

A visualization of a gravitational well, showing two black circular regions representing massive objects. The space around them is curved, with light rays bending towards the wells. The background is a dense field of stars and galaxies, illustrating the cosmic context of gravitational waves.

# Gravitational-Wave Astronomy

A.K.A. Detecting Ripples in Space and Time

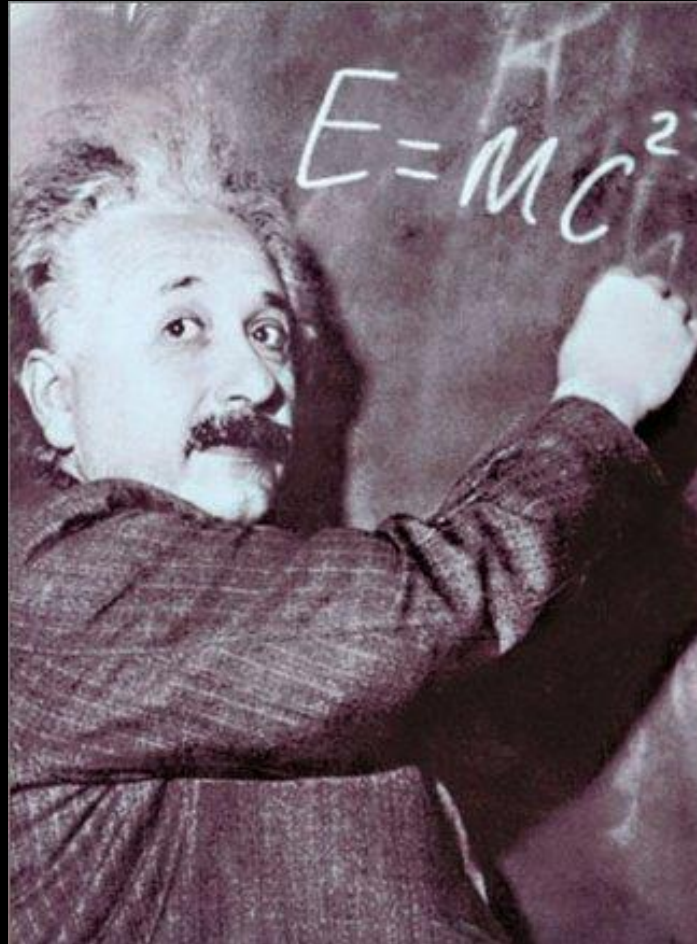
Laurel White

# What I' m going to talk about

- What is a gravitational wave?
- What is LIGO and how does it work?
- What is my research about?

