New accreting millisecond X-ray pulsar discovered

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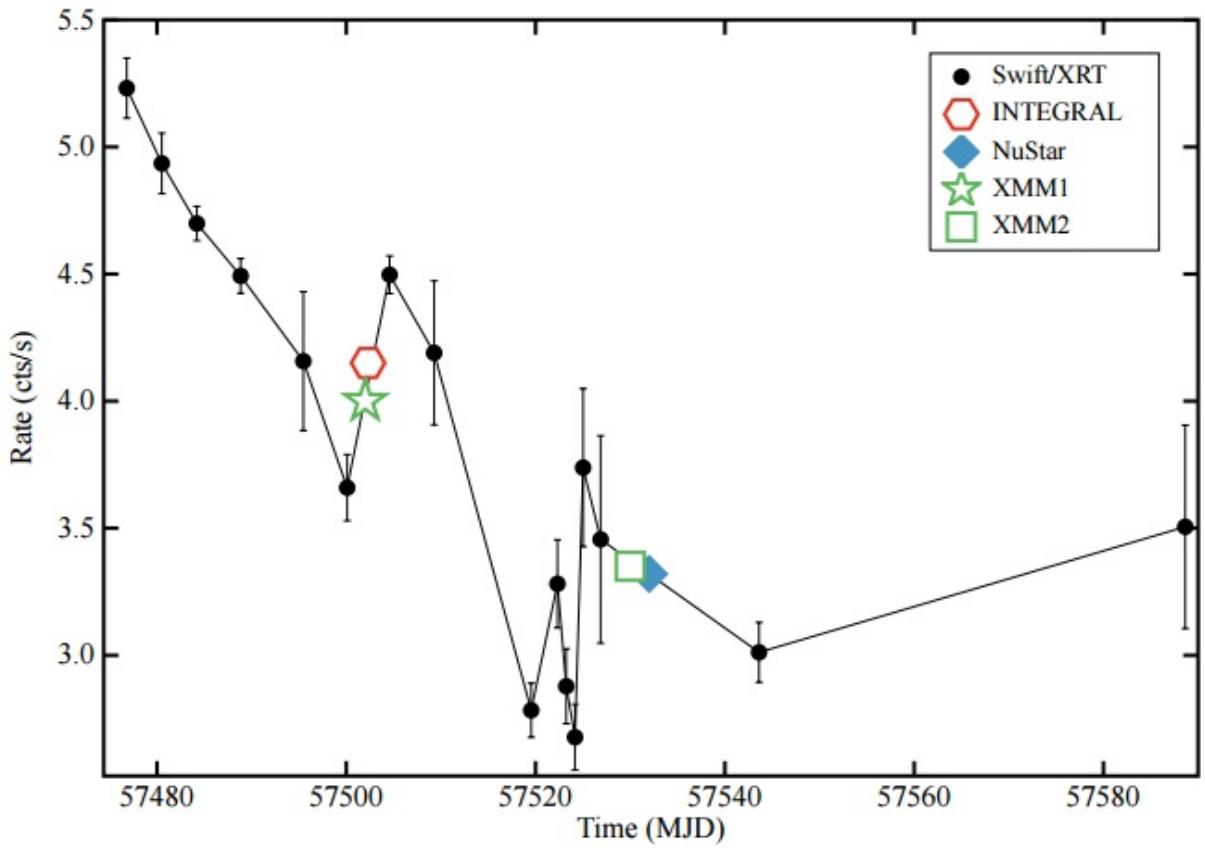

Light-curve of the outburst of MAXI J0911−655 as observed by Swift-XRT (black points). Green symbols, blue diamond and red hexagon represent the observations collected by XMM-Newton, NuSTAR and INTEGRAL respectively. Credit: Sanna et al., 2016.

(Phys.org)—A new accreting millisecond X-ray pulsar (AMXP) has been found in one of our galaxy's most massive clusters, NGC 2808. The newly detected AMXP received designation MAXI J0911-655 and is part of an ultra-compact binary system. A paper describing the discovery was published Nov. 9 on the arXiv pre-print server.

