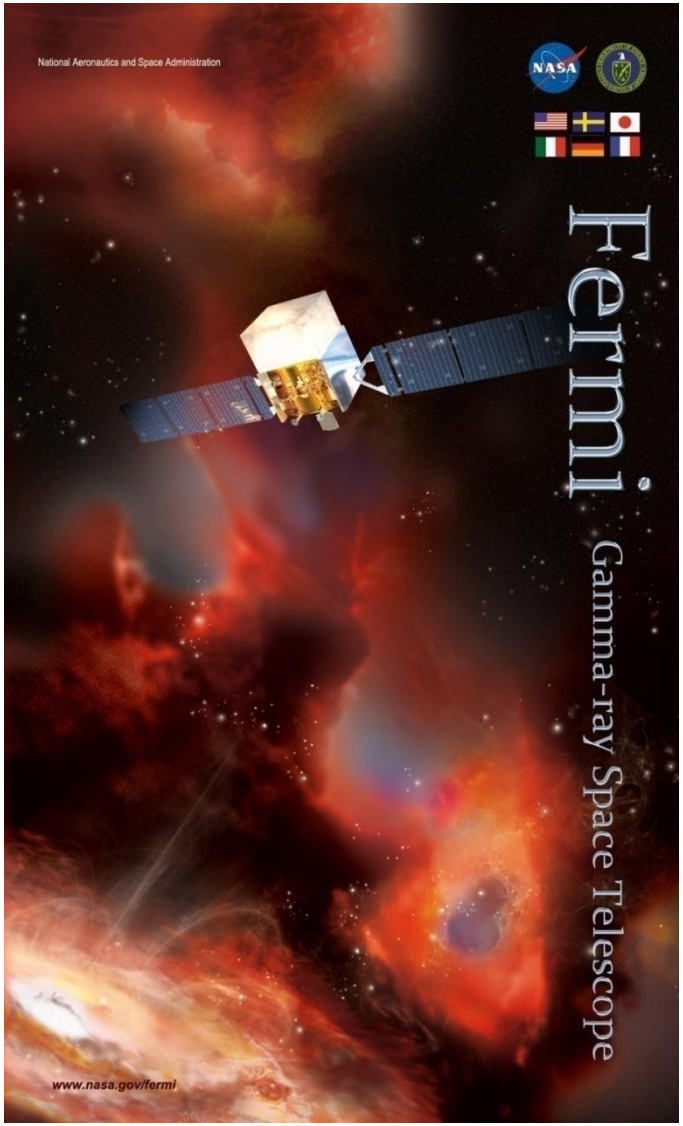

To be or not to be a blazar. The case of the Narrow-Line Seyfert 1 SBS 0846+513

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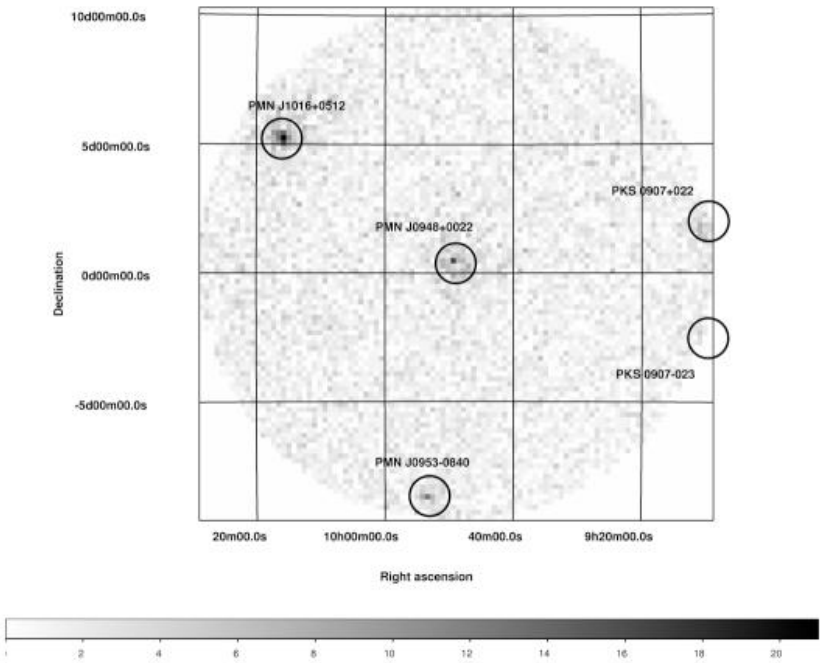
Gamma-ray emitting NLS1s

- Before the *Fermi* satellite γ-ray emitting AGNs are only blazars and radio galaxies
- *Fermi*-LAT first 2 years (1FGL and 2FGL) confirmed that the extragalactic γ-ray sky is dominated by those two classes but...

