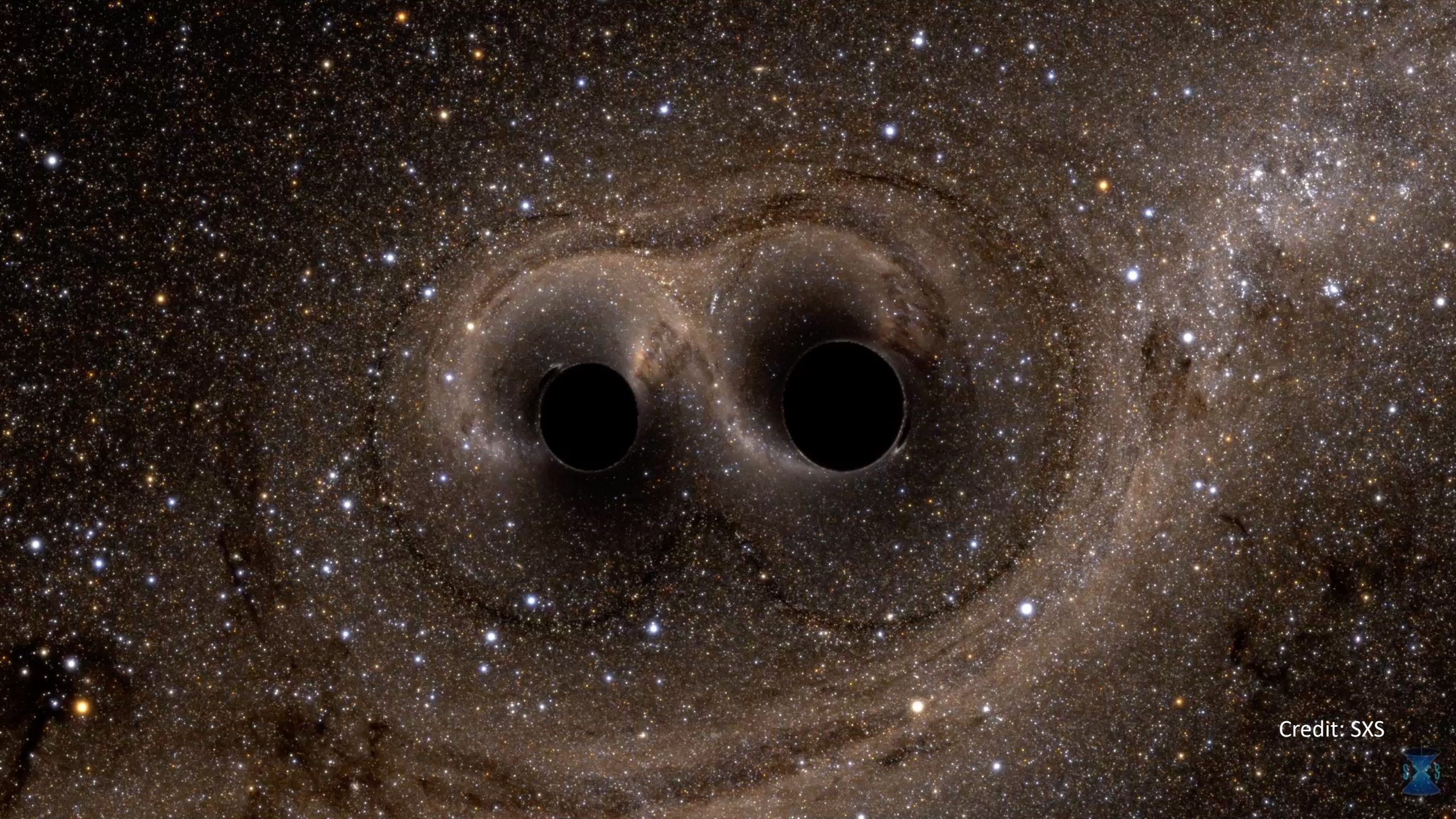

Credit: SXS

Welcome to LIGO!
The Most Sensitive Instrument in the World

Camilla Compton (she/her) - Operations Specialist

LIGO Hanford Observatory - 2022

G2201823-v1

ABOUT ME

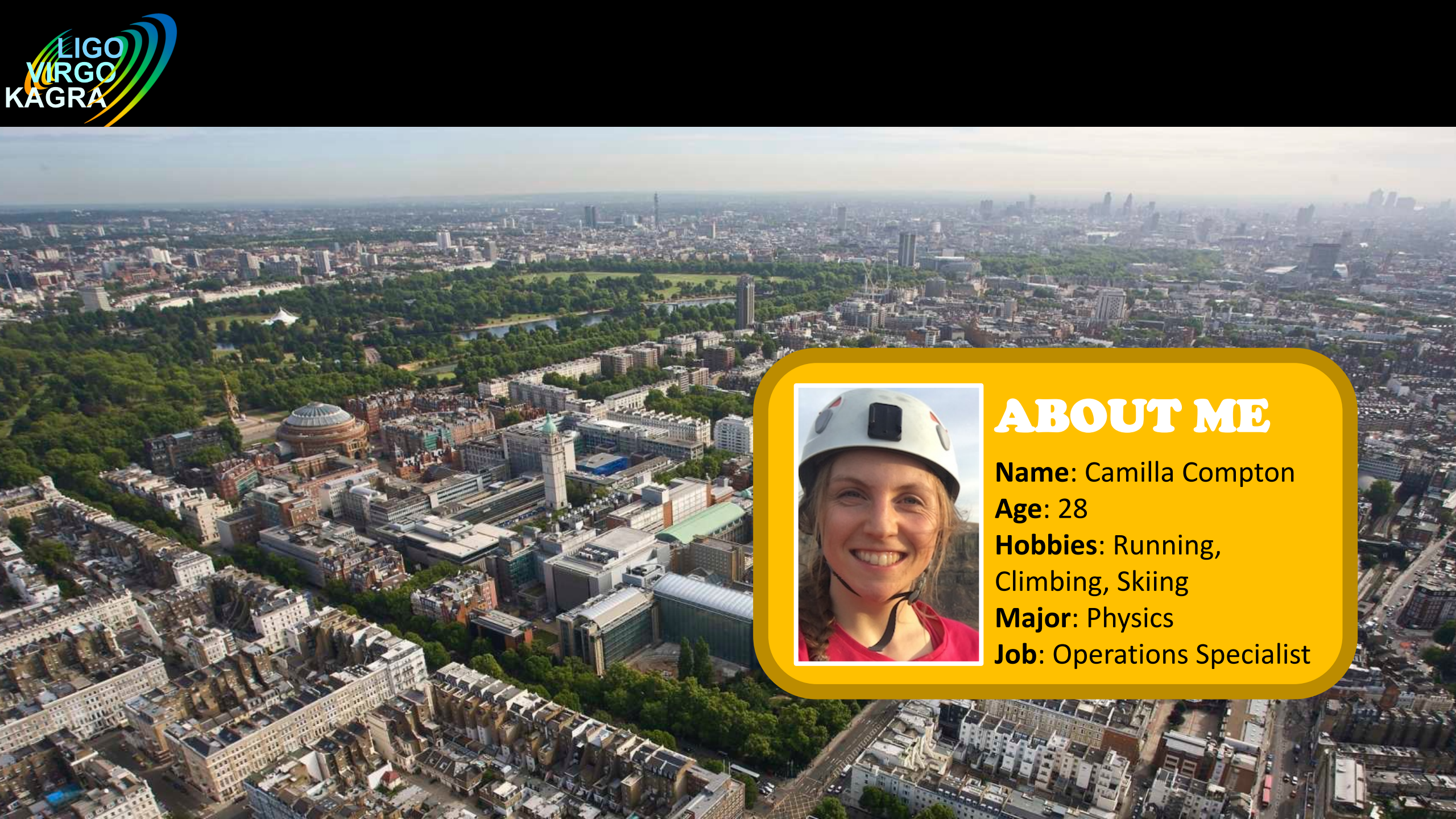
WHAT ARE WE SEARCHING FOR?

