New hard X-ray eclipsing polar identified

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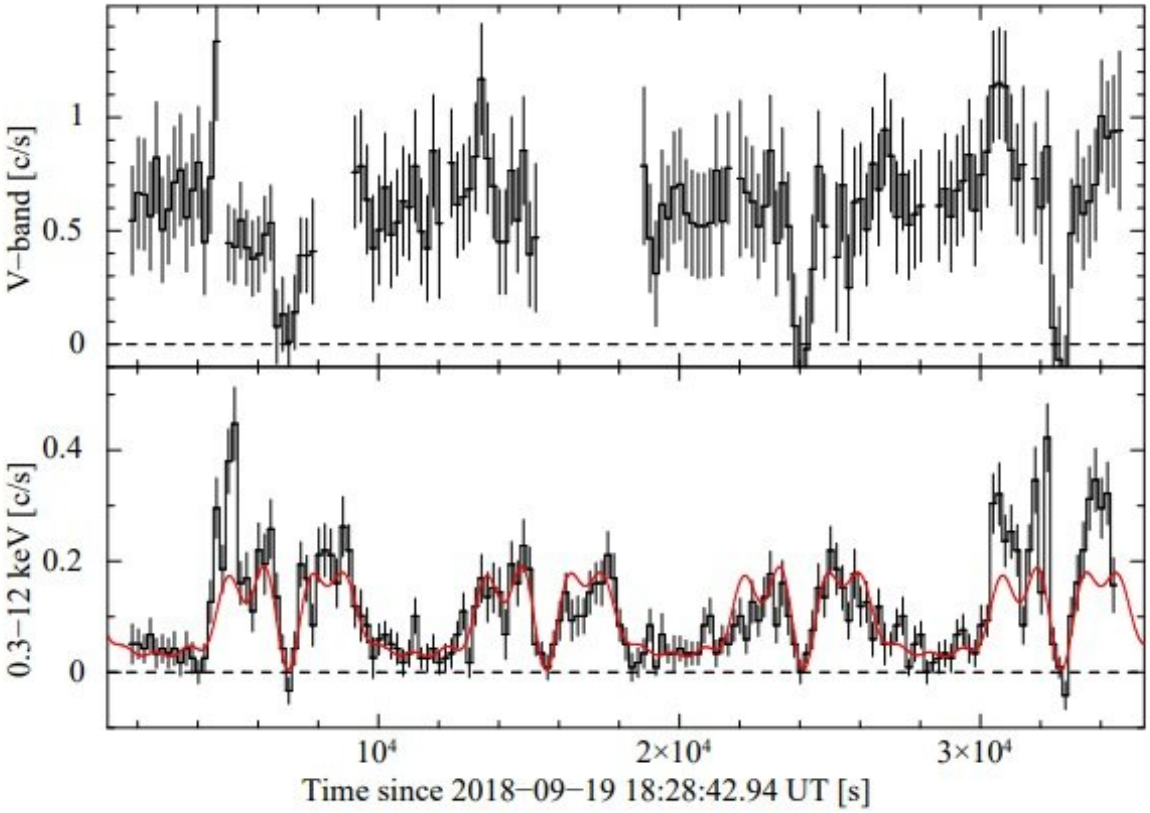

OM V-band (upper panel) and PN 0.3–12 keV (lower panel) background subtracted light curves of 2PBC J0658.0-1746 binned at 200 s, where for plotting purposes is also shown the result of a fit made with 7 sinusoids, the orbital period (8,565 s) and its first six harmonics (red curve). Image credit: Bernardini et al., 2019.

Using ESA's XMM-Newton and NASA's Swift spacecraft, astronomers have found that a hard X-ray source known as 2PBCJ0658.0-1746 is an eclipsing magnetic cataclysmic variable of the polar type. The finding, presented in a paper published July 11 on arXiv.org, makes the object one of only a handful hard X-ray eclipsing polars known to date.

Cataclysmic variables (CVs) are binary star systems consisting of a white dwarf and a normal star companion. They irregularly increase in brightness by a large factor, then drop back down to a quiescent state. Polars are a subclass of cataclysmic variables distinguished from other CVs by the presence of a very strong magnetic field in their white dwarfs.

Although over 140 polars have been detected to date, only 33 of them have been identified as eclipsing systems. Out of this number, so far, 12 such objects have been classified as hard X-ray eclipsing polars, which makes it a rare class. Therefore, any new addition to the still relatively short list of such objects is very important for building a larger database of these systems. This could offer astronomers more opportunities to study magnetic accretion in binaries, for instance.

Now, a team of researchers led by Federico Bernardini of Rome Observatory in Italy reports about the newest addition to this list. By analyzing the data from XMM-Newton and Swift, they found that 2PBCJ0658.0-1746 (J0658), an unidentified source discovered by the Swift/BAT survey, appears to be a hard X-ray eclipsing polar.

"The XMM-Newton observation, carried out a few months later in 2018, is here reported together with archival Swift/XRT and Swift/BAT light curves and spectra," the researchers wrote in the paper.

According to the paper, the X-ray emission shows bright and faint phases and total eclipses recurring every 2.38 hours. Moreover, the X-

ray emission was found to be modulated at the orbital period and the intensity of the modulation turned out to be variable from cycle to cycle. Such behavior is indicative of a non-stationary mass accretion rate.

The astronomers also found that the X-ray luminosity is highly variable on long timescales and the XMM-Newton spacecraft caught it at the lowest state ever observed. When it comes to the X-ray spectrum, observations have shown that it is thermal and consistent with a multi-temperature structure, as observed in many magnetic systems.

In general, the results confirmed that J0658 is the 13th hard X-ray eclipsing polar detected. The researchers added that its orbital period of around 2.38 hours makes it a rare find, as only one pulsar of this type with similar orbital period (between two and three hours) has been identified to date.

The study also reported fundamental parameters of the J0658 system. According to the research, the polar is located some 681 light years away and consists of a white dwarf with a mass of at least 0.6 solar masses and a companion of spectral type M4 about four times smaller than the sun, with a mass between 0.2 and 0.25 solar masses. The effective temperature of the white dwarf is estimated to be between 12,000 and 22,000 K, while for the companion this value was calculated to be at least about 3,000 K.

More information: 2PBC J0658.0-1746: a hard X-ray eclipsing polar in the orbital period gap, arXiv:1907.05318.
arxiv.org/pdf/1907.05318.pdf

https://phys.org/news/2019-07-hard-x-ray-eclipsing-polar.html