Nobel physics prize awards discovery in gravitational waves (Update)

October 3 2017

Three U.S.-based scientists won the Nobel Physics Prize on Tuesday for detecting faint ripples flying through the universe—the gravitational waves predicted a century ago by Albert Einstein that provide a new understanding of the universe.

Rainer Weiss of the Massachusetts Institute of Technology and Barry

Barish and Kip Thorne of the California Institute of Technology won the 2017 prize for a combination of highly advanced theory and ingenious equipment design, Sweden's Royal Academy of Sciences announced.

The scientists were key to the first observation of gravitational waves in September 2015. When the discovery was announced several months later, it was a sensation not only among scientists but the general public.

"It's a win for the human race as a whole. These gravitational waves will be powerful ways for the human race to explore the universe," said Thorne, speaking by phone with The Associated Press from California.

"I view this more as a thing that recognizes the work of a thousand people," Weiss told reporters at the announcement news conference.

The prize is "a win for Einstein, and a very big one," Barish told the AP.

The German-born Weiss was awarded half of the 9-million-kronor ($1.1 million) prize amount and Thorne and Barish will split the other half.

In this Feb. 11, 2016 file photo, Laser Interferometer Gravitational-Wave Observatory (LIGO) Co-Founder Rainer Weiss, left, and Kip Thorne, right, hug on stage accompanied by Interferometer Gravitational-Wave Observatory (LIGO) Exectutive Director David Reitze, bottom, during a news conference at the National Press Club in Washington, USA. The Nobel Physics Prize 2017 is announced Monday Oct. 3, 2017, is awarded to three scientists Rainer Weiss of the Massachusetts Institute of Technology, and Barry Barish and Kip Thorne of the California Institute of Technology. (AP Photo/Andrew Harnik, File)

Gravitational waves are extremely faint ripples in the fabric of space and time, generated by some of the most violent events in the universe. The waves detected by the laureates came from the collision of two black holes some 1.3 billion light-years away. A light-year is about 5.88 trillion miles.

Ariel Goobar of the Royal Swedish Academy of Sciences said the winners' work meant "we can study processes which were completely

impossible, out of reach to us in the past."

"The best comparison is when Galileo discovered the telescope, which allowed us to see that Jupiter had moons. And all of a sudden, we discovered that the universe was much vaster than we used to think about," Goobar said.

With the technology that the three developed "we may even see entirely new objects that we haven't even imagined yet," said Patrick Sutton, an astronomer at Cardiff University in Wales.

The waves were predicted by Einstein a century ago as part of his theory of general relativity. General relativity says that gravity is caused by heavy objects bending space-time, which itself is the four-dimensional way that astronomers see the universe.

Weiss in the 1970s designed a laser-based device that would detect gravitational waves. He, Thorne and Barish "ensured that four decades of effort led to gravitational waves finally being observed," the Nobel announcement said.