LIGO TECHNOLOGY

ABOUT ME

WHAT ARE WE SEARCHING FOR?

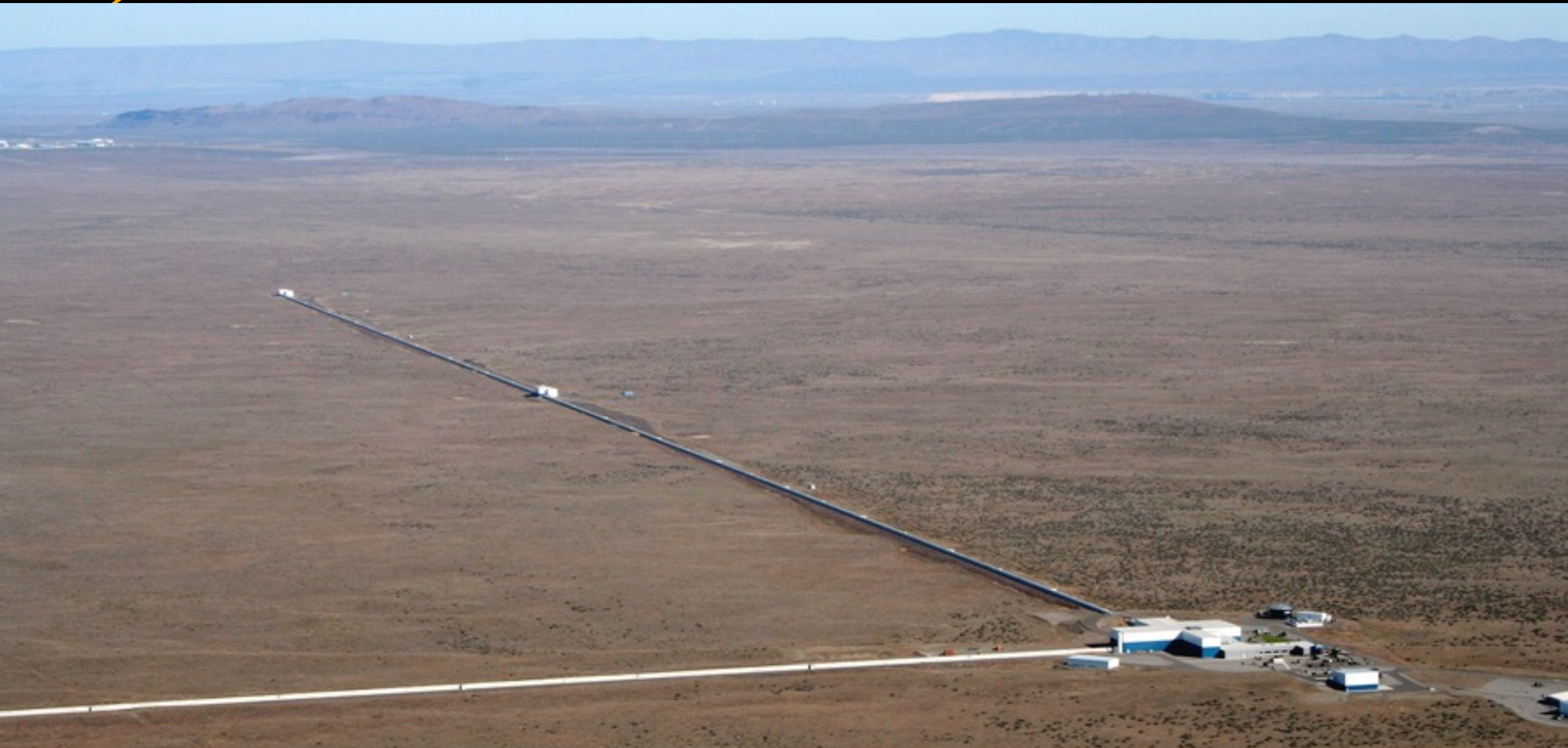
LIGO TECHNOLOGY



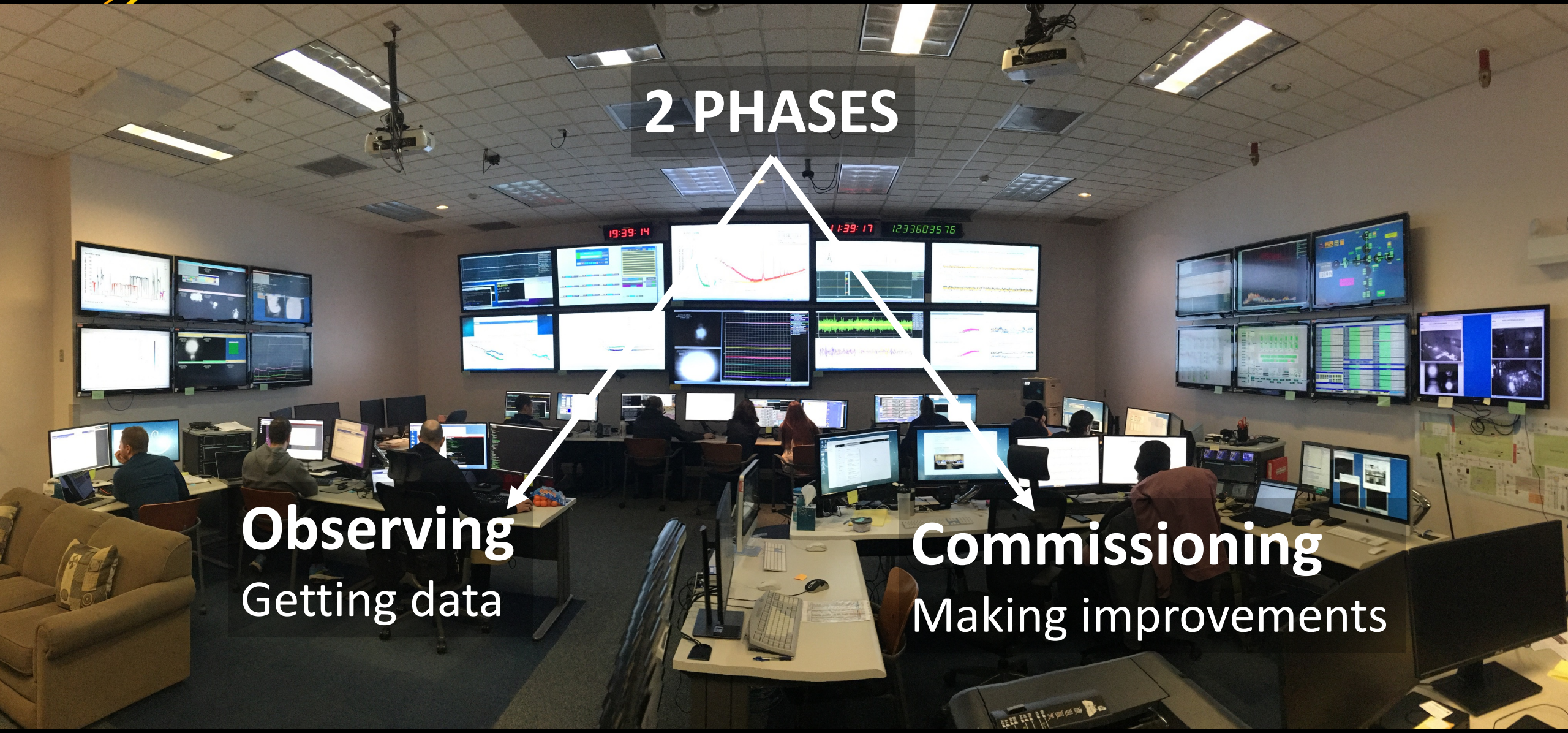
ABOUT ME

Name: Camilla Compton
Age: 28
Hobbies: Running, Climbing, Skiing
Major: Physics
Job: Operations Specialist

LIGO – Laser Interferometer Gravitational-Wave Observatory



THE LIGO CONTROL ROOM



