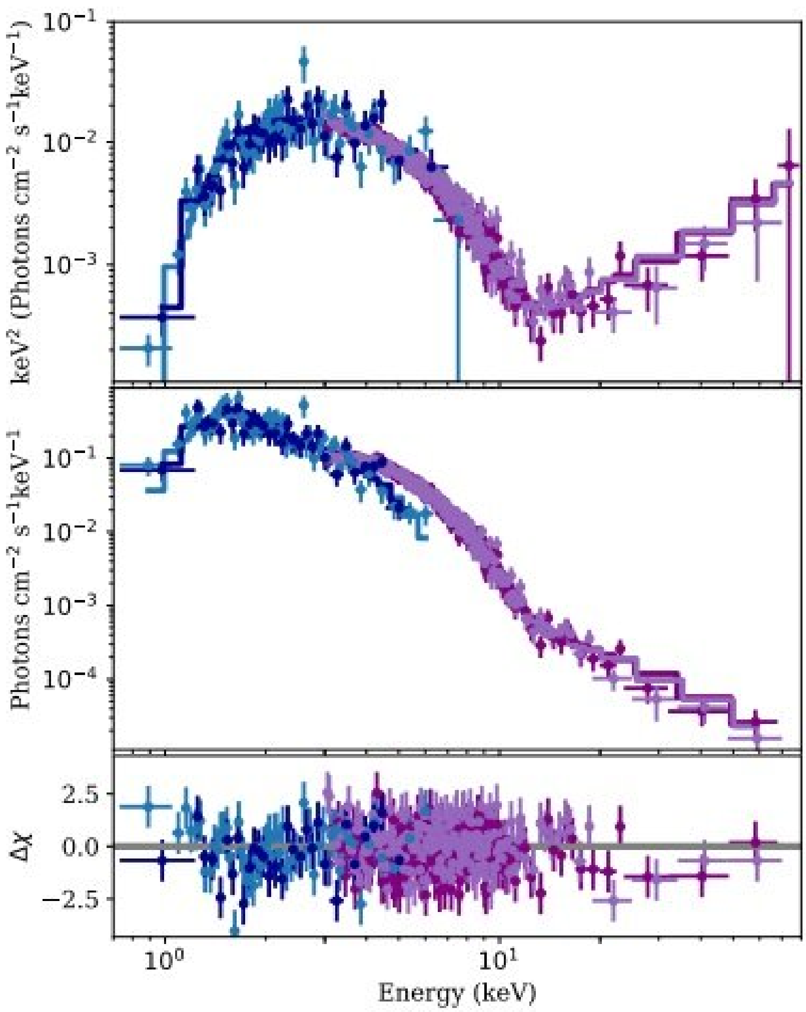
Two new outbursts detected from the magnetar 1E 1048.1−5937

January 28 2020, by Tomasz Nowakowski



X-ray spectra of 1E 1048.1−5937 in outburst. In all panels, the blue data points are from Swift-XRT, and purple data points from NuSTAR. Credit: Archibald et al., 2020.

Using NASA's Neil Gehrels Swift Observatory, astronomers have identified two new outbursts from the magnetar 1E 1048.1−5937. The newly detected events could shed more light on the nature of this source. The finding is detailed in a paper published January 17 on arXiv.org.

Magnetars are neutron stars with extremely strong magnetic fields, more than 1 quadrillion times stronger than the magnetic field of our planet. 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.

Discovered in 1986 as a persistent X-ray source, 1E 1048.1−5937 is a magnetar with a pulse period of 6.4 seconds. It is one of the most active known magnetars that has exhibited at least four long-term flux flares, as well as several magnetar-like bursts, and pulse profile changes.

What is puzzling is that 1E 1048.1−5937 showcases a dramatically changing spin-down rate, which seems to occur regularly following its radiative outbursts. While this behavior has previously been identified in many magnetars, the repeated observation of such activity following each flux flare is still unexplained.

In order get more insights into the mysterious behavior of 1E 1048.1−5937, a team of astronomers led by Robert Archibald of University of Toronto, Canada, has carried out a monitoring campaign of this source with Neil Gehrels Swift Observatory. Their study, complemented by data from NASA's Nuclear Spectroscopic Telescope Array (NuSTAR), resulted in the discovery of two new outbursts from this magnetar.

"Here we report on a continuing monitoring campaign with the Neil Gehrels Swift Observatory X-ray Telescope in which we observe two new outbursts from this source," the astronomers wrote in the paper.

The first outburst occurred in July 2016, reaching peak 0.5-10 keV absorbed flux of 32 one-trillionth erg/s/cm^2, accompanied by spin-up glitches with an amplitude of 0.447 μHz. For the second outburst, which took place in December 2017, these values were 22 one-trillionth erg/s/cm^2 and 0.432 μHz respectively.

It was found that the new outbursts were followed by periods of delayed torque fluctuations. During these phases, the spin-down rate reached about 1.73 time the value measured during the quiescent state. This value was at a level of 12.3, 7.32, and 4.4 for three previous outbursts respectively, which indicates a monotonic decrease in amplitude of torque variations. The astronomers propose further monitoring of this perplexing behavior.

"If the decline continues, by the next outburst, the torque variations should be smaller than order unity times the quiescent value. However, the monotonic decrease may also be purely coincidental. Further monitoring will be illuminating," the researchers noted.

In addition to the detection of new outbursts from 1E 1048.1−5937, the study also identified a hard X-ray emission from this source. The hard X-ray component was detected near the peak of the July 2016 outburst, with emission up to around 70 keV, and pulsed emission observed up to 20 keV.

More information: Two new outbursts and transient hard X-rays from 1E 1048.1−5937, arXiv:2001.06450 [astro-ph.HE] arxiv.org/abs/2001.06450

Citation: Two new outbursts detected from the magnetar 1E 1048.1−5937 (2020, January 28)