

Gravity wave astronomy has potential for a paradigm shift

Feb 16, 2016, DHNS:



One hundred years after their existence was predicted by Albert Einstein, an international team of physicists including several Indian researchers was finally able to capture the elusive gravity waves (GW) opening up a new window to look at the universe.

The existence of gravitational waves was first indirectly demonstrated by Joseph Taylor, Russell Hulse and colleagues in the 1970s and 1980s for which they were awarded the 1993 Nobel Prize in physics. The new discovery made using Laser Interferometer Gravitational-wave Observatory (LIGO) is the first direct observation of gravitational waves themselves, made by measuring the tiny disturbances the waves make to space and time as they pass through the earth.

Indian origin Abhay Ashtekar is one of the leading scientists associated with gravity wave research for decades and has done many fundamental contributions in the field. Director of the Institute for Gravitation and the Cosmos at Penn State University and Holder Eberly Chair in physics at the university, Ashtekar spoke to Deccan Herald's Kalyan Ray on the discovery, its implication and the Indian gravity wave detector project. Excerpts:

Why the excitement on gravity wave discovery? How will it improve human understanding of the nature and the laws of physics?

It is remarkable the discovery was made almost exactly 100 years after Einstein's 1916 paper which first showed that general relativity predicts gravitational waves. But the real excitement lies in the fact that this discovery opens a brand new window on the universe. Four hundred years ago, Galileo turned a telescope to the skies and that invention revolutionised our view of the universe. Planets were no longer heavenly bodies governed by some mysterious laws but very much like the earth. There was a true paradigm shift. Gravitational wave astronomy has the potential to bring about a comparable paradigm shift.

What are the exciting things in cosmic that scientists can see through the window of gravity wave?

This first direct detection of gravitational waves is a breathtaking discovery that will stand out among the major achievements of the 21st-century science because it opens the door to many discoveries that I believe will be made in the coming decade. This first detection by LIGO originated in a collision of two black holes orbiting each other, which we call binary pairs. It has already resolved the long debated issue of the existence of binary pairs with masses tens of times greater than that of our Sun.

What the scientists would look for in future observations?

Subsequent observations are already being made at LIGO and will continue under the auspices of an international network. They will enrich our understanding because gravitational waves are the only messengers that can reveal to us the secrets behind the most energetic events in the universe such as black hole collisions.

Will it throw new lights on the Black Holes ?

Already, the first event has shown that there are plenty of black holes of tens of solar masses, thereby resolving the long debated, important issue of their existence. This is only the tip of the iceberg. Over the next decade, discoveries will likely pour-in, with a potential to completely refashion the understanding of the cosmos we inhabit.

Why there is multiplicity of GW detectors?

Of the gravitational wave observatories that will have the required sensitivity, three have been fully funded: LIGO in the US, VIRGO in Europe and KAGRA in Japan. The detectors in these observatories are the most sensitive instruments on earth. In the LIGO detector laser beams bounce between mirrors separated by 4 km without distortions. The large tubes in which they bounce, represent the largest and the best vacuum systems anywhere. The detector can pick up the signal when the mirror is displaced by 1/1000th radius of the proton! Such accuracies are necessary to extract reliable information about cosmic explosions because the signal originates in the far reaches of the universe. Therefore, LIGO Science has made tremendous contributions to push forefront technology to new heights.

Is the public expenditure on building these detectors justified?

Pay offs on investments are spectacular not only for diverse areas of fundamental science but also for technology ranging from optics to vacuum systems to material science to computational innovations.

Why India was chosen as the site for yet another proposed gravity wave detector? In what way the Indian instrument would be different from the other observatories? LIGO-India will fill a critical gap. Because all existing detectors are roughly at the same latitude, they leave a large margin of error in localisation of the source. LIGO India will change that dramatically. The National Science Board that oversees the National

Science Foundation in the US, has approved the shipping of an advanced LIGO detector to India after numerous reviews and panel discussions that assured them that the Indian researchers are fully capable of carrying out the necessary research and development. This initiative will bring a forefront, international mega-facility on the Indian soil.

Are there enough scientific manpower in India to sustain the gravity wave related research once the detector is ready?

My colleagues from diverse institutions in India are so excited because it provides a once-in-a-life-time opportunity to spectacularly enhance fundamental science and cutting-edge technology in India. I am so convinced that, as the Chair of the International Advisory Board of the IndIGO consortium, I have already invested and will continue to invest a lot of time and energy to pursue this opportunity.