Team reports that black hole activity can be observed via visible rays

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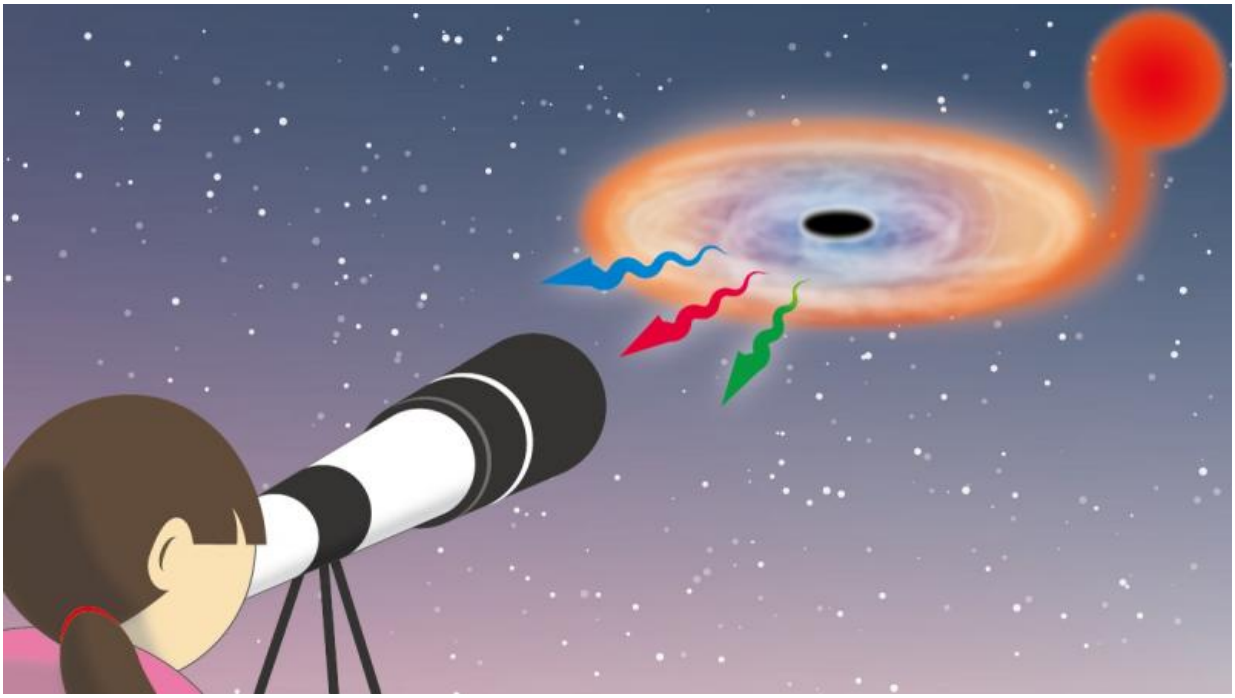

An international research team reports that the activity of black holes can be observed as visible light during outbursts, and that flickering light emerging from gases surrounding black holes is a direct indicator of this. The team's results, published in *Nature*, indicate that optical rays and not just X-rays provide reliable observational data for black hole activity. Credit: Eiri Ono/Kyoto University

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"We now know that we can make observations based on optical rays—visible light, in other words—and that black holes can be observed without high-spec X-ray or gamma-ray telescopes," explains lead author Mariko Kimura, a master's student at Kyoto University.

Once in several decades, some black hole binaries undergo "outbursts", in which enormous amounts of energy—including X-rays—are emitted from substances that fall into the black hole. Black holes are commonly surrounded by an accretion disk, in which gas from a companion star is slowly drawn to the hole in a spiral pattern. Activities of black holes are typically observed through X-rays, generated in the inner portions of accretion disks where temperatures reach 10 million degrees Kelvin or more.

V404 Cygni, one of the black hole binaries thought to be nearest to Earth, "woke up" after 26 years of dormancy on 15 June 2015 as it underwent such an outburst.

Led by astronomers from Kyoto University, the team succeeded in obtaining unprecedented amounts of data from V404 Cygni, detecting repetitive patterns having timescales of several minutes to a few hours. The optical fluctuation patterns, the team found, were correlated with those of X-rays.

Based on analyses of optical and X-ray observational data, Kyoto astronomers and their collaborators at national space agency JAXA,

national laboratory RIKEN, and Hiroshima University showed that the light originates from X-rays emerging from the innermost region of the accretion disk around a black hole. These X-rays irradiate and heat the outer region of the disk, making it emit optical rays and thus becoming visible to the human eye.

The outburst observation, the researchers say, was the fruit of international collaboration across countries in different time zones.

"Stars can only be observed after dark, and there are only so many hours each night, but by making observations from different locations around the globe we're able to take more comprehensive data," says co-author Daisuke Nogami. "We're very pleased that our international observation network was able to come together to document this rare event."

The study also revealed that these repetitive variations occur at mass accretion rates lower than one tenth of that previously thought. This indicates that the quantity of mass accretion rate isn't the main factor triggering repetitive activity around black holes, but rather the length of orbital periods.

More information: Mariko Kimura et al. Repetitive patterns in rapid optical variations in the nearby black-hole binary V404 Cygni, *Nature* (2016). DOI: 10.1038/nature16452

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