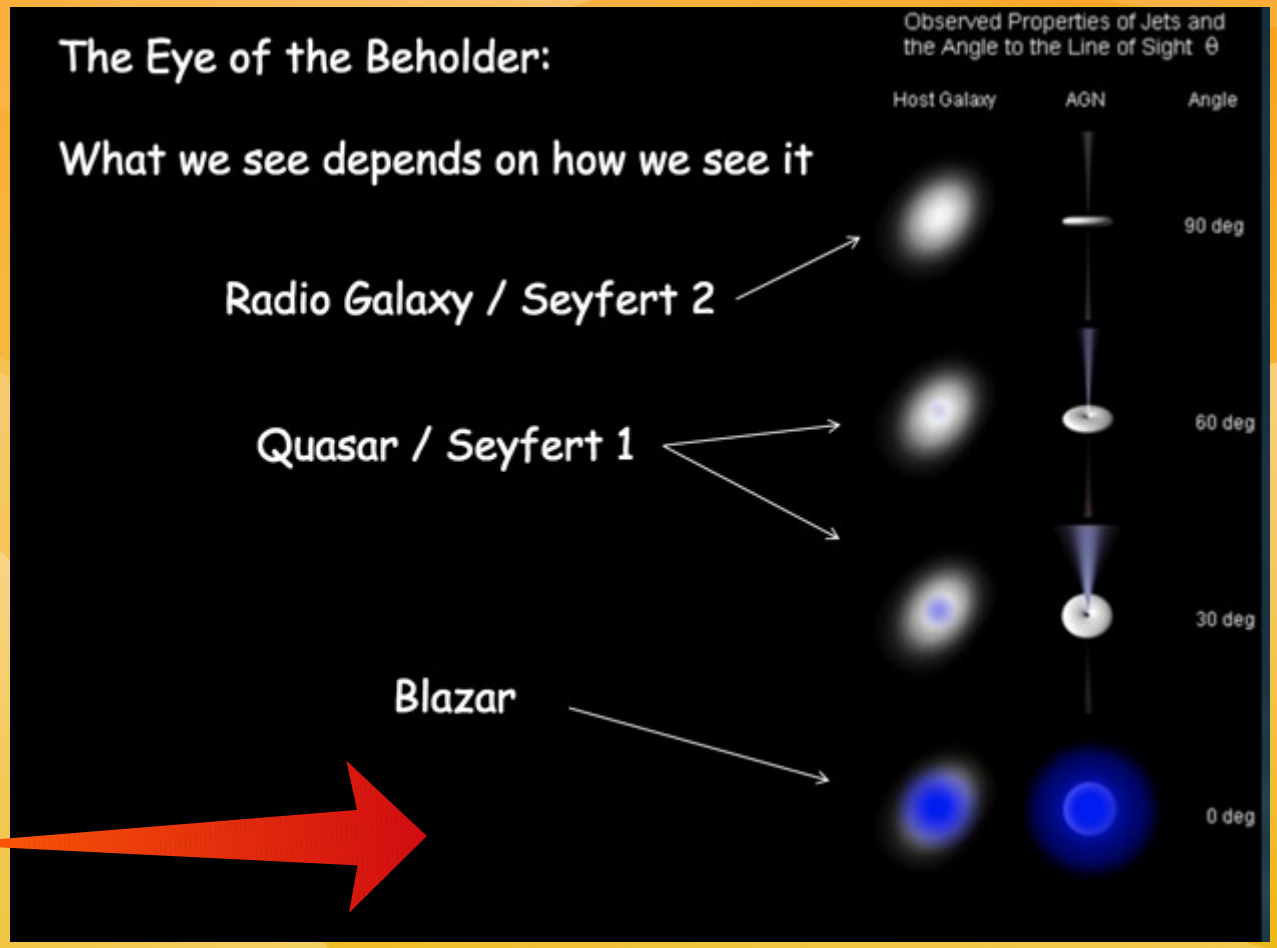
AGN: the structure



Main components:

- Supermassive black hole
- Accretion disk
- Torus
- Broad and narrow line regions
- Some of them have relativistic jets

The view point



FSRQ vs BL Lacs

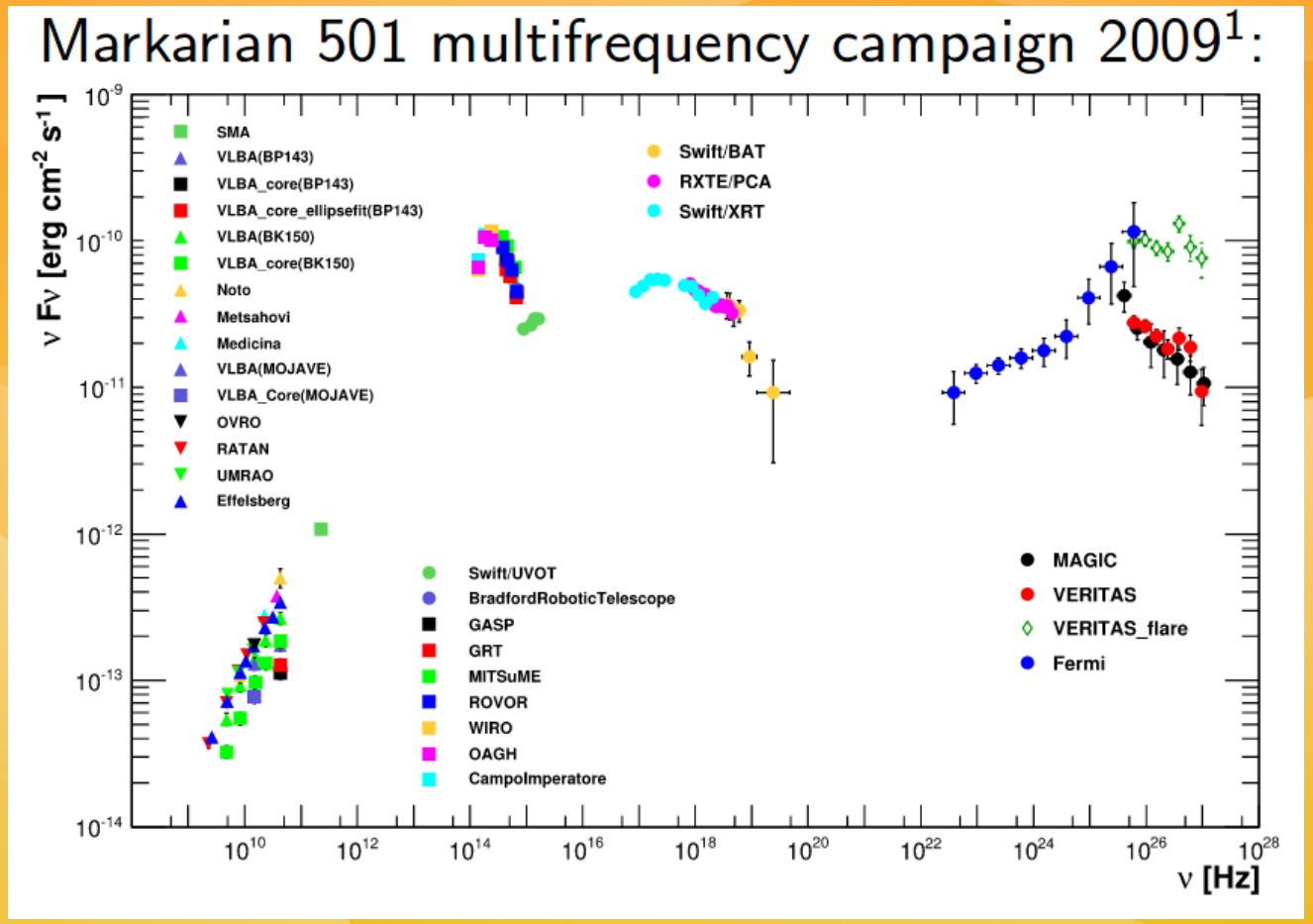
Blazars are divided into:

- **Flat spectrum radio quasars**: emission and absorption lines are present
- **BL Lac's type objects**: no spectral lines

Probably due to the different environment around the AGN.

Maybe BL Lac objects are more advanced in the evolution history of FSRQ

Blazar typical spectrum



Blazar typical spectrum

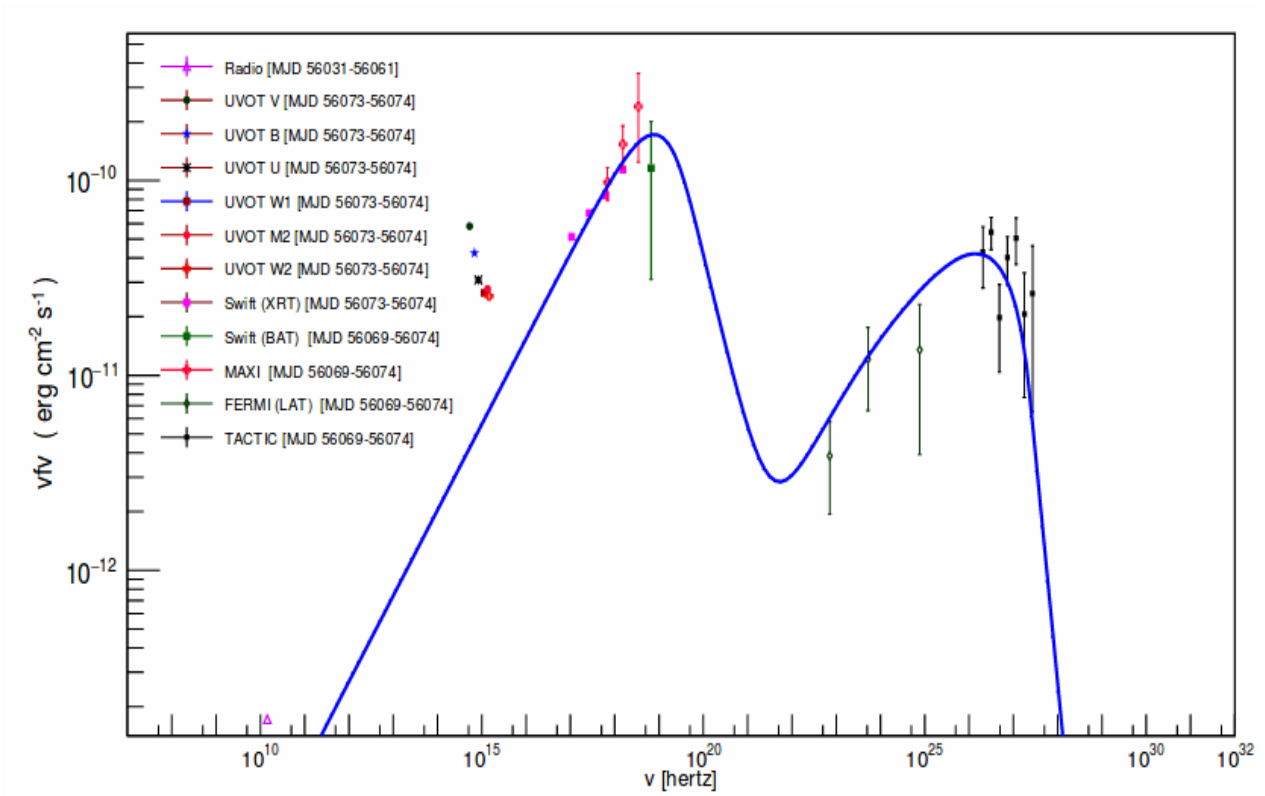


Figure 6: Spectral energy distribution for Mrk 501 during 22-27 May, 2012. The legend report instrument and duration in MJD. The TeV data from TACTIC have been corrected for the absorption due to extragalactic background light using the model reported in Franceschini model [49].