Everything clean to maintain vacuum

LIGO – Laser Interferometer Gravitational-Wave Observatory

LIGO Hanford

LIGO Livingston

GEO600

Virgo

KAGRA

LIGO India

Operational

Planned

Gravitational Wave Observatories

ABOUT ME

WHAT ARE WE SEARCHING FOR?

LIGO TECHNOLOGY

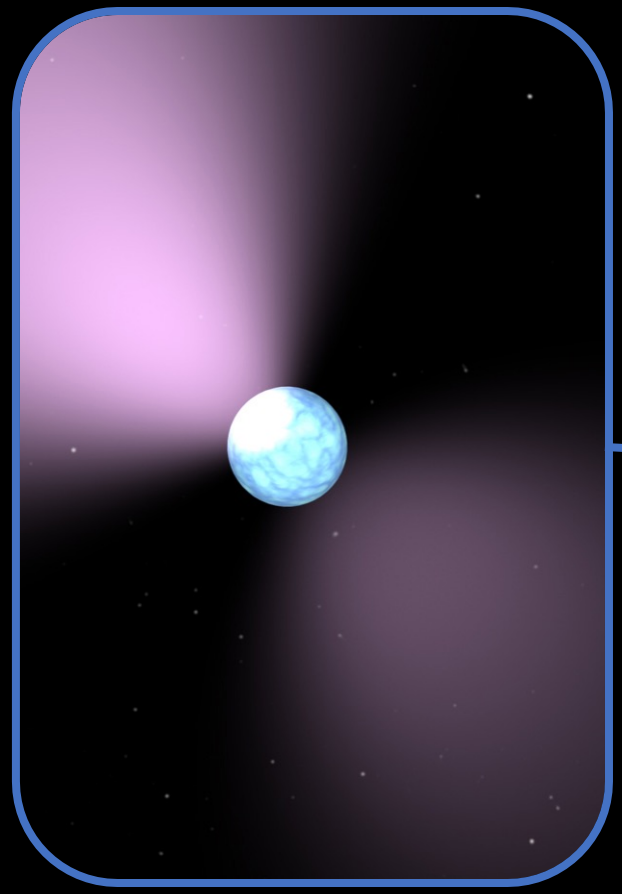
ABOUT ME

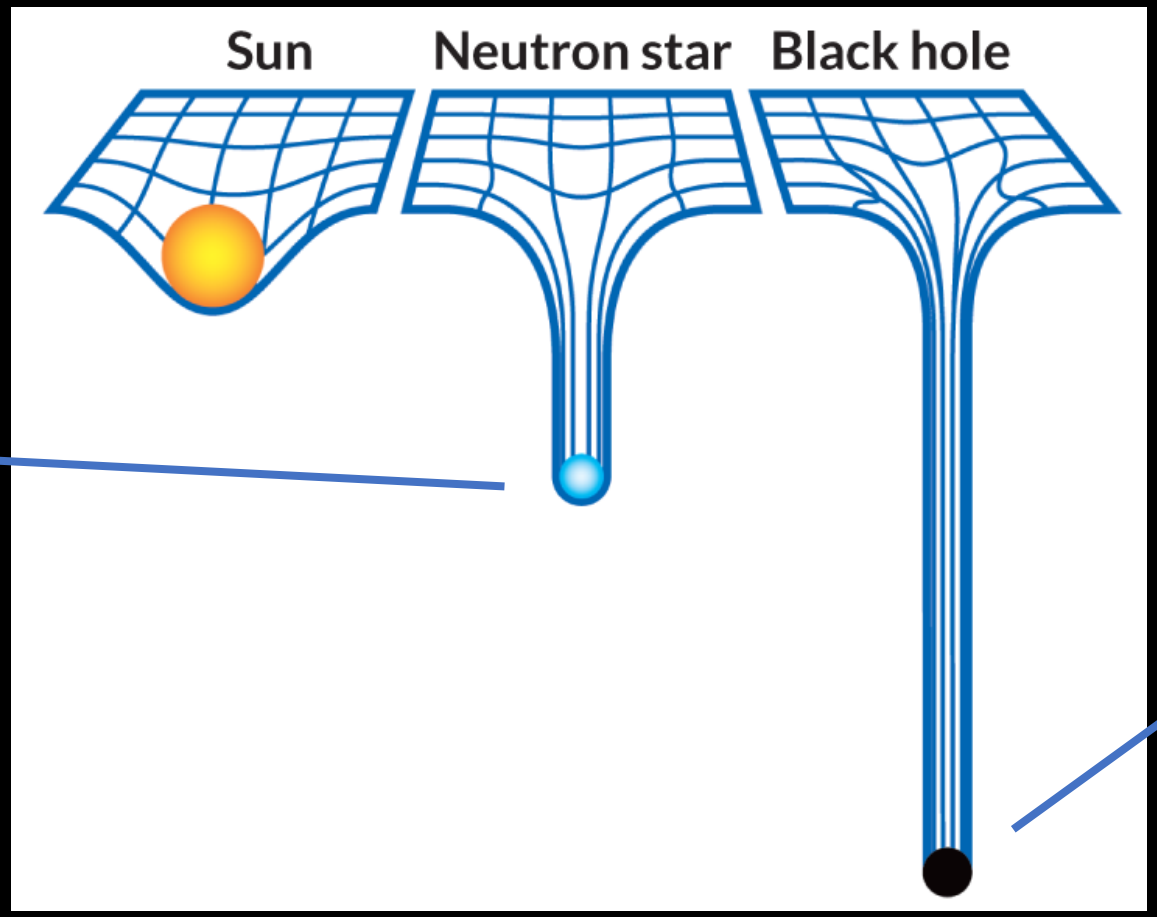
WHAT ARE WE SEARCHING FOR?

