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BLACK HOLE MERGES WITH UNUSUAL COMPACT OBJECT

Relevant for: Geography | Topic: The Earth and the Solar System

Puzzling merger: The mass of the primary was about 23.2 solar mass and the secondary was about 2.6 solar mass. | Photo Credit: Alex Andrix

The LIGO Scientific and VIRGO Collaborations (LSC) have detected an unusual compact object whose mass falls in between that of a typical black hole and a neutron star. The absence of accompanying electromagnetic signatures such as flashes of light are compatible with both. This puzzling event was registered by the LIGO and VIRGO detectors on August 14, 2019. The work has been published in *The Astrophysical Journal Letters.*

Since the first ever detection of gravitational wave signals emerging from the coalescing of binary black holes in 2015, the LIGO and VIRGO detectors have detected mergers of pairs of black holes, pairs of neutron stars and black hole-neutron star duo. From this experience and from the predictions of theory, the present merger detected on August 14, 2019, only posed a puzzle.

Looking at the signal waveform, it appeared that the primary object in this merger had a mass of about 23.2 times that of the Sun and the smaller, secondary object had a mass of about 2.6 times the solar mass. The pair joined to form a large black hole of mass 25.6 times the Sun's mass, having radiated away 0.2 solar masses.

This is unusual on many counts. For one thing, the mass ratio was approximately 1:9. This is the largest disparity in masses that has been observed till now between members of the coalescing pair. While at 23.2 solar masses, the primary is clearly a black hole, the calculated mass of the secondary object puts it in a dubious spot. It is too light to be a black hole and too heavy to be a neutron star, as far as observations go.

"Theoretically, both the maximum mass of neutron star and minimum mass of a black hole will depend on the complex physics at the core of a neutron star, details of supernova explosion a star undergoes at the end of its stellar evolution and so on," says K. G. Arun from Chennai Mathematical Institute, one of the authors of the paper, in an email to *The Hindu.* "Further, the current observational uncertainties cannot confirm or rule out whether there is a 'mass gap' between the maximum mass of the neutron star and the minimum mass of a black hole."

There is not much information about the lighter object except for the mass. "Due to the mass asymmetry, it becomes very difficult to detect any signatures of neutron star 'tides' which could have given us insights about the star. So one may be able to invoke exotic possibilities," says Prof. Arun. "It is going to be a very active topic of discussion in the astrophysics community in the coming days," he adds.

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