Which Do you Trust More and Why?

The New York Times | https://nyti.ms/2yERyMq

SCIENCE

2017 Nobel Prize in Physics Awarded to LIGO Black Hole Researchers

By DENNIS OVERBYE OCT. 3, 2017

Rainer Weiss, a professor at the Massachusetts Institute of Technology, and Kip Thorne and Barry Barish, both of the California Institute of Technology, were awarded the Nobel Prize in Physics on Tuesday for the discovery of ripples in space-time known as gravitational waves, which were predicted by Albert Einstein a century ago but had never been directly seen.

In announcing the award, the Royal Swedish Academy called it "a discovery that shook the world."

That shaking happened in February 2016, when an international collaboration of physicists and astronomers announced that they had recorded gravitational waves emanating from the collision of a pair of massive black holes a billion light years away, it mesmerized the world. The work validated Einstein's longstanding prediction that space-time can shake like a bowlful of jelly when massive objects swing their weight around, and it has put astronomers on intimate terms with the deepest levels of physical reality, of a void booming and rocking with invisible cataclysms.

PRL 116, 061102 (2016) Selected for a Viewpoint in *Physics* PHYSICAL REVIEW LETTERS week ending 12 FEBRUARY 2016

Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.*[*]
(LIGO Scientific Collaboration and Virgo Collaboration)
(Received 21 January 2016; published 11 February 2016)

On September 14, 2015 at 09:50:45 UTC the two detectors of the Laser Interferometer Gravitational-Wave Observatory simultaneously observed a transient gravitational-wave signal. The signal sweeps upwards in frequency from 35 to 250 Hz with a peak gravitational-wave strain of 1.0×10^{-21}. It matches the waveform predicted by general relativity for the inspiral and merger of a pair of black holes and the ringdown of the resulting single black hole. The signal was observed with a matched-filter signal-to-noise ratio of 24 and a false alarm rate estimated to be less than 1 event per 203 000 years, equivalent to a significance greater than 5.1σ. The source lies at a luminosity distance of 410^{+160}_{-180} Mpc corresponding to a redshift $z = 0.09^{+0.03}_{-0.04}$. In the source frame, the initial black hole masses are $36^{+5}_{-4} M_\odot$ and $29^{+4}_{-4} M_\odot$, and the final black hole mass is $62^{+4}_{-4} M_\odot$, with $3.0^{+0.5}_{-0.5} M_\odot c^2$ radiated in gravitational waves. All uncertainties define 90% credible intervals. These observations demonstrate the existence of binary stellar-mass black hole systems. This is the first direct detection of gravitational waves and the first observation of a binary black hole merger.

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I. INTRODUCTION

In 1916, the year after the final formulation of the field equations of general relativity, Albert Einstein predicted the existence of gravitational waves. He found that the linearized weak-field equations had wave solutions: transverse waves of spatial strain that travel at the speed of light, generated by time variations of the mass quadrupole moment of the source [1,2]. Einstein understood that gravitational-wave amplitudes would be remarkably small; moreover, until the Chapel Hill conference in 1957 there was significant debate about the physical reality of gravitational waves [3].

The discovery of the binary pulsar system PSR B1913+16 by Hulse and Taylor [20] and subsequent observations of its energy loss by Taylor and Weisberg [21] demonstrated the existence of gravitational waves. This discovery, along with emerging astrophysical understanding [22], led to the recognition that direct observations of the amplitude and phase of gravitational waves would enable studies of additional relativistic systems and provide new tests of general relativity, especially in the dynamic strong-field regime.

