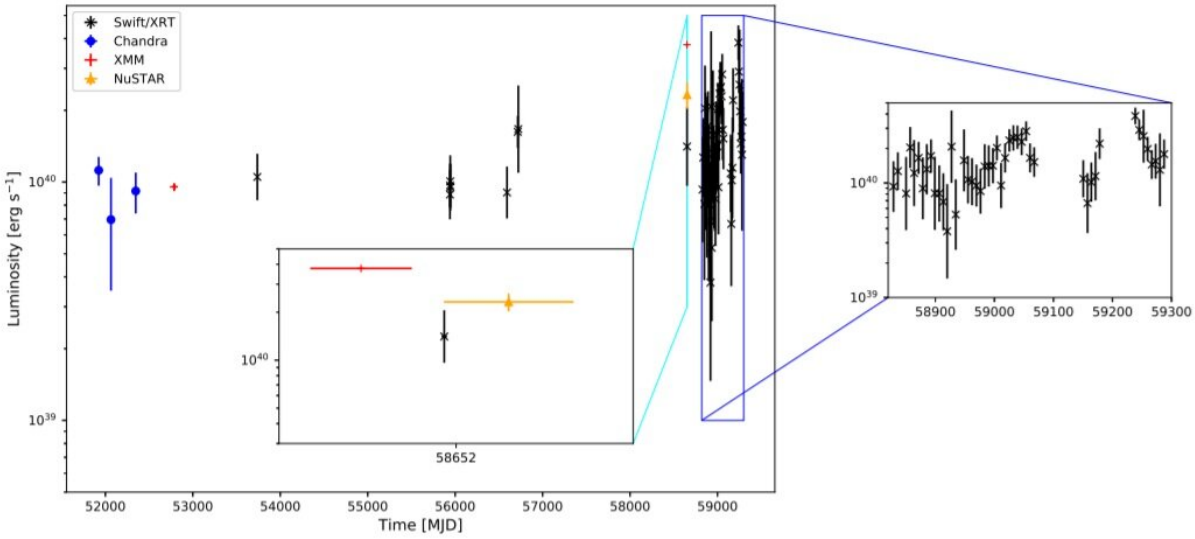
Unusual flaring activity observed from the ultraluminous X-ray source NGC 4559 X7

April 5 2021, by Tomasz Nowakowski



Long-term lightcurve of X7 in the 0.3–10 keV energy band obtained from the XMM-Newton, NuSTAR, Chandra and Swift/XRT observations. Credit: Pintore et al., 2021.

Italian astronomers have performed X-ray observations of an ultraluminous X-ray source (ULX) known as NGC 4559 X7 and found that this source exhibits unusual flaring activity. The finding is reported in a paper published March 26 on the arXiv pre-print repository.

ULXs are point sources in the sky that are so bright in X-rays that each emits more radiation than 1 million suns emit at all wavelengths. They are less luminous than active galactic nuclei, but more consistently luminous than any known stellar process. Although numerous studies of ULXs have been conducted, the basic nature of these sources remains unsolved.

At a distance of about 29 million light years away, NGC 4559 is an intermediate spiral galaxy in the constellation Coma Berenices. The galaxy is known to host two ULXs, designated X7 and X10, that have been poorly investigated by previous observations.

So a team of astronomers led by Fabio Pintore of the Institute of Space Astrophysics and Cosmic Physics of Milan, Italy, analyzed all the available X-ray observations of NGC 4559 X7 taken with XMM-Newton, NuSTAR, Chandra and Swift spacecraft.

"In this work, we present the first long-term light curve of the source NGC 4559 X7 using all the available Swift/XRT, XMM-Newton, Chandra and NuSTAR data. Thanks to the high quality 2019 XMM-Newton and NuSTAR observations, we investigated in an unprecedented way the spectral and temporal properties of NGC 4559 X7," the astronomers wrote in the paper.

The long-term X-ray light curve of X7 shows that the source varies in flux by up to a factor of about five to six. The results suggest that flux variations in X7 may happen on a time scale of a few hours.

By analyzing the data from XMM-Newton and NuSTAR a period of flaring activity of X7 has been detected. Such activity has never been seen in previous X-ray observations of this source and in the case of X7, manifests only when the source is at its highest observed luminosities.

During the flaring activity, the luminosity of X7 reached an observed maximum of about 60 duodecillion erg/s. It was noted that at the peak of the flares, the luminosity was a factor of three higher than the pre-flare luminosity, which indicates that the maximum variability of the source can span almost an order of magnitude. The study also identified a (quasi-)periodicity of the flare recurrency.

In concluding remarks, the researchers emphasized the importance of their findings in order to better understand flaring activity in the population of known ULXs. "Flaring activity is not common in ULXs and it was observed in the sources M51 ULX-7, NGC 253 X-1, NGC 6946 ULX-3, NGC 1313 X-1 and NGC 7456 ULX1. In none of them was a (quasi-)periodicity of the flare recurrency identified, as opposed to the quasi-periodic heartbeat of the ULX 4XMM J111816.0-324910 in the galaxy NGC 3621. This may indicate that the flares in ULXs cannot be explained with only one mechanism and, furthermore, whatever process that generates flares might or not generate periodic events," the astronomers concluded.

More information: The rare X-ray flaring activity of the Ultraluminous X-ray source NGC 4559 X7, arXiv:2103.14541 [astro-ph.HE] arxiv.org/abs/2103.14541