...first detection of a γ-ray emitting Narrow-line Seyfert 1 in 2008: PMN J0948+0022 and after that other 4 NLS1s were detected in gamma rays



Abdo+09

Confirmation of the presence of relativistic jets also in NLS1s

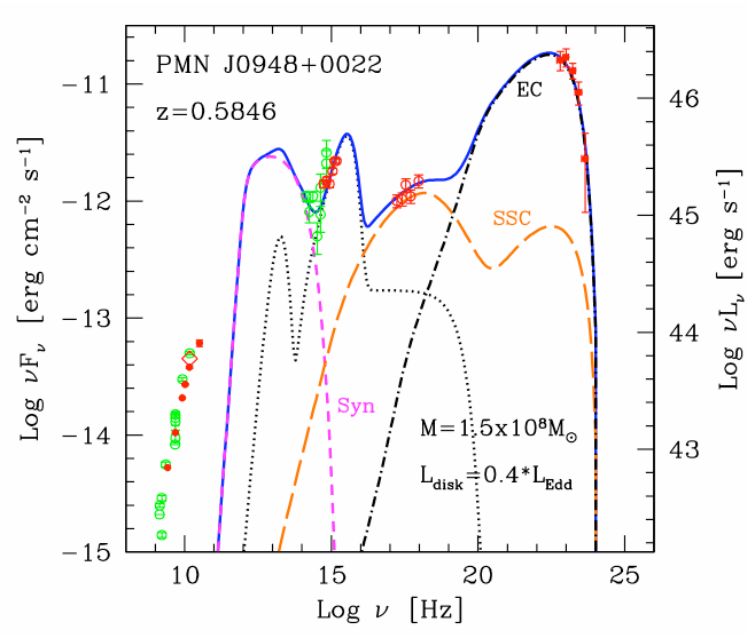
NLS1s are usually hosted in **spiral galaxies**, the presence of a relativistic jet in these objects seems to be contrary to the paradigm that the formation of relativistic jets could happen only in elliptical galaxies (e.g. Boettcher and Dermer 2002, Marcher 2009).

PMN J0948+0022

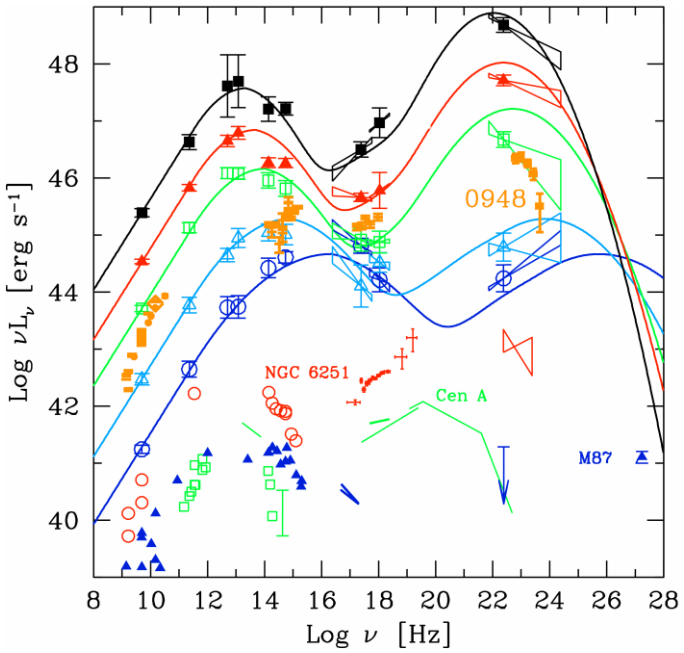
- Averaged SED similar to FSRQs, but at lower luminosity

