FAST detects 3D spin-velocity alignment in a pulsar

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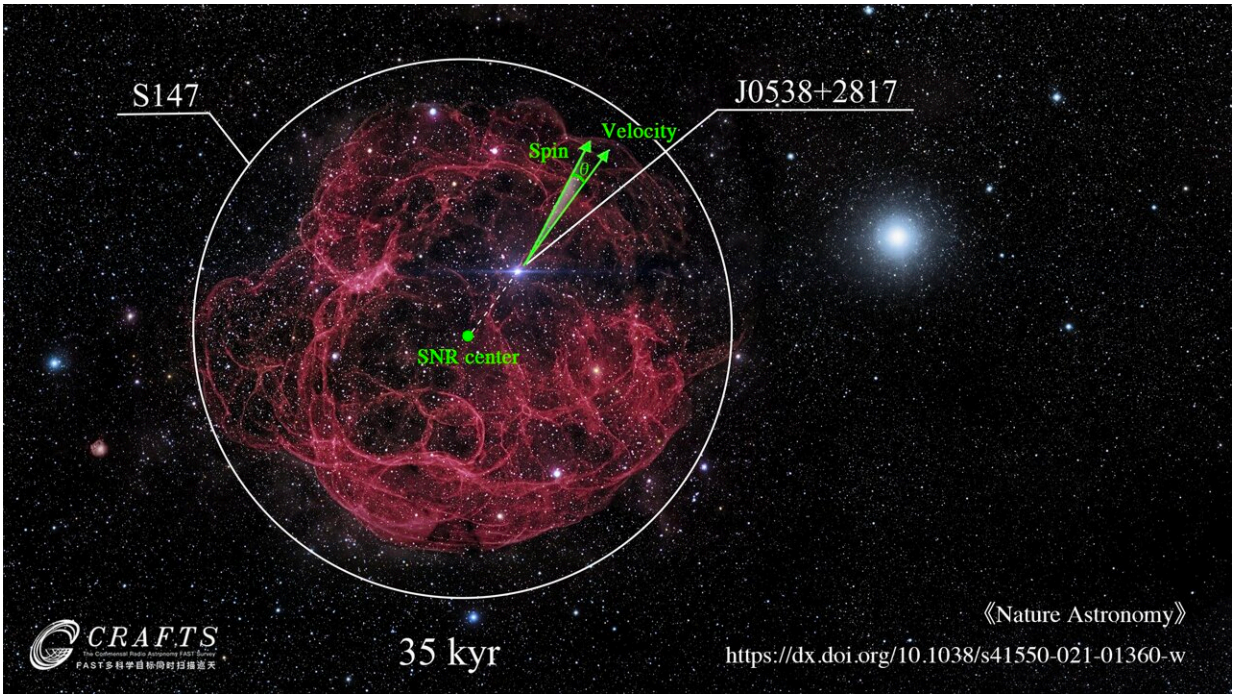

Illustration of supernova remnant S147 and pulsar J0538+2817. Credit: NAOC

Pulsars—another name for fast-spinning neutron stars—originate from the imploded cores of massive dying stars through supernova explosion.

Now, more than 50 years after the discovery of pulsars and confirmation of their association with supernova explosions, the origin of the initial spin and velocity of pulsars is finally beginning to be understood.

Based on observations from the Five-hundred-meter Aperture Spherical radio Telescope (FAST), Dr. Yao Jumei, member of a team led by Dr. Li Di from National Astronomical Observatories of Chinese Academy of Sciences (NAOC), found the first evidence for three-dimensional (3D) spin-velocity alignment in pulsars.

The study was published in *Nature Astronomy* on May 6. It also marks the beginning of in-depth pulsar research with FAST.

For decades, scientists have found observational evidence for spin-velocity alignment in young pulsars. The relationship thus revealed between pulsars' spin axis and spatial velocity vectors, however, has largely been restricted to a 2D sky plane perpendicular to the line of sight, due to the hardship in constraining radial velocity.

Focusing on PSR J0538+2817 in the supernova remnant (SNR) S147 and through the scintillation technique, Dr. Yao obtained its radial location with respect to the SNR boundary and its radial velocity for the first time. "Then we got the 3D velocity by combining the transverse velocity measured by Very Long Baseline Interferometers," said Dr. YAO. The polarization analysis resulted in the direction of the 3D spin axis. The best fit angle between these two vectors was found to be about 10 degrees, which is the first such measurement in 3D.

More information: Evidence for three-dimensional spin–velocity alignment in a pulsar, *Nature Astronomy* (2021). DOI: 10.1038/s41550-021-01360-w

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