The main model: SSC

Ref.: Maraschi e Tavecchio 2003

- Spherical and homogeneous emission region around the black hole
- Electrons are electromagnetically accelerated in the jet
- Electrons suffer synchrothron losses and produce photons in the optical to Xray band
- These photons are partly upscattered to VHE due to inverse compton scattering by the very same electrons

→ today is the fundamental model: it is successfull describing the double humped SED of BL Lac objects

→ it needs other contributions to describe details: external compton, hadronic models...

The main model: SSC

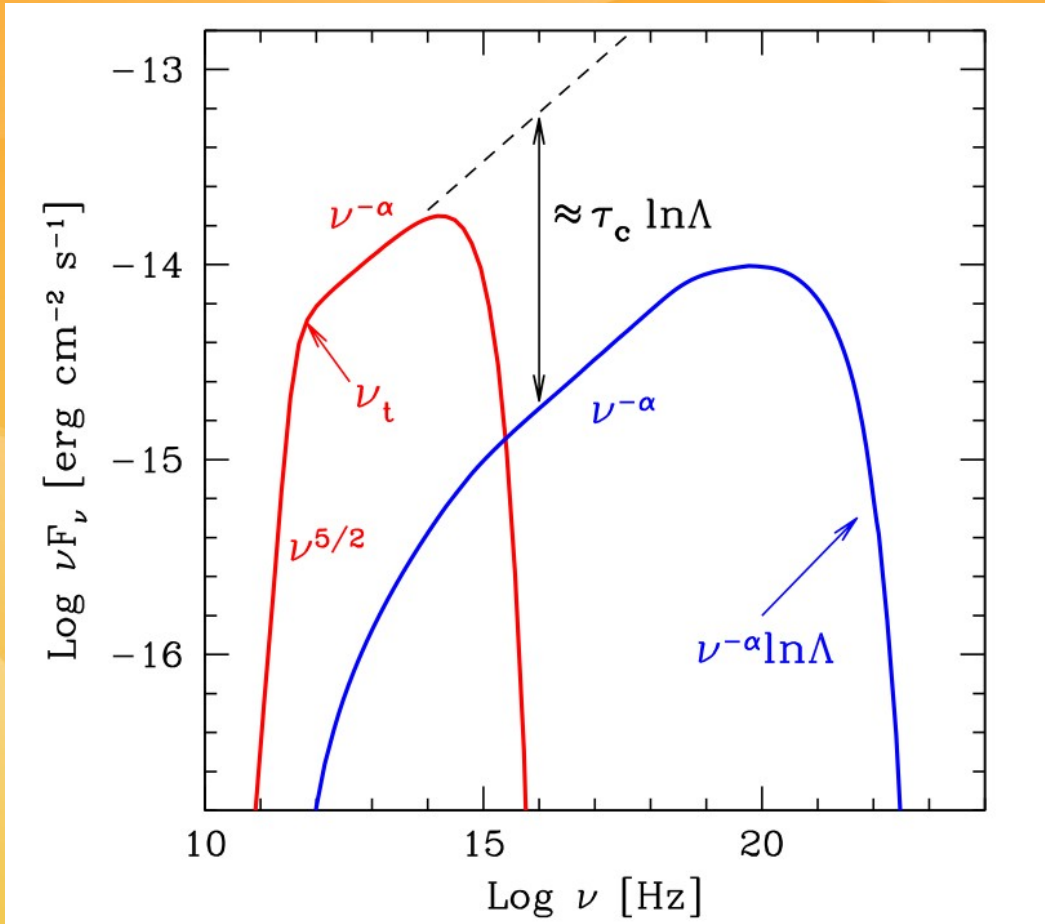
Ref.: Maraschi e Tavecchio 2003

Parameters:

- **R** radius of the emitting region
- **B** magnetic field
- **Γ** Lorentz factor
- **Θ** jet angle with respect to us
- **K** normalization factor in the electron distribution function N(γ)
- **γ-min** and **γ-max**: range of energy described by N(γ)
- **n** spectral index or indexes

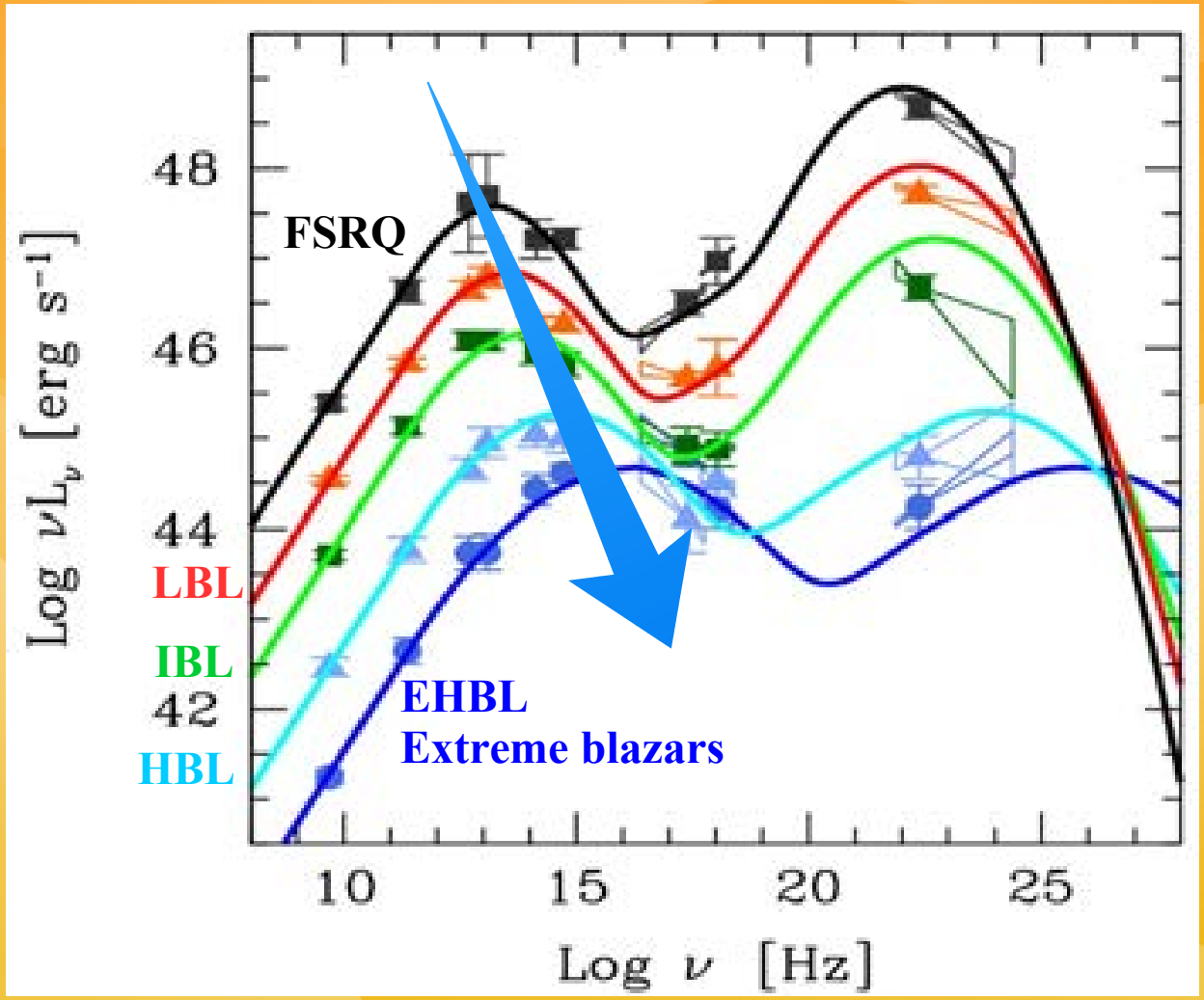
The main model: SSC

Ref.: Ghisellini 2013

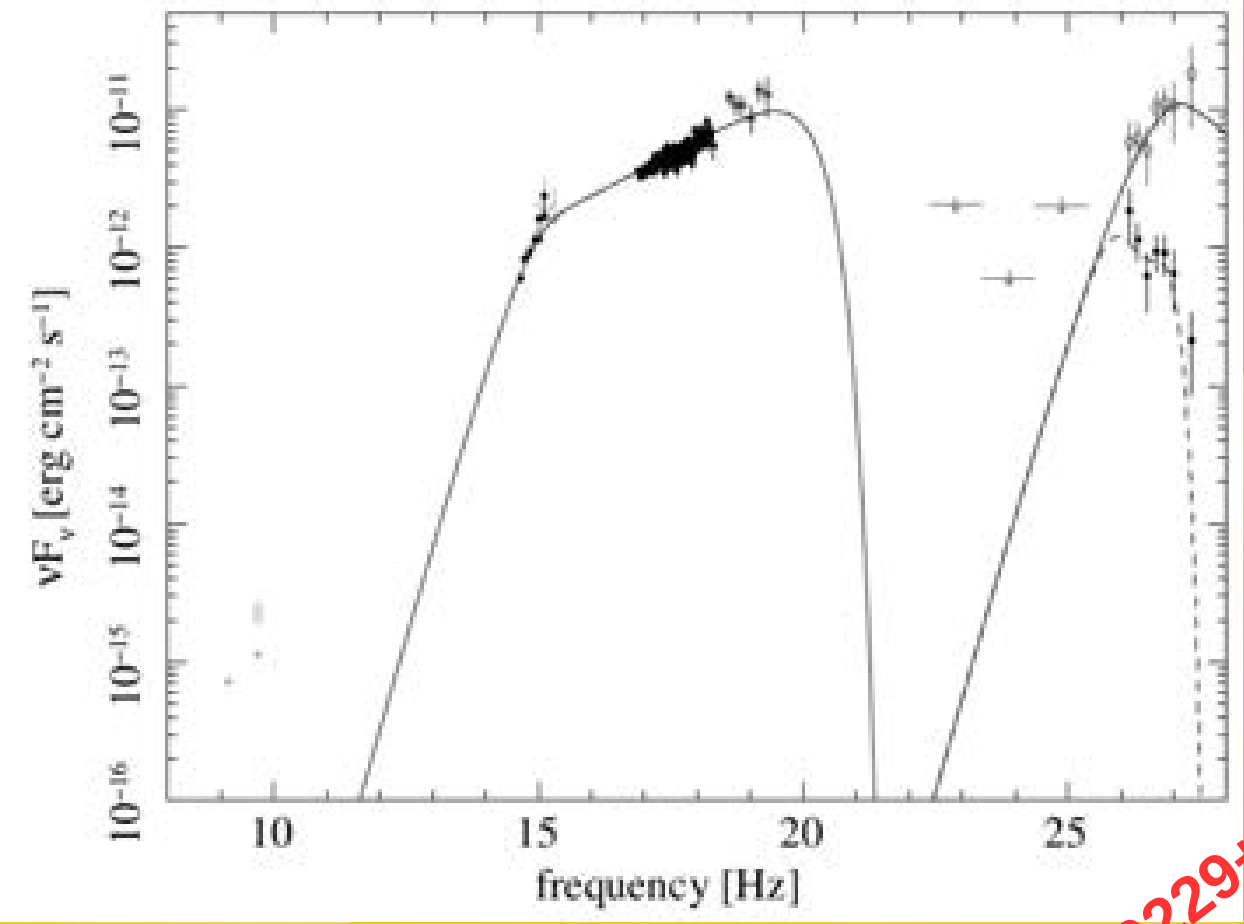


Blazar sequence

Ref.: Fossati et al 1998



Th archetypal of EHBL
1ES 0229+200



Ref.: Kaufmann et al 2011

1ES0229+200

Extreme blazars

Spectral properties and criteria:

