Mode changing phenomenon detected in the millisecond pulsar J1909−3744

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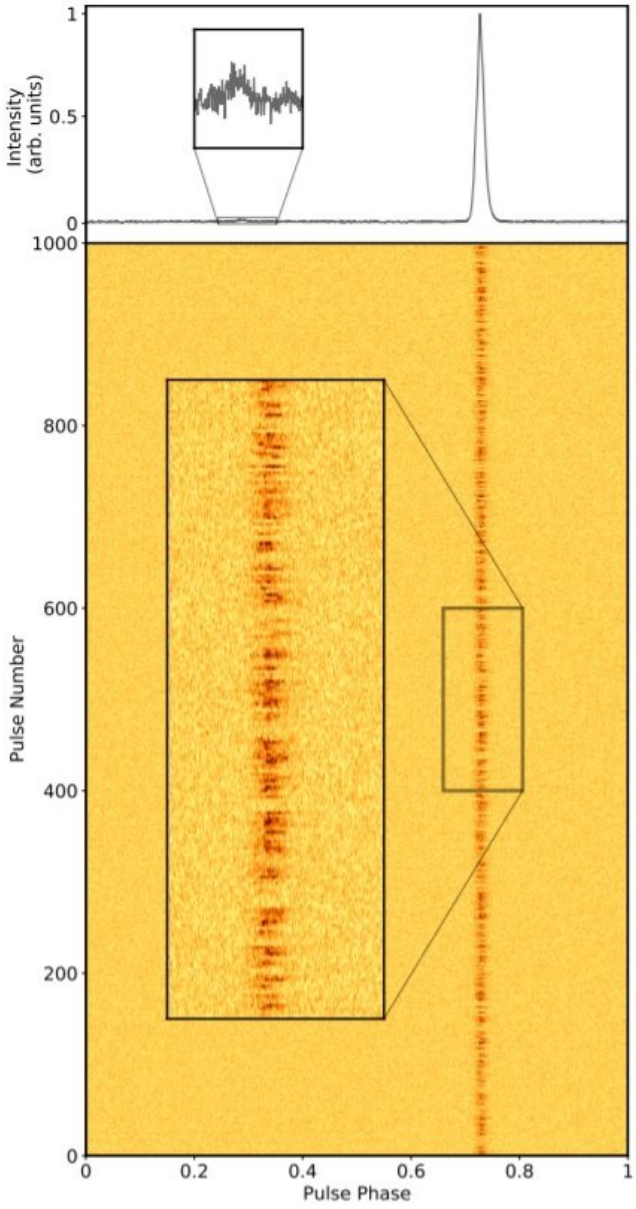

(Top) Average pulse profile PSR J1909−3744. The inset shows the very weak interpulse possessed by the pulsar. (Bottom) Intensities of 1,000 consecutive individual pulses of PSR J1909−3744. The inset shows a subset of 200 of these pulses, in which clear fluctuations in pulse intensity can be observed. Credit: Miles et al., 2021.

Using the MeerKAT telescope, astronomers have conducted radio observations of a millisecond pulsar known as J1909−3744. The study found that J1909−3744 experiences the so-called mode changing, which makes it only the third known millisecond pulsar that exhibits such behavior. The finding was detailed in a paper published December 2 on the arXiv pre-print server.

Pulsars are highly magnetized, rotating neutron stars emitting a beam of electromagnetic radiation. Some of them showcase variability in emission ranging from extremely short bursts like giant pulses to long-term changes in their emission profiles.

In some cases, mode changing has been observed in which the emission profile switches between two or more quasi-stable modes of emission. To date, this phenomenon has been observed in only two millisecond pulsars (MSPs)—the most rapidly rotating pulsars, with rotation periods below 30 milliseconds.

Now, a team of astronomers led by Matthew T. Miles of the Swinburne University of Technology in Australia, reports that J1909−3744 is another example of an MSP showcasing mode switching. The discovery was made with the MeerKAT telescope in South Africa as part of the MeerTime pulsar timing array campaign.

"In this work, we examine the single pulse variability of the MSP J1909−3744 using observations taken with the MeerKAT Array. We show that this MSP is the third of its kind to show strong evidence of mode changing," the researchers wrote in the paper.

J1909−3744 showed strong evidence of pulse mode changing during a particularly bright scintillation event. The astronomers identified two modes, differentiated by the relative signal to noise ratio of the pulses (S/N). It turns out that the lower S/N mode arrives earlier than its counterpart by approximately 9.26

More information: Matthew T. Miles et al, Mode changing in J1909−3744: the most precisely timed pulsar. arXiv:2112.00897v1 [astro-ph.HE], arxiv.org/abs/2112.00897

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