- double-humped SED with disk component in UV band

- BH mass upper limit: 1.5 x 10^8 $M_\odot$



Abdo+09

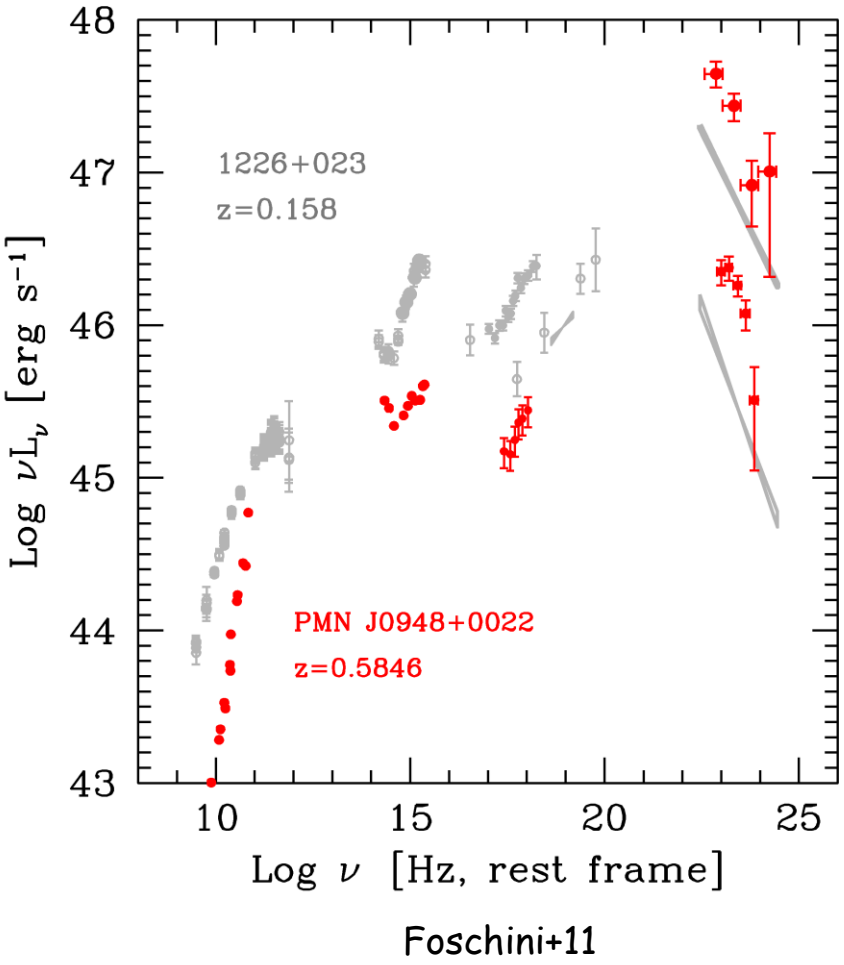


- SSC+EC components

- physical parameters blazar-like

- jet power similar to those of blazars

FSRQs vs RL-NLS1s



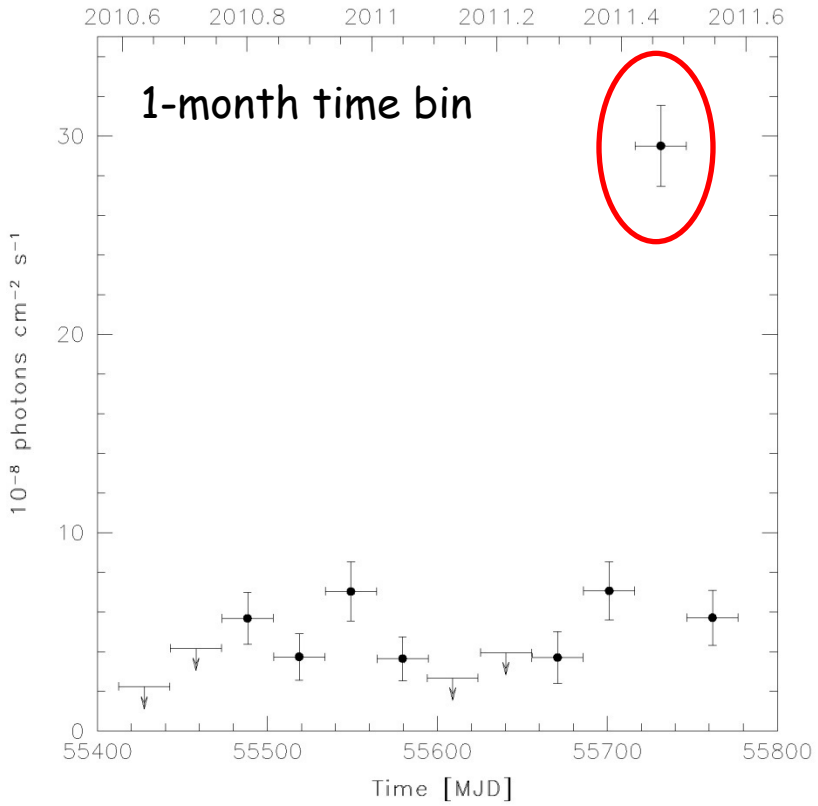
Foschini+11

- The power measured in the July 2010 flare confirms that NLS1s can host relativistic jets as powerful as those in blazars

- The comparison with the SED of a typical blazar with a strong accretion disk (3C 273) shows that the Compton dominance is more extreme in this NLS1

- The disagreement of the two SEDs can be accounted by the differences in mass of the central BH and Doppler factor of the two jets