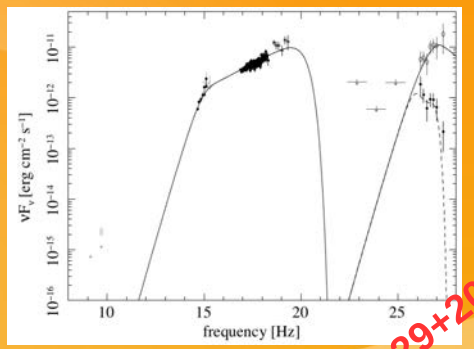
- High **maximum synchrothron peak frequency**

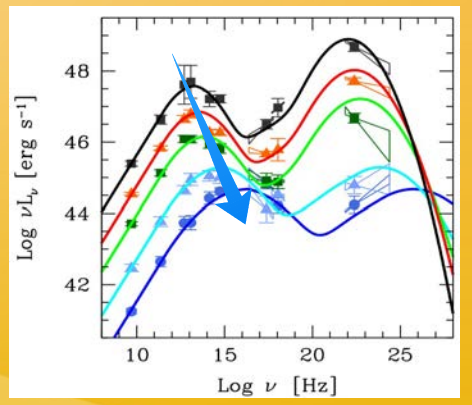
  $> 10^{18}$ hard X-rays

- Very high **“inverse compton” peak frequency**

  $> 10^{26}$ VHE

- **Hard spectrum** in X-ray and Gamma-ray
- Relatively **small luminosity** in comparison with FSRQ
- Detectable host **galaxy**
- Potentially absorbed in the VHE due to **EBL**
- Probably **not well detected in the HE** (Fermi)



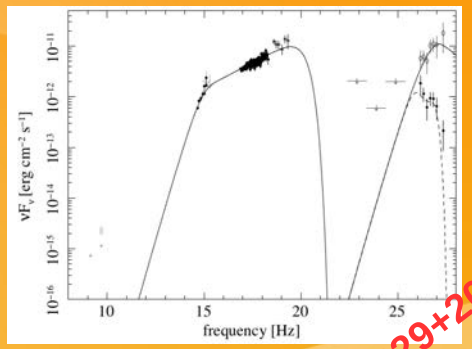


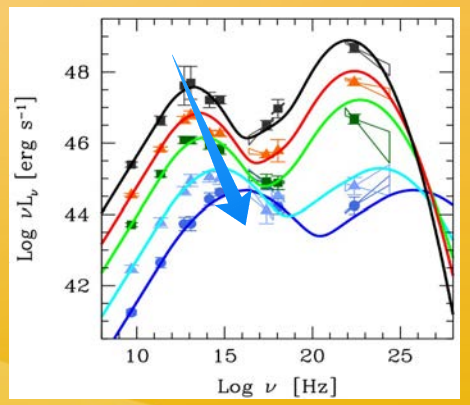
Extreme blazars

Why to study them?

- SSC model is not completely successfull

  → unknown emission mechanism
- Extremely energetic
- New category to be populated
- Challenge for new telescopes
- Multiwavelenght analysis needed
- Neutrinos source?





BAT vs Fermi 3LAC

BAT vs Fermi 3LAC

- ***Common* blazars** between BAT and 3LAC: **39**

  39 3LAC's blazars over 49 BAT's sources (79%)

  - **19 FSRQ** (indicated as “blazar” in BAT)
  - **20 BL Lac**

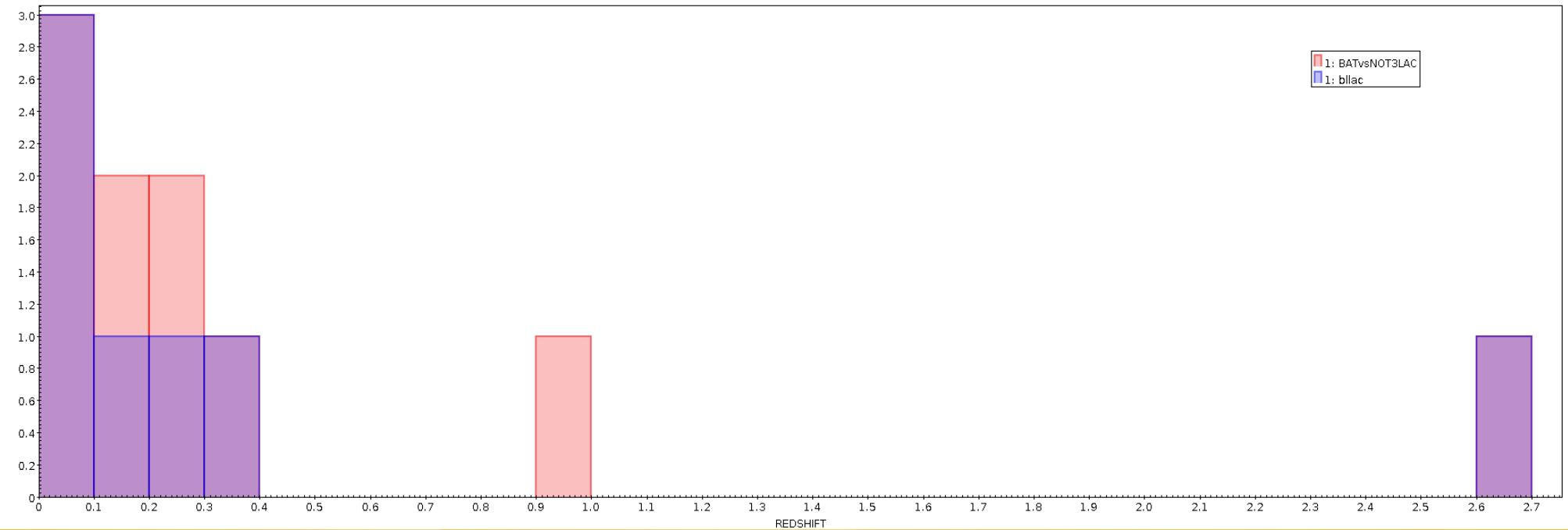
- And what about the remaining **10 blazars**?

BAT vs Fermi 3LAC

- BAT blazars **undetected** by 3LAC: **10 sources**
  - **3** indicated as **"blazar"** in BAT, maybe 2 of them are Sy
  - **7 BL Lac**

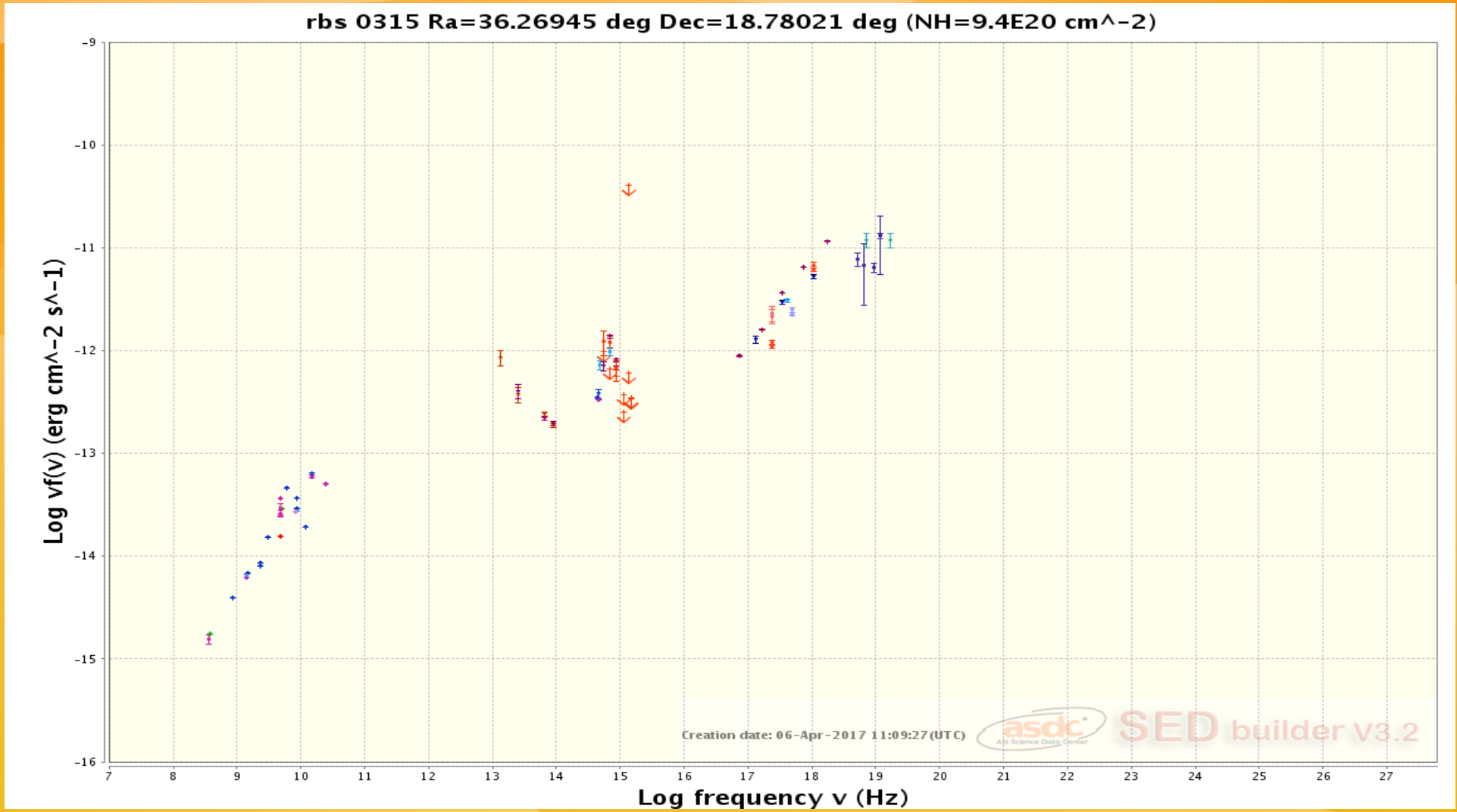
COUNTERPART_NAME	TYPE	REDSHIFT
RBS 0315	BL Lac	2.69
4C +10.08	BL Lac	0.07
PKS 0521-36	BL Lac	0.05534
PKS 0723-008	Bl Lac	0.128
Mrk 205	BL Lac	0.07085
RBS 1640	Blazar / Sy1.5	0.137
4C +34.47	Blazar / Sy1	0.206
4C +73.18	BL Lac LPQ	0.3021
PKS 2145+06	Blazar	0.99
1RXS J225146.9-320614	BL Lac	0.246