LIGO TECHNOLOGY

BLACK HOLES AND NEUTRON STARS

Credit: NASA JPL

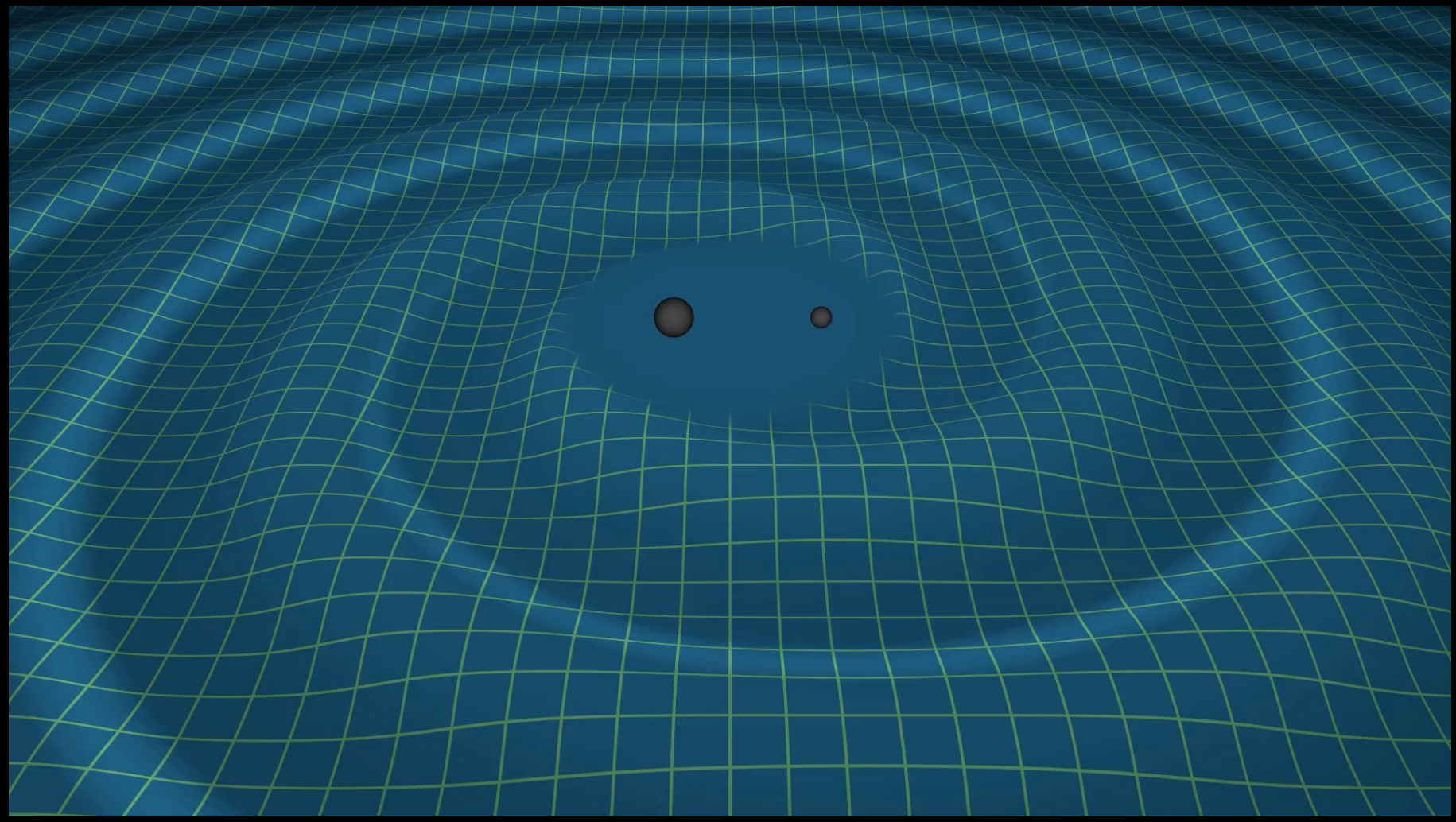




Neutron Star is left over from the gravitational collapse of a star after a supernova explosion.

Black hole is a very object so dense that even light cannot escape it’s gravitational field.

WHAT ARE GRAVITATIONAL WAVES? THEIR EFFECT ON SPACETIME



GW150914 Blackholes with $36M_{solar}$ and $29M_{solar}$ combine to make a bigger Blackhole with $62M_{solar}$. Remaining $3M_{solar}$ ejected as energy.

