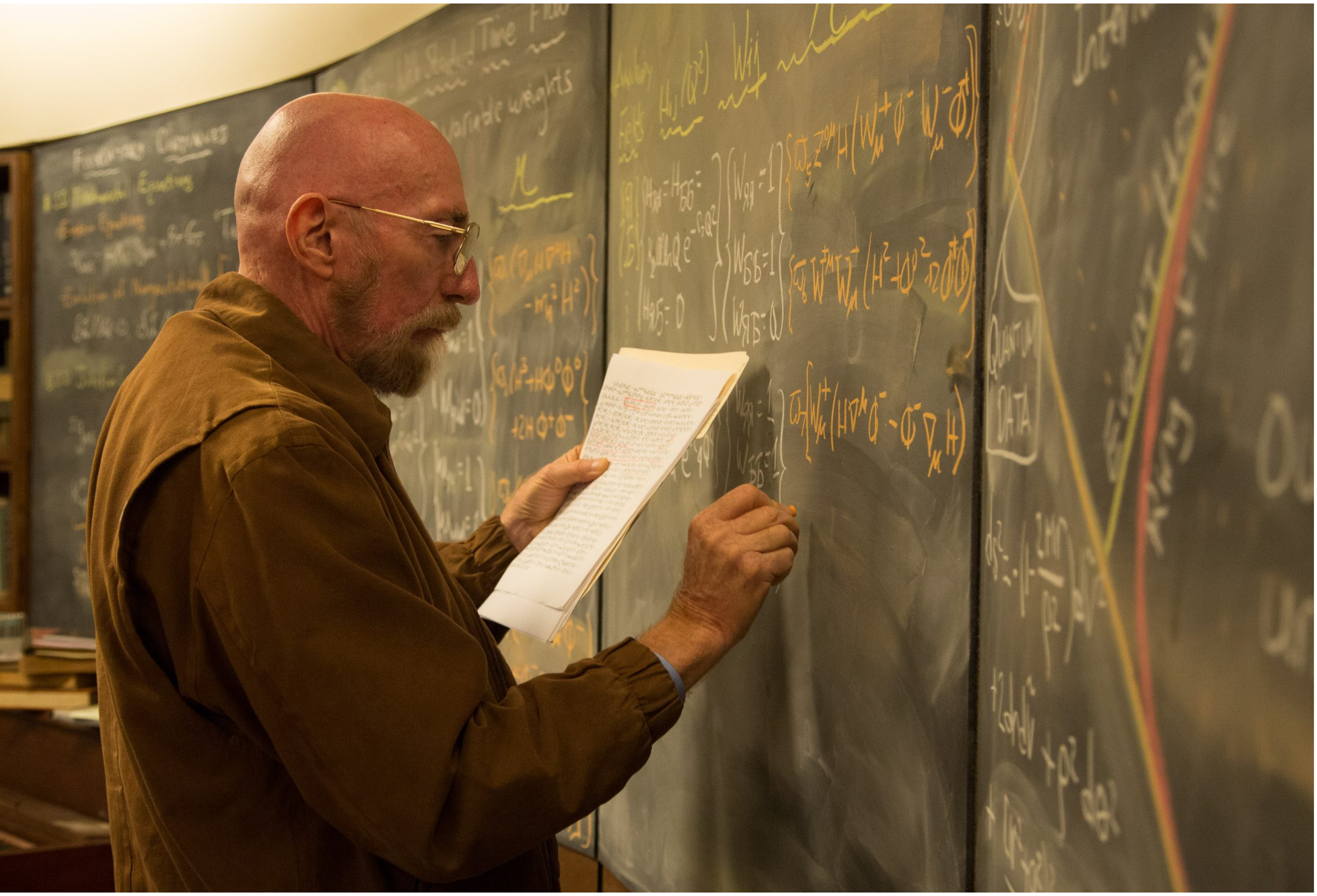
An Interview with Kip Thorne, Theoretical Physicist and 2017 Nobel Prize Recipient

Ahmed Elbenni (https://thepolitic.org/author/ahmed-elbenni/) • October 22, 2017



(https://thepolitic.org/wp-content/uploads/2017/10/fl-324321-e1508715716627.jpg)

Kip Thorne is an American theoretical physicist and one of three recipients of the 2017 Nobel Prize in Physics. He and the other two winners, Rainer Weiss and Barry Barish, played key roles in founding and leading the Laser Interferometer Gravitational-Wave Observatory—the instrument that detected gravitational waves for the first time in late 2015—and the LIGO Scientific Collaboration, a team of more than 1,000 scientists who analyzed the raw data. The detection finally confirmed the theretofore unseen "ripples" in spacetime that Albert Einstein predicted a century ago as part of his general theory of relativity.

