

# Astronomers discover a rare eclipsing X-ray binary

March 20 2024, by Tomasz Nowakowski

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An international team of astronomers reports the detection of a rare eclipsing Be/X-ray binary system as part of the Swift Small Magellanic Cloud (SMC) Survey (S-CUBED). The finding was detailed in a [research paper](#) published March 12 on the preprint server *arXiv*.

X-ray binaries are composed of a normal star or a white dwarf transferring mass onto a compact neutron star or a black hole. Based on the mass of the [companion star](#), astronomers divide them into low-mass X-ray binaries (LMXBs) and high-mass X-ray binaries (HMXBs).

Be/X-ray binaries (BeXRBs) are the largest subgroup of HMXBs. These systems consist of Be stars and, usually, [neutron stars](#), including pulsars. Observations have found that most of these systems showcase weak persistent X-ray emission that is interrupted by outbursts lasting several weeks.

Now, a group of astronomers led by Thomas M. Gaudin of the Pennsylvania State University (PSU) has identified a new BeXRB, which received designation Swift J010902.6-723710, during S-CUBED monitoring observations aimed mainly at detecting X-ray outbursts.

"This paper reports the detection of a previously unknown BeXRB via weekly observations of the SCUBED survey. This new system, Swift J010902.6-723710, was identified via a transient X-ray outburst and followed up via multi-wavelength observations," the researchers wrote.

Swift J010902.6-723710 started an X-ray outburst on October 10, 2023, which showcased characteristics of Type I and II outbursts. Deep follow-up X-ray observations conducted by Gaudin's team identified a proposed spin period of 182 seconds for the neutron star in this system.

The astronomers have analyzed the [light curve](#) of both ultraviolet and infrared emission. As a result, they detected strong eclipse-like features that reappear every 60.623 days, which is adopted as the proposed orbital period of the system. This makes Swift J010902.6-723710 the third eclipsing BeXRB known to date.

Spectroscopic observations have revealed that the companion star in Swift J010902.6-723710 is a B0-0.5 star of spectral class Ve. Based on the spectroscopy, the researchers also identified a strongly double-peaked hydrogen-alpha emission line, which suggests that Swift J010902.6-723710 is a highly-inclined system with an inclination of 72–90 degrees.

Furthermore, the study confirmed the presence of a large accretion disk surrounding the neutron star in Swift J010902.6-723710, which was suggested by previous observations. The authors of the paper found that the detected eclipsing behavior is caused by this disk, which has a radius of approximately 3.3 solar radii.

Summing up the results, the researchers underlined the need for further monitoring of Swift J010902.6-723710 as it represents the rare class of eclipsing BeXRBs.

"We note that this rare behavior provides an important opportunity to constrain the physical parameters of a Be/X-ray binary with greater accuracy than is possible in non-eclipsing systems," the scientists concluded.

**More information:** Thomas M. Gaudin et al, Discovery of a Rare Eclipsing Be/X-ray Binary System, Swift J010902.6-723710 = SXP 182, *arXiv* (2024). [DOI: 10.48550/arxiv.2403.05648](https://doi.org/10.48550/arxiv.2403.05648)

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