Redshift distribution



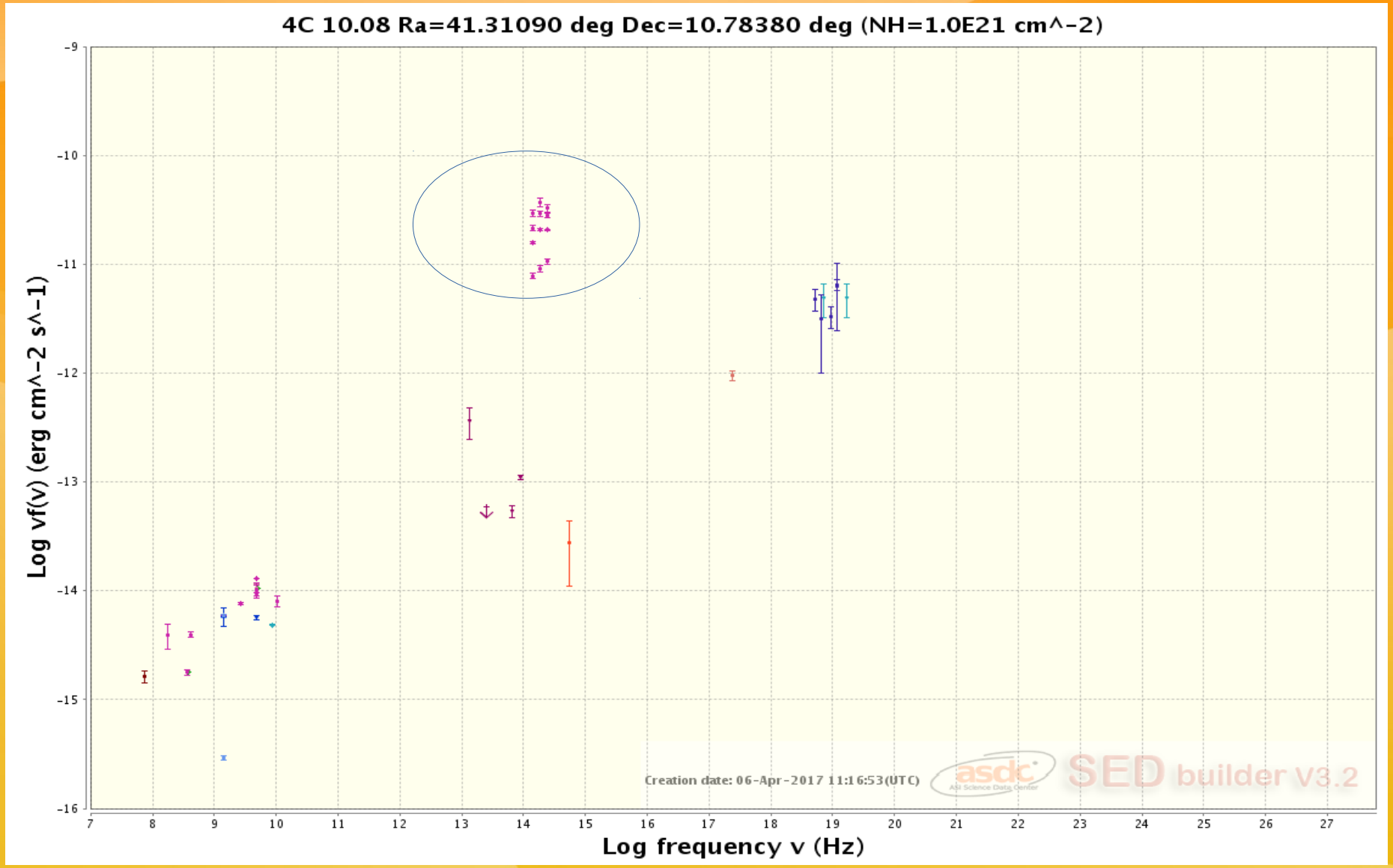
BAT blazars NOT in 3LAC

RBS 0315



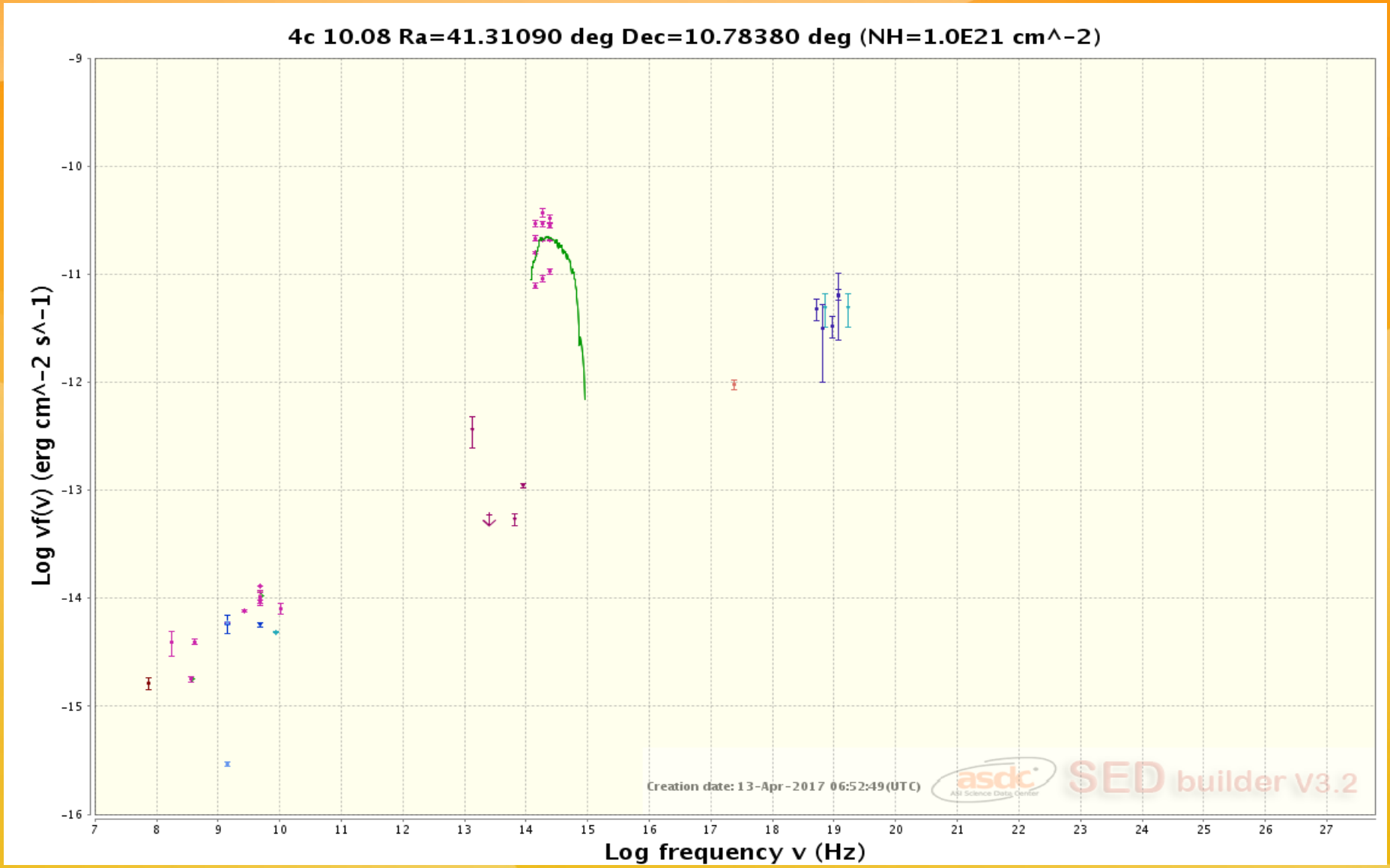
Z = 2.69 !!!!

4C 10.08


4C 10.08 Ra=41.31090 deg Dec=10.78380 deg (NH=1.0E21 cm^-2)
Log νf(ν) (erg cm^-2 s^-1)
Log frequency ν (Hz)
Creation date: 06-Apr-2017 11:16:53(UTC)
asdc
SED builder V3.2

Z = 0.07

4C 10.08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Log vf(v) (erg cm^-2 s^-1)
Log frequency ν (Hz)
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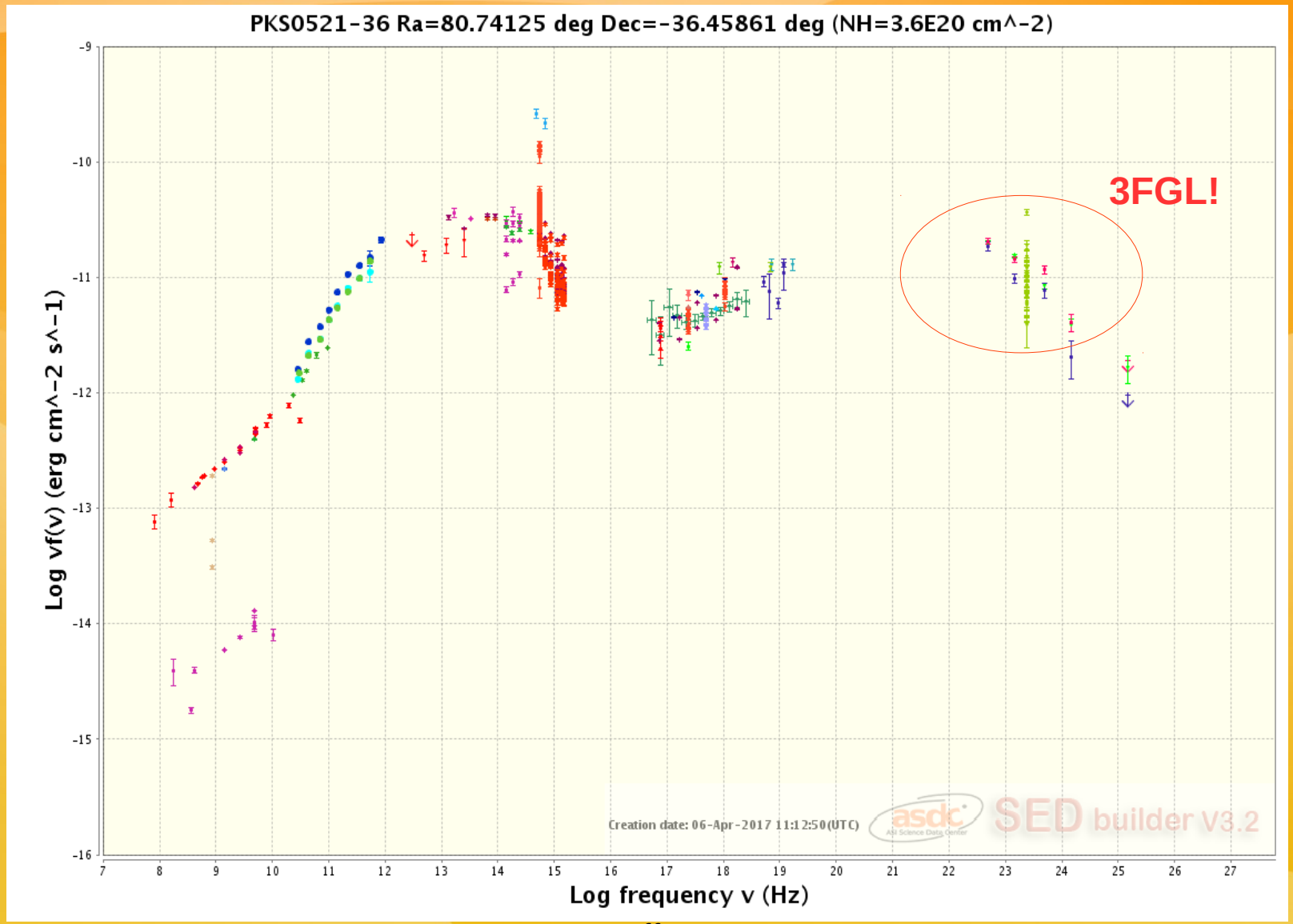
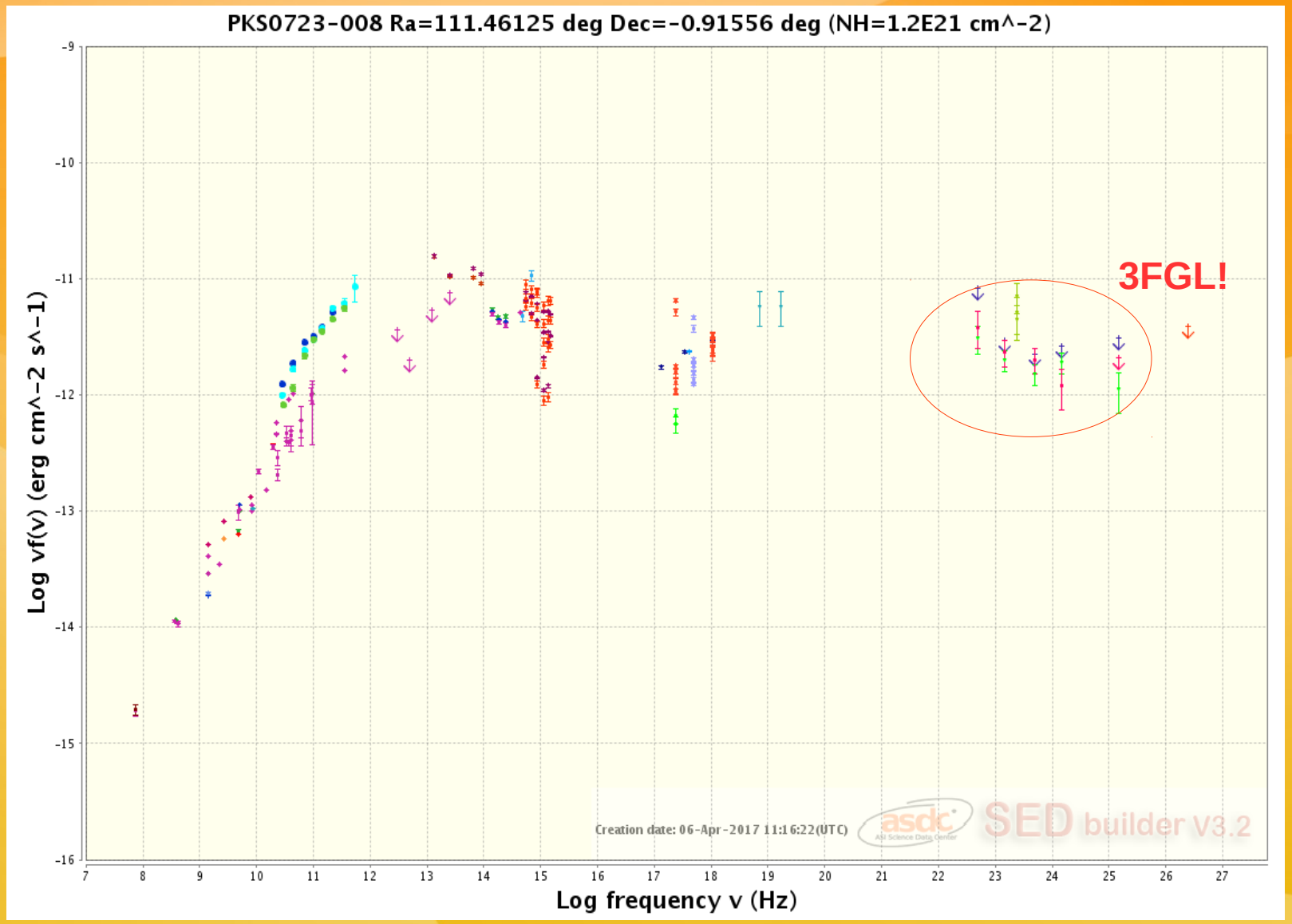
Z = 0.07

