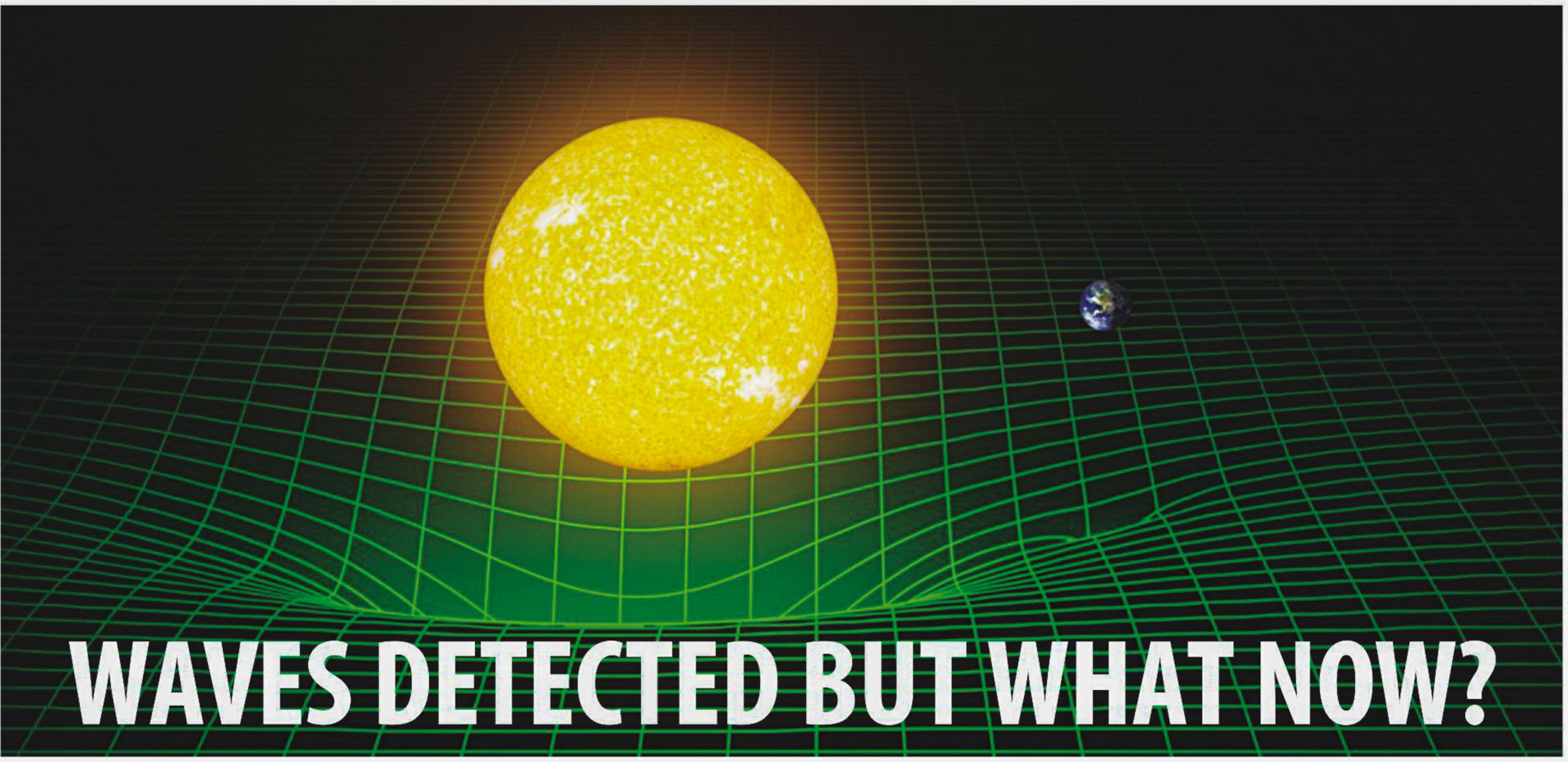
The Daily Star
DHAKA FRIDAY FEBRUARY 26, 2016



WAVES DETECTED BUT WHAT NOW?

WIDE ANGLE DESK

Right now, we can only see celestial objects that emit electromagnetic radiation -- visible light, X-rays, gamma rays, and so on. Visible light can get absorbed or reflected before it reaches our telescopes, leaving us with a cruddy view of things.

But some objects -- like colliding black holes or the smoking gun of the Big Bang -- don't emit any electromagnetic radiation. They emit gravity. The gravitational waves are unchanged by the matter they move through.

And that's why the LIGO's (The Laser Interferometer Gravitational-Wave Observatory) February 11 announcement of detection of gravitational waves of two merging black holes is so important. The invisible in the universe may soon become visible.

Focusing on gravitational waves, scientists were able to "see" or "hear" (both metaphors work) black holes in action for the very first time in scientific history.

Ethan Siegel, an astrophysicist who professes physics and astronomy at Lewis & Clark College in Portland, OR, wrote in Forbes, "Imagine that instead of the Sun, Moon, planets and stars in the sky, all you had ever seen was clouds. Not the puffy white ones silhouetted against a blue sky, but the thick grey, expansive stratus clouds. And these clouds lasted for all of human history. Yet someone devised the means to part the clouds one night ... Imagine that there was just one point of light that shone through, perhaps a planet, with incredible detail on it: rings, bands, colours, and maybe even moons. How dramatically would your conception of the Universe change from then?"

