New binary pulsar detected with CHIME
21 September 2022, by Tomasz Nowakowski

Using the Canadian Hydrogen Intensity Mapping Experiment (CHIME), astronomers have detected a new radio pulsar in a binary system with a massive non-degenerate companion star. The discovery of the pulsar, which received designation PSR J2108+4516, was detailed in a paper published September 14 on the arXiv pre-print server.

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.

Now, an international team of astronomers led by Bridget C. Andersen of McGill University in Montréal, Canada, reports the finding of a new rare type of a binary pulsar—hosting a massive companion. The detection was made using CHIME, a radio telescope possessing a very wide field of view, large collecting area and high sensitivity across the 400–800 MHz range.

"We discovered and initially monitored PSR J2108+4516 with the CHIME telescope, using the CHIME/FRB and CHIME/Pulsar backends to acquire various types of data," the researchers wrote in the paper.

All in all, the team acquired almost three years of near-daily CHIME/Pulsar observations of PSR J2108+4516 extending from October 20, 2018 to September 3, 2021. Profile drifts over pulse phase indicated that the pulsar was experiencing significant acceleration from orbiting with a massive binary companion.

The observations of PSR J2108+4516 revealed that it has a spin period of about 0.58 seconds and orbital period of 269 days. The orbital eccentricity was found to be at a level of approximately 0.09 and the pulsar's characteristic age was estimated to be around 2.1 million years. The surface magnetic field of PSR J2108+4516 was measured to be some 1.2 trillion Gauss.

When it comes to the companion object, the results suggest that its mass should be between 11.7 and 113 solar masses. The study found that the companion is a bright OBe star, known as EM* UHA 138, located at a distance of about 10,600 light years. The researchers estimate that the mass of this star is most likely between 17 and 23 solar masses.

Summing up the results, the astronomers underlined that PSR J2108+4516 is the sixth young pulsar with a massive non-degenerate companion so far detected.

"We have presented the CHIME/FRB discovery and 2.8-yr CHIME/Pulsar timing of a new radio pulsar/massive-star binary, PSR J2108+4516, only the 6th such binary pulsar known," they concluded.

The authors of the paper added that PSR J2108+4516 may serve as a rare laboratory for the exploration of massive star winds and circumstellar disks. They propose future optical spectroscopic observations of this pulsar in order to determine the
companion type and to investigate whether it has a
disk, as well as X-ray and gamma-ray studies to
inspect disk and wind interactions.

More information: Bridget C. Andersen et al,
CHIME Discovery of a Binary Pulsar with a Massive
Non-Degenerate Companion. arXiv:2209.06895v1
[astro-ph.HE], arxiv.org/abs/2209.06895

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