Even before becoming a Nobel Laureate, Dr. Thorne had distinguished himself as one of the world's leading gravitational physicists. He has conducted extensive astrophysical research on subjects pertaining to relativistic stars, black holes, and gravitational waves.

In 1967 he became an associate professor at the California Institute of Technology, where 52 physicists completed PhDs under his personal mentorship, before stepping down in 2009 as Feynman Professor of Theoretical Physics Emeritus.

He has authored and co-authored numerous influential works, including *Gravitation*, a textbook from which two generations of physicists have learned general relativity, and *Black Holes and Time Warps: Einstein's Outrageous Legacy*, an award-winning book that explains general relativity to a non-scientific audience. He most recently co-authored *Modern Classical Physics,* a graduate-level reference book based on a Caltech course he taught for three decades on the fundamentals and applications of twenty-first-century physics.

Unlike most advanced physicists, Dr. Thorne has penetrated the public consciousness multiple times, most notably for theorizing that wormholes could enable time travel and for his involvement in Christopher Nolan's 2014 science-fiction film *Interstellar.* He served as the film's executive producer and scientific consultant. He published *The Science of Interstellar* to explain the film's scientific underpinnings and to demonstrate their grounding in actual physics. Aside from assisting in the production of a film, Dr. Thorne himself has been featured as a film character: he was played by actor Enzo Cilenti in the 2014 biographical film *The Theory of Everything.*

The Politic: ***First if all, congratulations on winning the Nobel Prize. Obviously this is a huge achievement. To help our readers to appreciate the magnitude of what you have achieved here, could you talk a bit about the importance of detecting the gravitational waves, and why this was so significant?***

Kip Thorne: First let me say that the achievement was not mine, it was an achievement by a team of 1,000 people. The task of achieving this is so complex it could only be done by such a huge team and not any one or even three or even one hundred individuals. It's really the entire team, the LIGO team, and also the data analysis collaborators in Europe called Virgo, they are the ones that deserve the credit, and they should have received the prize.

But setting that aside, you asked about the importance of this. The laws of physics tell us that there are only two kinds of waves that can propagate across the universe, bringing us information about what's far far away: electromagnetic waves and gravitational waves, and that's it. It was Galileo 400 years ago who initiated the modern electromagnetic astronomy when he built a little optical telescope and pointed it at Jupiter and discovered the four largest moons around Jupiter. LIGO has done the analogous thing for gravitational waves.

Our team built these very large and very complicated detectors in Louisiana and Washington state, turned them on, and saw gravitational waves and colliding black holes a billion light-years away. It's important because it is doing [to] the second kinds of waves what Galileo did with electromagnetic waves. Just as the electromagnetic wave has blossomed in these past 400 years and has opened up other frequency bands besides the optical—so we now have radio astronomy, X-ray astronomy, gamma-ray astronomy, different frequency bands for electromagnetic waves—just like that, LIGO is beginning a process where we will have different frequency bands. Gravitational waves will have far different bands in 20 years. And by 400 years from now, it'll just be totally amazing the things that [will] have been discovered with gravitational waves.

So, a completely different way of understanding the universe?

Yes, absolutely.

You and other individuals have been working towards detecting gravitational waves since at least the 1960s. What was it like, in late 2015, when you finally detected gravitational waves for the first time?

My reaction was different from most of our team's reactions. Most of the team was very excited and euphoric. I just had a sense of profound satisfaction that I had chosen a direction for most of my career effort—I'd put 60 or 70 percent of my effort during my career into this—I made that choice tentatively in the 1960s, firmly by the mid-70s, and it was the right choice.

By 1980, I had begun to believe that the first thing we would see would be colliding black holes, would be heavy colliding black holes, and that's the way it turned out. That expectation became one of the guiding forces in our development of LIGO, that we should be optimizing ourselves for seeing such things. I did put a huge amount of effort myself but also all of my students, postdocs, in helping experimenters in every way that we could. By the early 2000s, I began to worry that the effort to simulate these collisions and compute the expected wave shapes was floundering. It had been going on also by now for about half a century.