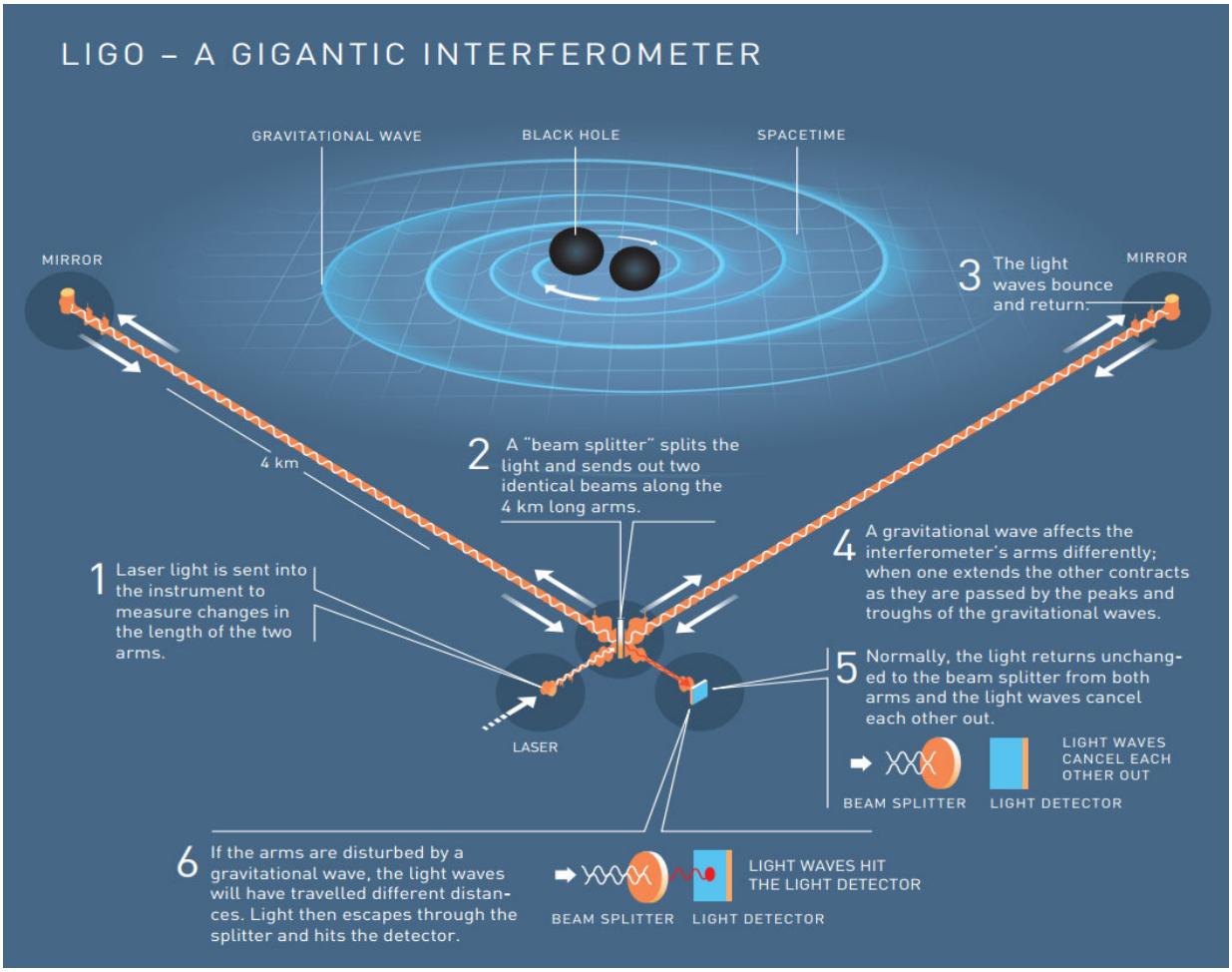
The laser device, called an interferometer, must be both exquisitely precise and extremely stable. "The beam must hit the mirrors precisely. They should hardly shake at all, not even when leaves fall from nearby trees," according to a Nobel background paper.

The first detection of gravity waves involved two of the devices about 3,000 kilometers (1,900 miles) apart—in Hanford, Washington, and Livingston, Louisiana. The wave first passed the Livingston facility and 7 milliseconds later at Hanford, consistent with the speed of light.

The announcement said Einstein was convinced that gravitational waves could never be measured. The laureates used laser devices "to measure a

change thousands of times smaller than an atomic nucleus."

In a moment of poetry aimed at making the distant and infinitesimal phenomenon understandable to non-experts, the academy announcement said gravitational waves "are always created when a mass accelerates, like when an ice-skater pirouettes or a pair of black holes rotate around each other."