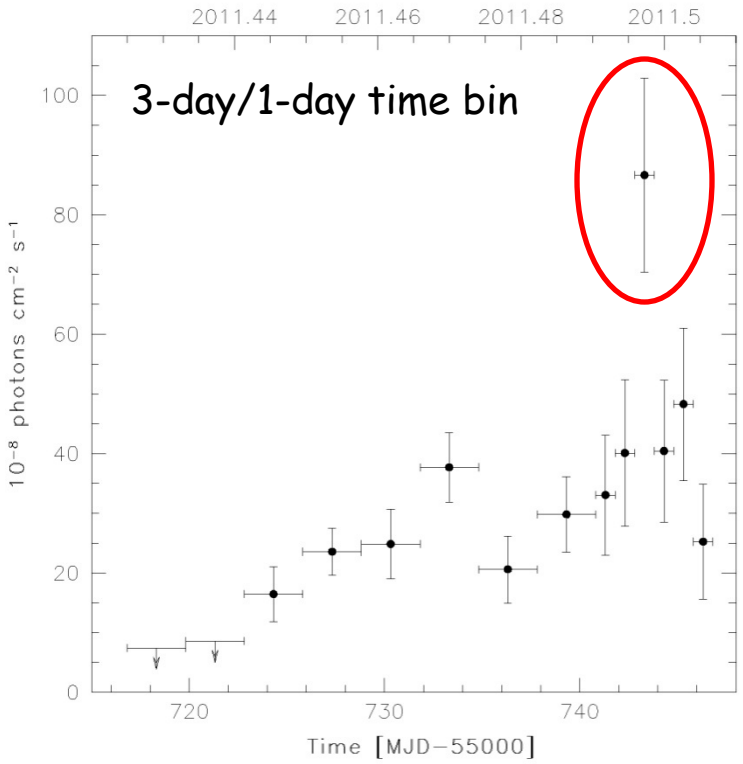
SBS 0846+513: a new gamma-ray NLS1



SBS 0846+513 was not detected in gamma rays with TS > 25 during the first 2 years of Fermi operation. UL ~8.5e-9 ph cm^{-2} s^{-1}

SBS 0846+513 clearly detected in gamma rays with TS = 653 (~25σ) **during the third year of Fermi operation.** Flux $_{E>100\ MeV}$ = (6.7±0.5)e-8 ph cm^{-2} s^{-1} and Γ = 2.23±0.05

A gamma-ray flare from SBS 0846+513

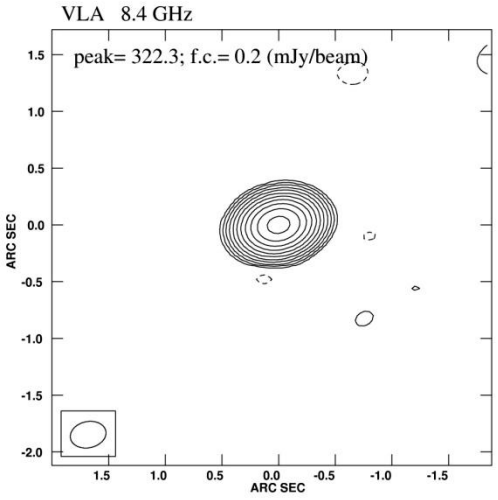


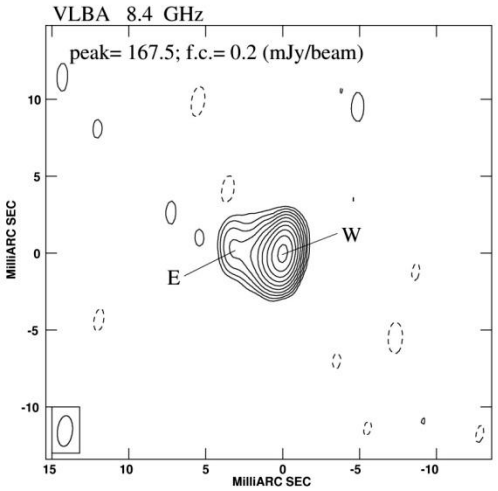
During the month of high activity there was spectral evolution in gamma rays, as already observed in other FSRQs

The gamma-ray peak with daily timescale on 29-30 June 2011 is (87±16)e-8 ph cm^{-2} s^{-1}, corresponding to an isotropic luminosity of ***~10^{48} erg s^{-1}, comparable to that of the luminous FSRQs***.