Theoretical Physicist and Prof of Physics at City College of New York Michio Kaku in an interview with the Observer said, "You may say to yourself, well what's the big deal? Well, every time a new wave was opened up for scientists, it changed our understanding of who we are. They've had religious, philosophical, and emotional consequences."

The first wave of discovery was Galileo's work with light waves, which demonstrated the Earth revolved around the sun. Galileo's findings shook the Catholic Church and its emphasis on Geocentrism to its core. The second wave, Kaku explained, took place during World War II, when radio waves were discovered as useful for providing insight into galaxies, leading to the discovery of objects in space like black holes.

"The third wave is now," Kaku added. "The third wave could be gravity wave detectors. In the first wave we discovered planets and stars, the second wave we discovered galaxies, what are we going to discover in the third wave? Not only will we discover colliding galaxies, but we will also get into the creation of the universe. We think one of the largest sources of gravity waves is genesis itself. Now we have baby pictures of the big bang, taken about 200,000 years after the instance of creation."

With the detection of gravitational waves, we could potentially determine what happened the moment our universe was created.

"This is still speculation, but if we have space-based gravity detectors orbiting the Earth or sun, and we detect radiation from the incident of the big bang, we could run the video tape backwards and therefore get insight into what happened before the big bang. That is, what triggered the creation of the universe," Kaku continued. "Of course we don't know, but some people believe perhaps there was an umbilical cord that connected our baby universe to a mother universe … Once we have space-based gravity wave detectors, we should be at the brink of being able to test for the impossible, that is, the world before the big bang."

"A lot of the things you see in science fiction revolve around black holes, because black holes are strong enough to rip the fabric of space and time. If space is a fabric, then of course fabrics can have ripples, which we have now seen directly. But fabrics can also rip. What happens when the fabric of space and time is ripped by a black hole? … A telescope that can look at the very instant which two black holes collided and this could open up a whole new chapter …"

" … We hope to launch the first space-based gravity wave detectors in 2034 ... These space-based detectors could be millions of miles across, because there is no need for shielding, no need for a tube or a vacuum chamber, space is empty up there. You could have three laser beams connecting 3 satellites in a triangle and that could be the basis of a new generation of space based gravity detectors. So a new chapter in Astronomy, as well as Theology, could be opening up."

KNOW THE NEW EARS OF THE UNIVERSE

The Laser Interferometer Gravitational-Wave Observatory (LIGO) is designed to open the field of gravitational-wave astrophysics through the direct detection of gravitational waves predicted by Einstein's General Theory of Relativity. LIGO's multi-kilometer-scale gravitational wave detectors use laser interferometry to measure the minute ripples in space-time caused by passing gravitational waves from cataclysmic cosmic sources such as the mergers of pairs of neutron stars or black holes, or by supernovae. LIGO consists of two widely separated interferometers within the United States—one in Hanford, Washington and the other in Livingston, Louisiana—operated in unison to detect gravitational waves.

The design and construction of LIGO was carried out by LIGO Laboratory's team of scientists, engineers, and staff at the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT), and collaborators from the over 80 scientific institutions world-wide that are members of the LIGO Scientific Collaboration.

LIGO is funded by the U.S. National Science Foundation and operated by the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT).

SOURCE: LIGO

WHAT IS GRAVITATIONAL WAVE?

The theory, put simply, states that space and time curve in the presence of mass, and that this curvature produces the effect known as gravity. When two black holes orbit each other, they stretch and squeeze space-time like children running in circles on a trampoline, creating vibrations that travel to the very edge; these vibrations are gravitational waves. They pass through us all the time, from sources across the universe, but because gravity is so much weaker than the other fundamental forces of nature—electromagnetism, for instance, or the interactions that bind an atom together—we never sense them.

*—**Nicola Twilley**, a contributing writer at newyorker.com*

FROM PREDICTION TO REALITY

1915 - Albert Einstein publishes general theory of relativity, explains gravity as the warping of spacetime by mass or energy

1916 - Einstein predicts massive objects whirling in certain ways will cause spacetime ripples—gravitational waves

1936 - Einstein has second thoughts and argues in a manuscript that the waves don't exist—until reviewer points out a mistake

1962 - Russian physicists M. E. Gertsenshtein and V. I. Pustovoit publish paper sketch optical method for detecting gravitational waves—to no notice

1969 - Physicist Joseph Weber claims gravitational wave detection using massive aluminum cylinders—replication efforts fail

1972 - Rainer Weiss of the Massachusetts Institute of Technology (MIT) in Cambridge independently proposes optical method for detecting waves

1974 - Astronomers discover pulsar orbiting a neutron star that appears to be slowing down due to gravitational radiation—work that later earns them a Nobel Prize

1979 - National Science Foundation (NSF) funds California Institute of Technology in Pasadena and MIT to develop design for LIGO