How to catch a gravitational wave. The world's first captured gravitational waves were created in a violent collision between two black holes, 1.3 billion lightyears away. When these waves passed the Earth, 1.3 billion years later, they had weakened considerably: the disturbance in spacetime that LIGO measured was

thousands of times smaller than an atomic nucleus. Credit: LIGO

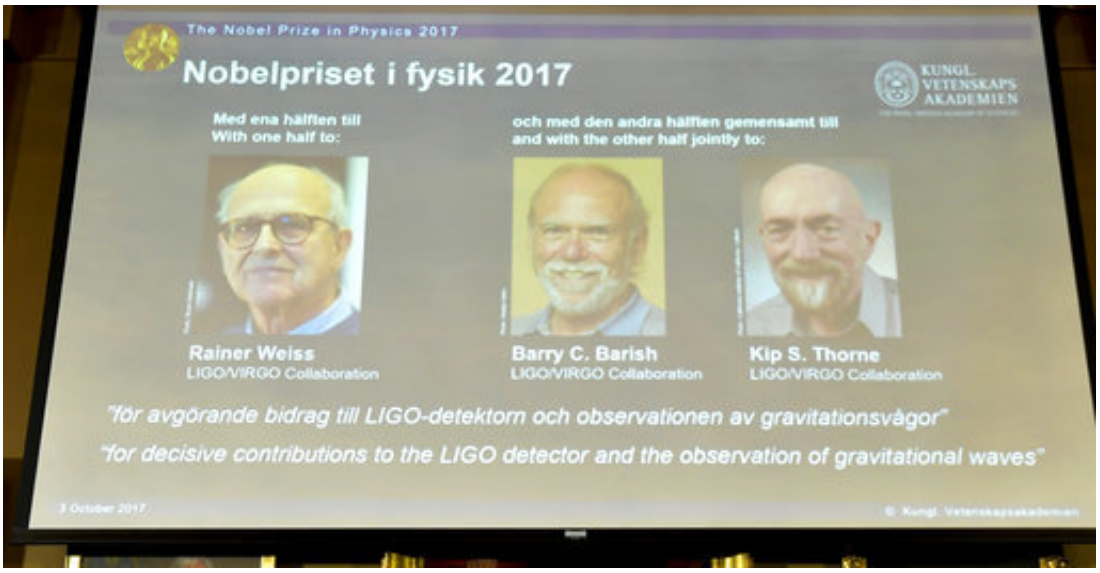
Professor Alberto Vecchio, from the University of Birmingham's Institute of Gravitational Wave Astronomy, said this discovery will produce results for decades to come.

"They have taken me, as well as hundreds of my colleagues, through such an intellectually rewarding and recently adrenaline-packed journey that we could not have even remotely imagined," he said. "The best part is that this is just the beginning of a new roller-coaster exploration of the universe."

For the past 25 years, the Nobel physics prize has been shared among multiple winners.

Last year's prize went to three British-born researchers who applied the mathematical discipline of topology to help understand the workings of exotic matter such as superconductors and superfluids.

The 2017 Nobel prizes kicked off Monday with the medicine prize being awarded to three Americans studying circadian rhythms—better known as body clocks: Jeffrey C. Hall, Michael Rosbash and Michael W. Young.



The 2017 Nobel Prize winners in Physics, seen on a projection and are from left, Rainer Weiss, Barry C. Barrish and Kip S. Thorne, at the Royal Swedish Academy of Sciences in Stockholm Tuesday Oct. 3, 2017. (Jessica Gow /TT via AP)

The chemistry prize will be announced Wednesday, the Nobel literature prize on Thursday and the peace prize on Friday. The economics prize, which is not technically a Nobel, will be awarded on Monday.

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The Nobel Prize in Physics 2017

Gravitational waves finally captured

On 14 September 2015, the universe's gravitational waves were observed for the very first time. The waves, which were predicted by Albert Einstein a hundred years ago, came from a collision between two black holes. It took 1.3 billion years for the waves to arrive at the LIGO

detector in the USA.

