HESS J1943+213 is an extreme blazar, study finds

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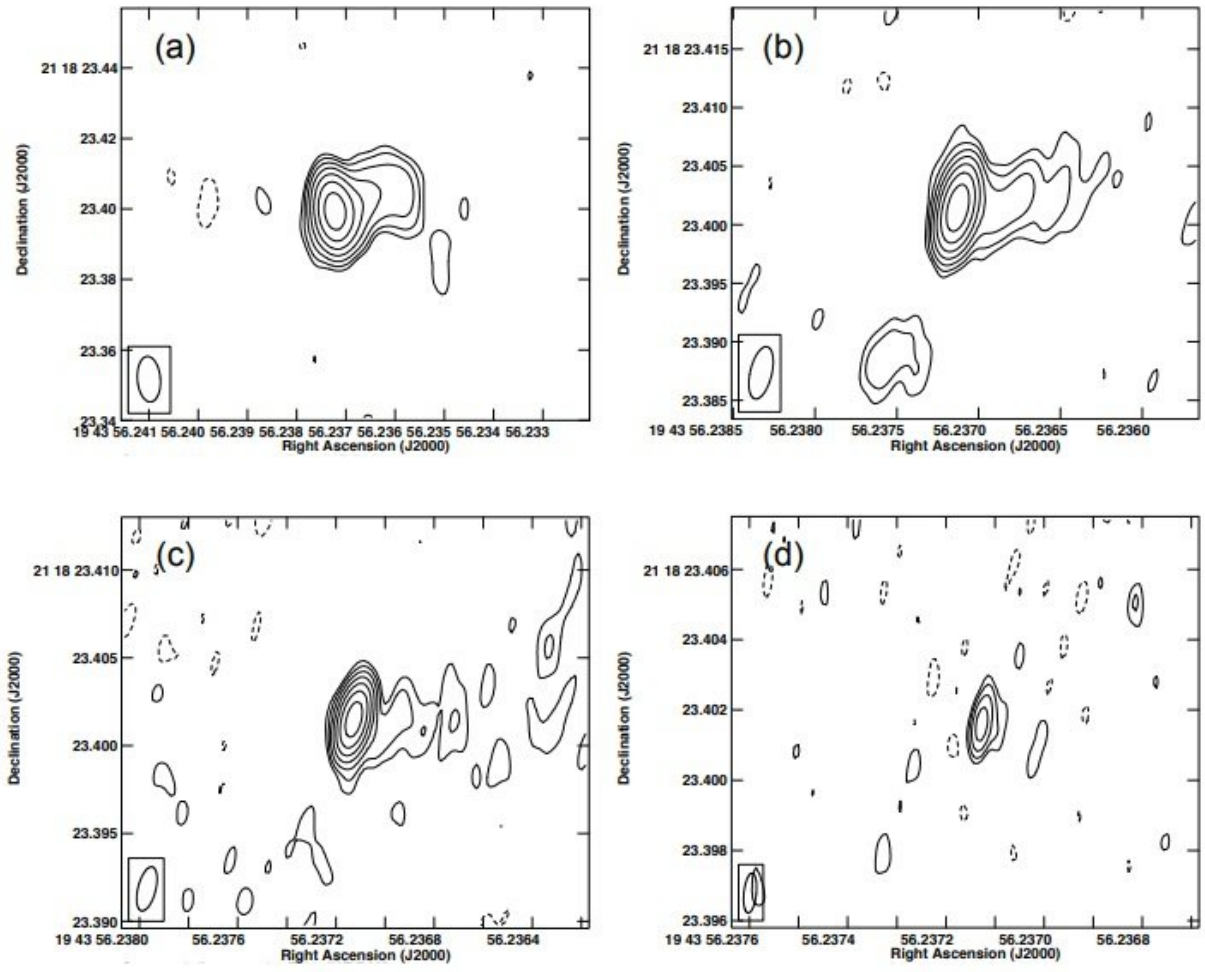

Contour images of HESS J1943+213 with VLBA (a) 1.6 GHz, (b) 4.3 GHz, (c) 7.6 GHz, and (d) 15 GHz bands. Contour levels plotted above 1% of the peak image intensity: −1, 1, 2, 4, 8, 16, 32, 64 (1.6 GHz); −2, −1, 1, 2, 4, 8, 16, 32, 64 (4.3 GHz and 7.6 GHz); −8, 8, 16, 32, 64 (15 GHz). Negative levels are shown with dashed lines. Credit: Archer et al., 2018.