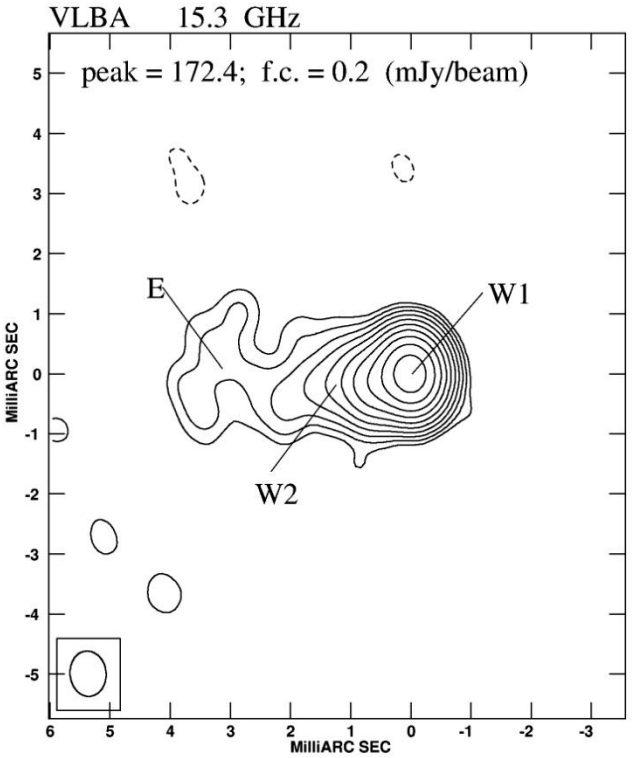
D'Ammando, Orienti, Finke , et al. 2012

The radio view of SBS 0846+513



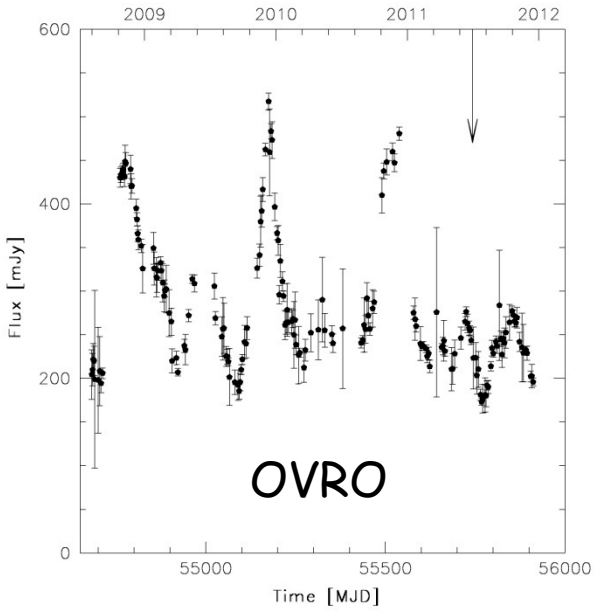


Core-jet structure on parsec scale.
Unresolved with the VLA.