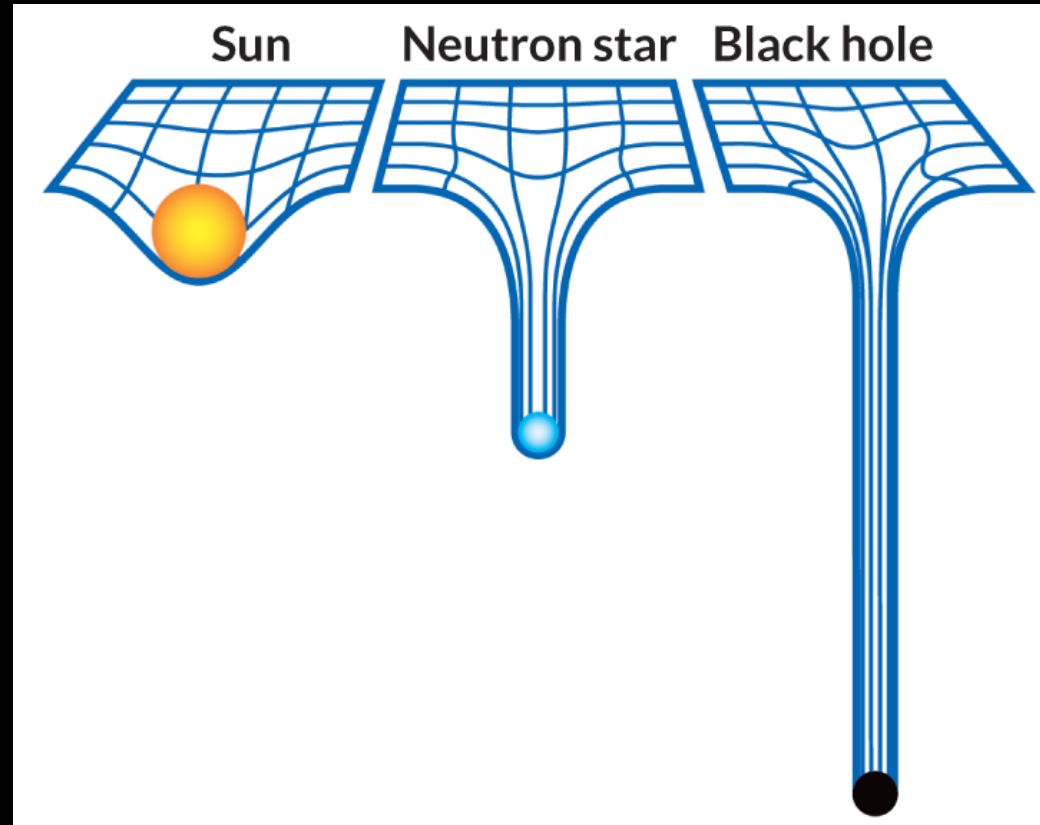


# Starting with Einstein...



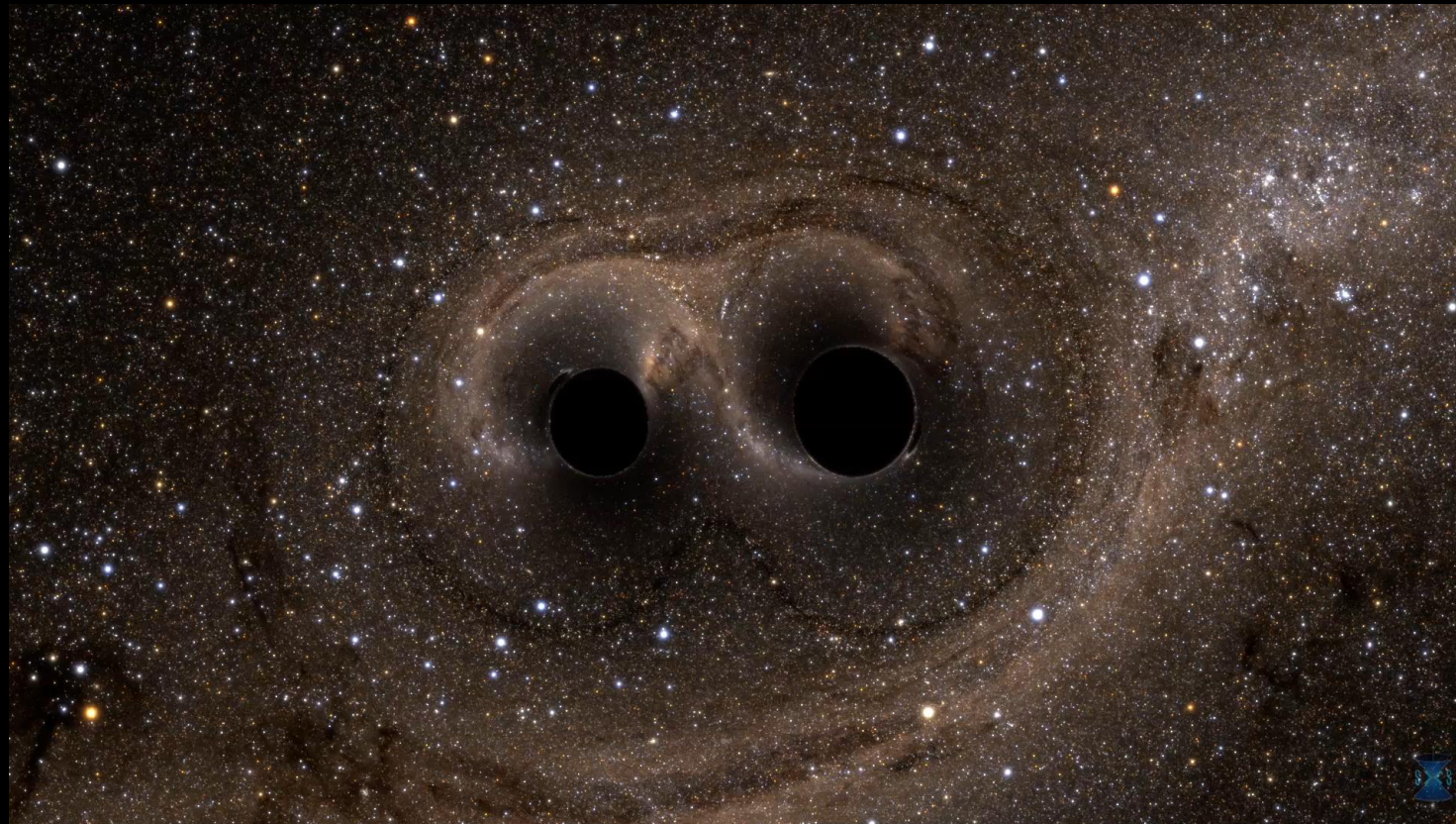
<https://d.gr-assets.com/books/1176674634/643669.jpg>