An international group of astronomers have carried out multi-wavelength observations of HESS J1943+213 and found evidence supporting the hypothesis that this gamma-ray source is an extreme blazar. The finding is reported in a paper published June 11 on the arXiv pre-print repository.

Blazars are very compact quasars associated with supermassive black holes 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 specially 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.

Recently, a team of astronomers led by the Very Energetic Radiation Telescope Array System (VERITAS) collaboration, presented the results of observations indicating that one of the gamma-ray sources in the plane of the Milky Way galaxy, designated HESS J1943+213, is actually an EHBL.

Discovered in 2011 by the H.E.S.S. Galactic Plane scan, HESS J1943+213 was initially classified as a very-high-energy gamma ray point source. Since its detection, the real nature of this source has been uncertain. Some astronomers suggested that it is a blazar, while other

proposed that the source is a pulsar wind nebula or a gamma-ray binary. Now, new observations, conducted with the use of the VERITAS telescope array, the Very Long Baseline Array (VLBA), as well as NASA's Swift and Fermi space telescopes, indicate that HESS J1943+213 is a blazar of EHBL subclass.

"We detail results from observations of HESS J1943+213 with VERITAS, FermiLAT, Swift-XRT, and VLBA and further characterize the properties of the source as an EHBL," the researchers wrote in the paper.

According to the study, new observations show that HESS J1943+213 has an extended, jet-like structure as well as a remarkably stable flux and spectrum in very-high-energy gamma rays. Moreover, the researchers found that the radio spectral indices of the core and the jet, together with the level of polarization, are in a range typical for blazars.

Taking into account the location of the synchrotron peak in HESS J1943+213, the blazar was classified as an EHBL. The astronomers noted that although high-energy gamma-ray blazars behind the galactic plane have been previously identified with the Fermi telescope, HESS J1943+213 is the first such blazar also seen in very-high-energy gamma-rays.

In concluding remarks, the researchers emphasized that although the real nature of HESS J1943+213 seems to be understood, there are still many unknowns about this blazar.

"High-sensitivity observations of HESS J1943+213 in the hard X-ray band with an instrument like NuSTAR would be valuable for characterizing both the spectral shape and the variability of the emission produced by the higher-energy particles and would help pinpoint the emission mechanism of the source. Moreover, a precise measurement of

the distance to HESS J1943+213 would be of great benefit for pinning down its physical properties," the paper reads.

More information: HESS J1943+213: An Extreme Blazar Shining Through The Galactic Plane, arXiv:1806.04144 [astro-ph.HE] arxiv.org/abs/1806.04144

Abstract

HESS J1943+213 is a very-high-energy (VHE; >100 GeV) γ-ray source in the direction of the Galactic Plane. Studies exploring the classification of the source are converging towards its identification as an extreme synchrotron BL Lac object. Here we present 38 hours of VERITAS observations of HESS J1943+213 taken over two years. The source is detected with ~20 standard deviations significance, showing a remarkably stable flux and spectrum in VHE γ-rays. Multi-frequency very-long-baseline array (VLBA) observations of the source confirm the extended, jet-like structure previously found in the 1.6 GHz band with European VLBI Network and detect this component in the 4.6 GHz and the 7.3 GHz bands. The radio spectral indices of the core and the jet and the level of polarization derived from the VLBA observations are in a range typical for blazars. Data from VERITAS, Fermi-LAT, Swift-XRT, FLWO 48″ telescope, and archival infrared and hard X-ray observations are used to construct and model the spectral energy distribution (SED) of the source with a synchrotron-self-Compton model. The well-measured γ-ray peak of the SED with VERITAS and Fermi-LAT provides constraining upper limits on the source redshift. Possible contribution of secondary γ-rays from ultra-high-energy cosmic ray-initiated electromagnetic cascades to the γ-ray emission is explored, finding that only a segment of the VHE spectrum can be accommodated with this process. A variability search is performed across X-ray and γ-ray bands. No statistically significant flux or spectral variability is detected.