Swift J1728.9–3613 is a black hole X-ray binary, research finds

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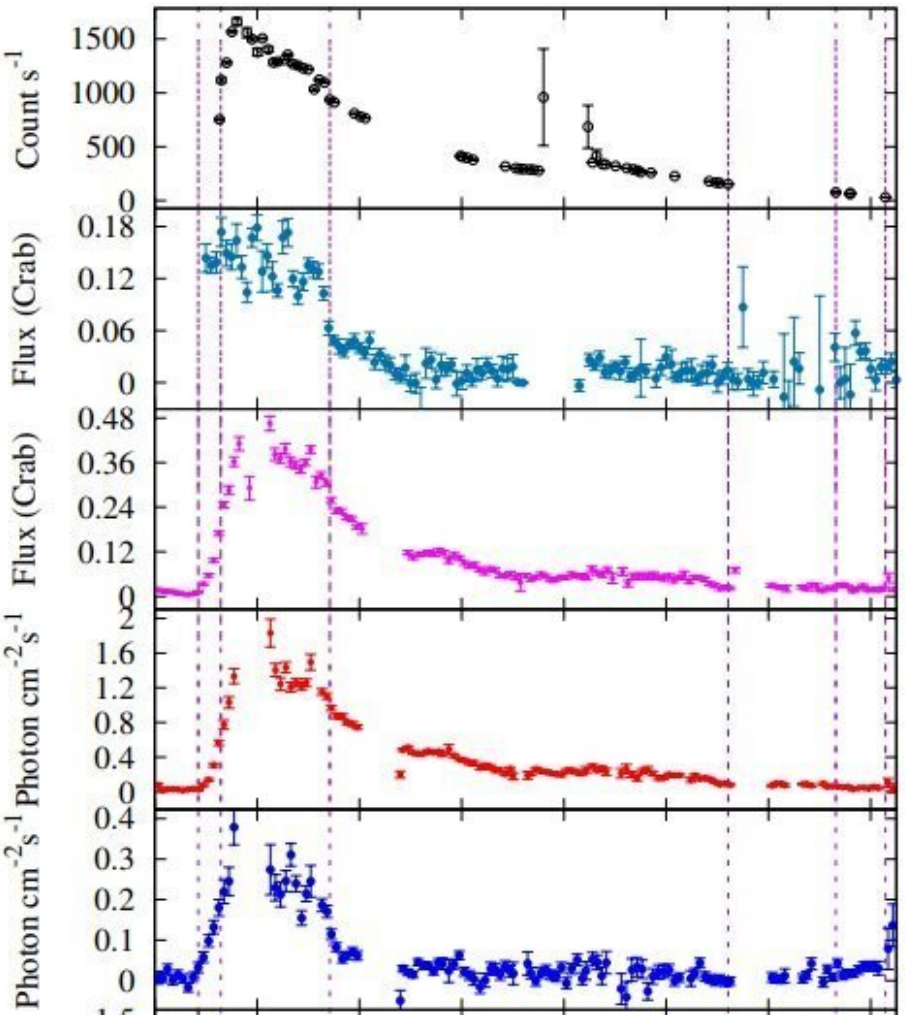

Variation in flux and hardness ratio towards Swift J1728.9–3613 observed by NICER, Swift/BAT and MAXI/GSC during the January 2019 outburst. Credit: Saha et al., 2022.

Using NASA's Swift telescope and the Neutron star Interior Composition Explorer (NICER) instrument onboard the International Space Station, Indian astronomers have inspected timing and spectral properties of an X-ray transient known as Swift J1728.9–3613. Their results show that this transient is a black hole X-ray binary. Their findings were detailed in a paper published October 21 on arXiv.org.

X-ray binaries (XRBs) consist of a normal star or a white dwarf transferring mass onto a compact neutron star or a black hole. Most black hole XRBs and some neutron star XRBs show transient events that are characterized by outbursts in the X-ray band.

Black hole X-ray binaries (BHXBs) are binary systems consisting of a black hole orbited by a stellar companion, typically a low-mass, evolved star. In BHXBs, X-rays are produced by material accreting from a secondary companion star onto a black hole primary. Such systems are usually detected in outbursts when the X-ray flux increases significantly.

Swift J1728.9–3613 (also known as MAXI J1728–360) is a Galactic X-ray transient discovered January 28, 2019 with the Swift's Burst Alert Telescope (BAT). Subsequent observations of this transient suggested that it might be an accreting pulsar or a black hole.

Therefore, in order to unveil the true nature of Swift J1728.9–3613, a team of astronomers led by Debasish Saha of Indian Institute of Science Education and Research Bhopal in Bhauri, India, has examined this transient using Swift and NICER.

"In this study, we used all available archival [NICER] data during the outburst between MJD 58512.64 and MJD 58657.00, having a total exposure of ~175 ks, to study the evolution of the timing and spectral properties and understand the nature of the source.... We used the monitoring data of BAT to study the evolution of X-ray flux of Swift

J1728.9–3613 in 15–50 keV," the researchers explained

The study found that outburst of Swift J1728.9–3613 was characterized by a fast rise and a very slow decay of flux, typical for outbursts of X-ray binaries. Moreover, by analyzing the timing evolution, the astronomers identified a "q" shaped track in the hardness-intensity diagram (HID) traversing in the anticlockwise direction. This is commonly observed during the outburst of black hole X-ray binaries.

Furthermore, a partial hysteresis has been detected in the root mean square-intensity diagram (RID). According to the researchers, this is another well-known phenomenon observed in black hole transients.

The research also identified two quasi-periodic oscillations (QPOs) during the soft intermediate state of the outburst Swift J1728.9–3613 and a small-scale reflare.

Summing up the results, the authors of the paper underlined that all the obtained results point to the BHXB nature of Swift J1728.9–3613. They estimate that the black hole in this system has a mass of approximately 4.6 solar masses, considering the distance to Swift J1728.9–3613 to be around 32,600 light years.

More information: Debasish Saha et al, Swift J1728.9-3613 is a black hole X-ray binary: spectral and timing study using NICER, *arXiv* (2022). DOI: 10.48550/arxiv.2210.13748