# Gravity is not a force



<https://i.stack.imgur.com/K7czr.png>

# Black holes collide



Courtesy of Simulating eXtreme Spacetimes



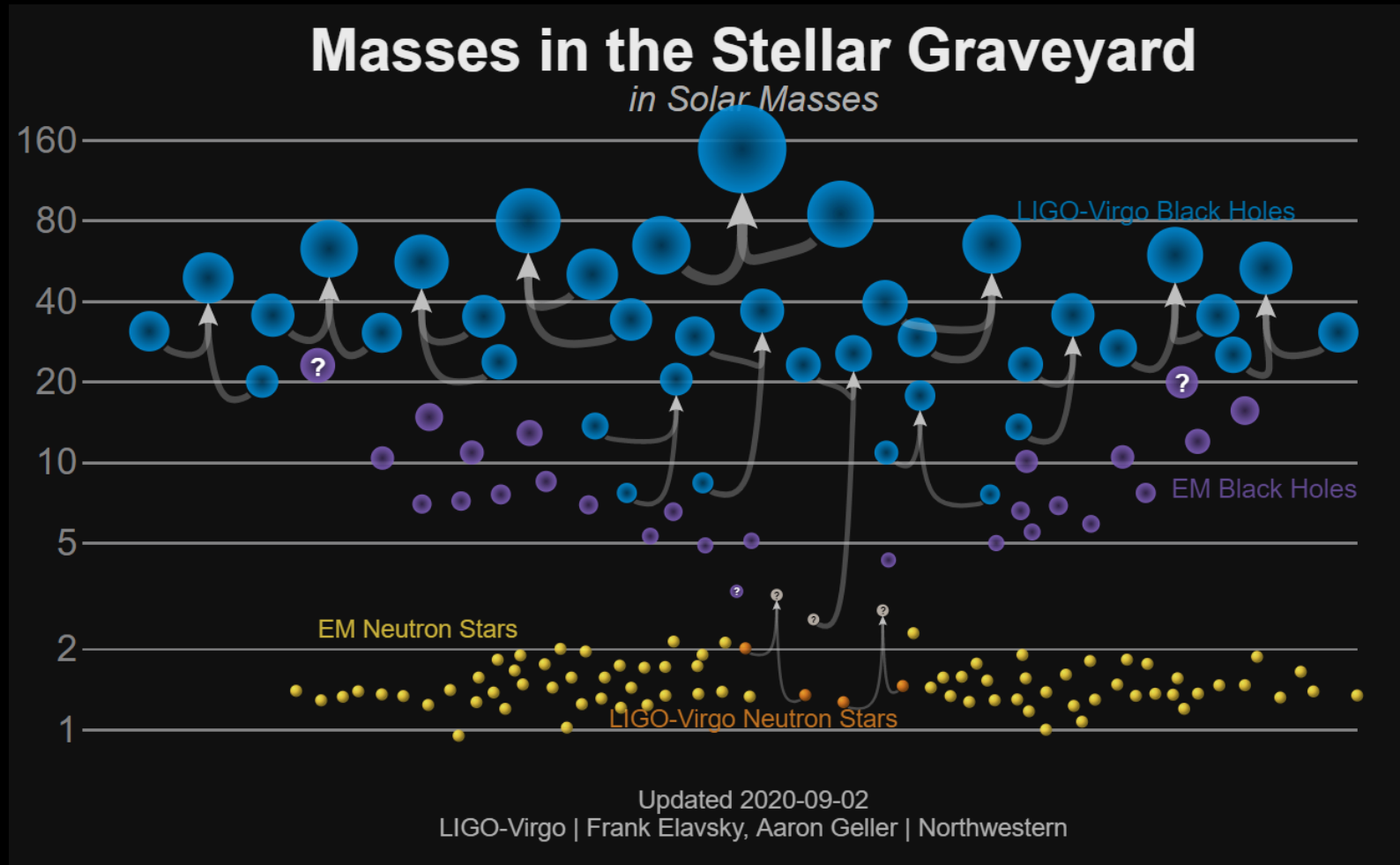
# LIGO and friends

- LIGO
- Virgo
- KAGRA

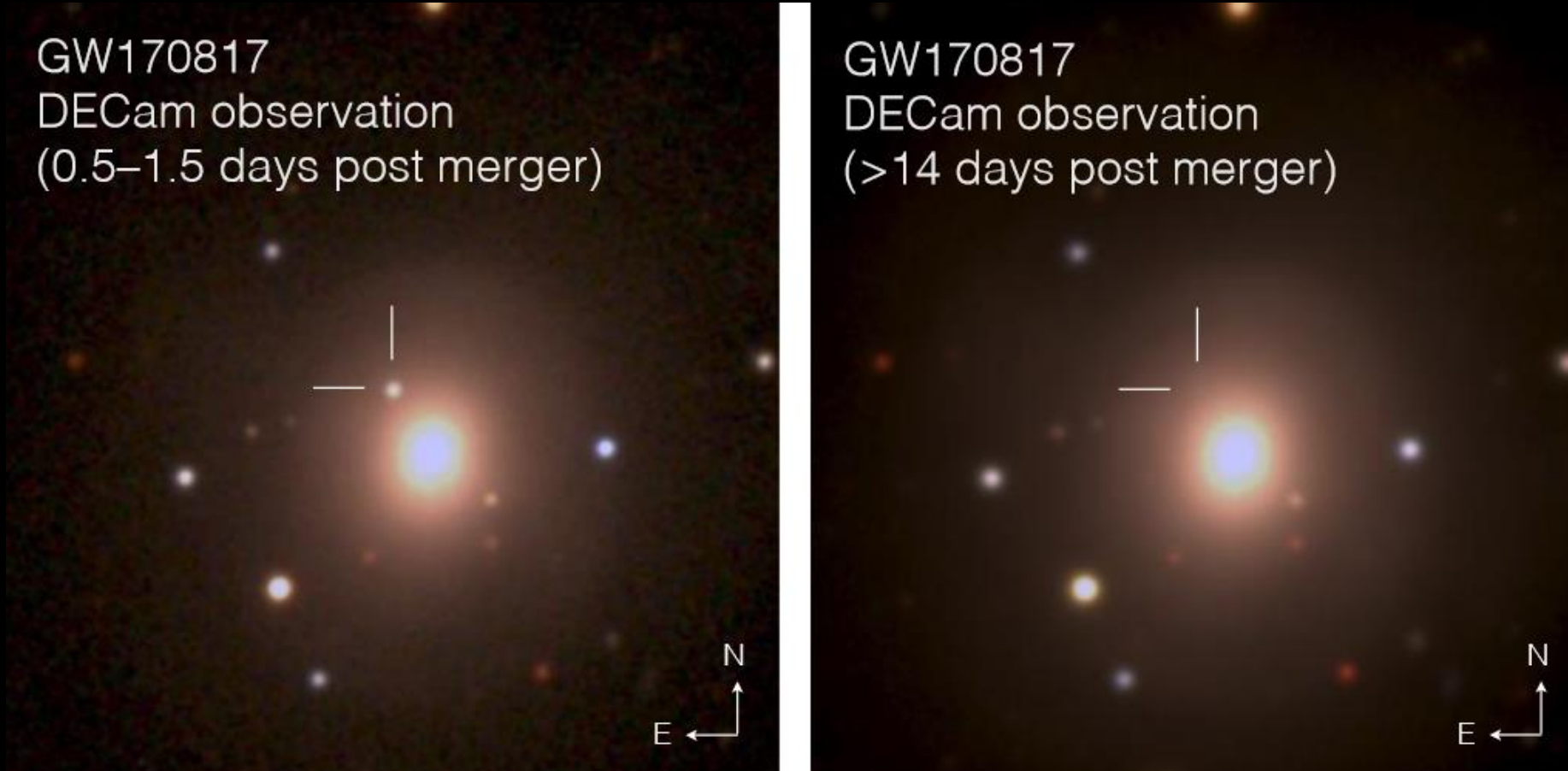


Courtesy of Caltech

# LIGO detections



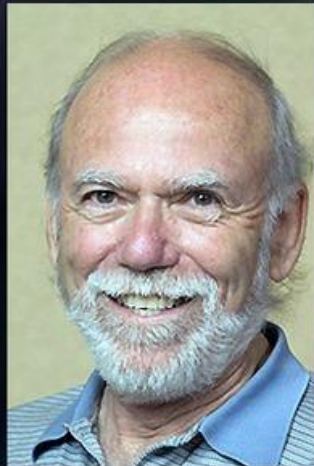
# Multi-messenger astronomy



Courtesy of Soares-Santos



# 2017 Nobel Prize in Physics



Barry C. Barish (Caltech)



Kip S. Thorne (Caltech)

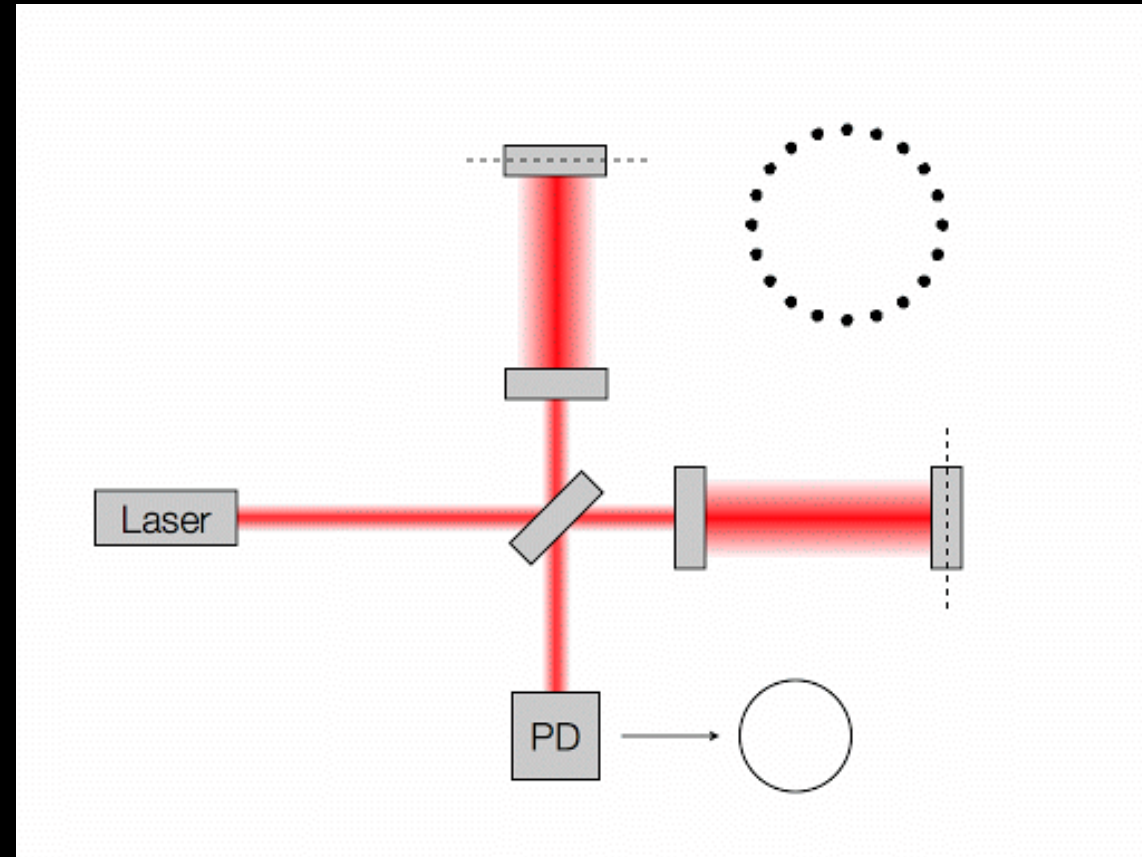


Rainer Weiss (MIT)



