PULSARS

Moving out of rotation

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From about 2004 until 2016, a radio beam from pulsar PSR J1906+0746 passed across the Earth twice every 144 ms, as both the pulsar's magnetic poles pointed towards us in one spin period. However, as 2016 came to a conclusion, Gregory Desvignes and collaborators noticed that the main pulse gradually weakened and eventually disappeared, while the interpulse continued. Drawing on archival data from the Parkes telescope, Desvignes and co-workers found the opposite situation in 1998: this pulsar had had a strong main pulse, but no interpulse. This apparent evolution makes PSR J1906+0746 a strong candidate for a general relativistic effect called spin precession.

PSR J1906+0746 is in a four-hour orbit with another neutron star of nearly equal mass. Should one (or both) of the neutron stars in the pair have received an asymmetric kick from its progenitor supernova, its spin vector could have possibly become misaligned from its total angular momentum vector. Over time, any misalignment will result in a wandering of the pulsar's beam, in accordance with the curvature of space-time, as stipulated by Einstein's general theory of relativity. Desvignes and co-workers were able to confirm this situation for PSR J1906+0746 using a relativistic rotating vector model based on polarimetric observations of the pulsar with PUPPI on the Arecibo radio telescope. They determined a large misalignment angle of 104° ± 9°, and were able to predict that the pulsar's interpulse beam will move out of our line of sight by the year 2028, causing the pulsar to vanish. The beams themselves subtend less than 44°, implying that roughly half the sky will be illuminated by the pulsar's radio beacon.

Paul Woods

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