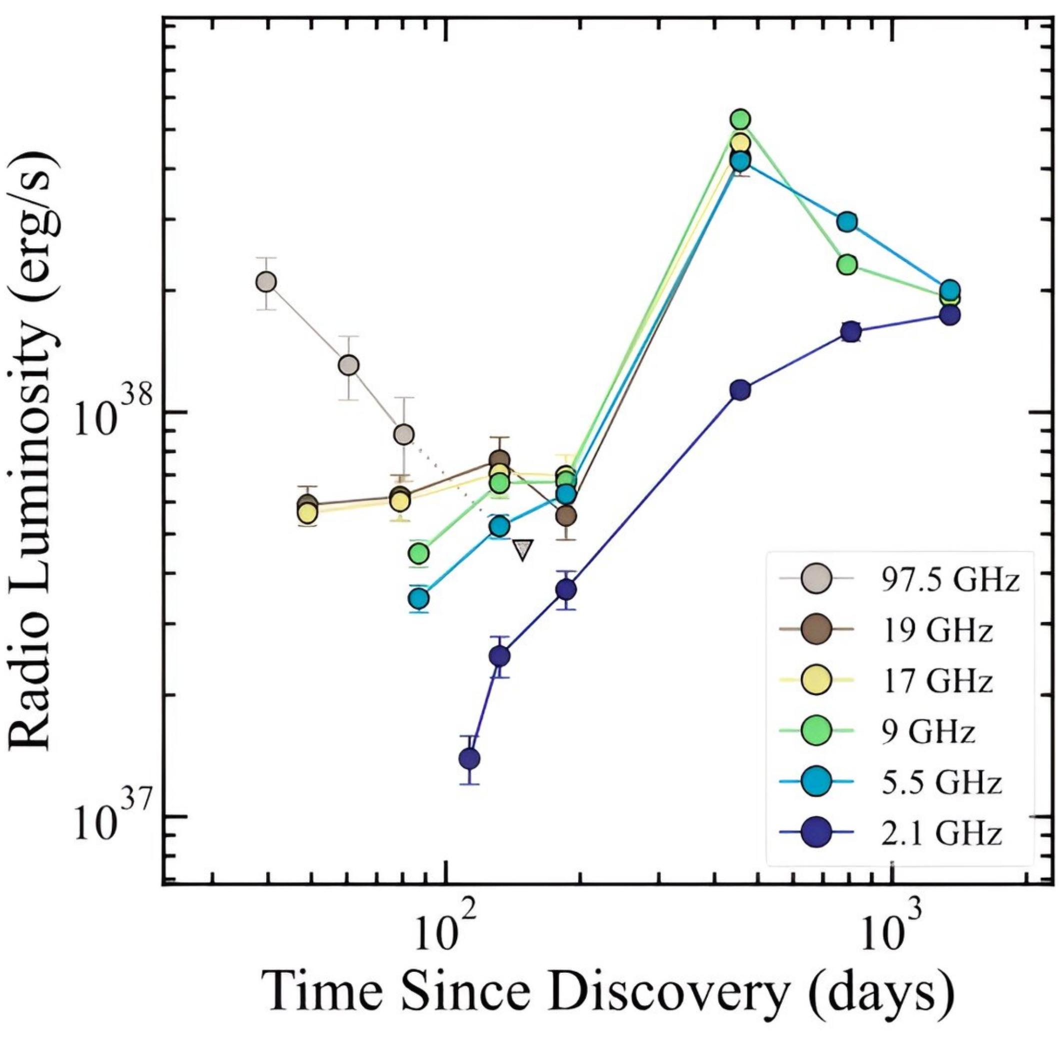
Tidal disruption event ASASSN-19bt experiences unusual radio evolution, observations show

April 29 2024, by Tomasz Nowakowski



Radio and millimeter light curves of ASASSN-19bt. Credit: Christy et al., 2024.

An international team of astronomers has conducted detailed radio and X-ray observations of a tidal disruption event (TDE) designated ASASSN-19bt. Results of the observational campaign, presented April 18 on the pre-print server *arXiv*, shed more light on the emission from this TDE, revealing that it showcases an unusual radio evolution.

TDEs occur when a star passes close enough to a supermassive black hole and is pulled apart by the black hole's tidal forces, causing the process of disruption. Such tidally disrupted stellar debris starts raining down on the black hole and radiation emerges from the innermost region of accreting debris, which is an indicator of the presence of a TDE.

ASASSN-19bt is a TDE at a redshift of 0.026, in the galaxy 2MASX J07001137-6602251. It was discovered in January 2019 by the All-Sky Automated Survey for SuperNovae (ASAS-SN) and its X-ray luminosity is among the lowest observed for any optically-selected TDE.

Shortly after the discovery of ASASSN-19bt, a group of astronomers led by Collin T. Christy of Steward Observatory in Tucson, Arizona, began monitoring of this TDE in order to get more insights into its properties. For this purpose, they employed the Australia Telescope Compact Array (ATCA), the Atacama Large Millimeter/submillimeter Array (ALMA), and the MeerKAT radio telescopes.

"We present the results of our radio and X-ray monitoring of the TDE ASASSN-19bt, spanning nearly four years after the onset of the optical flare," the researchers wrote.

Christy's team first detected radio emission from ASASSN-19bt shortly after the optical discovery. Afterward, the radio emission continued to rise for years. Therefore, ASASSN-19bt exhibits unusual radio evolution when compared to other known TDEs, as the peak brightness of its radio emission increases rapidly until 457 days post-optical discovery and then plateaus.

Contrary to radio emission, ASASSN-19bt appears to showcase very little activity in the X-rays. The observations detected no X-rays until approximately 225 days after the discovery of this TDE.

Trying to explain the origin of radio emission from ASASSN-19bt, the astronomers employed two models: a non-relativistic spherical blast wave and a relativistic jet launched off-axis from the line of sight.

According to the paper, the non-relativistic model points to a continuous energy rise in the outflow from about 0.01 to 10 quindecillion ergs, with a bulk outflow velocity of 0.05. When it comes to the relativistic model, it suggests a decreasing energy at early times and a roughly constant energy at a level of about 10,000 quindecillion ergs at late times in the maximally off-axis case.

Summing up the results, the authors of the study underlined the urgency of extended radio observations of ASASSN-19bt and other similar TDEs in order to understand the mechanisms behind such unusual late time radio emission.

More information: Collin T. Christy et al, The Peculiar Radio Evolution of the Tidal Disruption Event ASASSN-19bt, *arXiv* (2024). DOI: 10.48550/arxiv.2404.12431

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