LIGO detects 3rd gravitational wave, charts new course

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Paris: The Laser Interferometer Gravitational-wave Observatory (LIGO) said on Thursday that it has made the third successful detection of gravitational waves — ripples in space and time — from the merger of two massive black holes that happened three billion light years away, on January 4, 2017.

Scientists said that this reiterates their claims of having added a new window to the world of astronomy. The new detection was made on January 4, 2017 during the ongoing second observing run of the Advanced LIGO detectors in the USA, which began on November 30, 2016.

The first direct observation of gravitational waves was made in September 2015 and in quick succession, the second detection was made in December 2015. The third detection has been described in a new paper accepted for publication in the journal Physical Review Letters.

These detections, which were made possible by contributions from more than thousand researchers from different countries, had a strong Indian role. Indian scientists have done foundational work over the last three decades in modelling the signal waveforms and developing mathematical techniques to search for gravitational wave signals in noisy data. "With the third definite detection from a coalescing black hole binary, we have discovered a new class of astrophysical sources to test Einstein's theory of general relativity in extreme conditions," Bala Iyer, the principal investigator of the Indian team in LIGO said.

The contributions of the Indian team include the estimation of the mass and spin of the remnant black hole produced by the merger. Studying properties of such binaries will tell us how exactly they are formed in nature

Iyer is a Simons visiting professor at ICTS, Bengaluru. The ICTS group played a key role in developing and implementing an analysis that was used to test the consistency of the observed signals with general relativity. By combining results from multiple LIGO events, more precise constraints on deviations from the predictions of Einstein's theory were obtained.

Further, a new generation of Indian scientists is expanding these contributions on several other frontiers. The publication has 40 authors from 11 Indian institutions.

The third event, a specific statement shared with TOI read, "was produced by the merger of two black holes, 31 and 19 times as massive as the Sun, forming a larger black hole of about 49 solar masses. Also, the data suggests that at least one of the black holes in this binary system might have been spinning in a direction that is not completely aligned with the orbital rotation of the binary."

Indian scientists contributed to developing and carrying out tests of Einstein's theory using this event, to the estimation of the properties of the remnant black hole, and to the search for possible electromagnetic flashes associated with this event.