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Eclipses of binary star shed light on orbiting exoplanet

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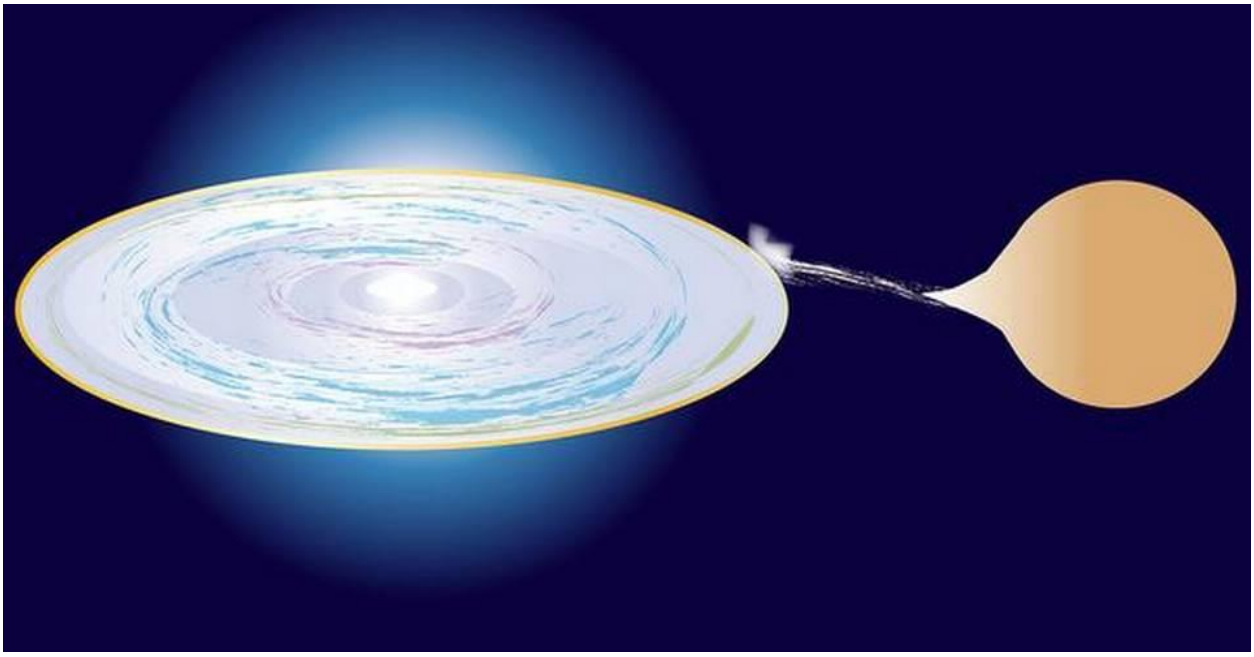

Tiny attractor An X-ray binary system comprises a compact star, either a black hole or a neutron star, and a less massive companion from which the former accretes mass. | Photo Credit: K.B. Jawaharr

In a first, a massive exoplanet was discovered using X-ray observations

A team of scientists from Raman Research Institute, Bengaluru, and University of Delhi have seen for the first time indications of a massive planet orbiting a low mass X-ray binary star system. The technique that has been used, namely, X-ray observations, is a new way of detecting exoplanets. The results have been published in *Monthly Notices of the Royal Astronomical Society*. The system is nearly 30,000 light years away and the planet is expected to be nearly 8,000 times as massive as the earth.

Paired with neutron star

The star system in question, MXB 1658-298 is an X-ray binary and a part of the constellation Ophiuchus (serpent bearer). X-ray binaries consist of a pair of stars orbiting each other of which one is compact one such as a black hole or a neutron star (in this case, a neutron star). The neutron star draws matter from its less-massive companion. The mass when drawn generates X-rays which are detected by detectors placed in satellites in space.

Discovered in 1976, this binary star system is so far and so faint that it may be observed only when it shows "outbursts" of X-rays. That is, an increase in X-ray intensity by a factor of 100 or more. Recently this system showed an outburst. "This provided us with an excellent opportunity to try to trace the orbital evolution of this system," Chetana Jain, Assistant Professor, Hansraj College, Delhi, who is the first author of the paper, says in an email.

As the two stars revolve around each other, the less-massive companion star hides the compact star everytime it crosses the line of sight, in between the detector and the neutron star, giving rise to eclipses. In X-ray binaries, the time in-between eclipses of the source can increase, decrease and also shows abrupt changes. This system, MXB 1658-298, is special in that the time between the eclipses increases and decreases periodically. "The eclipse first [time] arrived about ten seconds earlier and after about a year, arrived about ten seconds later that what would be expected [if these was no other body disturbing the system]" says Biswajit Paul, Raman Research Institute, who led the research, in an email. The team was surprised by this unusual behaviour.

The massive third

This periodic variation implied that there was a third body orbiting the system. "The long-term evolution of the mid-eclipse times indicated that this orbit is shrinking. Over and above this, we found periodic variation on shorter timescale," says Dr Jain, summarising the results.

"Till now, there are various indirect methods [of detecting exoplanets] such as transit photometry and microlensing," says Dr Jain. This discovery is made with a new technique, by measuring periodic delays in X-ray eclipses.

X-ray observations are done from space observatories such as NASA's Chandra X-ray Observatory. "In this particular work, we have used data from XMM-Newton and archival data from RXTE (NASA) and some earlier published values of mid-eclipse times," says Dr Paul, who has been studying this system for eight years.