**2017 Nobel Prize in Physics**

# Laser interferometry



Courtesy of Les Wade

# Really big interferometers



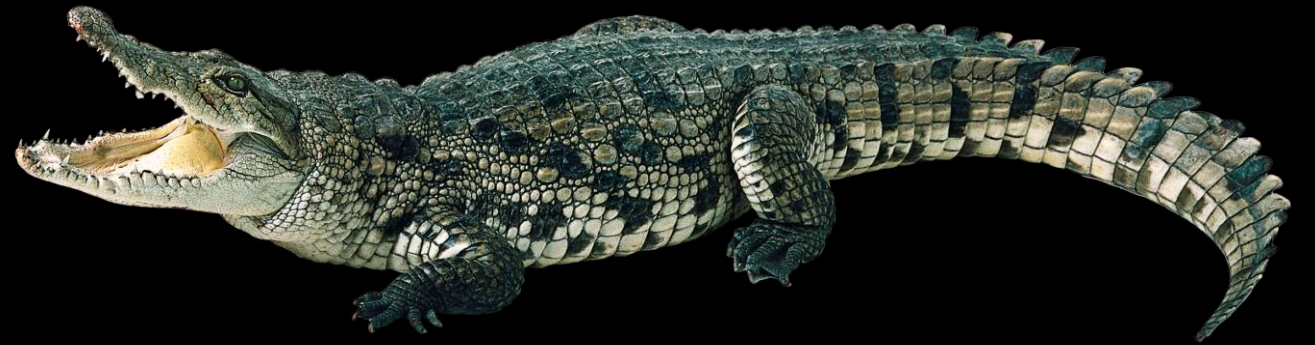
Courtesy of LIGO



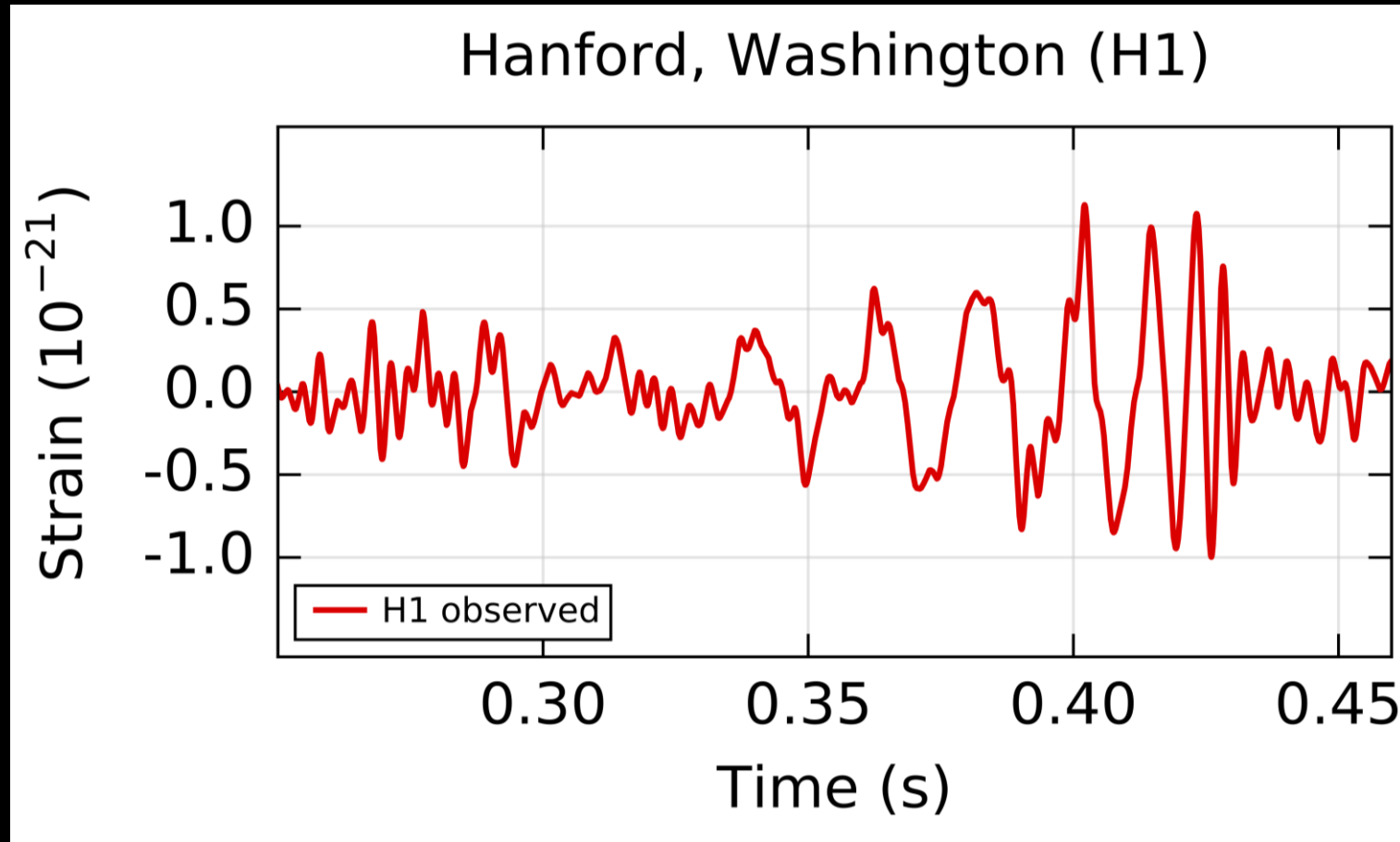