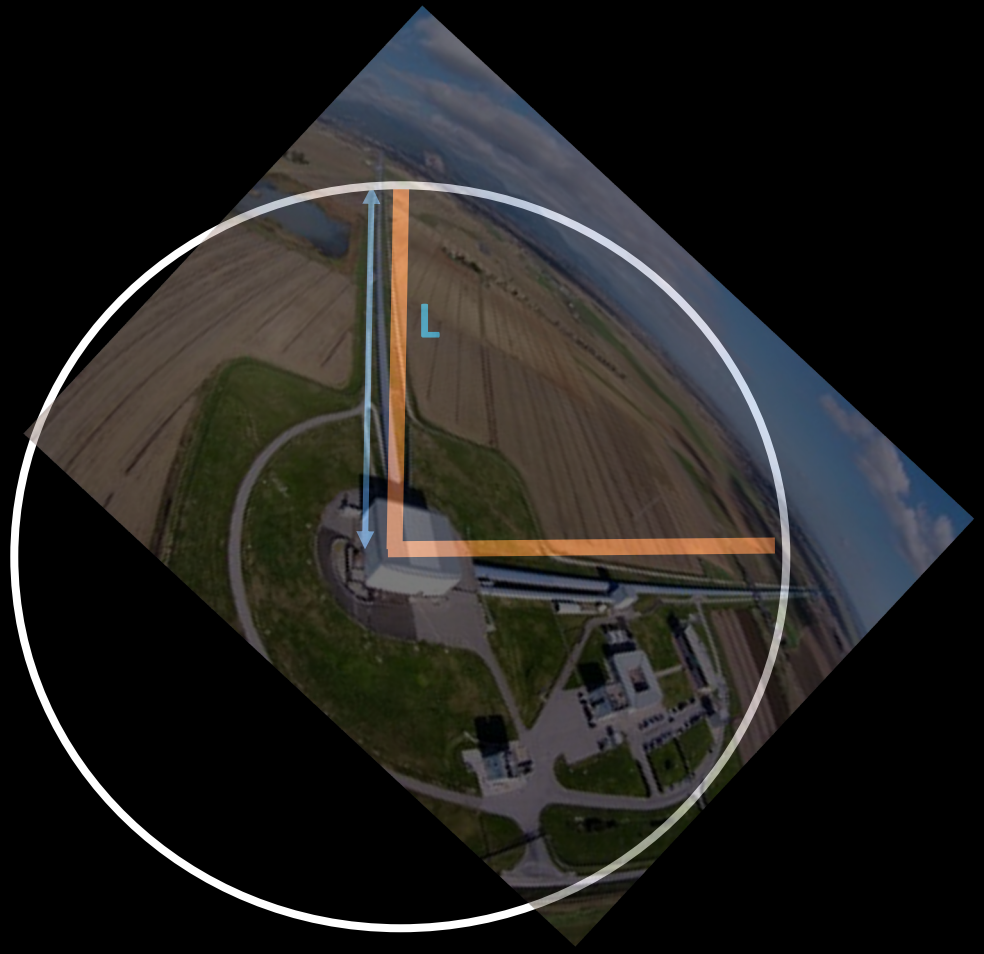
Credit: LIGO/T. Pyle

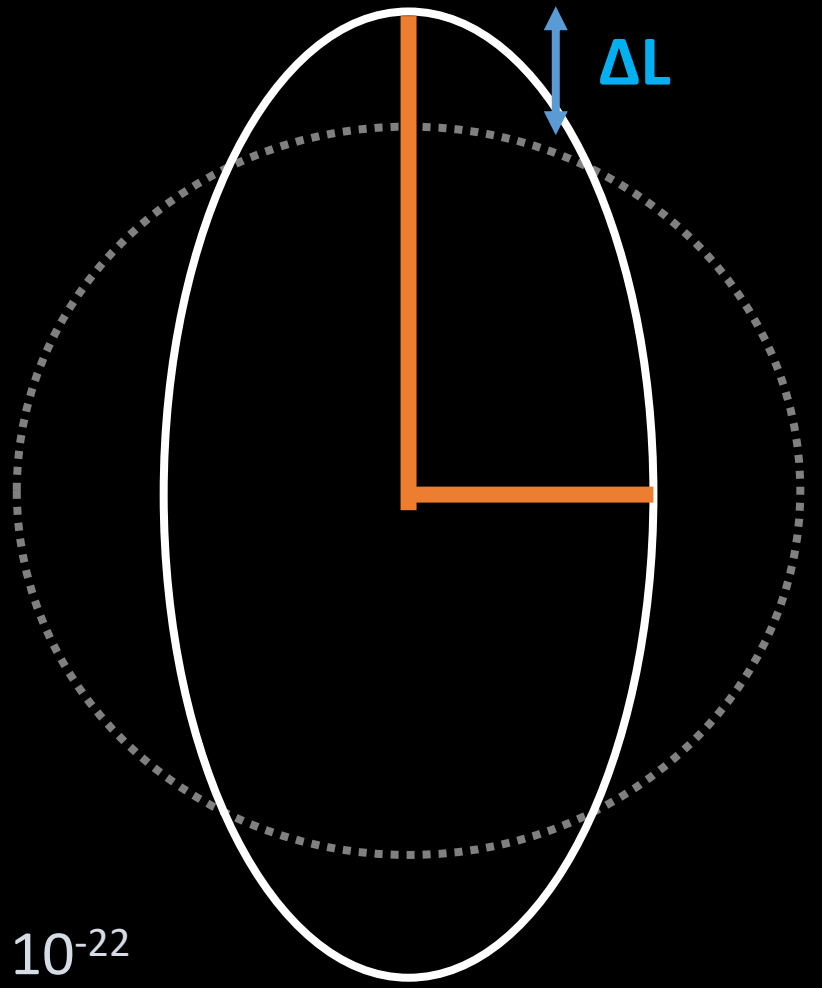
WHAT ARE GRAVITATIONAL WAVES? THEIR EFFECT ON SPACETIME

Credit: LIGO/R. Hurt

This is exaggerated, we want to be sensitive to the whole earth moving by the diameter of a proton!

GRAVITATIONAL WAVES - EFFECT ON SPACE





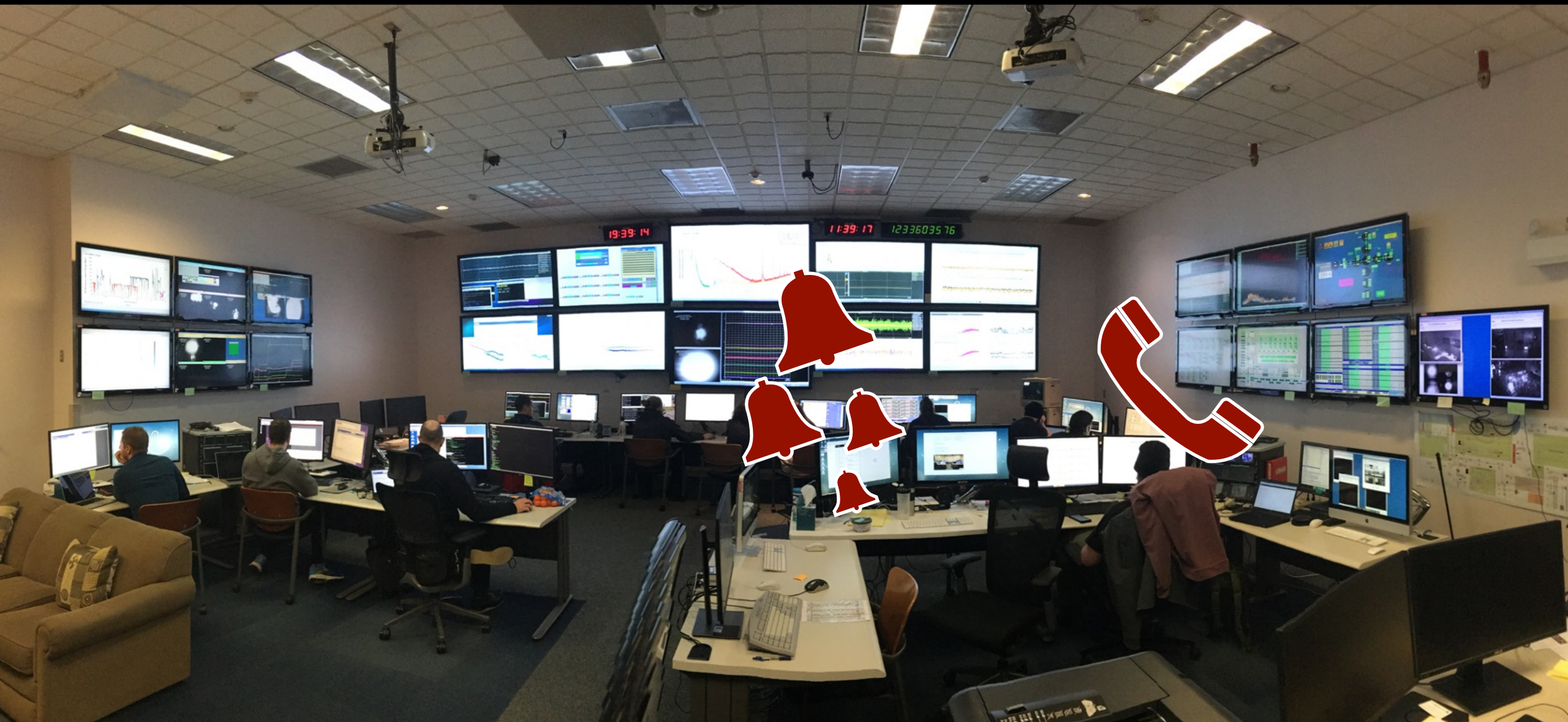
To detect gravitational wave signals we need a strain = $\frac{\Delta L}{L}$ = 10^{-22}