Goran K Hansson, centre, Secretary General of the Royal Swedish Academy of Sciences, announces the 2017 Nobel Prize winners in Physics, from top left, Rainer Weiss, Barry C. Barrish and Kip S. Thorne Tuesday Oct. 3, 2017, at the Royal Swedish Academy of Sciences in Stockholm. (Jessica Gow /TT via AP)

The signal was extremely weak when it reached Earth, but is already promising a revolution in astrophysics. Gravitational waves are an entirely new way of observing the most violent events in space and testing the limits of our knowledge.

LIGO, the Laser Interferometer Gravitational-Wave Observatory, is a collaborative project with over one thousand researchers from more than twenty countries. Together, they have realised a vision that is almost

fifty years old. The 2017 Nobel Laureates have, with their enthusiasm and determination, each been invaluable to the success of LIGO. Pioneers Rainer Weiss and Kip S. Thorne, together with Barry C. Barish, the scientist and leader who brought the project to completion, ensured that four decades of effort led to gravitational waves finally being observed.

In the mid-1970s, Rainer Weiss had already analysed possible sources of background noise that would disturb measurements, and had also designed a detector, a laser-based interferometer, which would overcome this noise. Early on, both Kip Thorne and Rainer Weiss were firmly convinced that gravitational waves could be detected and bring about a revolution in our knowledge of the universe.

In this file photo dated Friday, April 17, 2015, a national library employee shows the gold Nobel Prize medal awarded to the late novelist Gabriel Garcia Marquez,

in Bogota, Colombia. The Nobel prize has greater personal impact than merely receiving the monetary award, as it marks the recipient in terms of esteem and global recognition. (AP Photo/Fernando Vergara, FILE)

Gravitational waves spread at the speed of light, filling the universe, as Albert Einstein described in his general theory of relativity. They are always created when a mass accelerates, like when an ice-skater pirouettes or a pair of black holes rotate around each other. Einstein was convinced it would never be possible to measure them. The LIGO project's achievement was using a pair of gigantic laser interferometers to measure a change thousands of times smaller than an atomic nucleus, as the gravitational wave passed the Earth.

So far all sorts of electromagnetic radiation and particles, such as cosmic rays or neutrinos, have been used to explore the universe. However, gravitational waves are direct testimony to disruptions in spacetime itself. This is something completely new and different, opening up unseen worlds. A wealth of discoveries awaits those who succeed in capturing the waves and interpreting their message.

In this file photo dated Thursday, Feb. 11, 2016, Laser Interferometer Gravitational-Wave Observatory (LIGO) Co-Founder Rainer Weiss speaks during a news conference at the National Press Club in Washington, as it is announced that scientists have finally detected gravitational waves. The Nobel Physics Prize 2017 is announced Monday Oct. 3, 2017, awarded jointly to three scientists Rainer Weiss of the Massachusetts Institute of Technology, and Barry Barish and Kip Thorne of the California Institute of Technology. (AP Photo/Andrew Harnik, FILE)

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The Royal Swedish Academy of Sciences, announces the 2017 Nobel Prize winners in Physics, seen on a projection are from left, Rainer Weiss, Barry C. Barrish and Kip S. Thorne at the Royal Swedish Academy of Sciences in Stockholm Tuesday Oct. 3, 2017. (Jessica Gow /TT via AP)

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In this file photo dated Thursday, Feb. 11, 2016, Laser Interferometer Gravitational-Wave Observatory (LIGO) Co-Founder Kip Thorne speaks during a news conference at the National Press Club in Washington, USA, to announce that scientists have finally detected gravitational waves. The Nobel Physics Prize 2017 is announced Monday Oct. 3, 2017, awarded to 3 scientists including Kip Thorne, for discoveries in gravitational waves. (AP Photo/Andrew Harnik, FILE)

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More information: www.nobelprize.org/nobel_prize … sics/laureates/2017/

Scientific Background

Popular Science Background