New finding on Blazars—the brightest jets in the universe could provide clues to processes close to black holes

The short term optical flux stability detected in some of the brightest jets in the universe could provide clues to the processes close to black holes**.**

Blazars are one of the most luminous and energetic objects in the universe powered by material falling onto a supermassive black hole at the center of the host galaxy – the luminosity being because of their a jet composed of ionized matter traveling at nearly the speed of light towards an observer (the Earth).

Six scientists spanning over three countries--- India, Serbia, and the USA studied some of the brihtest blazers called TeV (Tera-electron Volt) blazars and found that they stand out as a semblance of stability of brightness among the blazar family in the short duration. While their brightness varies in the long duration, they maintain their brightness levels in short duration.

Blazars are among one of the most favourite astronomical transient objects, and their study could provide clues to the processes happening close to the black hole, not visible through direct imaging.

The scientists, including researchers from Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, an autonomous institute of the Department of Science and Technology (DST), Government of India, took 1741 image frames during 2013 – 2019 by using two (1.04 m and 1.3 m) telescopes, in ARIES, India and two (0.6 m and 1.4 m) telescopes in Serbia. A detailed study of the optical flux and spectral variability of three extreme TeV (Tera-electron Volt, i.e., 10^{12} eV) gamma-ray emitting blazars, namely 1ES 0229+200, 1ES 0414+009, 1ES 2344+514 was carried out by this team.

In the study by Dr. Ashwani Pandey and Dr. Alok C. Gupta, published in Monthly Notices of the Royal Astronomical Society Journal, a detailed study of the flux, color, and spectral index variations of the three extreme TeV blazars was carried out on diverse timescales --- as short as within a day, and as well as on months to years timescales. The study also explained the physical processes responsible for such variations.

According to the team, in TeV emitting blazars, peak of spectral energy distribution lies in the UV/X-ray range. Thus in optical bands, magnetic fields and electrons energies are less, causing short term optical flux stability or low amplitude variability. Variations on months to years timescales can most likely be explained by the propagation of shocks along with the jet, due to which the electrons at the shock front get accelerated to very high energies. These high energy electrons are then cooled via different emission processes while leaving the shock front. Other possible explanations for months to years timescale variations include a change of the magnetic field and/or change in the Doppler factor caused by either helical motion of the emitting region within the jet or wiggling of jets or helical jets.

In this age of multi-wavelength (MW) time-domain astronomy in which the transient astronomical sources are of great interest due to their rapid change in flux, simultaneous MW observation of a particular transient source on an extended period of time is important for understanding the emission mechanism in different electromagnetic (EM) bands.

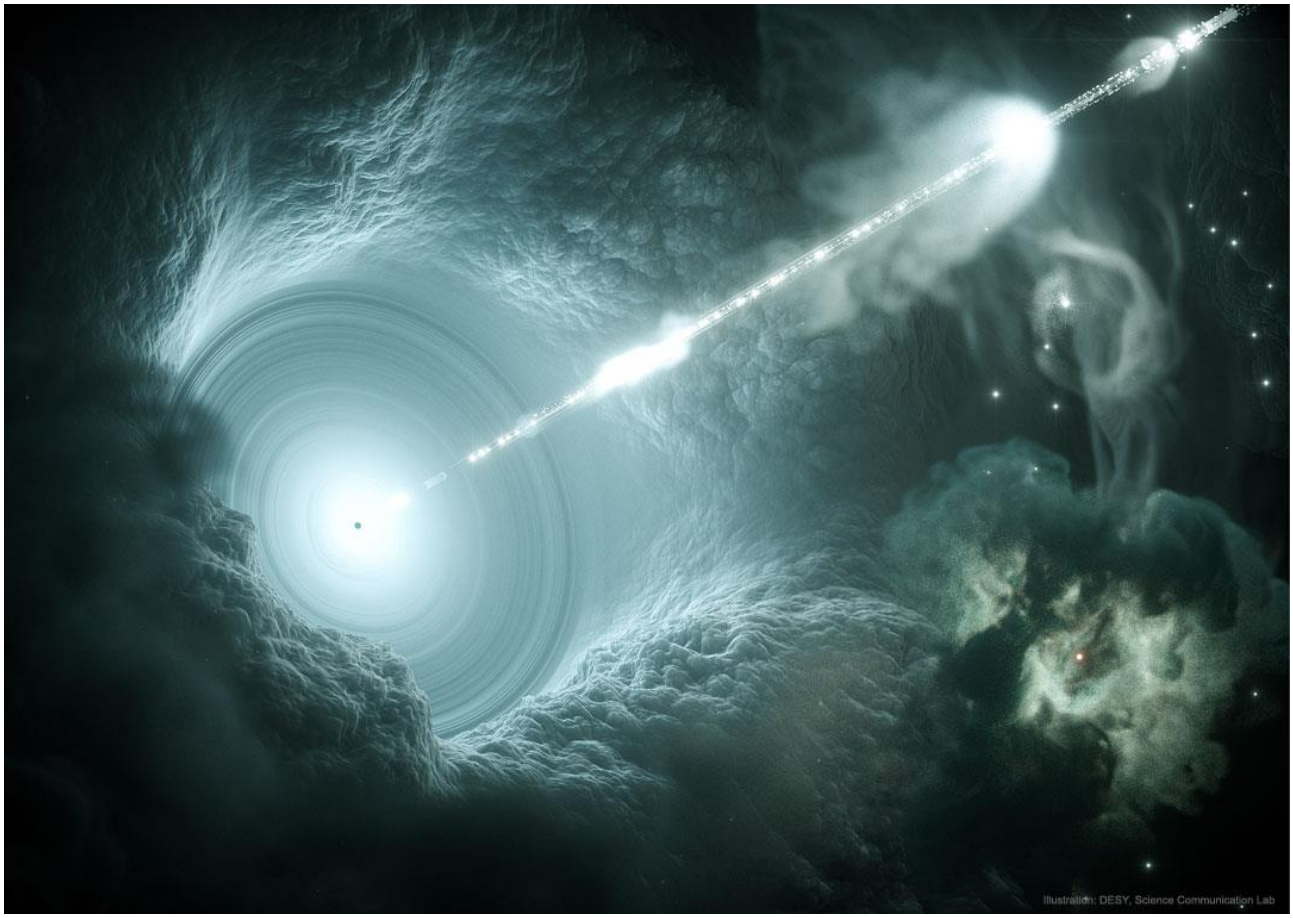

Figure: Artist's impression of the blazar having a powerful relativistic jet.
Image source: https://apod.nasa.gov/apod/ap180716.html

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