Length of arms = L = 4000m ~ 10^3 m

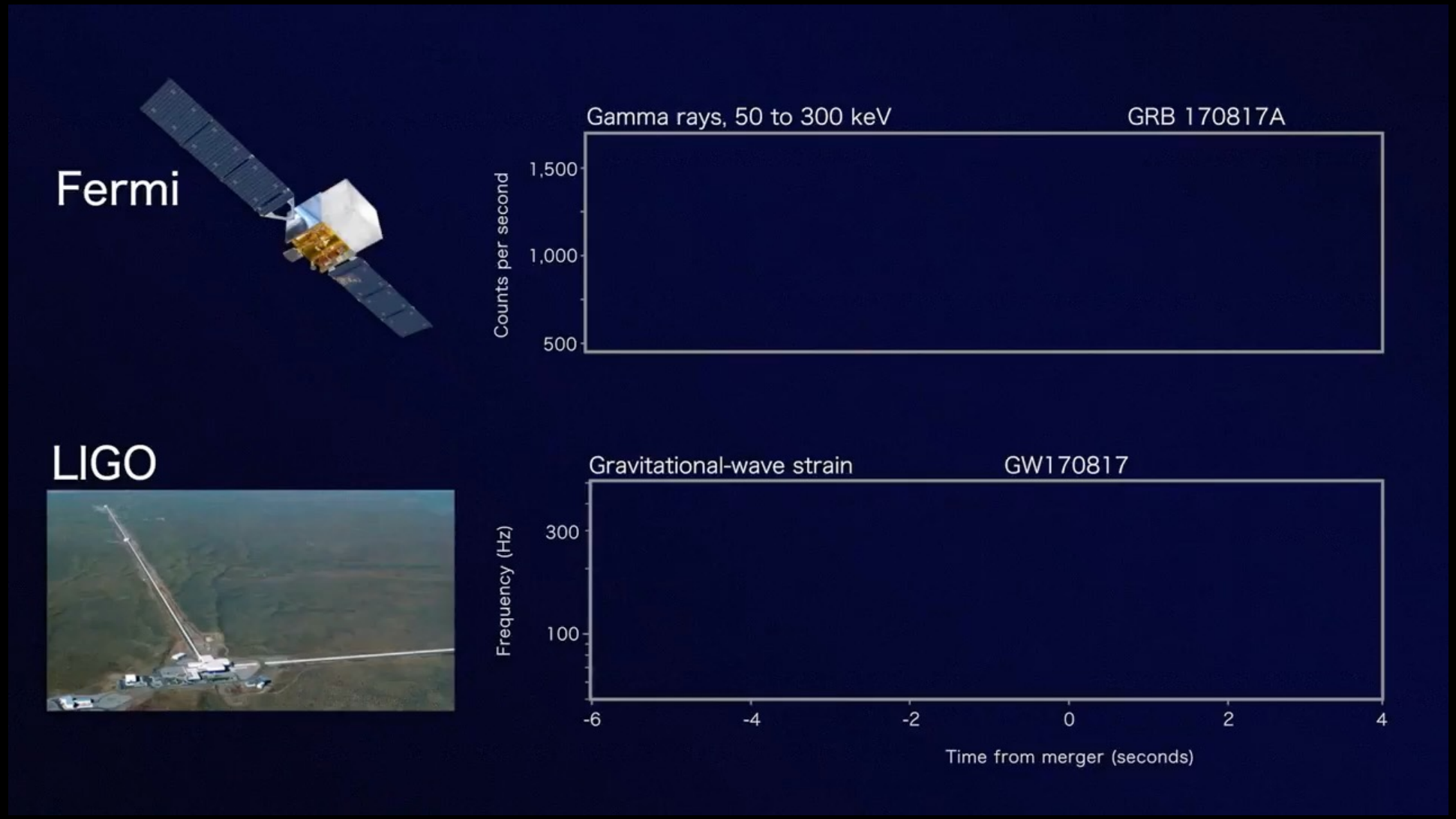
So we need to detect changes in length $\underline{\Delta L = 10^{-18}\ \mathbf{m}}$