# Really big interferometers



# Location, location, location

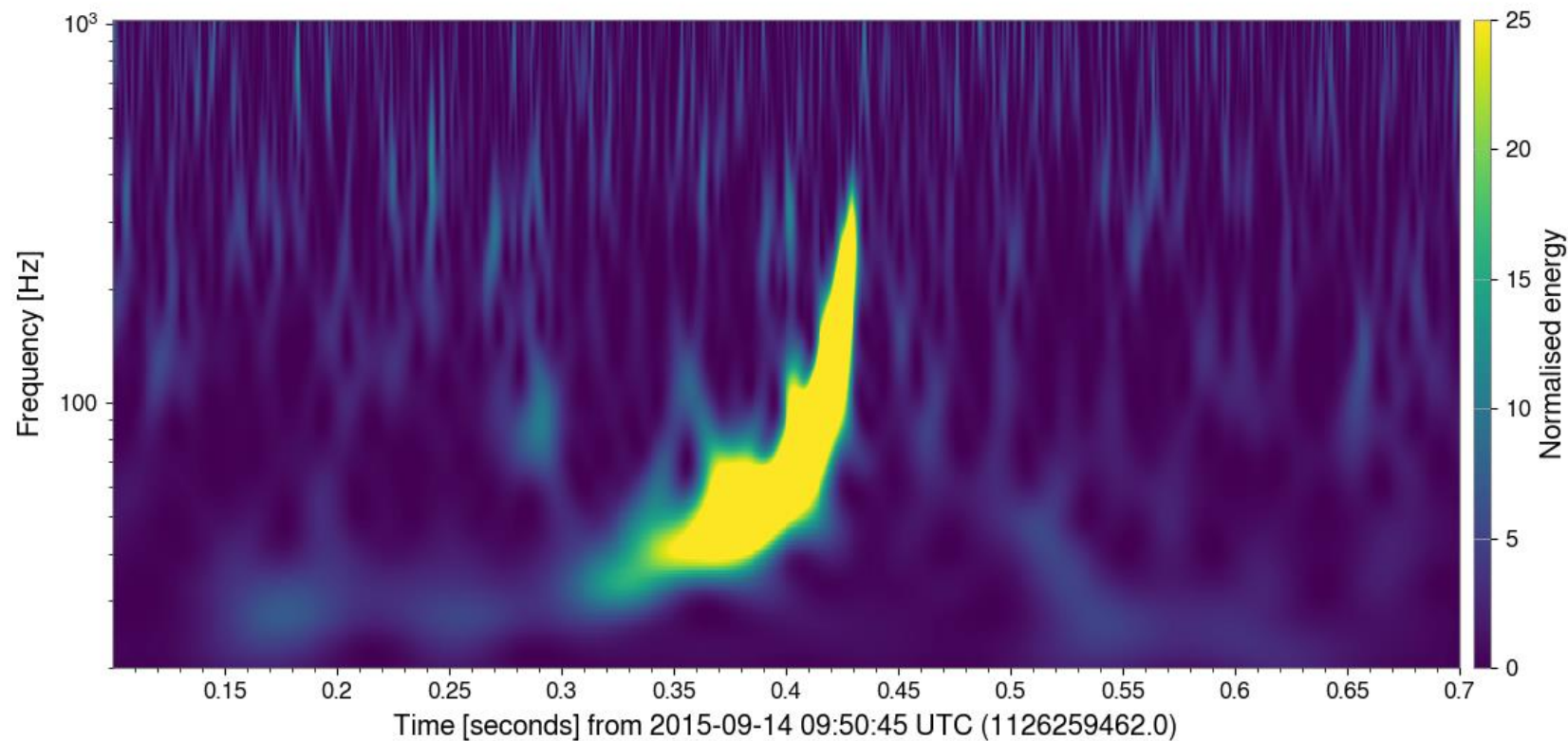


# What does a gravitational wave look like...



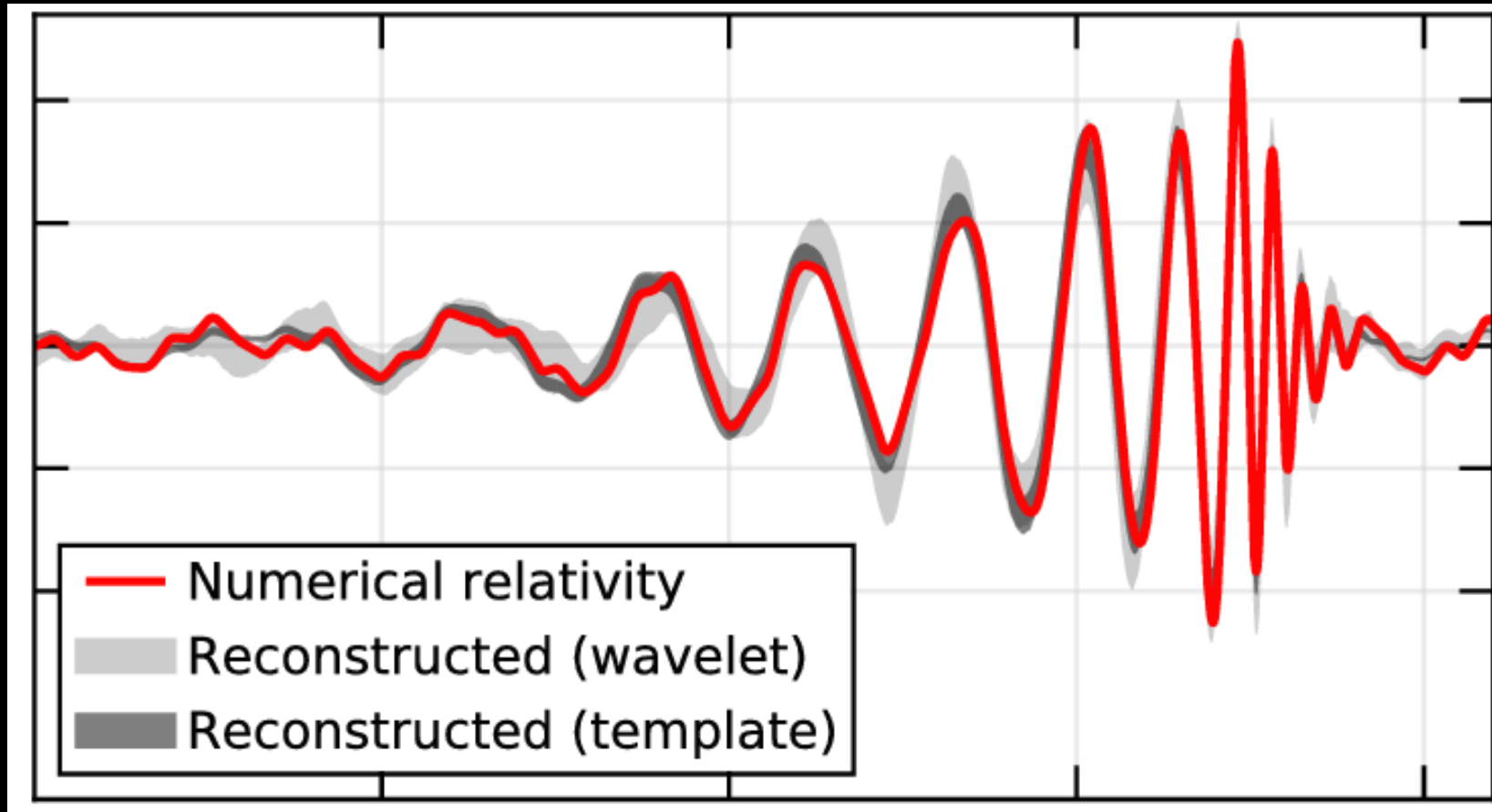


...and what does it “sound” like?