PKS 0521-36



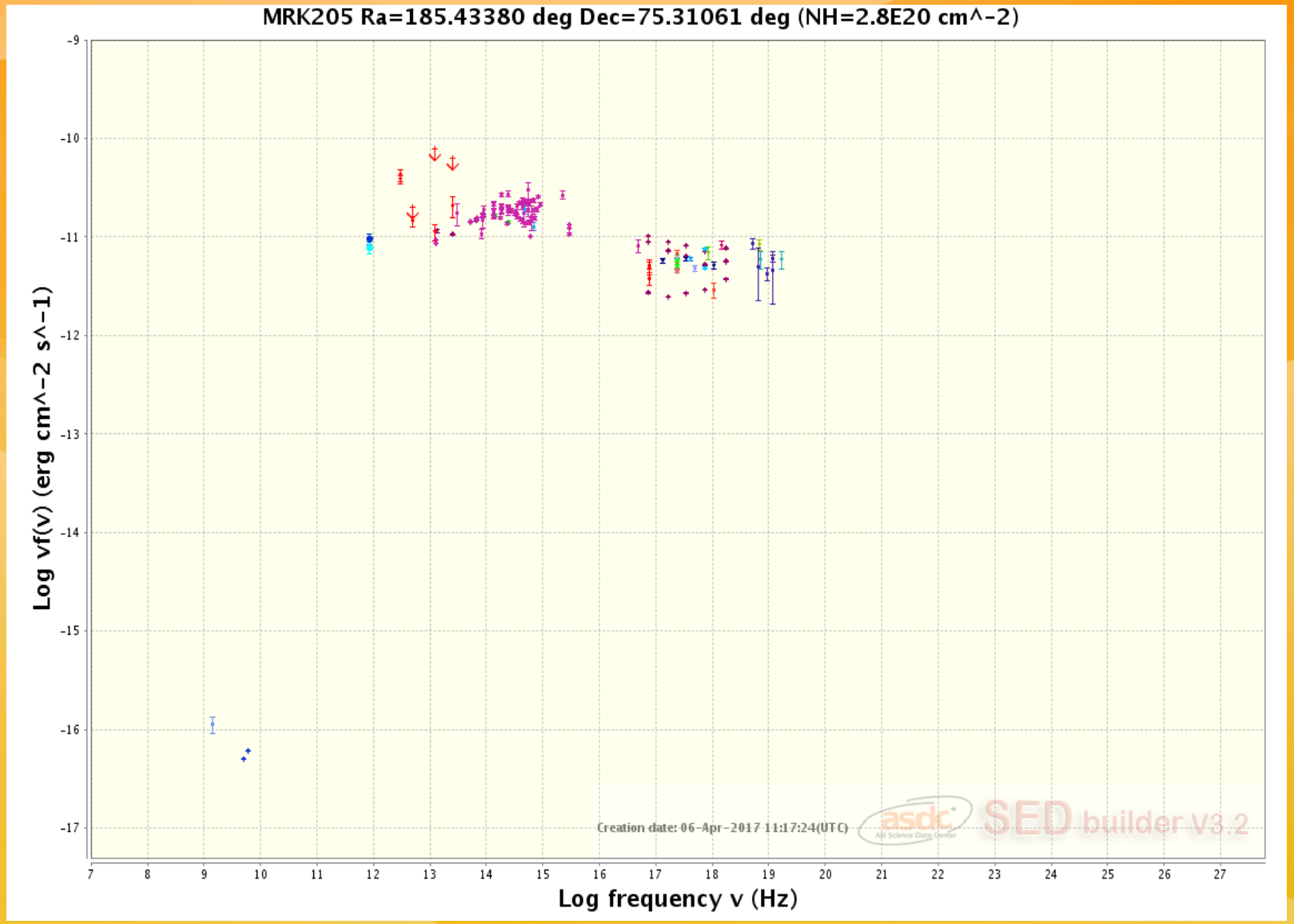
Z = 0.055

PKS 0723-008



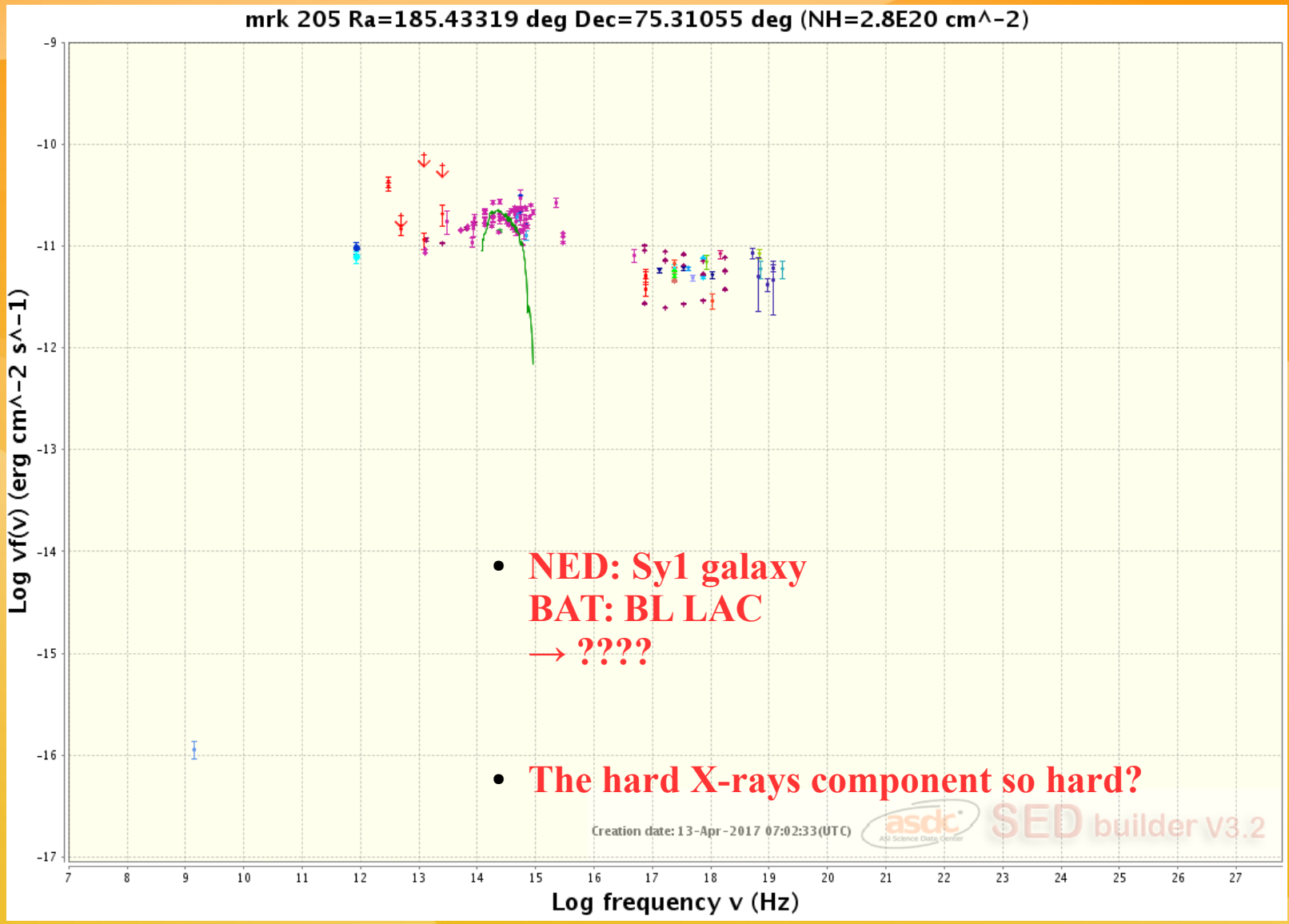
Z = 0.128

MRK 205


MRK205 Ra=185.43380 deg Dec=75.31061 deg (NH=2.8E20 cm^-2)
Log vf(v) (erg cm^-2 s^-1)
Log frequency v (Hz)
Creation date: 06-Apr-2017 11:17:24(UTC)
asdc
SED builder V3.2

