Astronomers investigate radio burst emission from the magnetar XTE J1810−197

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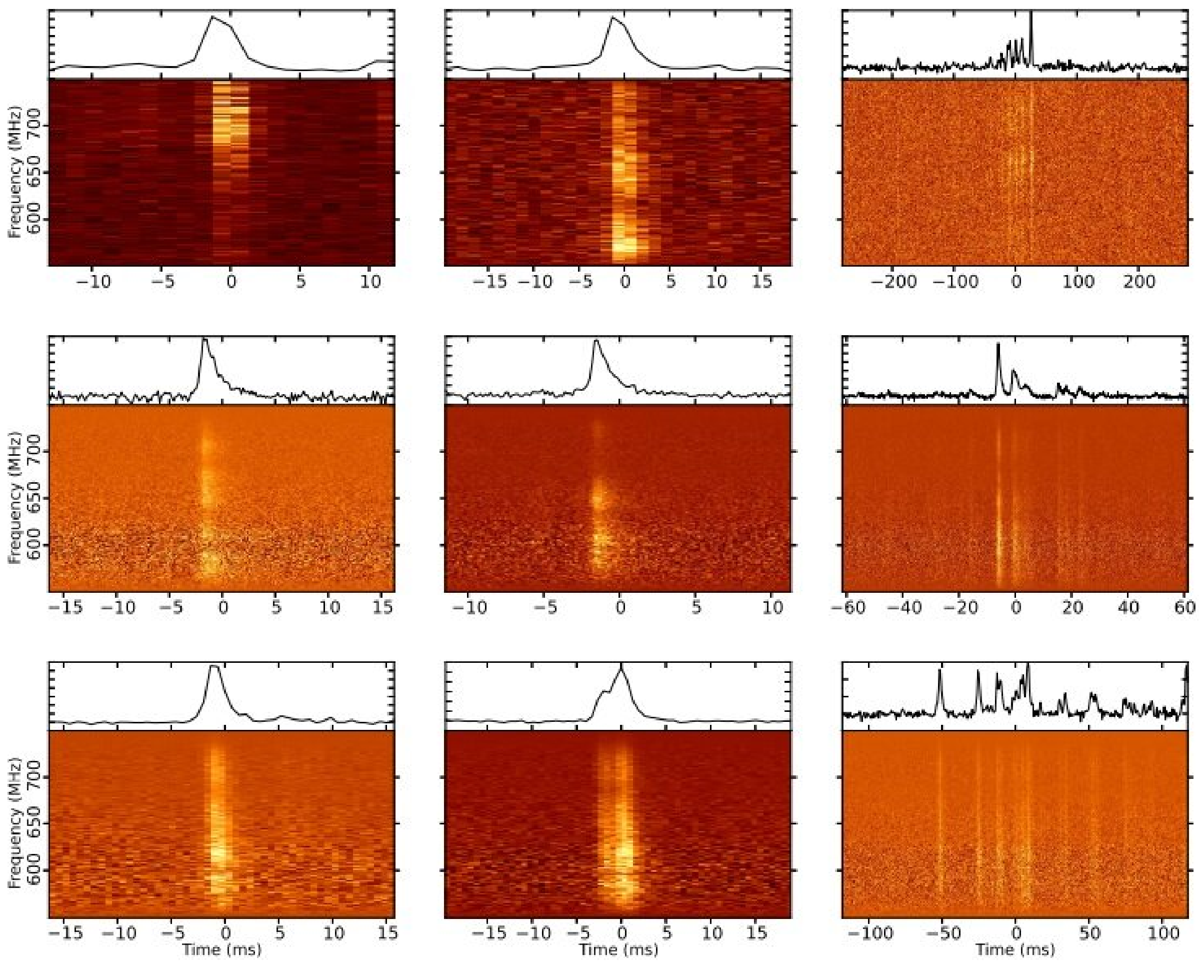

Spectro-temporal properties of a sample of bursts from XTE J1810−197 at 650 MHz are shown. Image credit: Maan et al., 2019.

Using Giant Metrewave Radio Telescope (GMRT), astronomers have observed the magnetar XTE J1810−197 after its recent radio outburst to investigate its emission. Results of the study, presented in a paper published August 12, offer more insights into the nature of this magnetar.

Magnetars are neutron stars with extremely strong magnetic fields, more than quadrillion times stronger than magnetic field of Earth. Decay of magnetic fields in magnetars powers the emission of high-energy electromagnetic radiation, for instance, in the form of X-rays or radio waves.

With a spin period of around 5.54 seconds and magnetic field strength at a level of 2 trillion G, XTE J1810−197 (also known as PSR J1809−1943) was detected as the first of only four known magnetars to emit radio pulsations. In 2003, an X-ray outburst from XTE J1810−197 was observed, while one year later, radio emission from this source was discovered. Afterward, the object showcased highly variable pulsed radio emission until late 2008, when it entered a radio-quiet state.

XTE J1810−197 reactivated on December 8, 2018, when a bright pulsed radio signal at 1.52 GHz was detected from this source. Shortly after the second radio outburst, a team of astronomers led by Yogesh Maan of the Netherlands Institute for Radio Astronomy in Dwingeloo, the Netherlands, commenced an observational campaign of XTE J1810−197 with GMRT in order to uncover the properties of the radio emission from this magnetar.

"We have presented the spiky emission properties of the magnetar XTE J1810−197 as well as its flux density evolution and low-frequency spectrum in the early phases of the recent outburst (December 2018)," the astronomers wrote in the paper.

The observations show that radio bursts from XTE J1810−197 have a characteristic width between 1.0 and 4.0 ms at 650 MHz, which becomes even narrower (below 1.0 ms) at 1,360 MHz. The results indicate that the period-averaged flux density has decreased rapidly since the onset of the recent outburst. In particular, at 650 MHz the flux density decreased at least five times in the first 20 to 30 days, when compared to the 2004 outburst. A similar trend has been observed for the flux density at 1.52 GHz.

The astronomers emphasize that the recent burst activity is not only narrow, but relatively strong. For instance, the brightest pulses have the peak flux densities of about 2.5 and 3.5 Jy, which could be indicative of giant pulses or giant micropulses.

Furthermore, the researchers ponder the possibility that the observed bursts could be associated with the so-called fast radio bursts (FRBs)—intense bursts of radio emission with durations of milliseconds.

"The bursts exhibit spectral structures which cannot be explained by interstellar propagation effects. These structures might indicate a phenomenological link with the repeating fast radio bursts which also show interesting, more detailed frequency structures," the astronomers explained.

Therefore, the authors of the paper propose high time resolution investigation of the emission from XTE J1810−197 at adequately high frequencies, in order to confirm the FRB hypothesis.

More information: Distinct properties of the radio burst emission from the magnetar XTE J1810-197, arXiv:1908.04304 [astro-ph.HE] arxiv.org/abs/1908.04304