Experiments to detect gravitational waves began with Weber and his resonant mass detectors in the 1960s [23],

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Reviewing Papers & Writing Referee Reports

(Brian DeMarco, Lance Cooper, Tony Liss, Doug Beck, Celia Elliott)

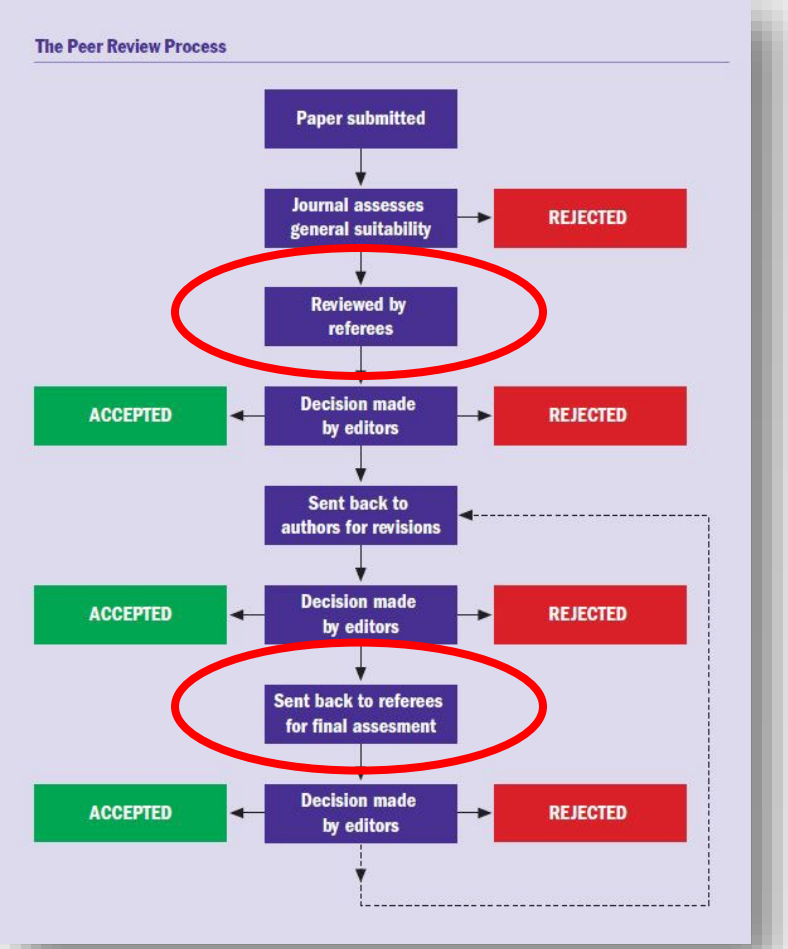
What does a referee do for science?

Safeguards the integrity of the archival literature

Ensures $$ invested in research are spent wisely

Ensures that people are rewarded on the merits of their work

Referees evaluate articles *before* they are published



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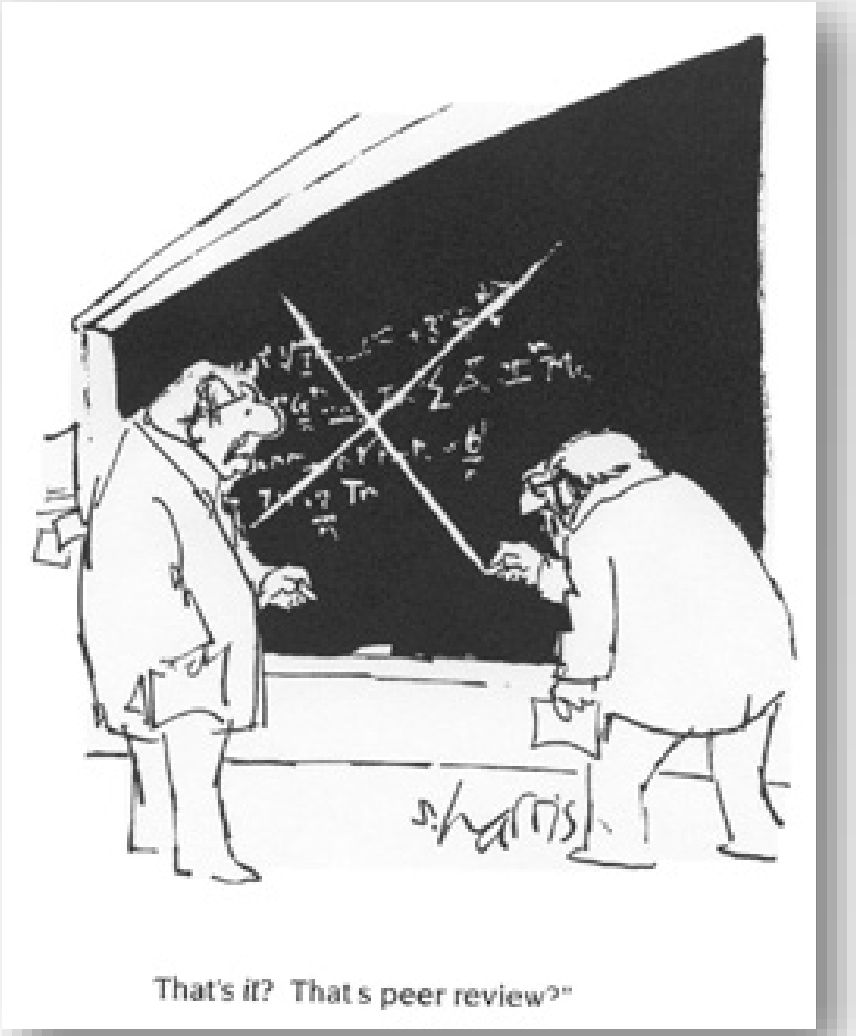
Improves the quality of published papers