Z = 0.07

MRK 205

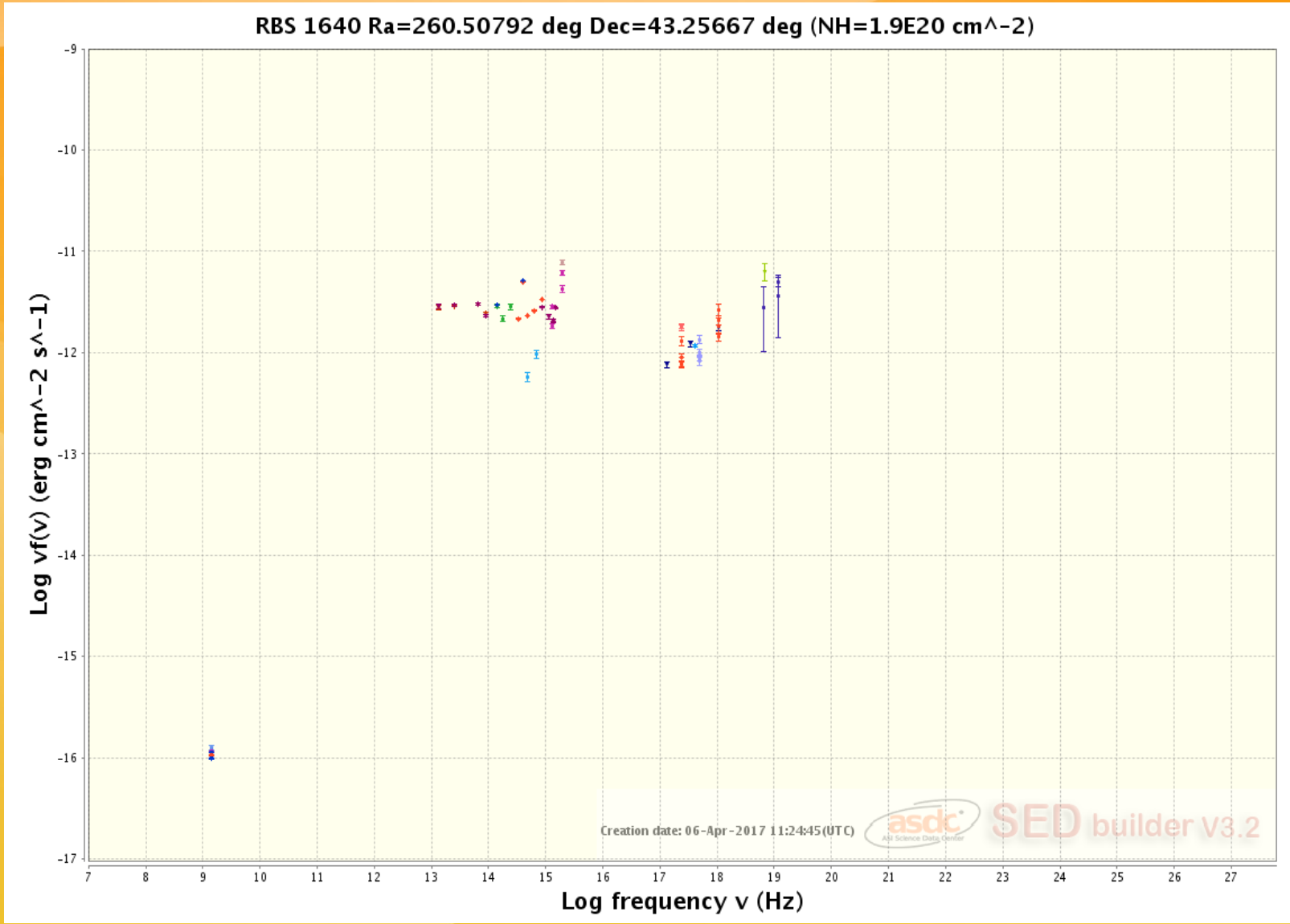


- **NED: Sy1 galaxy**
  BAT: BL LAC
  → ????

