

## **LIGO to Publish Paper on Analysis Techniques**

### **Why in news?**

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- The LIGO (Laser Interferometer Gravitational-Wave Observatory) Scientific Collaboration detected gravitational waves in 2015.

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- It has recently announced that it would publish a detailed explanation of how it analyses the noise in its detectors.

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### **What was the 2015 discovery?**

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- Gravitational waves are ripples in the fabric of space-time, arising from the merger of a pair of black holes in distant space.

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- LIGO's 2015 announcement of the discovery of gravitational waves was an exciting finding in physics for decades.

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- The discovery confirmed a prediction made by Einstein.

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- It stated that space-time itself can squeeze and stretch in rhythmic waves, when deformed by cataclysmic events like collision of black holes.

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- The collaboration's founders were awarded the Nobel prize in physics in 2017. Click [here](#) to know more.

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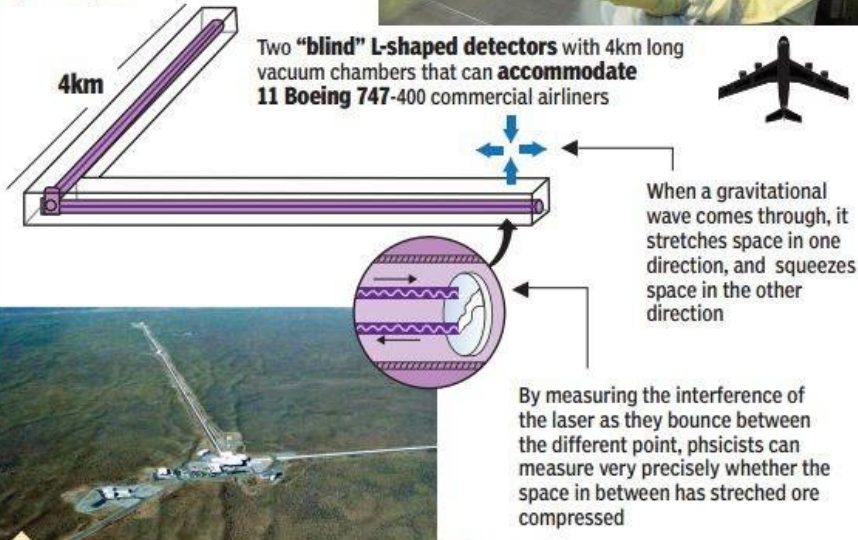
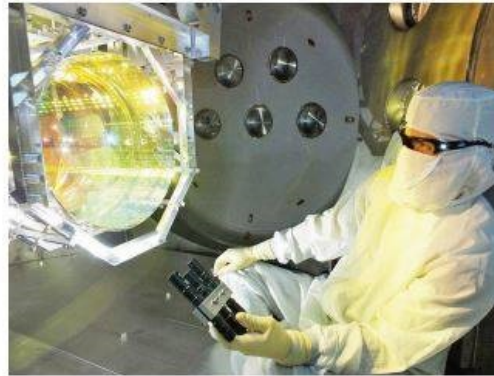
## WHAT IS LIGO?

The advanced Laser Interferometer Gravitational Wave Observatory (or LIGO) is at the centre of the path-breaking find:

**The LIGO experiment is an example of extreme engineering chasing an impossible dream**

The twin LIGO installations — one in Livingston, Louisiana, and the other in Hanford, Washington — are located 3,000km apart

Source: TNN, phdcomics.com, LIGO, Scientific American, phys.org, aps.org, symmetrymagazine.org



- Built **3,000km** apart, operating in unison
- To make the smallest measurement ever attempted by science — **a motion 10,000 times smaller than an atomic nucleus**
- Caused by the most violent and cataclysmic events in the Universe occurring millions of light years away
- Can detect gravitational waves in a volume of 1 billion cubic light years — **covering about 1 million Milky Way type galaxies**

- To detect a gravitational wave we should be able to tell when something changes in length by a few parts in 10 to the power 23
- LIGO makes the smallest measurement ever attempted — **a motion 10,000 times smaller than an atomic nucleus**
- It's like trying to hear a song being hummed in a very, very noisy party

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## What were the further observations?

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- Since detecting the binary black hole (BBH) merger, the LIGO Scientific Collaboration (LSC) has made six such observations.

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- Five of these were mergers of black holes in very different locations in space and with very different characteristics such as mass.

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- Another was the merger of a pair of so-called neutron stars (binary neutron stars).

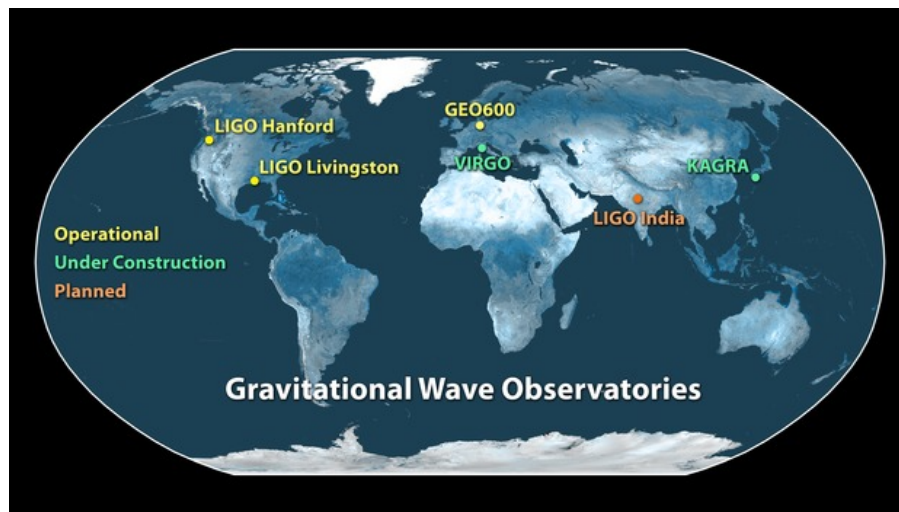
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- The last few detections have been done in conjunction with another detector,

Virgo (Italy-based).

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## What is the need for LIGO's explanation now?

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- **Challenge** - LIGO's detectors aim to measure a shortening of space equivalent to about a thousandth of the width of a proton.
- This sort of measurement is swamped by natural thermal vibrations, known as noise.
- This makes picking out the signal from a gravitational wave tricky and challenging.
- The collaboration thus used sophisticated analysis techniques to remove this noise.
- Also, after the first discovery, the LSC made public its data on these techniques.

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- **Dispute** - Analysing the data, in 2017, a group of scientists questioned the validity of the first detection.
- Weeding out noise from the signal is crucial in any such experiment.

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- Some claimed that this had not been done properly by the LSC.

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- They argued that the two detectors belonging to LIGO were correlated and that this led to a correlation in the noise factor.

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- Other scientific investigations also uncovered a number of irregularities in the data.

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- **LSC** - After a long silence, recently, the LSC has thus put up a clarification on its website.

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- The LIGO collaboration is learnt to be in the process of preparing their paper clarifying their approach and explaining the analysis techniques.

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**Source: The Hindu, NewScientist**

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