Ensures papers are published in appropriate journals

Why referees are needed



An enormous number of scientific articles are submitted yearly (about 10,000 to Physical Review Letters)

Most journals rely on impartial external reviewers to help evaluate and decide the fate of submitted papers

This is generally performed as a service to the community, i.e., you don't get paid to referee papers!

A referee is not your average reader

The average reader relies on peer-review to weed out questionable papers.

The referee (a peer) should be much more skeptical than the average reader.

Being skeptical is different from not believing.

Reviewing vs. reading a paper

As a reader, you are more likely to presume the details presented in the paper are true and correct (experts have already signed off on it)

As a referee, you have an obligation to carefully evaluate:

1. the “truth” of what is being presented
2. the originality and significance of the work
3. the suitability of the methods used
4. the validity of the conclusions drawn

You should have three objectives when refereeing a paper:

1. “Protecting the cathedral by testing the brick”
2. Helping the authors produce a better paper (clearer, more persuasive, more concise, more complete)
3. Maintaining your objectivity and professional ethics

Essential Components of a Good Referee Report

(1). Brief summary of the main points of the paper

- to educate the editor
- to convince the editor and other referees that you've actually read the paper (no joke!)

(2). Brief evaluations of the different criteria provided by the journal

- the quality/appropriateness of the research methodologies and techniques
- the quality of the logical arguments made to arrive at the key conclusions of the paper
- the clarity of the presentation

(3). Highlights of the paper's strengths as well as its weaknesses

Essential Components of a Good Referee Report

(*continued*)

(4). An explicit recommendation for or against publication

Your recommendation can be equivocal if you provide sufficient discussion of the pros and cons of publication.

If you do recommend rejecting a paper, you can suggest alternative journals to which the paper might be more appropriately submitted.

(5). List essential and suggested changes to the paper

Even if you recommend rejecting the paper, your suggestions might allow the paper to be published elsewhere, or even in the same journal after revision.

Be *clear* and *specific* about your questions and suggestions so the authors can respond appropriately.

“Review unto others…*

Do not personally criticize the authors; focus on improving the paper, not straightening out the researchers

Do not make statements or claims without providing examples, explanations, and evidence

Strive for the highest standards of objectivity and honesty

Do not use information obtained through review for personal benefit—ever!

*Professor Lance Cooper’s “Golden Rule for Referees”

For HW #6…

You will be assigned two articles to review

For each article, provide a written assessment, using the posted review criteria

- First, write a one-paragraph summary of the article
- Next, evaluate the contents of the article using the rubric; address each criterion
- Finally, give specific suggestions for how the article could be improved

Remember to make positive comments as well as critical ones

For ***any*** review

1. **Briefly summarize the main points of the paper**

2. **Provide brief evaluations of the different criteria provided by the journal**

3. **List essential and suggested changes to the paper**

4. **Make an explicit recommendation about publishing the paper**