So I left LIGO. I was not involved in the endgame. I left day-to-day involvement to start an effort at Caltech on simulations for the collisions. But I did this basically as an adjunct to help out a team that was already doing this at Cornell led by [a] former student. My students and postdocs at Caltech helped this group pull off the simulations that were required in the end to extract the information carried by the first gravitational waves and are central to underpin the searches for gravitational waves from other black hole collisions.

So time after time I had made the right choice, a good choice for what to do with my career. It's a long way of explaining why I was profoundly satisfied when the first waves came in.

What solidified your decision to stick to this path all the way back in the 1970s?

When I first heard about these kinds of gravitational wave detectors, which were invented by Rai Weiss at MIT, and when I understood that this would require measuring the motions of huge mirrors at a level that is one trillionth the wavelength of the light that is used to measure those mirror motions—when I first heard that I thought it was crazy. So in a textbook that I co-authored called *Gravitation,* that I co-authored with Charles Misner and John Wheeler, I wrote that this was not a very promising approach. I was wrong, I didn't realize I was wrong.

After studying in detail a technical paper that Rai Weiss wrote about this method, in which he described all the major sources of noise that the detections would have to confront and described ways to deal with them, and estimated the sensitivity that detectors could reach, after studying that paper, after long discussions with Weiss, long discussions with Vladimir Braginsky, a Russian physicist who was superb, I did become convinced. That was 1975. At that point, I made the decision to go forward. It was only after intense studying of Weiss' proposal that I came to agree that this could succeed and decided therefore that I would help.

Since you first detected gravitational waves in late 2015, have you detected [any] since then?

I believe there are three or four other detections that have been announced, and there will be further announcements over the coming months. We are off and running, the LIGO team is off and running, now in collaboration with the Virgo gravitational detector in Pisa, Italy, which joined our search the first of August, and is contributing in very important ways. This first stage now, opening this gravitational window out into the universe, is going great with natural detections.

Note: Since this interview was conducted, LIGO and Virgo have announced a joint detection of gravitational waves emitted by two colliding neutron stars. This is the first time that a cosmic event has ever been observed via both light and gravitational waves, and therefore this detection constitutes a genuine *astronomical revolution.*

Where do you see gravitational wave usage going from here?

LIGO's gravitational wave detectors are about three times less sensitive than they were designed to be. Between now and about 2020, the LIGO team of experimenters, which does not include me, I emphasize again, the team will push forward with debugging the detectors and bringing them down to their set design sensitivity. At the moment, on average, LIGO is seeing about one black hole collision per month. [By] 2020 LIGO will be seeing three times further, and that means the volume of the universe that LIGO will cover is three times three times three or 27 times bigger. That means instead of seeing one per month, LIGO should be saying about one per day and should be seeing things other than black holes, other phenomena in the universe.

Let's shift gears. Christopher Nolan consulted you for the science for the science-fiction film* Interstellar. *How do you think* Interstellar *turned out from the perspective of scientific accuracy and plausibility?

What I need to is explain a bit about the history of *Interstellar*. So *Interstellar* was initiated not by Christopher Nolan, but by Lynda Obst, who is a Hollywood producer friend of mine. We wrote a treatment for the movie, which we called *Interstellar*. The treatment is a description of the science in the movie and of the story and some characters. [Lynda] brought Christopher Nolan and his brother Jonathan Nolan on board to write the screenplay and to direct. They changed the story almost completely, so it wound up being their story, except in some broad brush sense what we began with. They kept the science, and through the whole screenwriting phase, they consulted with me every few weeks, at least, about the science and each phase of the screenwriting. When we went into production, the key thing that had to be done in a creative new way was the computer graphics, so I worked hand in hand with the computer graphics team on those. The final product had the science built in from the very outset because it was initiated by me and Lynda Obst. It was preserved, and I was very very pleased with the final result. It really is Christopher Nolan and Jonathan Nolan's film, but the science we jointly put into it from the very beginning.

At one point in the film, there's a moment where the main character sort of goes back in time to communicate with his daughter. You have also been very interested in the question of whether or not time travel is possible according to the laws of physics. Was [the time travel] part of the initial science that was in the film before Nolan took it over, an influence from your own fascination with the topic?