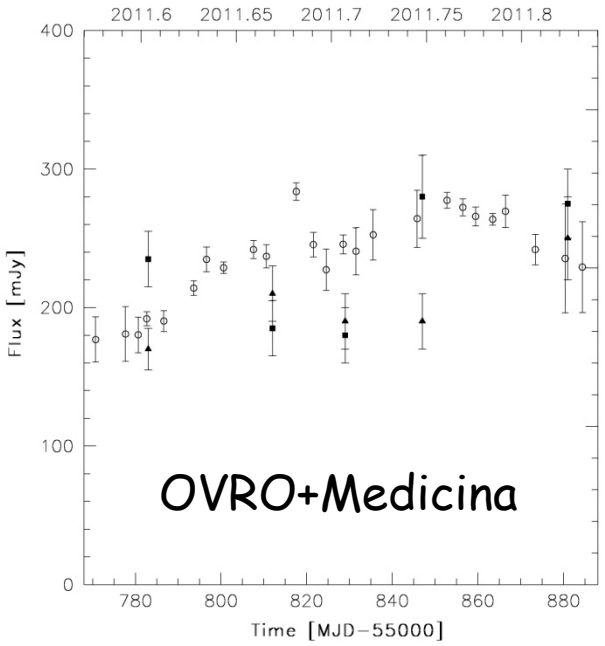


D'Ammando, Orienti, Finke , et al. 2012

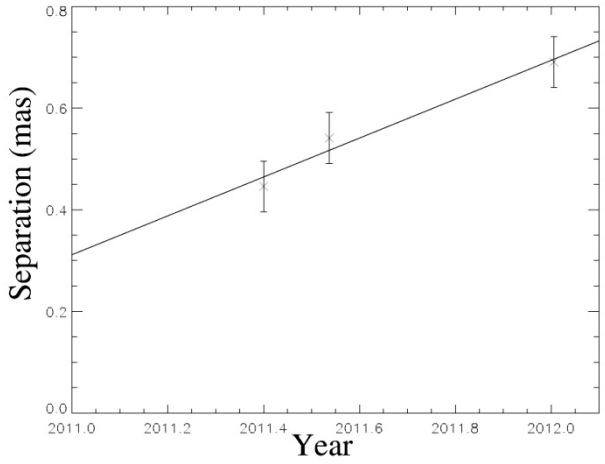
The radio variability of SBS 0846+513



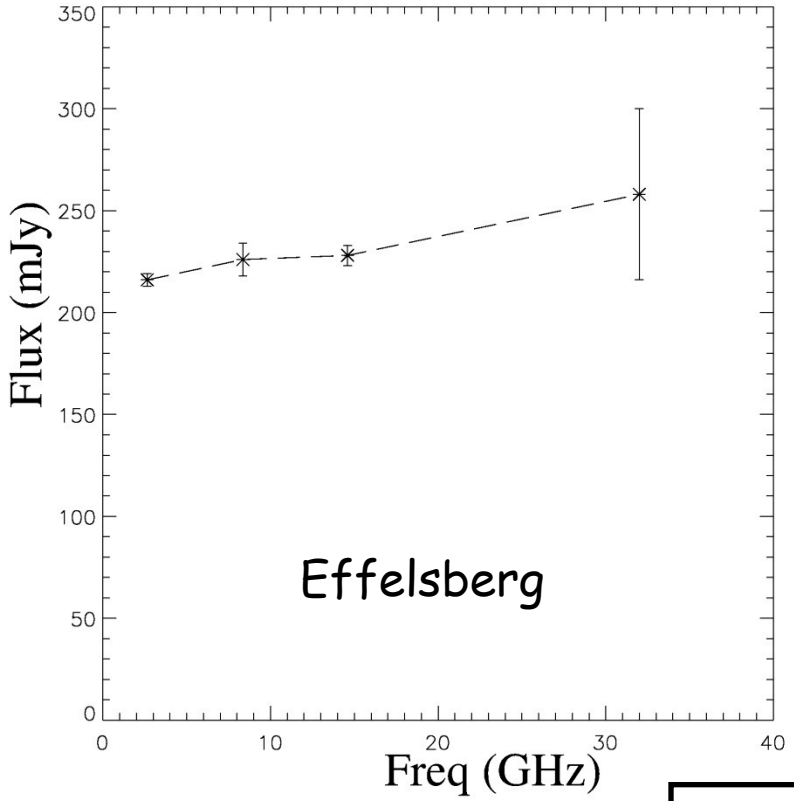
The OVRO light curve showed strong variability at 15 GHz, but not so high during the peak of the gamma-ray activity

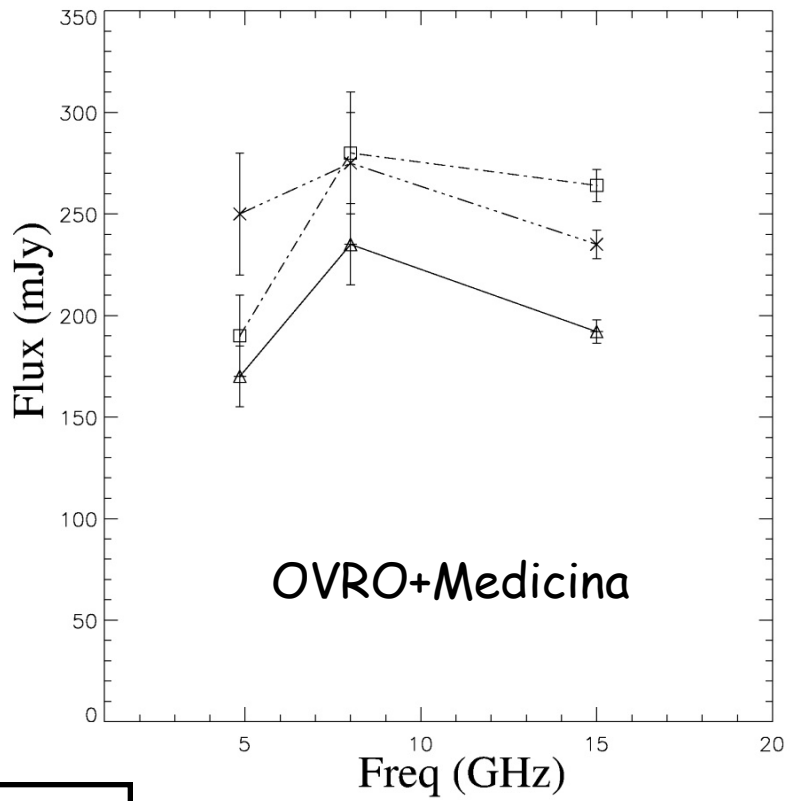


From the model-fitting of 3-epoch MOJAVE data in 2010-2011 we found that W1 and W2 are separating with an **apparent velocity of (8.2+/-1.5)c.** This value suggests the presence of boosting effect as well as in blazars.