- **The hard X-rays component so hard?**

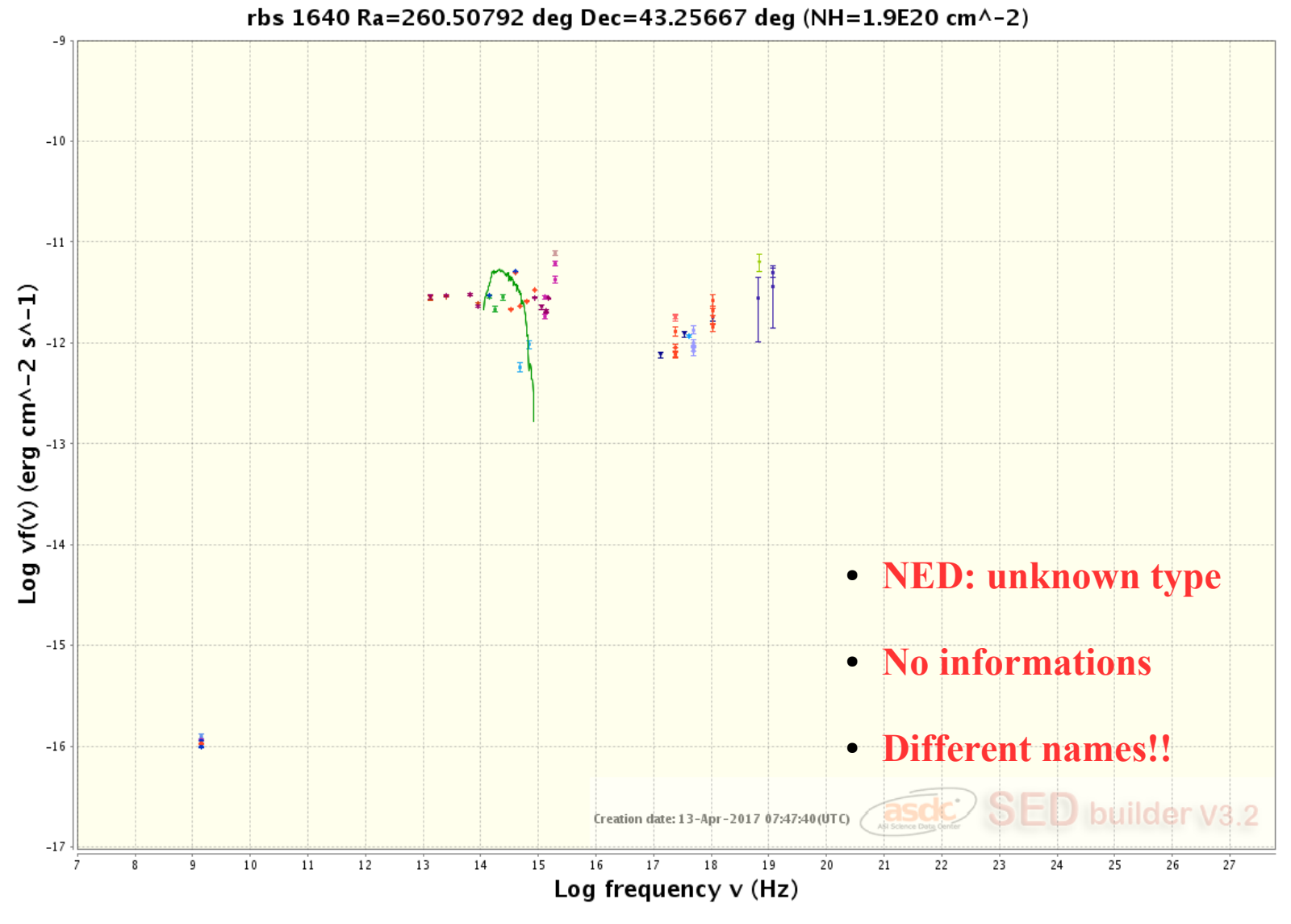
Z = 0.07

RBS 1640



Z = 0.137

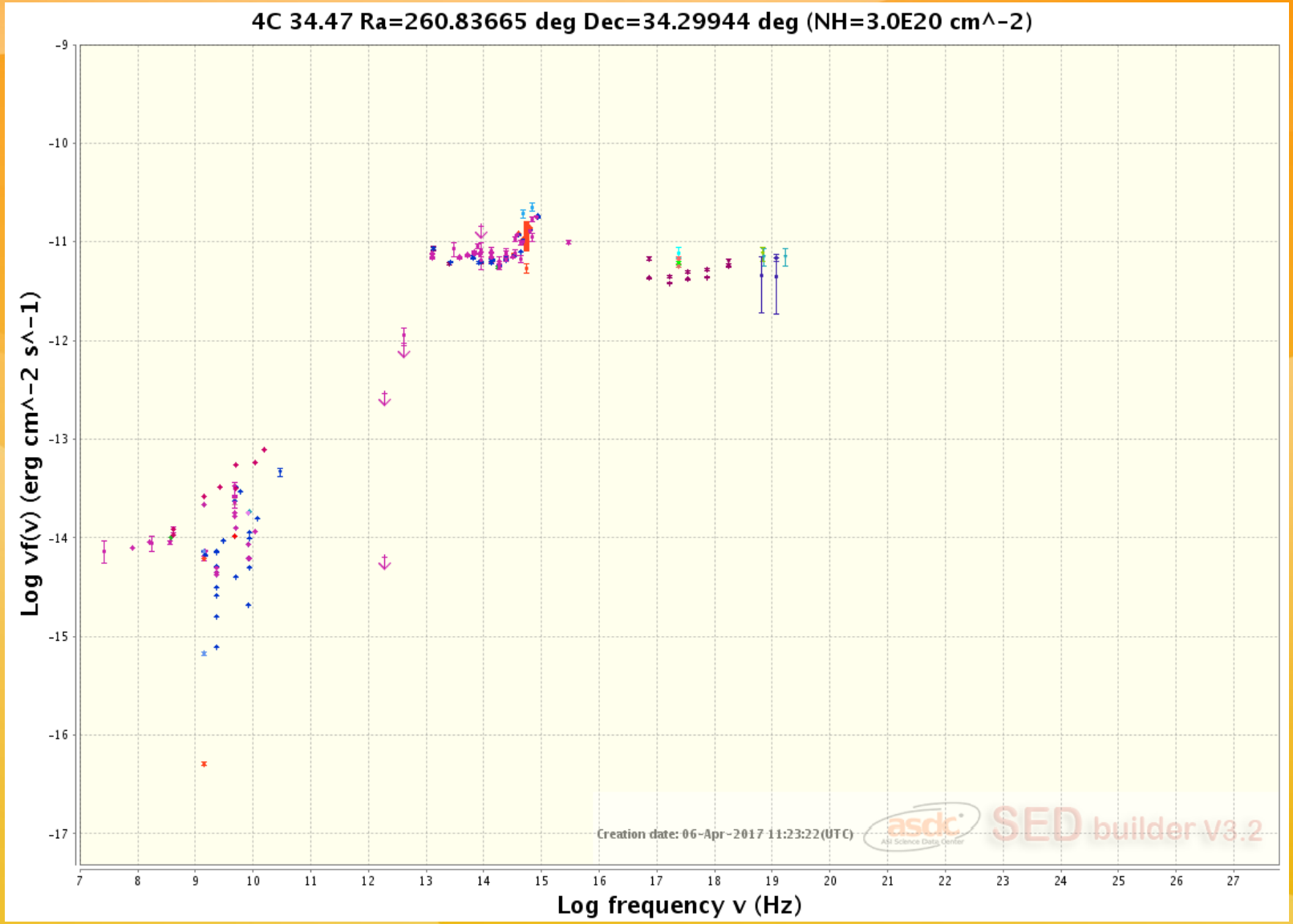
RBS 1640



- **NED: unknown type**
- **No informations**
- **Different names!!**

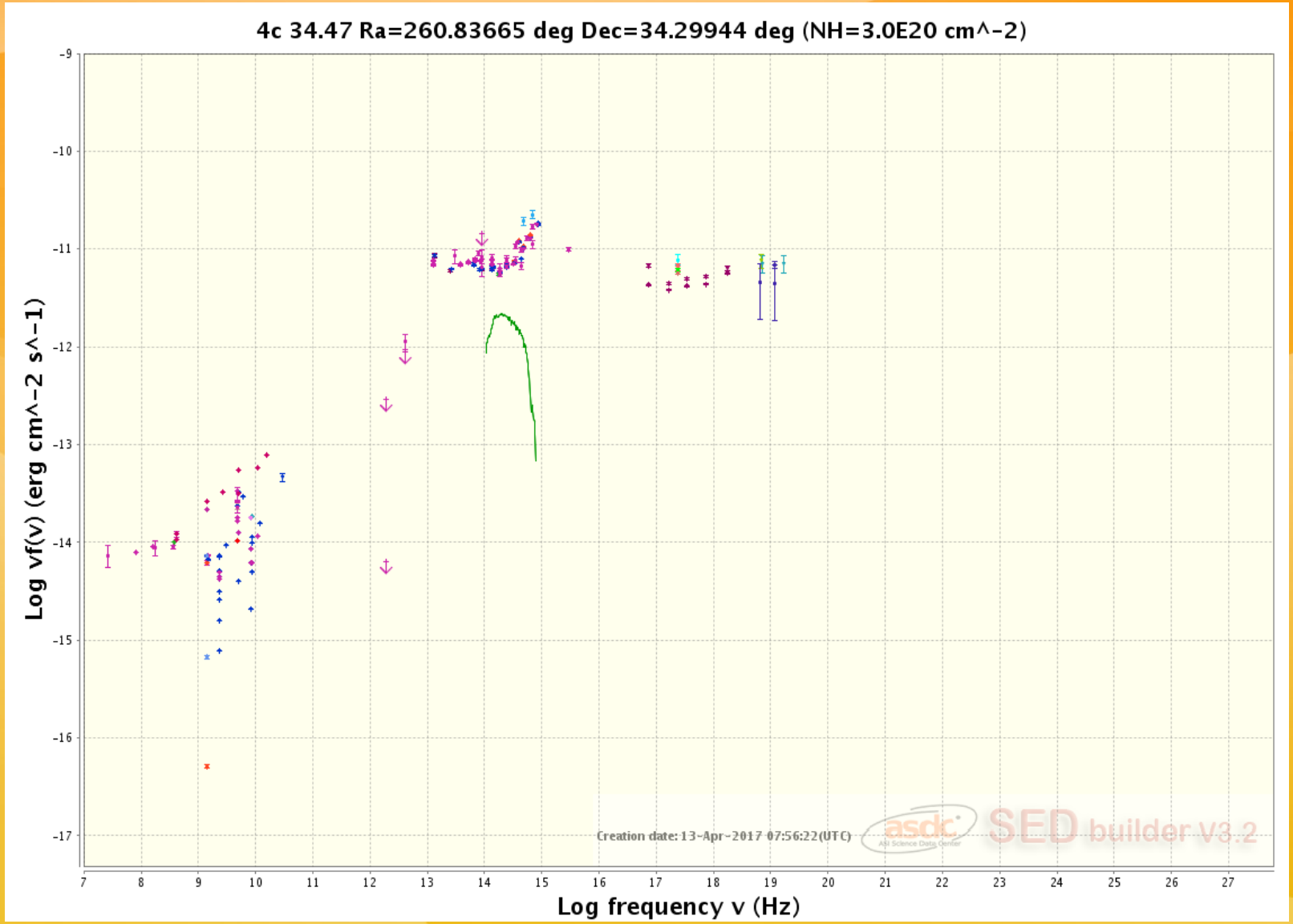
Z = 0.137

4C 34.47



Z = 0.206

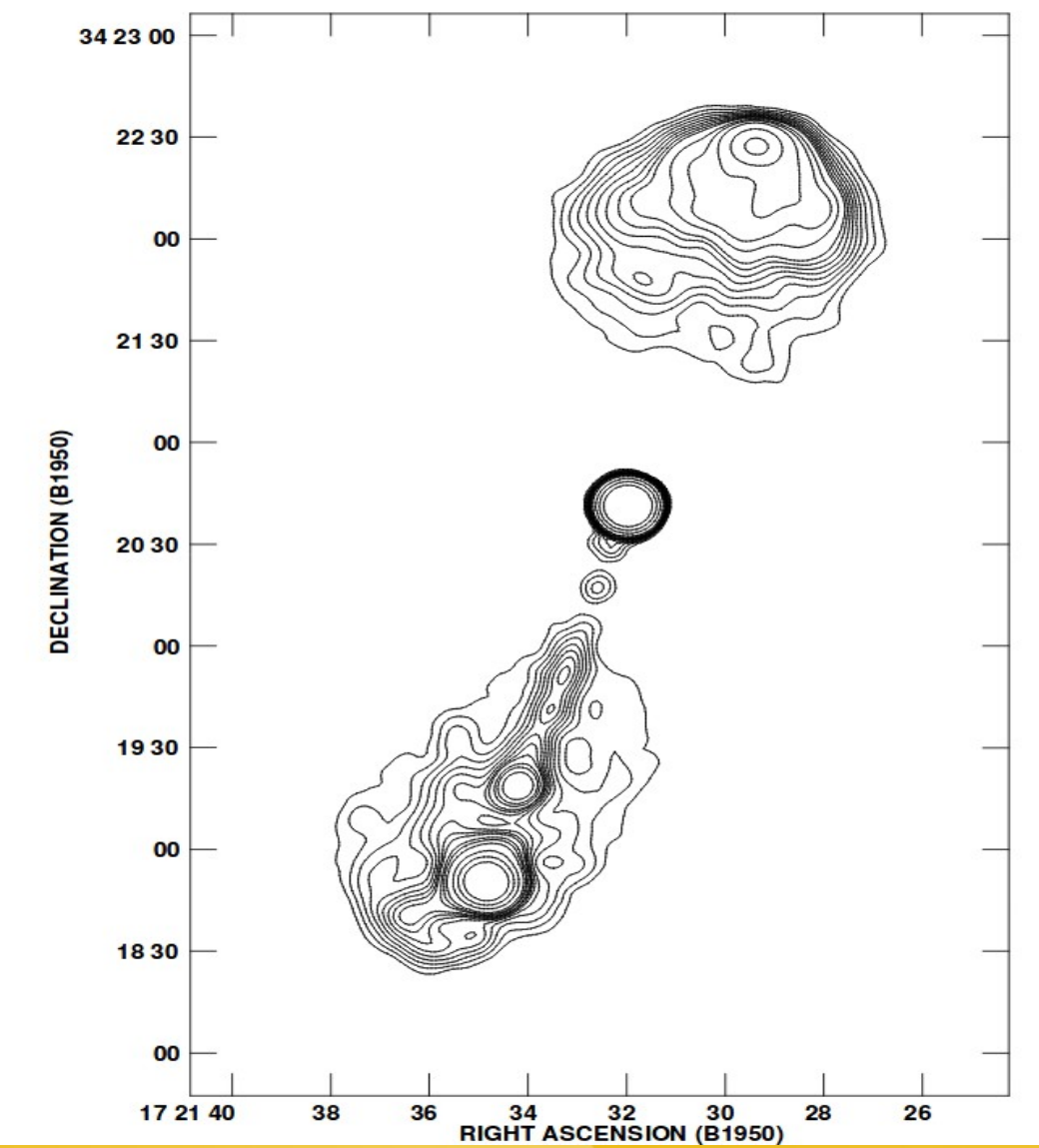
4C 34.47



Z = 0.206

Number 7 of 10

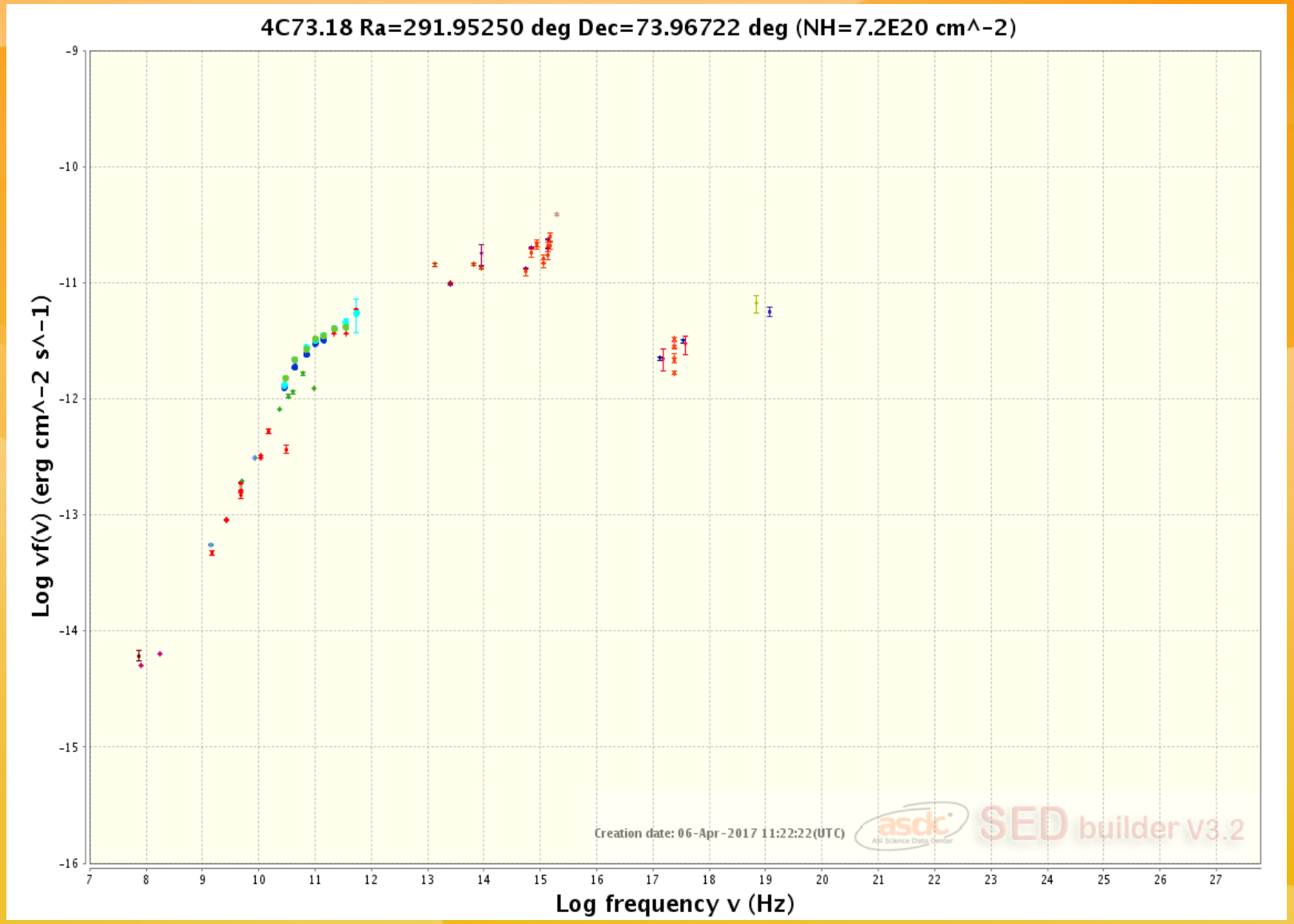
4C 34.47



- **NED: radio jetted**
- **Angle ~ 53/57°**
- **Size ~ 0.84 Mpc!**

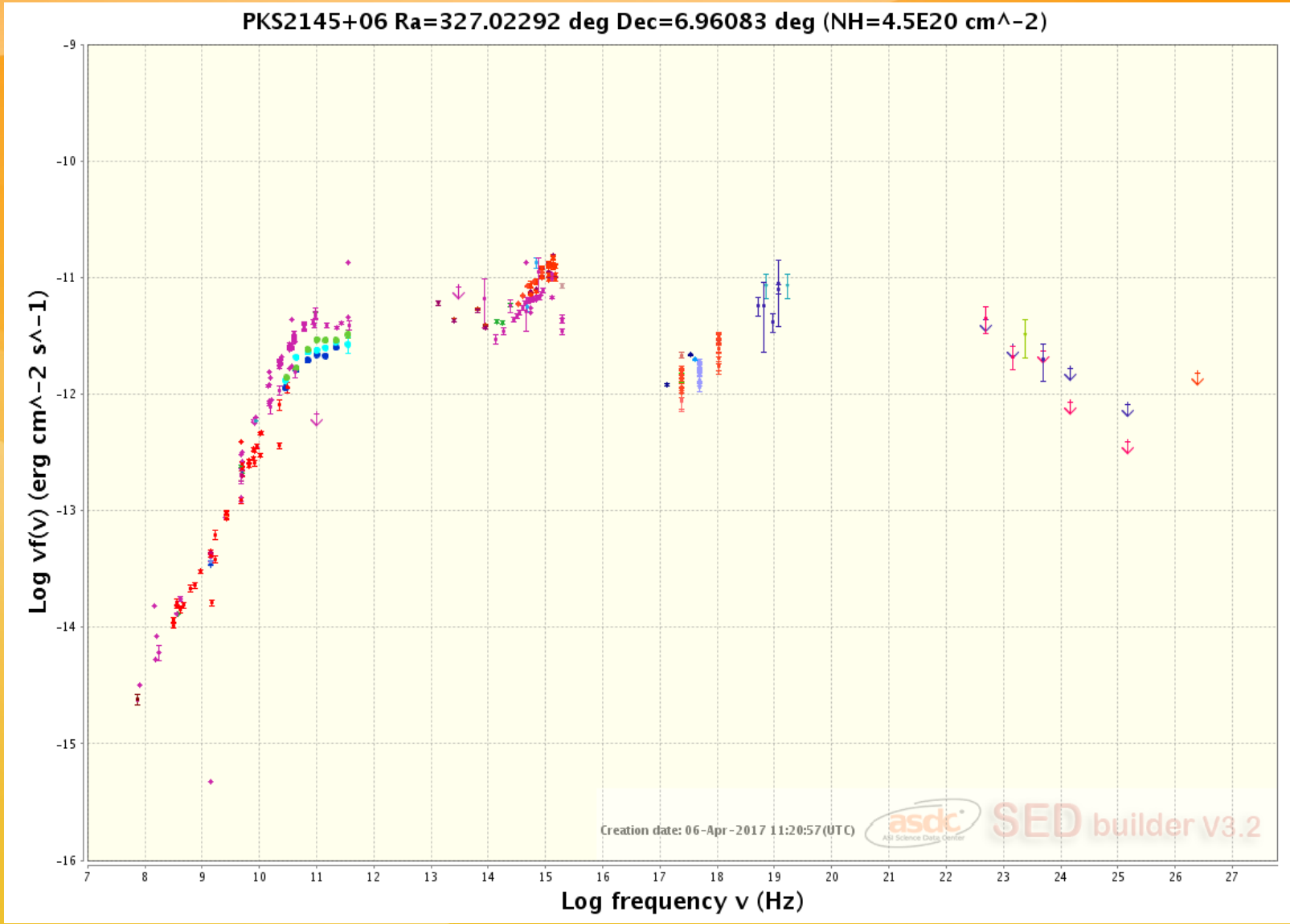
Number 8 of 10

4C 73.18



Z = 0.30

PKS 2145+06



Z = 0.99

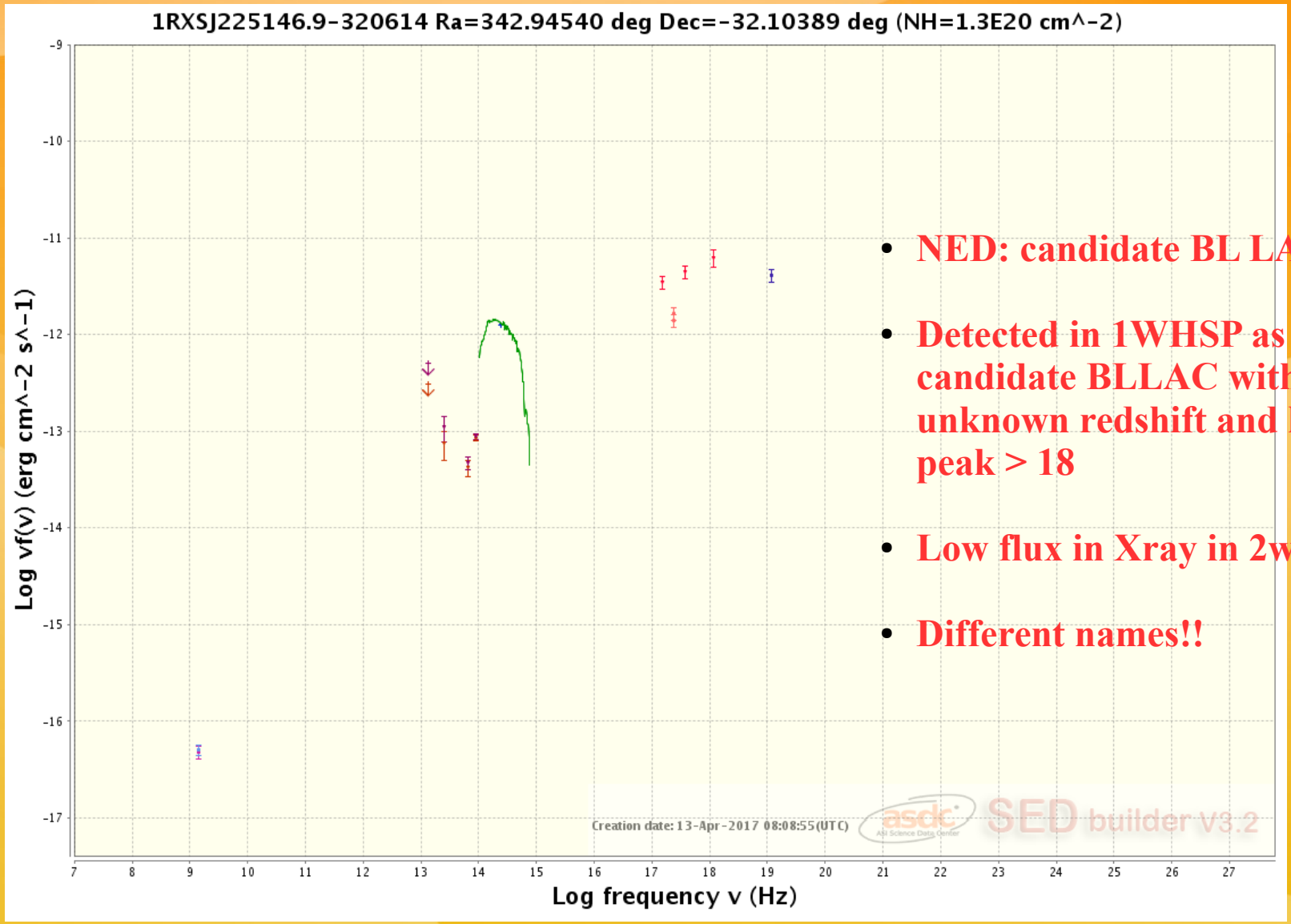
Number 10 of 10

