Research investigates radio emission of the rotating radio transient RRAT J1854+0306

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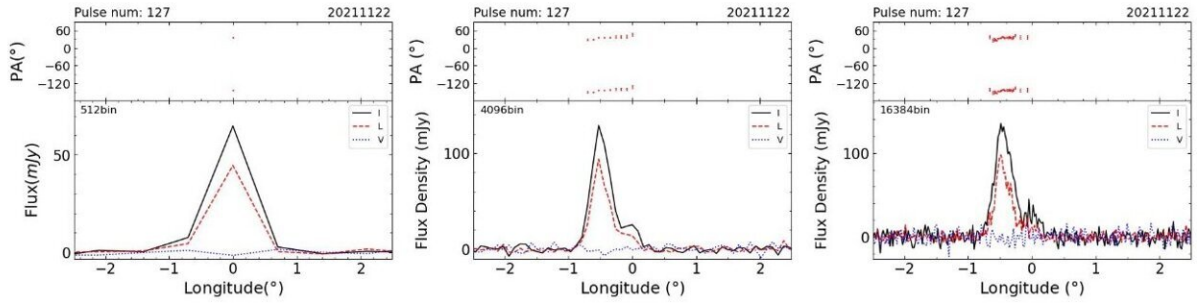

Polarized pulse profiles of RRAT J1854+0306 with different phase bins. From left to right, the 127th pulse observed on 2021-11-22 is exhibited with 512, 4,096 and 16,384 phase bins. The total intensity(□□), linear (□□) and circular polarization(□□) of each pulse is represented by black solid, red dashed and blue dotted lines in the bottom panel of each plot. The PAs of linear polarization exceeding 5□□□□ are indicated by red dots with error-bars of ± □□□□ □□ in the top panels of the plots. □□□□ and □□□□ □□ represent the uncertainties of L and PA. Credit: *arXiv* (2024). DOI: 10.48550/arxiv.2404.09418

Using the Five-hundred-meter Aperture Spherical radio Telescope (FAST), Chinese astronomers have investigated radio emission from a rotating radio transient known as RRAT J1854+0306. Results of the study, published April 15 on the preprint server *arXiv*, shed more light on the properties of this transient.

Pulsars are highly magnetized, rotating neutron stars emitting a beam of electromagnetic radiation. They are usually detected in the form of short bursts of radio emission; however, some of them are also observed via optical, X-ray and gamma-ray telescopes.

Rotating radio transients (RRATs) are a subclass of pulsars characterized by sporadic emission. The first objects of this type were identified in 2006 as sporadically appearing dispersed pulses, with frequencies varying from several minutes to several hours. However, the nature of these transients is still unclear. In general, it is assumed that they are ordinary pulsars that experience strong pulses.

So far, only slightly more than 100 RRATs have been found. Therefore, astronomers are interested in studying them in detail in order to improve our knowledge about their still largely unknown nature.

Discovered in 2009, RRAT J1854+0306 has a spin period of 4.56 seconds and dispersion measure of 192.4 pc/cm^3. It exhibits occasional strong pulses and is among the strongest RRATs, which makes it possible to explore its emission details.

A team of astronomers led by Qi Guo of the Hebei Normal University in China conducted highly sensitive observations of RRAT J1854+0306 with the aim of investigating its polarized emission. For this purpose, they employed the central beam of FAST's 19-beam receiver with a

frequency range of 1000 to 1500 MHz, which was divided into 2,048 channels.

The observations found that the emission from RRAT J1854+0306 is dominated by nulls with a nulling fraction of about 53.2%, which is interspaced by narrow (less than 1 degree) and weak (less than 0.5 mJy) pulses with occasional wide and intense bursts. It appears that individual pulses showcase diverse profile morphology, exhibiting single, double and multiple peaks.

According to the study, the pulses of RRAT J1854+0306 exhibit diverse polarization behaviors. Their degree of linear polarization can reach 100% for some pulses, and their circular polarization exhibits various senses and variation.

"These features are related to the density distribution of relativistic particles and their emission processes and/or caused by the propagation effects. For some pulses, the position angles depart a lot from the average one, which might be caused by emission generated from different plasma conditions of the magnetosphere," the authors of the paper explained.

All in all, based on the collected data, the researchers concluded that the behavior of polarized emission of RRAT J1854+0306 indicates that its emission originates from a magnetosphere similar to those of normal pulsars. This could have implications for the overall understanding of rotating radio transients, as the finding suggests that RRATs may have the same physical origins as normal pulsars.

More information: Qi Guo et al, Polarized radio emission of RRAT J1854+0306, *arXiv* (2024). DOI: 10.48550/arxiv.2404.09418