I don't even remember whether we had any time travel aspects in our original treatment because Chris changed the story so much. The time travel that is in there was in a form that Christopher Nolan initiated with me. I've written a book called *The Science of Interstellar*, which explains all this, and as I describe in there, no person, particularly not Matthew McConaughey, [he] does not really go backward in time. But he sends signals backward in time through the bulk, through a higher dimension. In the movie, the only place where anything goes backward in time is in the bulk, in this higher dimension. Gravitational signals go backward in time from Cooper, who is played by Matthew McConaughey, to his daughter Murph, who is played by Jessica Chastain.

What is your current stance on time travel, as a question of physics?

We simply don't know whether backward time travel is possible. The answer, as best I can tell, is controlled by laws of quantum gravity, laws that come from combining general relativity with quantum physics. Only when we understand those laws of quantum gravity far better than we do today will we be able, theoretically, to answer the question of whether you can go backward in time. That's probably a few decades away. I'm a little pessimistic about it, but I regard it as a very open question.

Tags:
Interviews (https://thepolitic.org/tag/interviews/) nobel prize (https://thepolitic.org/tag/nobel-prize/)
science (https://thepolitic.org/tag/science/)

PREVIOUS ARTICLE
Urban Ignorance: On Yale's Lack of an Urban Studies Program (https://thepolitic.org/urban-ignorance-on-yales-lack-of-an-urban-studies-program/)

NEXT ARTICLE
Poverty in the Christian Narrative: Victim-Blaming the Poor? (https://thepolitic.org/poverty-in-the-christian-narrative-victim-blaming-the-poor/)

1 Comment The Politic 1 Login

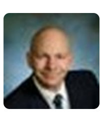
Recommend 3 Tweet Share Sort by Best

Join the discussion…

LOG IN WITH

OR SIGN UP WITH DISQUS ?

Name



Tim G. Meloche • 2 years ago

Answer to a very open question: The principles of atomic gravity.

The answers begin by understanding how gravity works
at the atomic scale. The principles of atomic gravity are simple and have been proven over and over again.

Discover the principles in the google links below.

https://docs.google.com/doc...

Zero G flight at the Atomic Scale

Zero G flight at the Atomic Scale

https://docs.google.com/doc...

Reply · Share ›

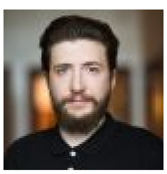
The Politic

POPULAR POSTS

The Calculus of Retention: Why Are Yale Students Leaving STEM? (https://thepolitic.org/the-calculus-of-retention-why-are-yale-students-leaving-stem/)

Henry Reichard (https://thepolitic.org/author/henry-reichard/) • December 30, 2018

RECENT POSTS

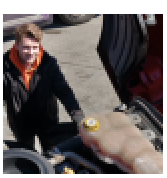


Sergey Baloyan (Yale Financial Markets Certificate 19), Co-founder of X10 Agency and Consultant on Security Token Offerings (https://thepolitic.org/sergey-baloyan-yale-financial-markets-certificate-19-co-founder-of-x10-agency-and-consultant-on-security-token-offerings/)

CRYPTO/BLOCKCHAIN (HTTPS://THEPOLITIC.ORG/CATEGORY/CRYPTO-BLOCKCHAIN/), INTERVIEWS (HTTPS://THEPOLITIC.ORG/CATEGORY/INTERVIEWS/)

John Song (Yale SOM), Director of Special Situations Investments for Angel Capital and Advisor to LucyLabs Crypto Firm (https://thepolitic.org/john-song-yale-som-director-of-special-situations-investments-for-angel-capital-and-advisor-to-lucylabs-crypto-firm/)

CRYPTO/BLOCKCHAIN (HTTPS://THEPOLITIC.ORG/CATEGORY/CRYPTO-BLOCKCHAIN/), INTERVIEWS (HTTPS://THEPOLITIC.ORG/CATEGORY/INTERVIEWS/)



An Interview with Joshua Collins, Truck Driver, Democratic Socialist, and Candidate for U.S. Congress (https://thepolitic.org/an-interview-with-joshua-collins-truck-driver-democratic-socialist-and-candidate-for-u-s-congress/)

INTERVIEWS (HTTPS://THEPOLITIC.ORG/CATEGORY/INTERVIEWS/)

FOLLOW THE POLITIC

(HTTPS://WWW.FACEBOOK.COM/THEYALEPOLITIC/)

(HTTPS://TWITTER.COM/YALEPOLITIC?LANG=EN)

(HTTPS://WWW.INSTAGRAM.COM/THEYALEPOLITIC/)