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LIGO OFFERS CLUES TO BLACK HOLE PHYSICS

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Artist's rendition of a neutron star on the cusp of being swallowed by a black hole. | Photo Credit: Dana Berry/NASA

About 900 million years ago, there was a collision between a black hole and another compact object which resulted in gravitational waves being spewed out into space. The LIGO and VIRGO collaborations which look for gravitational waves emanating from such events have picked up this signal. Astrophysicists are keenly analysing this signal, as it could signify new insights into black hole physics or hold promise for developing gravitational wave astronomy.

On August 14, the LIGO collaboration announced a 'super-event' alert on its GraceDB (Gravitational Wave Candidate Event Database). The event, dubbed S190814bv, after the date of its discovery, has sent waves of excitement through the astrophysics community because it is unlike any that has been detected so far.

"Early analysis suggests these originated from the collision of a black hole with 'something else'," says Karan Jani, astrophysicist and LIGO scientist at Vanderbilt University, U.S.

The 'something else' here could be a neutron star or a black hole of low mass. Either way there are new things to be learnt. "This signal has been located within about 20 square degrees in the sky and major telescopes across the globe are currently following up on this," says Mr. Jani.

"It is clear that this is a real gravitational wave signal, produced by the merger of two compact objects [neutron stars or black holes]. But whether the second object object (in the binary) is a neutron star or black hole can be established only at the end of a careful analysis, which is currently ongoing," says P. Ajith, astrophysicist from International Centre for Theoretical Sciences, Bengaluru, and a member of the LIGO Scientific Collaboration.

If the second object is a neutron star, it would be fascinating not just because such a merger has never been seen earlier.

The extreme gravity of the black hole would shred the neutron star, releasing, in addition to gravitational waves, light in the form of gamma rays, X-rays, Ultraviolet rays and so on.

Telescopes around the world look out for such electromagnetic counterparts to gravitational waves. Two of India's telescopes — Astrosat which is very sensitive to X-ray flashes from such objects and the GROWTH-India optical telescope at Ladakh — seem to have missed observing the event.

"Unfortunately, Astrosat was in the 'South Atlantic Anomaly' (SAA) at the time of the event, and the instruments were switched off," says Varun Bhalerao of IIT Bombay, who is a part of the Astrosat team. "SAA is a region above the South Atlantic ocean where there are a large number of charged particles that can damage sensitive instruments. All space telescopes are shut down when they pass through the SAA, and Astrosat is no exception," he explains. As the sky had been cloudy in Ladakh for many days, that telescope did not get any observations on this event either.

If the other possibility turns out to be correct and it is a merger of two black holes, then the second black hole would have to have a mass smaller than allowed by current theories.

“If confirmed, this will significantly advance our understanding of black hole population in the universe,” says Mr. Jani.

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