Astronomers monitor nearby blazar Markarian 501

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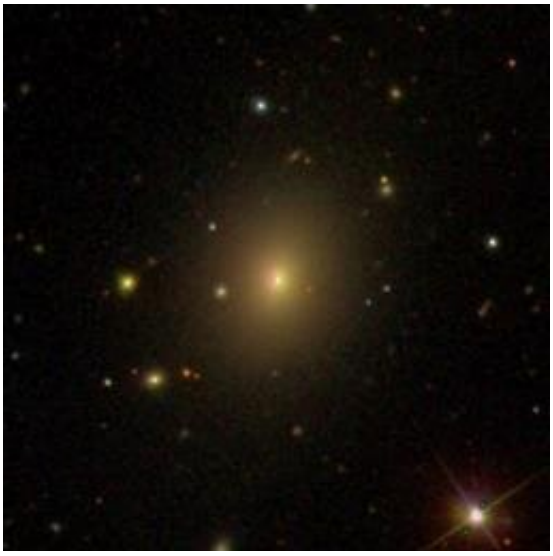

Sloan Digital Sky Survey image of blazar Markarian 501. Credit: Arbet-Engels et al., 2021.

A team of astronomers from Switzerland and Germany has conducted a long-term multi-band photometric monitoring of a nearby blazar known as Markarian 501. The observational campaign delivered essential information regarding the blazar's variability and detected numerous flares from this source. Results of the study were published September 7 on arXiv.org.

Blazars are very compact quasars associated with supermassive black

holes (SMBHs) at the centers of active, giant elliptical galaxies. They belong to a larger group of active galaxies that host active galactic nuclei, and are the most numerous extragalactic gamma-ray sources. Their characteristic features are relativistic jets pointed almost exactly toward the Earth.

BL Lacertae objects (BL Lacs) are a type of blazar showcasing lower-power jets and higher Doppler factors than other blazars. Based on the location of the synchrotron peak, they can be divided into low (LBLs), intermediate (IBLs), and high synchrotron peak BL Lacs (HBLs). Astronomers are especially interested in finding rare extreme HBLs (EHBLs)—identified by synchrotron emission peaks at energies above 1 keV. Such objects are believed to be among the most efficient and extreme accelerators in the universe.

At a redshift of 0.034, Markarian 501 (or Mrk 501) is one of the most frequently studied nearby bright blazars. Previous observations of this source have suggested that it may be an EHBL. A group of researchers led by Axel Arbet-Engels of the Swiss Federal Institute of Technology in Zürich, Switzerland, decided to further investigate this hypothesis by conducting a long-term multi-band photometry of Mrk 501 using various ground-based facilities and space telescopes, including the First G-APD Cherenkov Telescope (FACT).

"We studied the broadband variability of Mrk 501 from the end of 2012 to the middle of 2018. Data from eight instruments were considered," the astronomers wrote in the paper.

The variability of Mrk 501 was detected in all wave bands. The fractional variability is lowest in the radio and highest in the TeV band, and it monotonically increases from the radio to the X-rays and from the GeVs to the TeVs.

The lag between the TeV and X-ray variations were estimated to be less than 0.4 days. According to the researchers, this almost zero lag is consistent with synchrotron self-Compton (SSC) emission, where TeV photons are produced through inverse Compton scattering.

"The reported delay

The observations also identified numerous TeV and X-ray flares from Mrk 501. The characteristic time interval between TeV flares was found to be comparable with the expectation if these flares are triggered by the so-called Lense-Thirring precession (a relativistic correction to the precession of a gyroscope near a large rotating mass) of the accretion disk around the SMBH.

More information: Axel Arbet-Engels et al, Long-term multi-band photometric monitoring of Mrk 501. arXiv:2109.03205v1 [astro-ph.HE], arxiv.org/abs/2109.03205

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