

Optical telescopes obtain long-term monitoring results of flux variability in blazars

March 31 2020, by Liu Jia

Blazars are a special kind of rare active galactic nuclei. They are currently the most likely candidates for high-energy neutrinos. Their relativistic jets may be the origin area of super-high-energy cosmic rays and neutrinos.

Using the 60-cm, fully automatic optical telescope jointly constructed by IAA-CSIC and Yunnan Observatories (BOOTES-4, the first professional-level program-controlled autonomous telescope in China), Dr. XIONG Dingrong from Lijiang Astronomical Observatory, Yunnan Observatories of the Chinese Academy of Sciences and the collaborators, carried out long-term optical monitoring of the [blazar S5 0716+714](#) which is a candidate of high energy neutrino and has very high energy radiation.

The researchers obtained the largest quasi-simultaneous multi-color photometry sample of this blazar. The results are published in *The Astrophysical Journal Supplement Series*.

For the long-term variations, a strong flatter when brighter (FWB) trend at a low flux state and then a weak FWB trend at a higher flux state are reported for the first time, which are well explained by the acceleration and cooling mechanisms of different electrons in the relativistic jet.

A method was proposed by the researchers. Assuming that the flux

variability in the long-term trend is related to variation of Doppler factor, they used the relationship between flux and Doppler factor to track the jet geometry when the spectral index (after the flux variability in the long-term trend is removed) remains unchanged. Generally, it is necessary to track the jet geometry through the radio observation.

The researchers used this method to analyze the multi-color fluxes and spectral index variations, and found that the relativistic jet (or shock in jet) of the blazar traveled along a curved path, which supported inhomogeneous jet models.

These findings showed the progress in studying long-term flux variability, the most basic feature in blazars.

In recent years, using the Lijiang 2.4 m optical telescope and the 1m optical telescope of Yunnan Observatories, the researchers have obtained the long-term optical monitoring results of two famous blazars 3C 273 and MRK 501. Long-term monitoring of optical bands can provide a large amount of observation data to study the origin of [flux](#) variability, provide early warning for the observation of high-energy and very high-energy gamma rays, and increase the probability of identifying blazar as a high-energy neutrino source.

More information: Dingrong Xiong et al. Multicolor Optical Monitoring of the Blazar S5 0716+714 from 2017 to 2019, *The Astrophysical Journal Supplement Series* (2020). [DOI: 10.3847/1538-4365/ab789b](#)

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