Tidal disruption event J150052 was caused by a rapidly spinning intermediate-mass black hole, study finds

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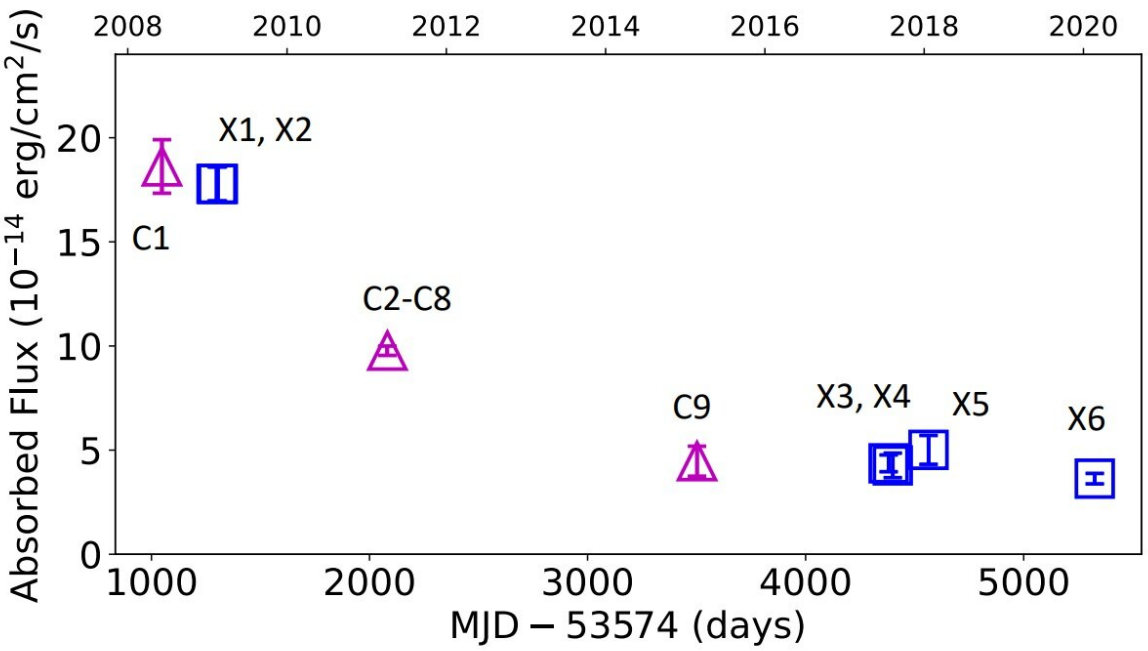

Long–term lightcurve of J150052 starting from 2008. Credit: Cao et al, 2022

Using NASA's Chandra and ESA's XMM-Newton space telescopes, astronomers from the Radboud University in the Netherlands and elsewhere have conducted X-ray observations of a tidal disruption event designated 3XMM J150052.0+015452, or J150052 for short. The results

show that J150052 was triggered by a rapidly spinning intermediate-mass black hole. The finding was detailed in a paper published November 30 on arXiv.org.

Tidal disruption events (TDEs) are astronomical phenomena that occur when a star passes close enough to a supermassive black hole and is pulled apart by the black hole's tidal forces, causing the process of disruption. Such tidally disrupted stellar debris starts raining down on the black hole and radiation emerges from the innermost region of accreting debris, which is an indicator of the presence of a TDE.

For astronomers and astrophysicists, TDEs are potentially important probes of strong gravity and accretion physics, providing answers about the formation and evolution of supermassive black holes.

J150052 was first detected in 2005 as an X-ray source, during XMM-Newton and Chandra observations of the foreground galaxy group NGC 5813 at a redshift of 0.0064. Its position is coincident with the center of the galaxy SDSS J150052.07+015453.8 at a redshift of 0.145.

Follow-up observations of this source have found that it is a slowly-decaying TDE, experiencing a decade-long decay. Some studies have suggested that the black hole responsible for J150052 has a mass of around 100,000 solar masses, what makes it an intermediate-mass black hole (IMBH).

Now, a team of astronomers led by Radboud's Zheng Cao presents the results of their study confirming the IMBH hypothesis.

"In this paper, we present and analyze all the publicly available XMMNewton and Chandra data of the tidal disruption event J150052 since 2008, obtained during its decade-long decay. We fit the X-ray spectra with the slim disk model (Wen et al. 2020, 2021), thereby

constraining the black hole mass and spin to a higher precision than previously possible," the researchers wrote.

The black hole mass for J150052 was measured to be about 200,000 solar masses. The dimensionless spin parameter of the black hole was calculated to be at least 0.97. Therefore, the researchers concluded that J150052 is a fast spinning, and perhaps near-extremal, IMBH.

The mass and spin measurements indicate that J150052 did not form near its current mass. Hence, the authors of the paper assume that the black hole must have accreted up to its current mass in episodes where the angular momentum vectors of the spin and accreted material were aligned.

Furthermore, the spectral analyses of J150052 suggests that it undergoes a transition during its decay, quenching the corona while the mass accretion rate decreases from super-Eddington to Eddington levels. The study also found that the corona of J150052 to be optically thick and warm.

Summing up the results, the researchers noted that their findings demonstrate the potential of using the X-ray spectra of TDEs to find IMBHs and measure their masses and spins.

More information: Z. Cao et al, The Rapidly Spinning Intermediate-Mass Black Hole 3XMM J150052.0+015452, *arXiv* (2022). DOI: 10.48550/arxiv.2211.16936

https://phys.org/news/2022-12-tidal-disruption-event-j150052-rapidly.html