1990 - NSF agrees to fund $250 million LIGO experiment

1992 - Sites in Washington and Louisiana selected for LIGO facilities; construction starts 2 years later

1995 - Construction starts on GEO600 gravitational wave detector in Germany, which partners with LIGO and starts taking data in 2002

1996 - Construction starts on VIRGO gravitational wave detector in Italy, which starts taking data in 2007

2002 - 2010 - Runs of initial LIGO—no detection of gravitational waves

2007 - LIGO and VIRGO teams agree to share data, forming a single global network of gravitational wave detectors

2010 - 2015 - $205 million upgrade of LIGO detectors

2015 - Advanced LIGO begins initial detection runs in September

2016 - On 11 February, NSF and LIGO team announce successful detection of gravitational waves

SOURCE: SCIENCEMAG.ORG

Albert Einstein: the man who predicted gravitational waves

There was this pretty clever guy 100 years ago who said this is happening all the time. But we didn't know for sure until we finally managed to build a machine – like a giant ear – so we could to listen to it.

He made huge strides in physics, to the point that his surname is used as another way of calling someone a genius. Yet there is plenty more to know about the man himself.

HE PLAYED THE VIOLIN

He started learning when he was a young boy and continued playing until old age stopped his left hand from being able to move as quickly and precisely as was needed.

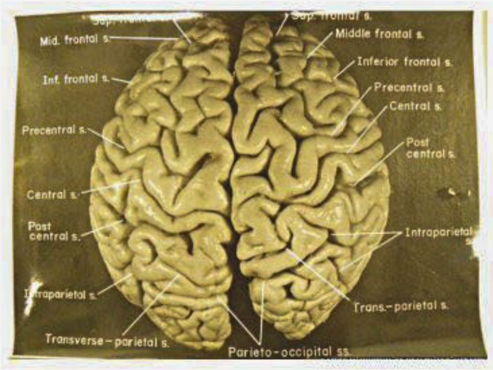
He performed at benefit concerts and used music as a relaxation tool all his life. He was a particular fan of Mozart and Bach.

HIS TEACHER SAID HE WOULD NEVER AMOUNT TO ANYTHING

Einstein and his family told the press that he was comparatively slow to learn to walk and talk. His sister Maja, writing about her famous brother, said that when Albert was a little boy at home in Germany, people around him worried that he would never speak.

At school, he did not enjoy studying humanities subjects. He struggled with writing and it is widely supposed that he had dyslexia, in a time before it was routinely tested for. According to his sister, his Greek teacher once told him off for the quality of work he had submitted by saying nothing would ever become of him.

He failed his university entrance exam but it was in a job as a clerk that he found time to develop his ideas. He published scientific



papers, moved into an academic career, made ground-breaking strides in physics including developing the theory of general relativity, and was given the Nobel Prize in 1921.

EINSTEIN'S BRAIN

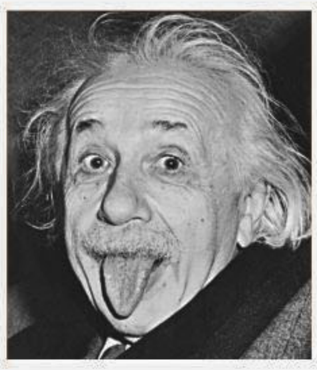
His brain was found to have more tightly-packed neurons than usual, which might have allowed him to process information more quickly than other people. The part of his brain responsible for spatial cognition and mathematical thought was wider than normal. But some people say this is all speculation - and it would be hard to prove any link between his physical brain and his genius. Brain size varies from person to person.

A pathologist called Thomas Harvey kept the brain for four decades. In one BBC documentary in 1994, he was seen cutting a piece of the brain to give it to a visitor. Most of the remains of the brain are now in New Jersey.

HE WAS A REFUGEE

By the time the Nazis came to power, Einstein was already famous. His Jewish ethnicity was widely known and it became more and more difficult for him to work in the face of anti-Semitism in Europe.

In the early 1930s, Einstein took a job in the USA. Shortly afterwards, the Third Reich accused him of treason, and his books were thrown on the fire at a ceremonial book-burning by Nazi students.



Einstein helped Jews escape from Germany but had mixed feelings about having left.

He wrote in a letter: "I am almost ashamed to be living in such peace while all the rest struggle and suffer."

TURNED DOWN ISRAELI PRESIDENCY

In 1952, the Israeli ambassador to the US wrote to Einstein on the prime minister's behalf, asking whether he would take the role of president as a mark of "the deepest respect which the Jewish people can repose in any of its sons".

The letter assured him that he would be given "complete facility and freedom to pursue [his] great scientific work".

Turned the offer down, he replied that he was "deeply moved" but was not suited to it due to old age and his personality.

WHAT HE DID AND DID NOT SAY

There is a truism that if you can't explain something simply, you haven't understood it well enough. The line is often attributed to Einstein, but there is no historical evidence that he said it, and versions of the same idea had been written down centuries before.

In the 1950s, a few years before his death, Einstein complained that people were quoting him too much.

He said: "In the past it never occurred to me that every casual remark of mine would be snatched up and recorded. Otherwise I would have crept further into my shell."

SOURCE: BBC