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DISCOVERY OF GRAVITATIONAL WAVES

AN ATTRACTION FOR INDIA

Gp Capt Ashok K Chordia
Senior Fellow, CAPS

"LIGO Hanford Observatory team receives a cosmic gift to help celebrate its 20th anniversary in the TriCities."

~News Release, LIGO Hanford¹

Observation of a Rare Phenomenon

Gravitational Waves were detected on September 14, 2015 by the detectors of the twin Laser Interferometer Gravitational-Wave Observatory (LIGO), located in Livingston, Louisiana, and Hanford, Washington, USA. As per the News Release of Hanford Observatory Press, those *Waves* were produced during the final fraction of a second of the merger of two black holes--about 29 and 36 times the mass of the sun--to produce a single, bigger spinning black hole. In the process, about three times the mass of the sun was converted into *Gravitational Waves* with peak power output of about 50 times that of the whole visible universe. These *Waves* carry a wealth of information about their

dramatic origins and about the nature of gravity that cannot otherwise be obtained.

That the origin of *Gravitational Waves* is in some cataclysmic event in the distant universe--is something that had been talked about in the scientific circles for a long time but they had not been seen, felt, or heard earlier. This is the first occasion when scientists have made such an observation in time and space. It confirms a major prediction of Albert Einstein's general theory of relativity (1915) and opens an unprecedented new window onto the cosmos.

Understanding *Gravitational Waves*

It is interesting to know that those *Gravitational Waves* were generated 1.3 billion years ago. The scientists knew about the process of their generation--Einstein had hinted at it--but the observation had not been possible in the absence of the requisite technology and for want of suitable equipment. That such observations are now possible--is an extraordinary



achievement. The power packed in those *Waves* can be visualised from the fact that they caused momentary compression of the earth as they passed by.² Those *Waves* are continuing on their path beyond the earth. If what went past last September was a crest, a trough will follow and vice versa. Knowing the characteristics of the September *Wave* it should be possible to predict the arrival of the next crest/trough accurately--to the nearest nano-second. The event itself might happen a good thousand years hence.

The *Waves* observed last September, were a part of a series of compressions and rarefactions. Each sound wave is also but a series of compressions and rarefactions. Theoretically, once generated, a sound wave does not *die*;³ it just fades. The amplitude keeps diminishing; it becomes infinitesimally small but does not perhaps become *zero*. If it has been possible to detect *gravitational waves* so many years later and trillions of miles away, it should be relatively easy for an observation post to *detect* sound waves created nearer in time and space as they pass by--even if they are not audible to the human ear. There is a case for a *LIGO-like* observatory, which can detect very feeble sound waves much after they have left their source. Reviving, recording and reproducing them should not be difficult.

There could be some spinoffs of the knowledge of the *Waves*, and their next pass, if we are prepared.

Possible Spinoffs!

Armed with the knowledge of the *Waves'* revisit, the scientific community of planet earth could keep spacecraft ready--laden with payload of scientific equipment and sensors--to be launched when the *Waves* pass the earth the next time. The launch of those spacecraft could be timed to make use of the tremendous energy of the *Waves* to literally *surf* a million miles to other planets/galaxy. It could just be possible that those spacecraft carry mostly scientific payload and very little propellant.

Talking of the power of the *Gravitational Waves*, as said earlier, the September *Waves* caused momentary compression of the earth. It might be possible, the next time, to harness the energy contained in the *Waves*, or to store it for subsequent use. Storage of such large amounts of energy might be a possibility a thousand years hence.

Instant recording of sound for surveillance and espionage using ultra-sensitive voice recorders pointing at, and focused onto a target, has been a possibility for several decades. Though very little is known about this in the open domain, it can be said with some certainty that such devices work on principles of elementary physics. They have electrical, mechanical, and electronic components. If laser technology is used for detection of sound (as in the case of *gravitational waves*), it might be possible to detect sound signals even after a

lapse of some time and at a greater distance; not necessarily in the line of sight of the source. If and when it becomes possible to detect *dead* (read almost *dead*) sound waves; and isolate and revive the musing laser technology, it might be possible to *capture* sound waves generated by conversation among humans. Imagine the spinoffs of a conversation among the adversaries/terrorists sitting a mile away, being detected and heard in an observation post by a vigilant quick reaction team.

Imagination alone will limit the application of such discoveries.

India Climbs on the Bandwagon

In his address to the nation through “*Man ki Baat*,” on Sunday, March 27, 2016, Prime Minister Narendra Modi prided in the fact that Indian scientists were a part of the American discovery team and made public the decision to open a similar observatory in India.⁴ While several countries were involved in the discovery, India is among the first few countries going ahead with creation of an Observatory. An agreement has already been signed between India and the US during the PM’s recent visit to Washington to participate in the Nuclear Security Summit—to set up a LIGO project in the country. It is understood that the Indian cabinet has approved \$180 billion for the project.⁵

In other major scientific endeavours—space, missile and nuclear technology—India

joined the fray a wee bit late and, as a result, had to speed-march in an effort to catch up with the others. India is still working overtime to get abreast with the leaders in those spheres. The acceptance of India on the new bandwagon—as of now being steered by the US—is a recognition of several facts. Firstly, Indian scientific community has proved its prowess repeatedly. Secondly, the Indian political leadership has displayed maturity and wisdom in directing and ensuring responsible use of indigenously developed technologies. Thirdly, when abandoned and isolated, India as a country has shown remarkable resolve to go it alone—we have followed the dictum of *Ekla Chalo* with determination, poise and elan.

The new discovery is not only a significant milestone for physics, but also the start of many astrophysical discoveries. It has offered an opportunity to the humanity to find answers to many unanswered questions about the origin of the universe. To India, it has bestowed an opportunity to prove its scientific prowess yet again. India must bag the early bird benefits and create a niche for itself.

“Thanks to LIGO,... we can [now] listen to the Universe, to the rustle and the chirp of the cosmos.”

~Allan Adams⁶

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily

reflect the position of the Centre for Air Power Studies [CAPS])

Notes

¹“Gravitational Waves Detected 100 Years after Einstein’s Prediction,” *News Release*, LIGO Hanford Observatory Press, February 11, 2016, https://www.ligo.caltech.edu/system/media_files/binaries/310/original/LHO-NewsRelease-11Feb16-Final.pdf?1455201669. Accessed on April 2, 2016.

²“LIGO detects gravitational waves”, Announcement at Press Conference, LIGO, <https://www.ligo.caltech.edu/detection>. Accessed on April 5, 2016.

³ If a medium is available.

⁴ Narendra Modi, “India to establish lab to study gravitational waves: Narendra Modi”, *Economic Times* (online), <http://timesofindia.indiatimes.com/home/science/India-to-establish-lab-to-study-gravitational-waves-Narendra-Modi/articleshow/51177962.cms>. Accessed on March 31, 2016.

⁵ Tyler MacDonald, “India Inks Agreement With U.S. For LIGO Gravitational Waves Research,” *Headlines & Global News*, Apr 02, 2016 <http://www.hngn.com/articles/194565/20160402/india-inks-agreement-u-s-ligo-gravitational-waves-research.htm>. Accessed on Apr 3, 2016.

⁶ Allan Adams, “What the discovery of gravitational waves means,” *TED2016*, Filmed in February 2016, http://www.ted.com/talks/Allan_Adams_what_the_discovery_of_gravitational_waves_means/transcript?Language=en. Accessed on March 30, 2016.