The radio spectra of SBS 0846+513

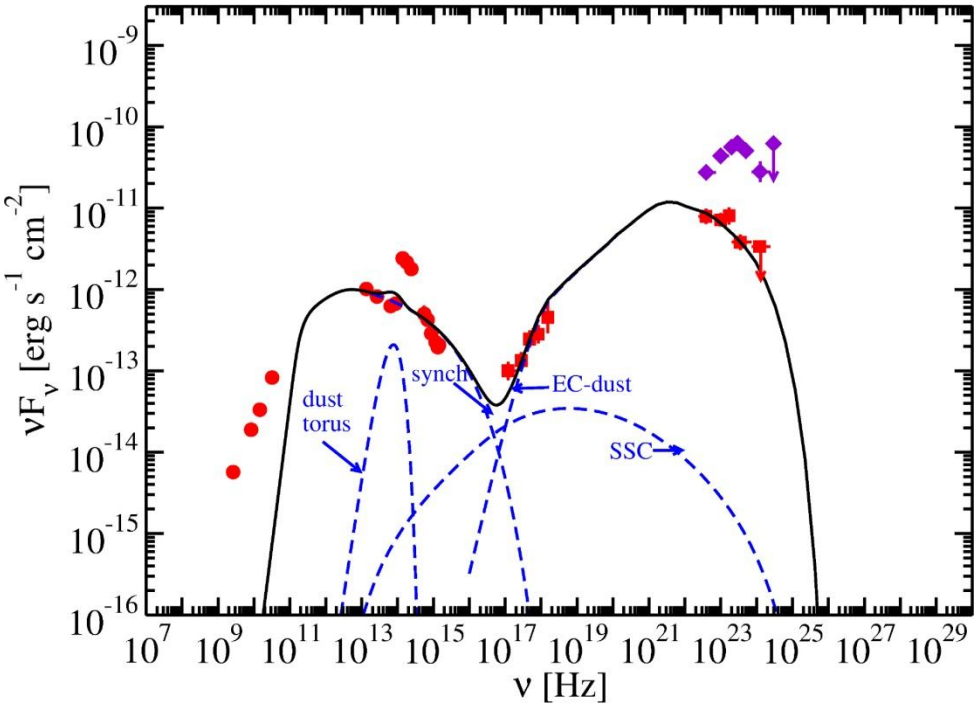




D'Ammando+2012

A flat radio spectrum was observed on April 2011, before the high gamma-ray activity. After the gamma-ray flare (August-November 2011) also the radio shape changed, a quite typical blazar-like behaviour.

Spectral energy distribution of SBS 0846+513



D'Ammando+2012

Modeling of the SED of the source in an average state with SSC+EC (dust)

Γ = 15, B = 1 G, P_{jet} = 1.8x10^{45} erg s^{-1}

Magnetic field and electrons energies are nearly in equipartition

Compton dominance (~7) and X-ray spectral index consistent with FSRQs

Radio-loudness and jet formation

• The mechanism at work for producing a relativistic jet is not clear, and the physical parameters that drive the jet formation is still under debate

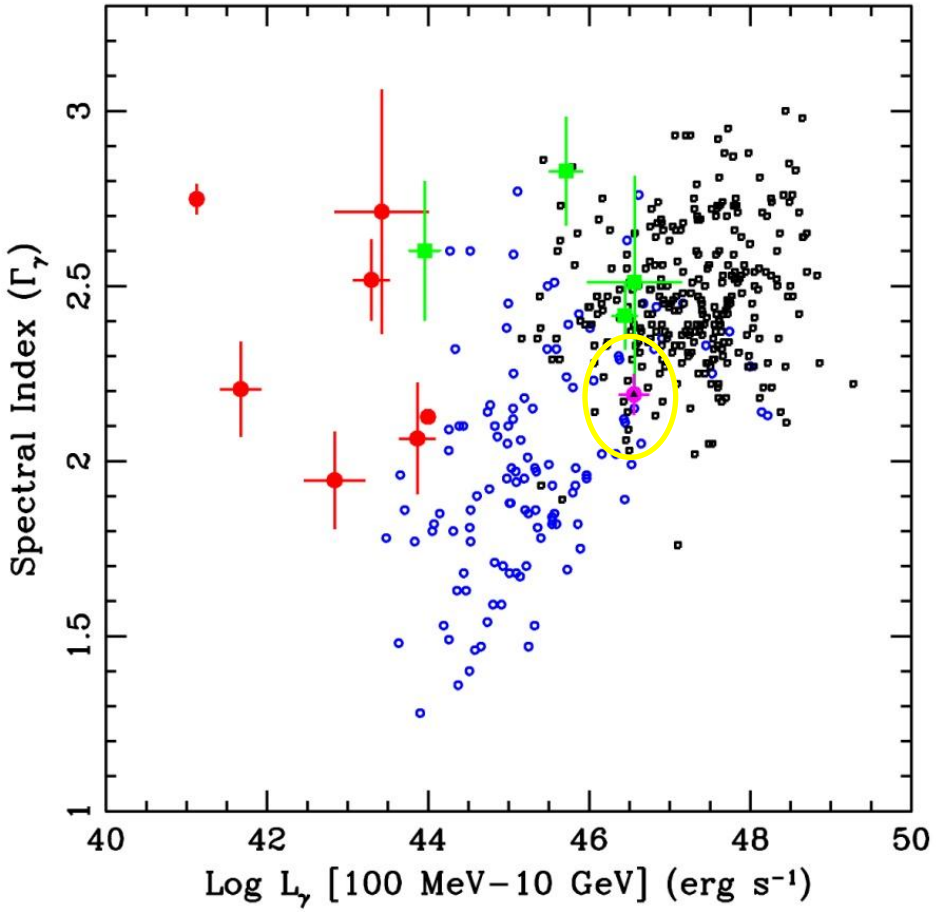
• One fundamental parameter could be **the BH mass**, with only large masses allowing relativistic jet formation

• Sikora et al. (2007) suggested that AGN with $M_{BH} > 10^8$ solar masses have radio loudness 3 order of magnitudes greater than the AGN with $M_{BH} < 3 \times 10^7$ solar masses

• Another fundamental parameter should be **the BH spin**, with SMBHs in elliptical galaxies having much larger spins than SMBHs in spiral galaxies

• **The spiral galaxies are characterized by multiple accretion events with random orientation of angular momentum vectors and small increments of mass, while elliptical underwent at least one major merger with large matter accretion triggering an efficient spin up of the SMBH**

Gamma-ray luminosity and spectrum



D'Ammando+2012

In the L_γ-Γ plane SBS 0846+513 lies in the blazar region. This should reflect a similar viewing angle with respect to the jet axis and beaming factor.

