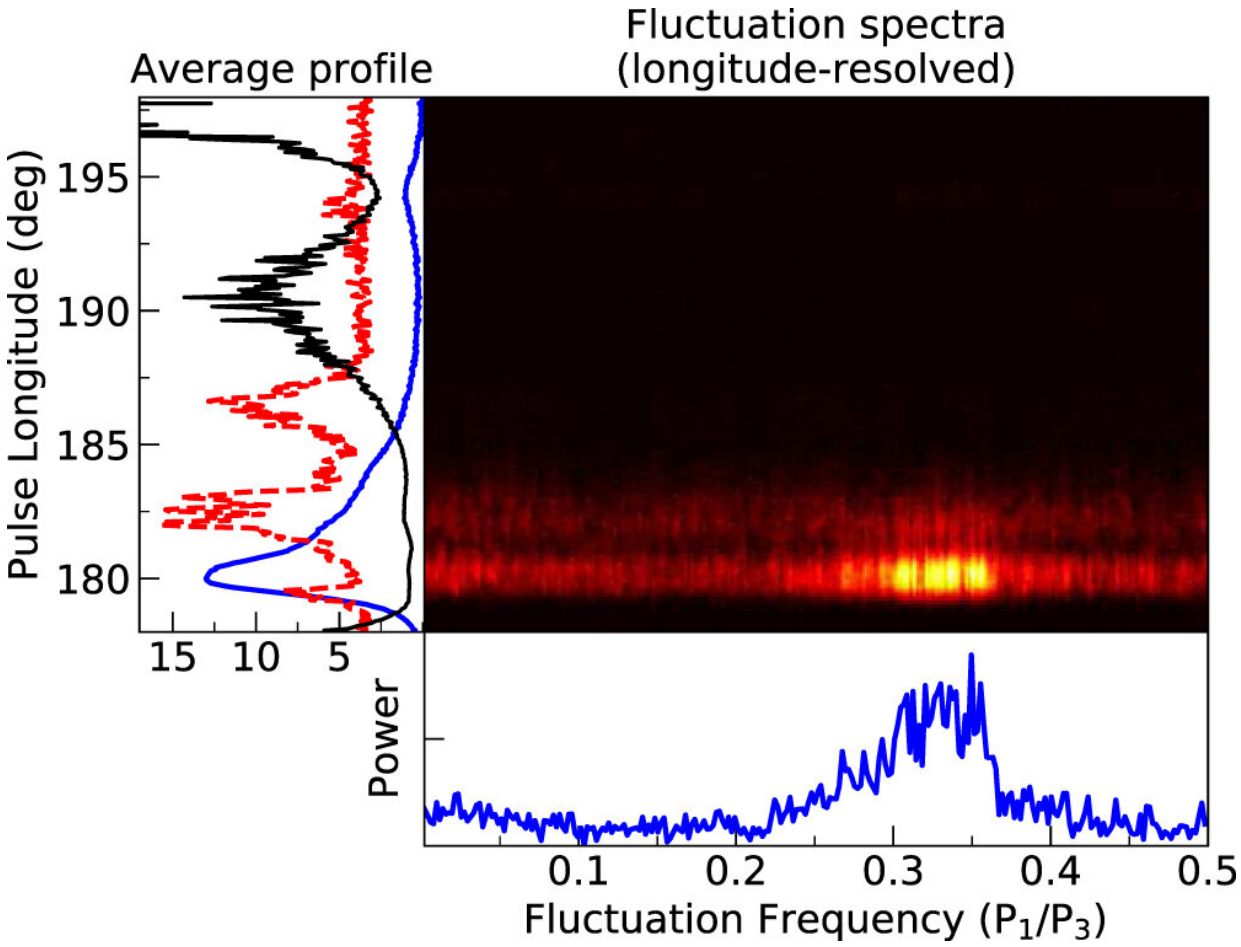
Pulse-to-pulse energy distribution and longitude-resolved modulation properties of a FAST-CRAFTS pulsar

May 10 2022, by Li Yuan



Longitude-resolved fluctuation power spectrum (top-right panel) for data obtained on 2020 September 17, showing evidence for periodic modulation. The units of the horizontal axis are in cycles per period (cpp), which corresponds to P1/P3 (where P3 is the interval over which the subpulses repeat at any specific

location within the pulse window). The vertical axis is the pulse longitude in degrees. A 256-point Fourier transform is used and averaged over the blocks of the whole pulse sequence. The average pulse profile (blue) is shown in the left panel, and the lower panel displays the overall fluctuation spectrum. The longitude-resolved modulation index and R parameter are indicated with black and red curves, respectively. Credit: *The Astrophysical Journal* (2022). DOI: 10.3847/1538-4357/ac5d5d

The Five-hundred-meter Aperture Spherical Radio Telescope (FAST), the largest telescope ever built by far, has discovered more than 200 pulsars. PSR J1631+1252 is an isolated normal pulsar with a rotational period of 0.310 s discovered by the FAST in the Commensal Radio Astronomy FAST Survey (CRAFTS).

Researchers led by Wen Zhigang from the Xinjiang Astronomical Observatory (XAO) of the Chinese Academy of Sciences (CAS) and their collaborators have investigated the pulse-to-pulse energy distribution and longitude-resolved modulation properties of PSR J1631+1252 at 1250 MHz.

The study was published on April 10 in *The Astrophysical Journal*.

The researchers found that the representative surface-dipole magnetic field strength was 1.13×10^{11} G and the spin-down energy loss was 5.34×10^{31} erg s^{-1}.

"The pulse-to-pulse energy distribution can be well described by a lognormal distribution with approximately constant fitting parameters," said Wen. "The associated pulsar emission mechanism involves only linear processes."

Using the fluctuation spectral analysis, the researchers identified PSR

J1631+1252 as a subpulse drifter. The leading component was phase-modulated with a drifting periodicity of 3.28 rotational periods. A bimodal distribution was present in the time interval between successive drift bands, which implied that the pulsar possibly consisted of two different drift patterns.

The results of this research provide more insights into the physics of pulsar emission mechanism and the physical state of pulsar magnetospheres.

More information: Z. G. Wen et al, A Single-pulse Study of the Subpulse Drifter PSR J1631+1252 Discovered at FAST, *The Astrophysical Journal* (2022). DOI: 10.3847/1538-4357/ac5d5d