1RXSJ225145-320614

Z = 0.246

Number 10 of 10

1RXSJ225145-320614



- NED: candidate BL LAC
- Detected in 1WHSP as candidate BLLAC with unknown redshift and log nu peak > 18
- Low flux in Xray in 2whsp
- Different names!!

Z = 0.246

Conclusions

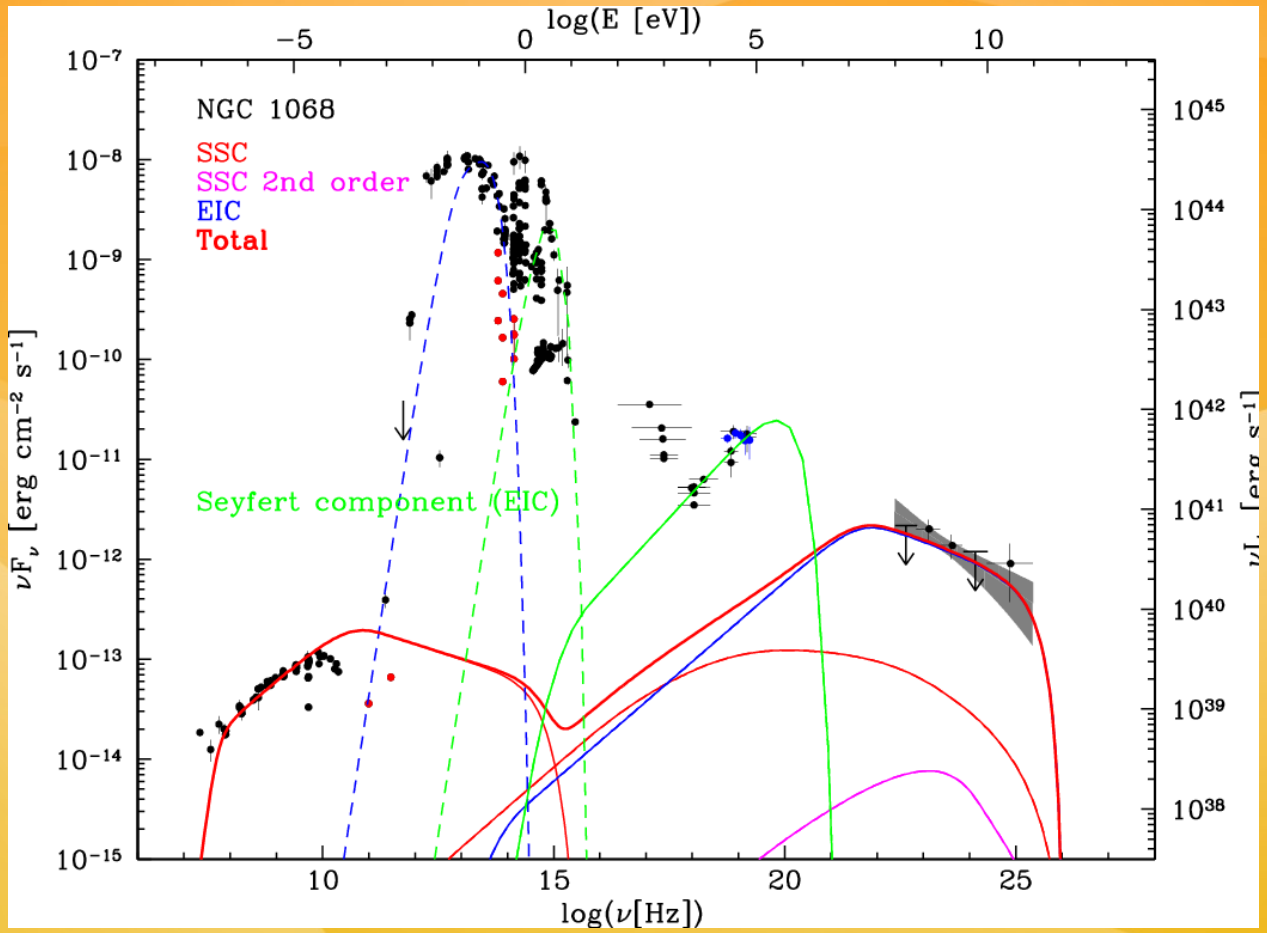
- EHBL candidates:
  - 4C 10.08
  - 1RXSJ225145-320614
  - RBS 1640
  - 4C 34.47 (?)
  - MRK 205 (?)

→ at least 3 sources to be studied better!

Conclusions

- How to continue?
  - Analysis in X-ray and Fermi
  - Analysis of literature of the sources
  - Proposal for observations with telescopes (MAGIC, Nustar...?)
  - Other suggestions are welcome! :)

Thank you!

BACKUP SLIDES

Seyfert galaxy's spectrum