An eclipsing binary millisecond pulsar discovered by FAST

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An image of GC M92 with the pulsar M92A embedded in the dense core. Credit: ESA/Hubble

Using the data obtained by the Five-hundred-meter Aperture Spherical radio Telescope (FAST), a research team led by Prof. Pan Zhichen and Prof. Li Di from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) discovered an eclipsing binary millisecond pulsar in Globular Cluster (GC) Messier 92 (M92).

Named as PSR J1717+4307A or M92A, it is the first pulsar known in M92, with a spinning period of 3.16 ms and a dispersion measure (DM) of 35.45 pc cm^{-3}. Follow-up observations showed that this binary system is in a circular orbit with an orbital period of 0.2 day and a radius of 120 thousand kilometers. The companion is a 0.18 solar mass star, evolving to be a sub-giant.

Due to the compactness of the orbit, materials from the companion are being swallowed by the pulsar. Such a binary system is nicknamed a 'redback' spider. Like this type of spider, wherein the females tend to eat their companions, the pulsar tends to accrete the mass from its companion.

Since the discovery of the first pulsar in 1967, thousands of pulsars have been found in our Galaxy. While some are located in the Galactic plane, we've also observed a population of pulsars in GCs that orbit the Milky Way.

These pulsars are a useful tool for probing a very different environment: the dense stellar cores consisting of stars as old as 10 billion years. To date, there are 157 pulsars discovered in 30 GCs.

M92A was first detected on October 9, 2017, during the commissioning of FAST. With more than twice the collecting area of that of the Arecibo Telescope in Puerto Rico, more discoveries are expected from FAST and they will improve our understanding of the pulsar population in the Milky Way and of related astrophysics, such as massive stellar evolution and equations of states of condensed matters.

This work was published in *Astrophysical Journal Letters* on Mar. 19, and it was highlighted by the American Astronomy Society (AAS) Nova site on April 17, 2020.

More information: Zhichen Pan et al, The FAST Discovery of an Eclipsing Binary Millisecond Pulsar in the Globular Cluster M92 (NGC 6341), *The Astrophysical Journal* (2020). DOI: 10.3847/2041-8213/ab799d

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