1ES 1215+300: un faro cosmico nello spazio profondo

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The source 1ES 1215+303 is a blazar of the BL Lac class located about 1.2 billion light-years from Earth. These objects are characterized by an active galactic nucleus with a supermassive black hole that emits extremely powerful radiation across the entire electromagnetic spectrum, from X-rays to gamma rays. Its intense gamma-ray emission makes it a highly interesting object for astronomers studying the behavior of these extreme systems. The blazar 1ES 1215+303 is also an important candidate for research on dark matter and high-energy astrophysical phenomena.

1. Introduction

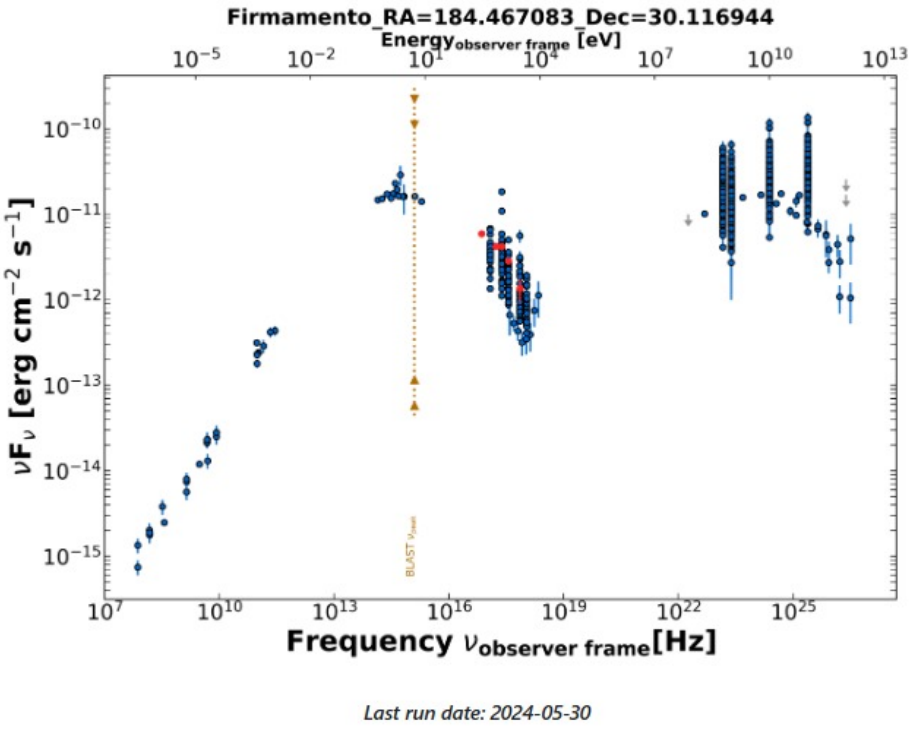
Our journey begins at the Faculty of Physics of the University of Naples Federico II during the International Cosmic Day, where we delved into the topic of cosmic rays for the first time, focusing in particular on the analysis of the muon flux thanks to the use of the Cosmic Ray Cube.

The second meeting took place at our institute, IIS Telesi@, where we delved into the study of extragalactic sources, focusing in particular on blazars. Participants were divided into groups of three, each of which received a specific source to analyze. To obtain information on these sources we used specific tools and databases, such as TeVcat and Fermi and Google Colab for data processing.

- A blazar is a type of active galactic nucleus (AGN) with a relativistic jet that points almost directly toward the Earth. These objects emit radiation over a wide range of frequencies, from radio to very high-energy gamma rays. 1ES 1218+304, in particular, belongs to the HBL subclass, where the peak of synchrotron radiation is found in the high frequencies (ultraviolet or X-rays).

2. Research methods

The analysis of the source 1ES 1215+303 was performed by collecting data from different sources, such as TevCat and Fermi. The processing phase was performed using Google Colab, through which the necessary scripts were written to generate the SED (Spectral Energy Distribution) plot, after obtaining the CSV file via Firmamento.



The graph shows the spectral distribution of the source energy.

This graph represents the energy flux of the blazar. The SED of a blazar describes how the emitted energy varies over a wide frequency range. In the case of 1ES1215+303, it presents the two classic peaks typical of a blazar:

the first peak, usually located in the radio and infrared regions of spectroscopy, is found, in this case, in the ultraviolet region, at a frequency of about 10^15 Hz and an energy of approximately 10^-11 eV. It is characteristic of HBLs, in which the energy of the electrons is particularly high.

The second peak, commonly located in the optical, ultraviolet and X-ray bands, is found this time in gamma rays, at a frequency of 10^25 Hz. It is produced by the interaction of the same electrons with low-energy photons, which are "pushed" towards higher energies.

3. Results

The blazar 1ES 1215+300 is located at right ascension 12h 17m 52.1s and declination +29° 56’ 34”, a position that allows for the observation of the source using various telescopes, both ground-based and space-based [1]. Its identification as a blazar was made possible through astronomical studies based on observations across different wavelengths of the electromagnetic spectrum. The characterization of 1ES 1215+300 was conducted using radio and optical telescopes, enabling an in-depth analysis of its behavior and physical properties. 1ES 1215+300 is considered a potential candidate for the acceleration of high-energy cosmic rays. Recent studies have analyzed data from the Fermi telescope, which has monitored the source for over a decade, revealing variations in the gamma-ray flux. Data from other frequency bands, such as X-rays and visible light, have also been examined to better understand the emission mechanisms of 1ES 1215+300. In January 2012, a sudden increase in gamma-ray emission led to targeted observations with the MAGIC telescope, revealing intense high-energy gamma-ray emission. In the following years, multiwavelength observational campaigns provided detailed light curves, highlighting the variability of 1ES 1215+300’s emission over time. A possible connection between 1ES 1215+300 and certain ultra-high-energy cosmic ray sources detected by the Telescope Array has been discussed. However, recent studies suggest that 1ES 1215+300 is not one of the primary sources of such cosmic rays. Among the most significant observations, intense peaks in radio emission were recorded in September 2023, indicating a change in the source’s activity. The measurements were conducted using the Very Long Baseline Array (VLBA), a system of radio telescopes known for its extremely high angular resolution.

4. References

[1] https://firmamento.nyuad.nyu.edu/data_access
[2] https://tevcat2.tevcat.org/sources/agykYI