X-ray pulsars exhibit strict periodic variations in X-ray intensity, which can be as short as a fraction of a second. AMXP are a peculiar type of X-ray pulsar in which short spin periods are caused by long-lasting mass transfer from a low-mass companion star through an accretion disc onto a slow-rotating neutron star. They are perceived by the scientific community as astrophysical laboratories that could be essential to our understanding of thermonuclear burst processes.

MAXI J0911-655 was first spotted on Feb. 19, 2016, by the Monitor of All-sky X-ray Image (MAXI) nova-alert system, mounted on the International Space Station. MAXI searches for transient objects using its real-time Gas Slit Camera (GSC). It found the source at a position compatible with the globular cluster NGC 2808.

A few days later, the Burst Alert Telescope (BAT) aboard NASA's Swift space telescope detected X-ray activity from MAXI J0911-655, confirming that it is an X-ray transient source. Follow-up observations of this source during outburst, conducted by a team of European researchers led by Andrea Sanna of the University of Cagliari in Italy, uncovered coherent pulsations from this X-ray transient.

"Here, we report on the discovery of coherent ms X-ray pulsation from MAXI J0911-655, and we describe the detailed analysis of XMM-Newton and NuSTAR observations from which we derived the orbital solution for the pulsar," the scientists wrote in the paper.

Using ESA's XMM-Newton space observatory and NASA's Nuclear

Spectroscopic Telescope Array (NuSTAR), the team detected X-ray pulsations at 339.97 Hz during the outburst of the new X-ray source, with an average pulse fraction of 7 percent. This observational campaign was carried out in April and May 2016 and allowed the researchers to calculate that these pulsations have a period of 2.9 milliseconds.

The researchers also found that MAXI J0911-655 is part of an ultra-compact binary system with an orbital period of about 44 minutes and a projected semi-major axis of approximately 17.6 lt-ms. They calculated that the neutron star is about 40 percent more massive than the sun and that the companion star has a minimum mass of about 0.024 solar masses.

However, the most intriguing thing about the newly discovered pulsar is that it is a rare example of an accreting, rapidly-rotating neutron star harbored in a low-mass X-ray binary system. So far, only 18 such AMXPs have been detected and almost 80 percent of them show persistent X-ray pulsation during the outburst phase. Therefore, any new addition to this list is of high scientific value for astronomers trying to better understand outburst processes.

Moreover, MAXI J0911-655 turns out to be the second AMXP with an outburst duration longer than 100 days. The researchers noted that if the outburst started with the first detection of the source, it indicates that the outburst lasted at least 150 days, which is quite long when compared with other AMXPs.

More information: Discovery of a new accreting millisecond X-ray pulsar in the globular cluster NGC 2808, arXiv:1611.02995 [astro-ph.HE] arxiv.org/abs/1611.02995

Abstract
We report on the discovery of coherent pulsations at a period of 2.9 ms

from the X-ray transient MAXI J0911-655 in the globular cluster NGC 2808. We observed X-ray pulsations at a frequency of ∼339.97 Hz in three different observations of the source performed with XMM-Newton and NuSTAR during the source outburst. This newly discovered accreting millisecond pulsar is part of an ultra-compact binary system characterised by an orbital period of 44.3 minutes and a projected semi-major axis of ∼17.6 lt-ms. Based on the mass function we estimate a minimum companion mass of 0.024 M⊙, which assumes a neutron star mass of 1.4 M⊙ and a maximum inclination angle of 75◦ (derived from the lack of eclipses and dips in the light-curve of the source). We find that the companion star's Roche-Lobe could either be filled by a hot (5×106 K) pure helium white dwarf with a 0.028 M⊙ mass (implying i≃58◦) or an old (>5 Gyr) brown dwarf with metallicity abundances between solar/sub-solar and mass ranging in the interval 0.065–0.085 M⊙ (16