12:41:04 UTC = 4:41am in the LIGO Hanford Control Room

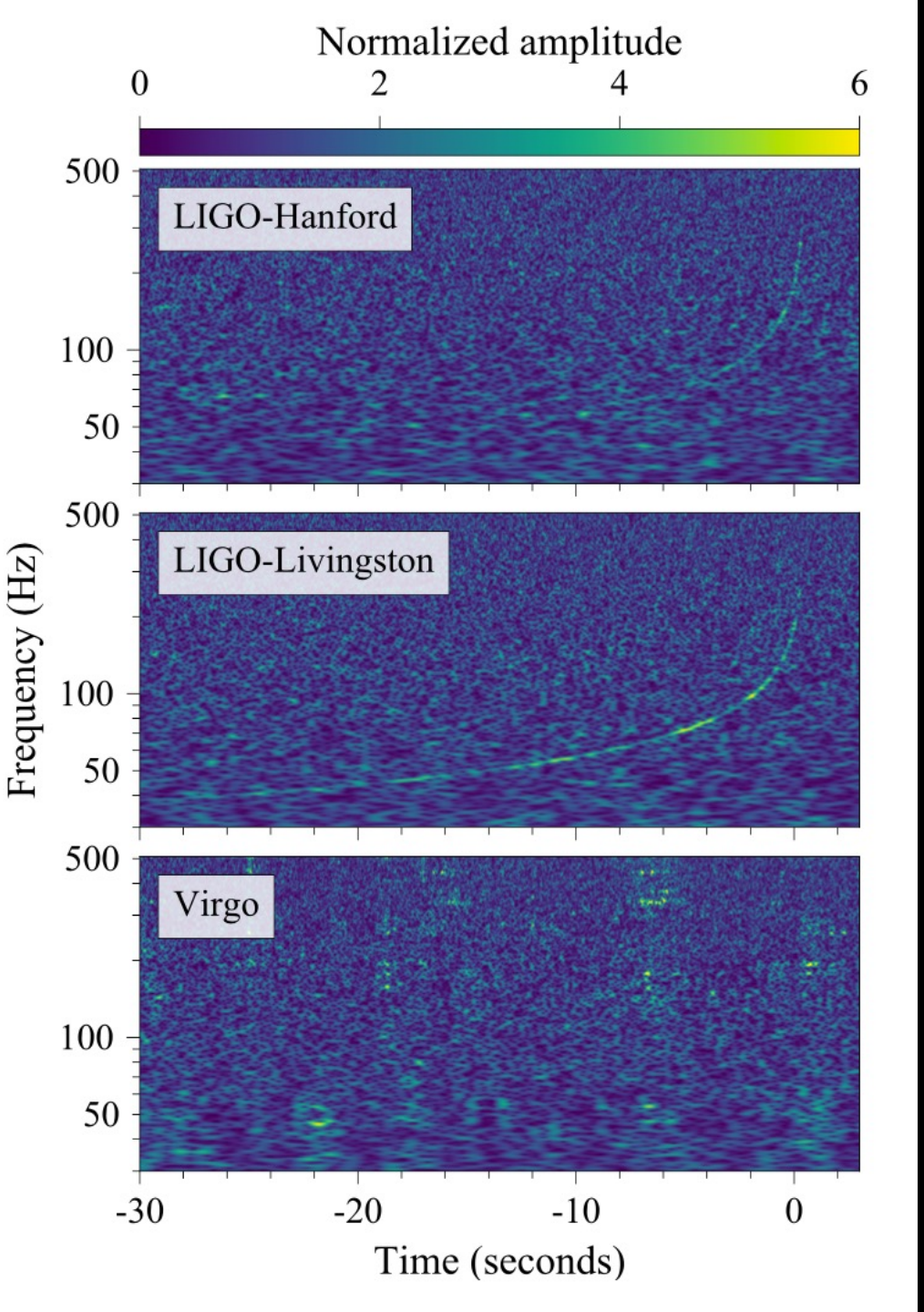
12:41:06 UTC = 4:41am in the LIGO Hanford Control Room