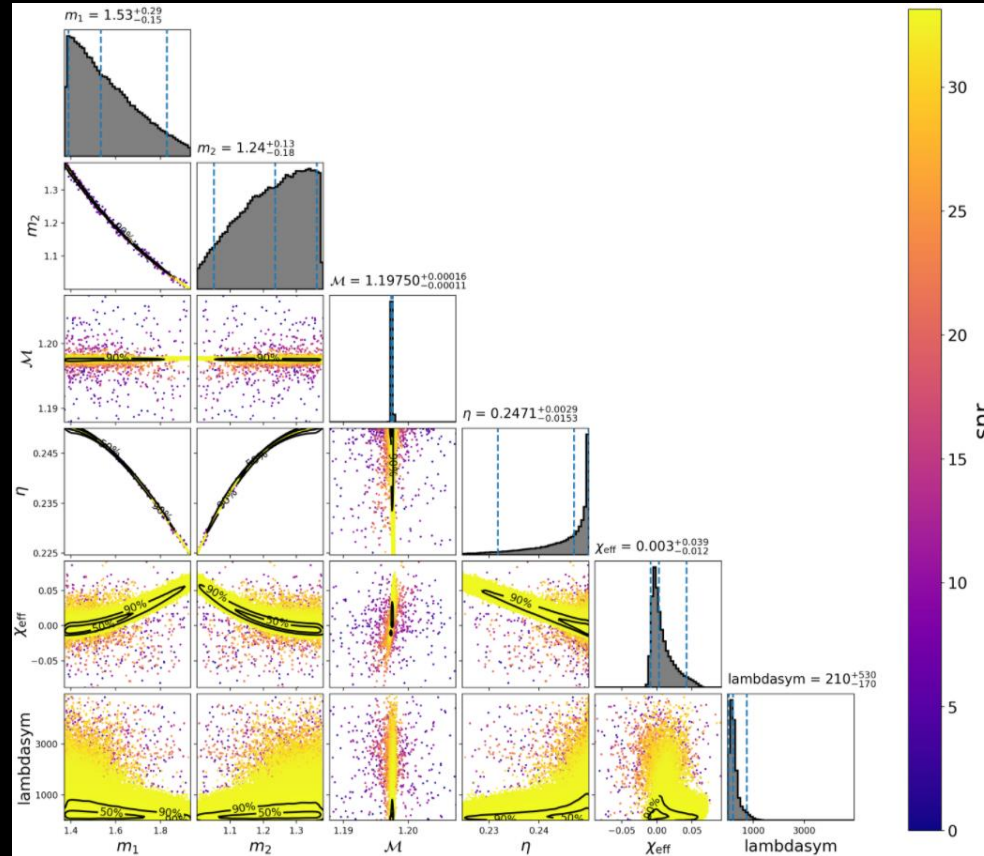
Courtesy of LOSC

# Turning squiggles into cool astrophysics



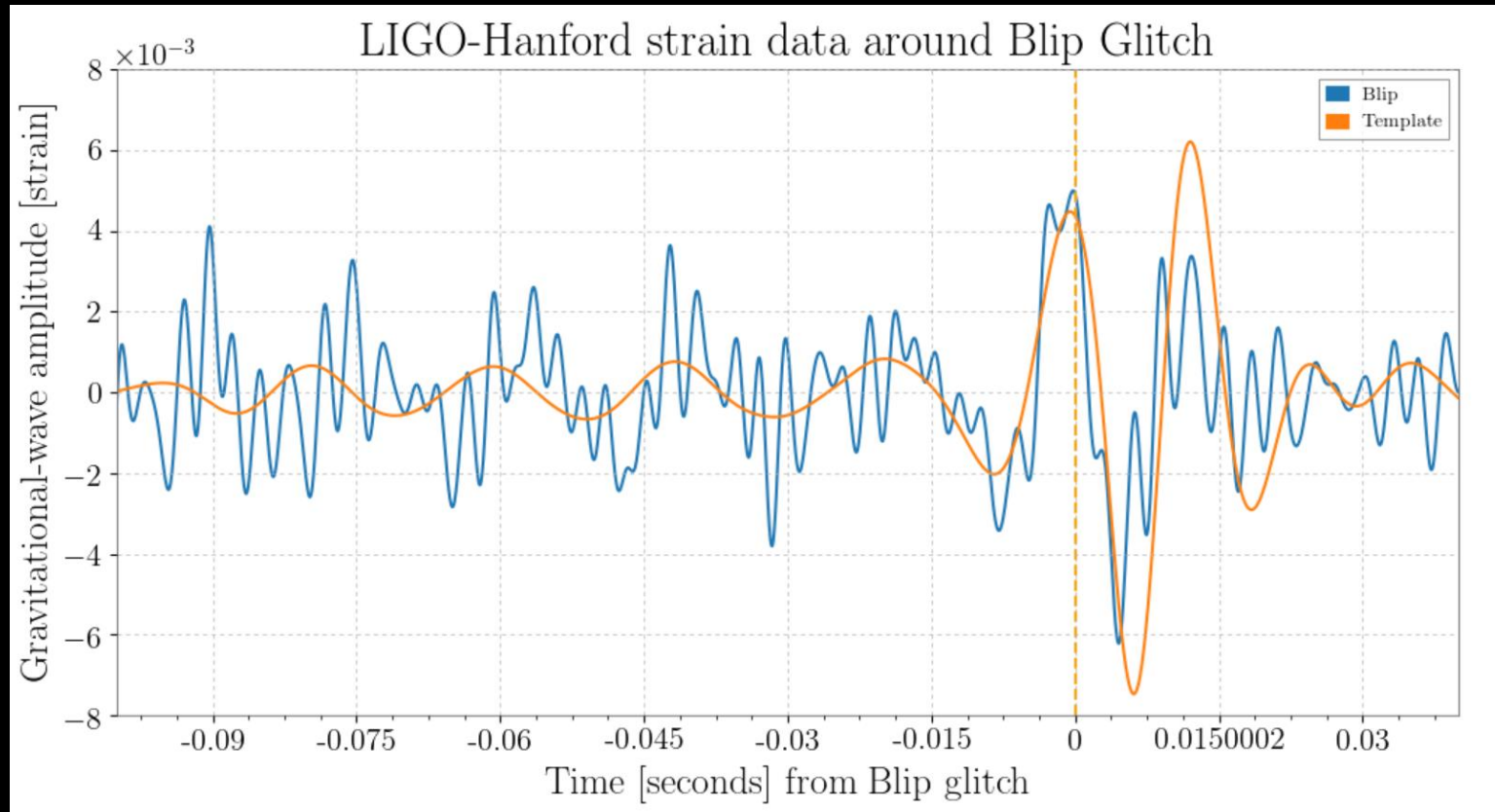
Courtesy of LIGO

# Effects of Spin Priors on Masses Recovered from Binary Neutron Star Gravitational-Wave Signals

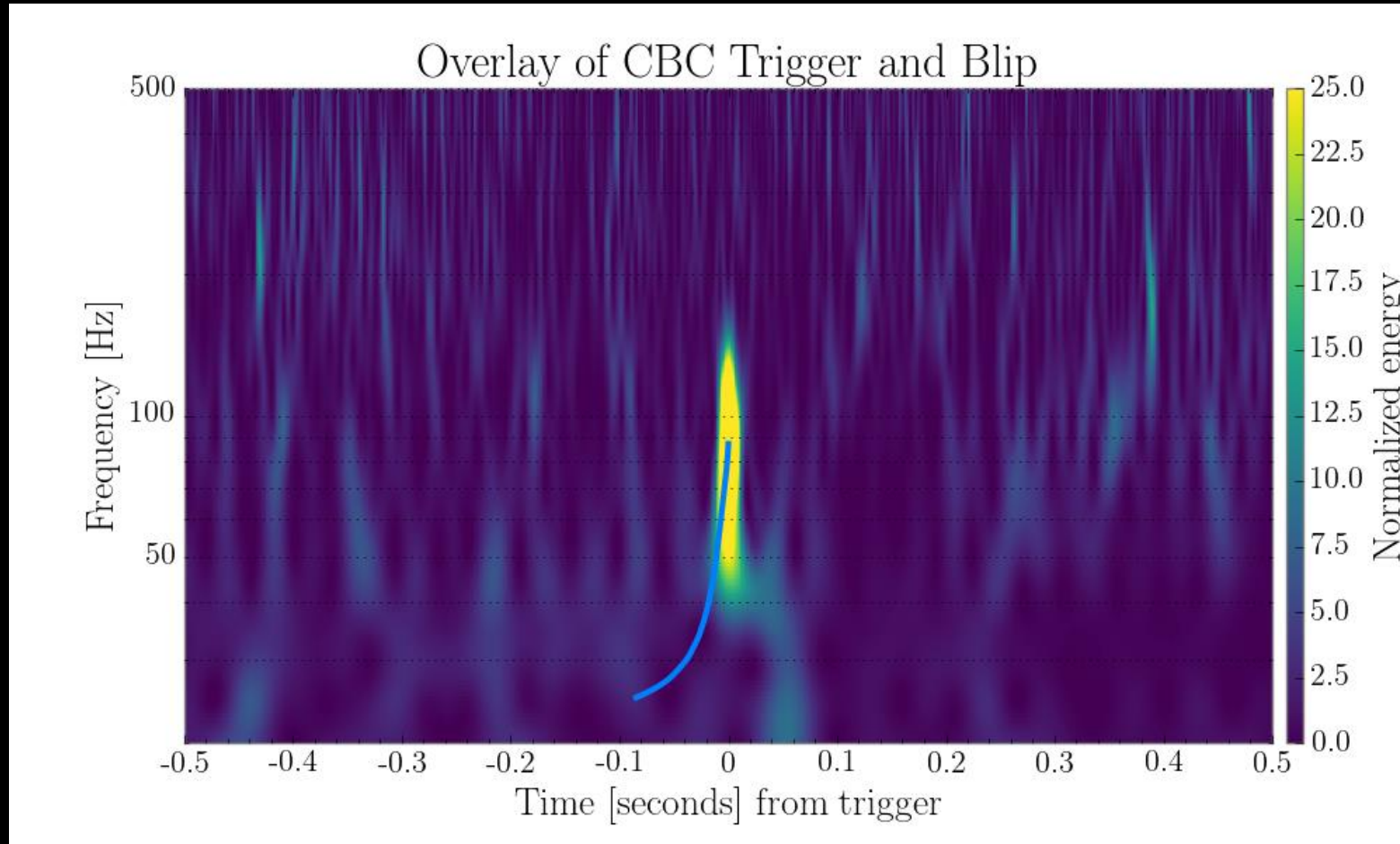




# Noise or gravitational wave?



# Noise or gravitational wave?



Courtesy of Derek Davis

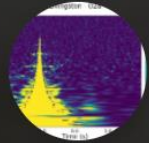
# What's it like to be a GW data scientist?

- Lots of coding
- Lots of pretty plots
- Group meetings
- Papers
- Presentations
- Travel!





# How you can get involved



Gravity Spy ✓

ABOUT

CLASSIFY

TALK

COLLECT

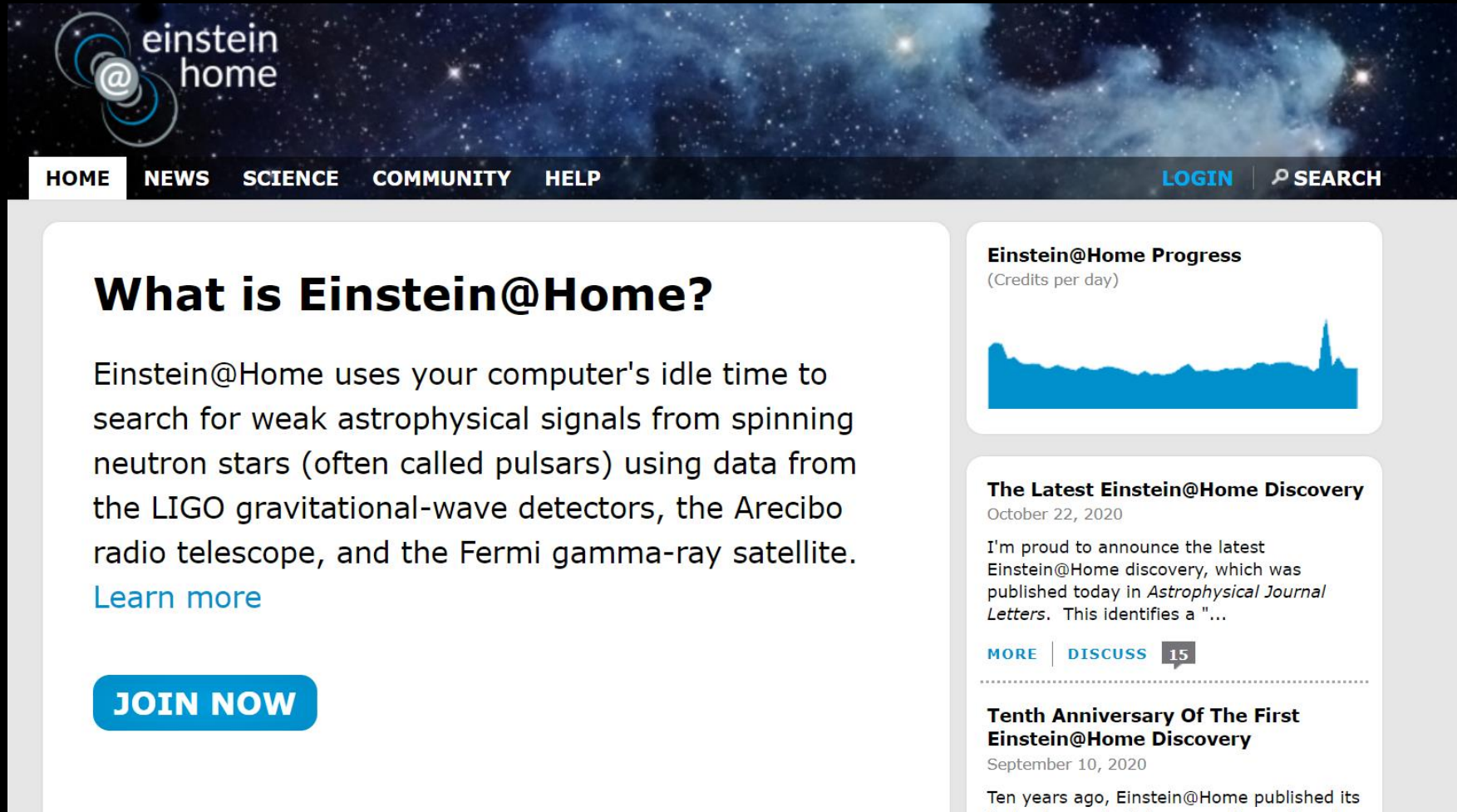
The newest member of the gravitational wave family has been announced! LIGO-Virgo discovered a merger with one object in the mysterious "mass gap" between the heaviest neutron stars and lightest black holes. We aren't able to tell what it is because it was swallowed whole by its black hole companion. Find out more about this enigma in [discovery paper](#), check out some out-of-this-world [media here](#), and read about the major contributions to this discovery made by members of the Gravity Spy from [Northwestern](#) and [CSU Fullerton](#)!

Help scientists at LIGO search for  
gravitational waves, the elusive  
ripples of spacetime.

Learn more

Get started

# How you can get involved



The screenshot shows the Einstein@Home website homepage. The header features the Einstein@Home logo on the left and navigation links (HOME, NEWS, SCIENCE, COMMUNITY, HELP) in the center. On the right, there are links for LOGIN and SEARCH. The main content area is divided into two columns. The left column contains a large heading 'What is Einstein@Home?' followed by a paragraph explaining the project's goal: to search for weak astrophysical signals from spinning neutron stars (pulsars) using data from the LIGO gravitational-wave detectors, the Arecibo radio telescope, and the Fermi gamma-ray satellite. Below this is a blue button labeled 'JOIN NOW'. The right column contains two smaller sections. The top section is titled 'Einstein@Home Progress' and shows a blue line graph representing 'Credits per day'. The bottom section is titled 'The Latest Einstein@Home Discovery' and mentions a discovery announced on October 22, 2020, published in *Astrophysical Journal Letters*. It includes links for 'MORE' and 'DISCUSS' with a count of 15. Below this is another section titled 'Tenth Anniversary Of The First Einstein@Home Discovery' dated September 10, 2020, mentioning the project's first discovery.

