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•Editorial•
Editor's Focus

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The dawn of a new era of pulsar discoveries by Chinese radio telescope FAST

Pulsars are rapidly rotating compact stars subjected to physical conditions far beyond the reach of any laboratory on Earth. These astrophysical laboratories could help answer many fundamental physical questions. The *Fermi* Large Area Telescope (LAT) has discovered >250 γ-ray pulsars since its launch in 2008. Targeted radio searches of pulsar-like *Fermi*-LAT γ-ray sources have led to the discovery ~100 millisecond pulsars (MSPs), with most of these subsequently showing γ-ray pulses [1]. High sensitivity radio searches of unassociated γ-ray sources have proven to be an effective way of finding new pulsars. Pulsar searches with FAST, with the best absolute sensitivity at L-band and below, have resulted in the discovery of hundreds of new pulsars, and thus are shedding new lights into our inventory of the neutron star population while potentially contributing to the future detection of gravitational waves via pulsar timing array (PTA) experiments.

Recently, a research group led by Dr. P. Wang and Prof. D. Li from the National Astronomical Observatories, Chinese Academy of Sciences, reported FAST discovery of an extremely radio-faint millisecond pulsar from the targeted deep searches of *Fermi*-LAT unassociated source 3FGL J0318.1+0252 [2]. With the aid of the radio ephemeris, an analysis of 10 years of *Fermi*-LAT data revealed that PSR J0318+0253 also displays strong γ-ray pulsations, which confirmed this discovery. This is the first result from the collaboration between FAST and the *Fermi*-LAT teams as well as the first confirmed new MSP discovery by FAST. Follow-up multi-band analysis found that PSR J0318+0253, the faintest high energy MSP ever discovered in the radio bands, has a spin frequency of 192.68 Hz and a spin-down power Edot of 5×10^{33} erg s^{-1}. PSR J0318+0253 likely possesses a spectral turn-over at around 350 MHz, which is not common among MSPs and could be related to its environment or shed light into its intrinsic emission mechanism.

This discovery demonstrates the great potential of FAST in pulsar searching, highlighting the vitality of the large aperture radio telescope in the new era. "The discovery by FAST of a very faint millisecond pulsar associated with a high-energy γ-ray source discovered by *Fermi*-LAT is a demonstration of the importance of international scientific collaboration for enabling breakthroughs in humanity's exploration of the Universe. I applaud the efforts of all my *Fermi*-LAT and FAST colleagues and look forward to more discoveries like this in the future. I particularly celebrate the collaboration that led to this remarkable result," said P. F. Michelson, professor of Stanford University and spokesperson of the *Fermi*-LAT Collaboration.

The PTA attempts to detect low-frequency gravitational waves from merging supermassive black holes using the long-term timing of a set of stable millisecond pulsars. Pulsar search is the basis of gravitational wave detection through PTAs. "The international radio-astronomy community is excited about the amazing FAST telescope, already showing its power in these discoveries. FAST will soon discover a large number of millisecond pulsars and I am looking forward to seeing FAST's contribution to gravitational wave detection," said G. Hobbs, scientist of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia and member of the Gravitational Wave International Committee (GWIC). The ongoing FAST pulsar surveys (CRAFTS [3], http://crafts.bao.ac.cn/; GPPS [4], http://zmtt.bao.ac.cn/GPPS/) are expected to discover many millisecond pulsars and thus will make significant contribution to the PTA experiment.

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