Host galaxy of gamma-ray NLS1s

• Unfortunately only very sparse observations of the host galaxy of the radio-loud NLS1s are available at this time

• The sample of objects studied by Deo et al. (2006) and Zhou et al. (2006) had $z < 0.03$ and $z < 0.1$, respectively, including both radio-quiet and radio-loud objects

• The BH masses of radio-loud NLS1s are generally larger with respect to the entire sample of NLS1s: $(2\text{-}10)\times10^7$ solar masses (Komossa et al. 2006), even if still small when compared to radio-loud quasars

• The larger BH masses of radio-loud NLS1s could be related to the prolonged accretion episode that can spin-up the BHs

• **The small fraction of radio-loud NLS1s with respect to radio-quasars could be an indication that in the former the high accretion usually does not last sufficiently long to significantly spin-up the BHs (Sikora 2009)**

Concluding Remarks about SBS 0846+513

• The power released by SBS 0846+513 during the flaring activity and the apparent superluminal velocity are strong indications of the presence of a relativistic jet as powerful as those of blazars

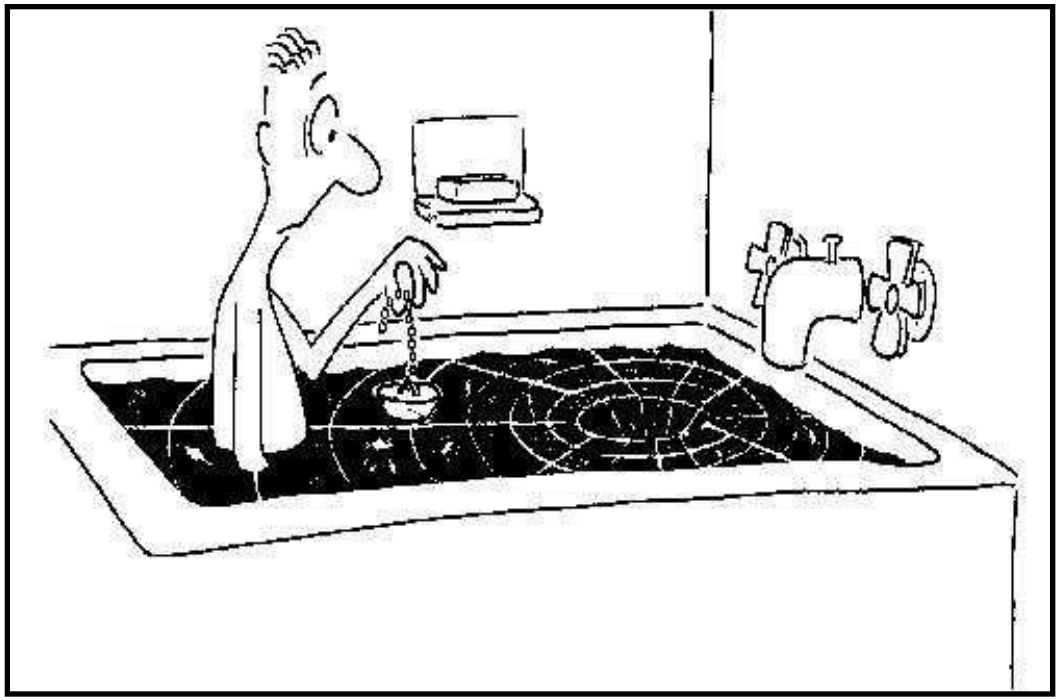
• Variability and spectral properties in radio and gamma rays bands indicate blazar-like behaviour

• The black hole mass of SBS 0846+513 was estimated in the range between 8.2×10^6 and 5.2×10^7 solar masses

• This source could be a blazar at the low end of the blazar's BH masses (possibly young), indicating that radio-loud AGNs can host relativistic jets as powerful as those of blazars, despite the BH mass

• *The discovery of relativistic jets in a class of AGN usually hosted by spiral galaxies was a great surprise but…*

…BH masses of radio-loud NLS1s are larger than the entire sample of NLS1s. This could be related to prolonged accretion episodes that can spin-up the BH leading to the relativistic jet formation. Only for a small fraction of NLS1s the high accretion last sufficiently long to significantly spin-up the BH



Thanks for your attention!!!