**einstein@home**

[HOME](#) [NEWS](#) [SCIENCE](#) [COMMUNITY](#) [HELP](#) [LOGIN](#) [SEARCH](#)

## What is Einstein@Home?


Einstein@Home uses your computer's idle time to search for weak astrophysical signals from spinning neutron stars (often called pulsars) using data from the LIGO gravitational-wave detectors, the Arecibo radio telescope, and the Fermi gamma-ray satellite.

[Learn more](#)

**JOIN NOW**

### Einstein@Home Progress

(Credits per day)



### The Latest Einstein@Home Discovery

October 22, 2020

I'm proud to announce the latest Einstein@Home discovery, which was published today in *Astrophysical Journal Letters*. This identifies a "...

[MORE](#) | [DISCUSS](#) 15

### Tenth Anniversary Of The First Einstein@Home Discovery

September 10, 2020

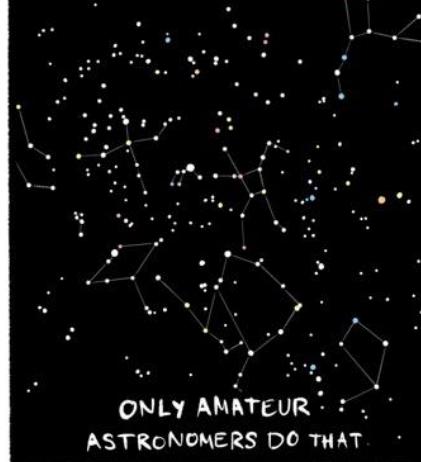
Ten years ago, Einstein@Home published its

# What's next?

- A+
- Cosmic Explorer
- LISA

# HOW TO BECOME A REAL ASTRONOMER

DON'T MEMORIZE  
CONSTELLATIONS



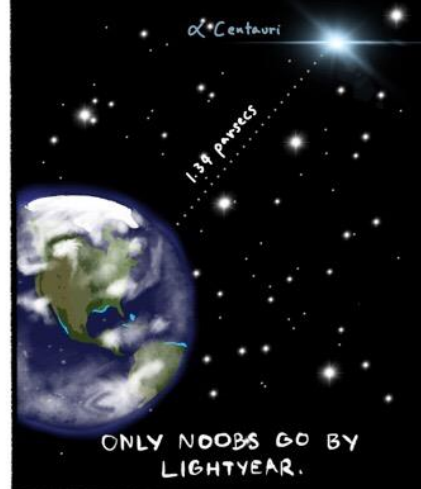
ONLY AMATEUR  
ASTRONOMERS DO THAT.

DON'T BUY A  
TELESCOPE



YOU CAN STILL ENJOY IT, BUT IT  
DOESN'T MAKE YOU A REAL ASTRONOMER.

GET USED TO PARSEC



ONLY NOOBS GO BY  
LIGHTYEAR.

GET A PHYSICS DEGREE



A PHD TO BE PRECISE.  
ALL ASTRONOMERS USE PHYSICS  
THESE DAYS (UNLESS THEY'RE  
CRACKPOT SCIENTISTS).

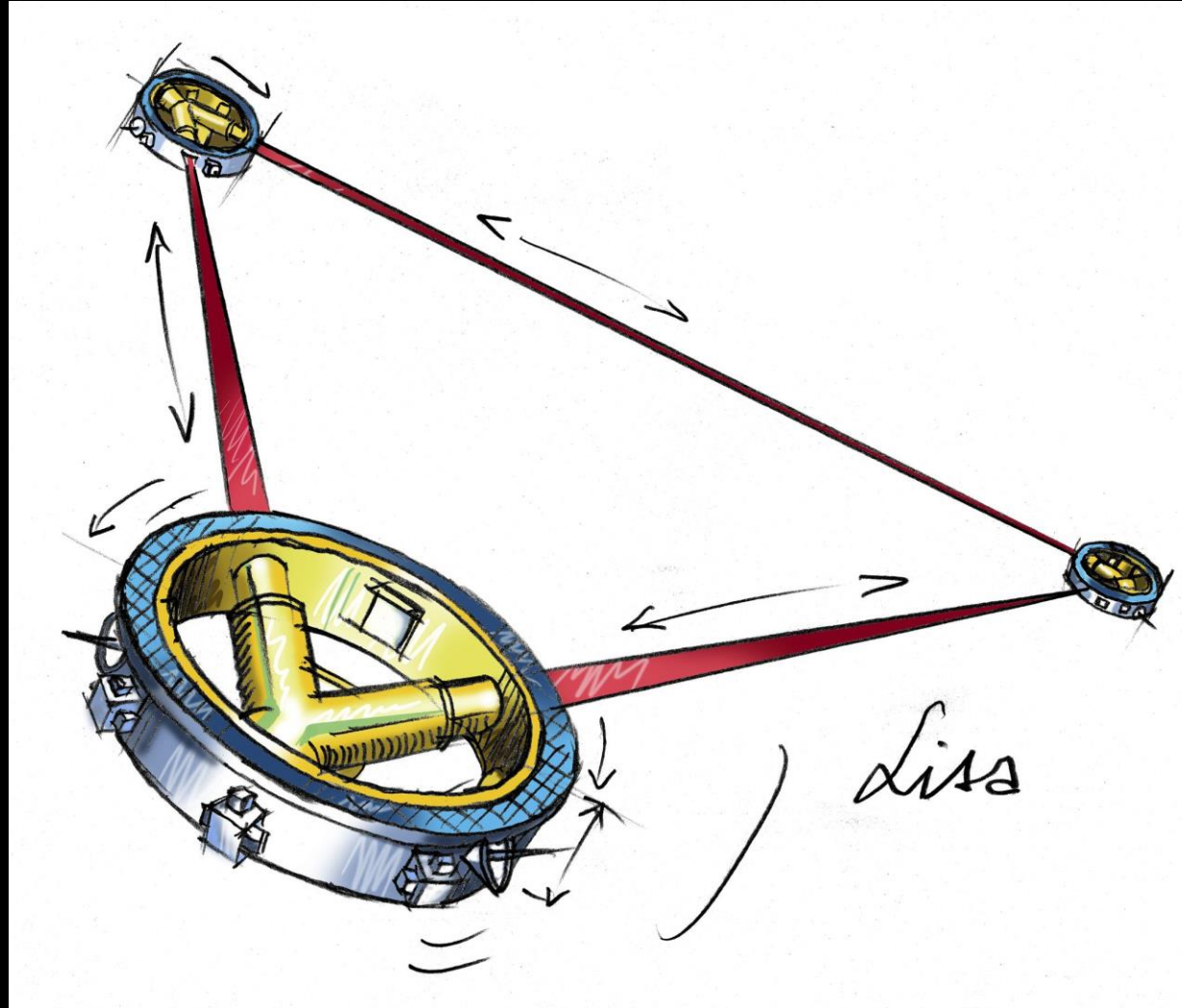
ANTIMATTERWEBCOMICS.COM

NUTSINEE K © 2017



# Extra Slides

# LISA



# NSBH Mergers