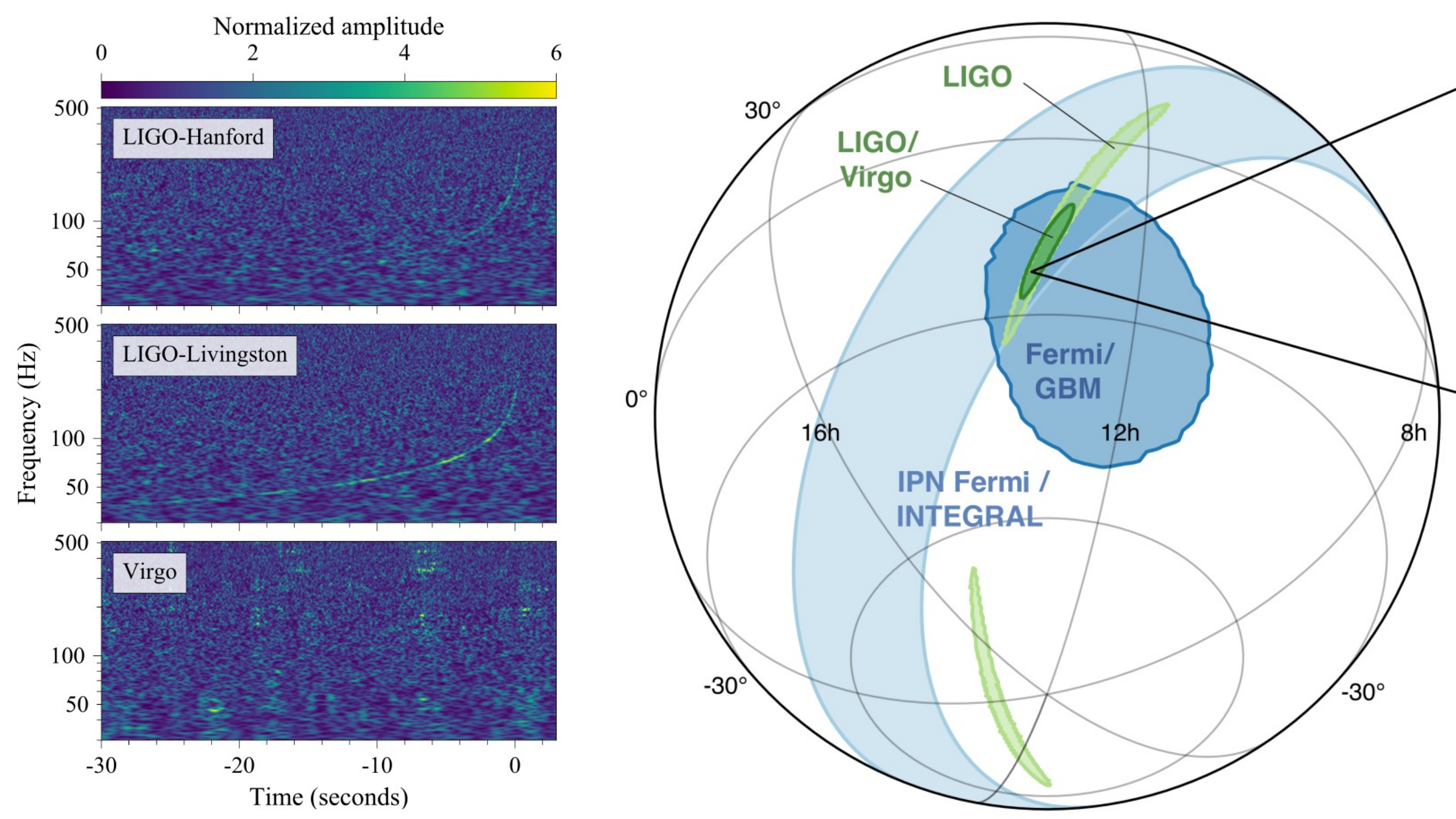


FIRST DECTECTION OF NEUTRON STAR MERGER – GW170817

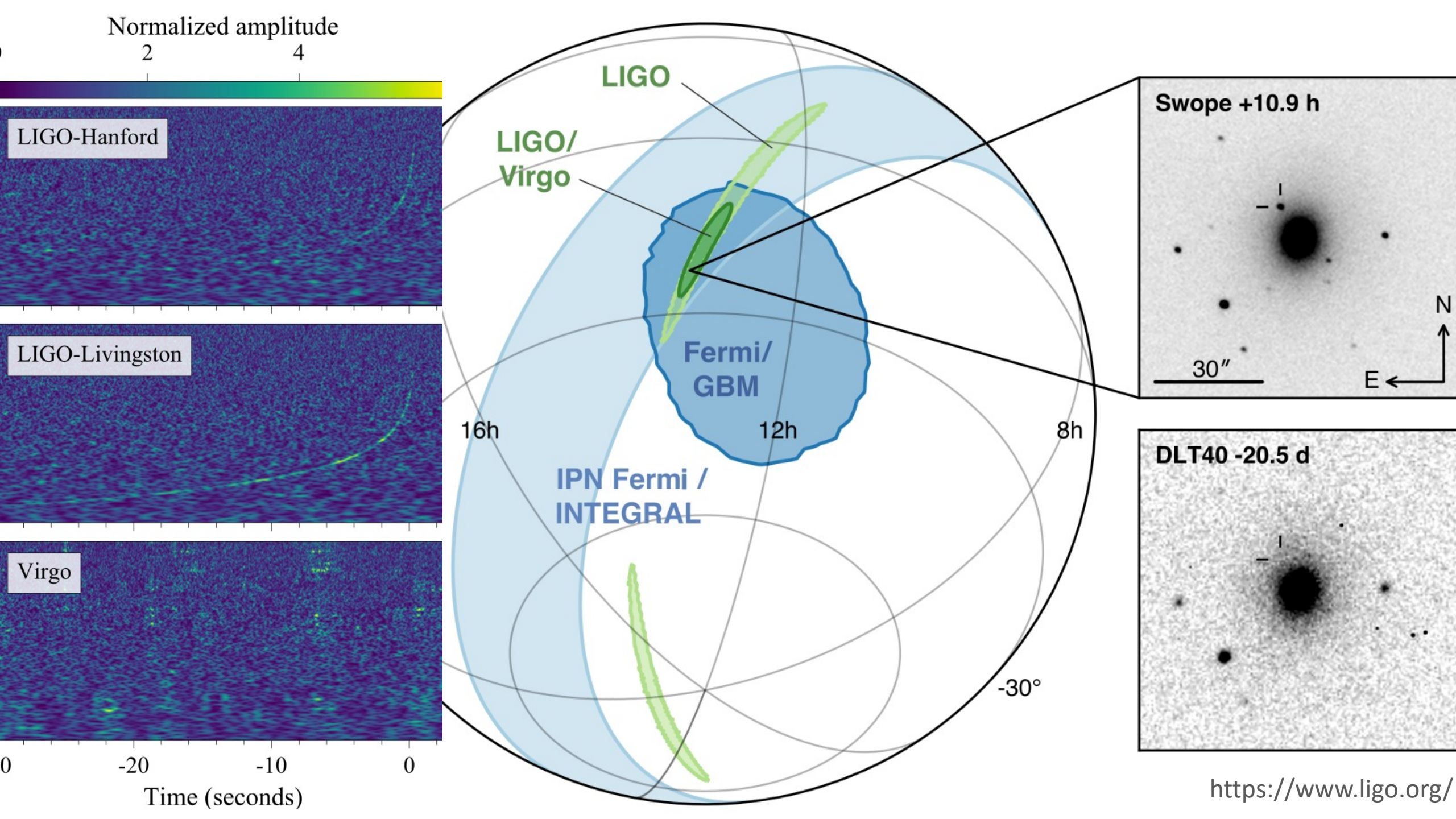


Credit: NASA GSFC & Caltech/MIT/LIGO Lab


Normalized amplitude
0
2
4
6
LIGO-Hanford
LIGO-Livingston
Virgo
500
100
50
Frequency (Hz)
-30
-20
-10
0
Time (seconds)


Normalized amplitude
0
2
4
6
LIGO-Hanford
LIGO-Livingston
Virgo
500
100
50
Frequency (Hz)
-30
-20
-10
0
Time (seconds)
LIGO
LIGO/
Virgo
Fermi/
GBM
IPN Fermi /
INTEGRAL
30°
0°
-30°
16h
12h
8h


+10 hours 52 minutes

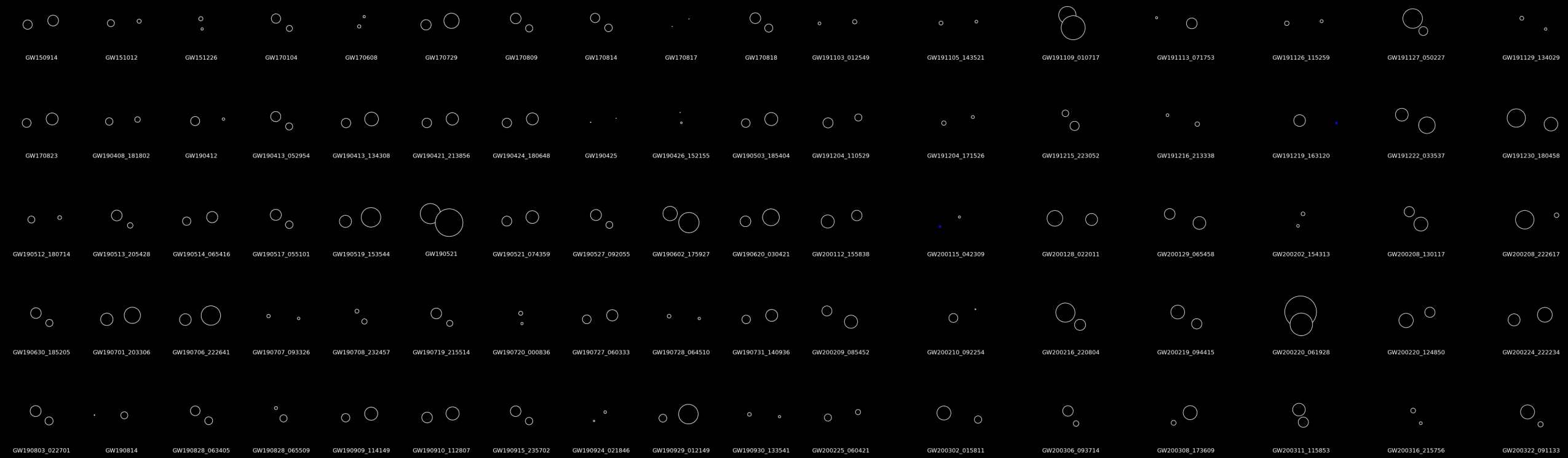


https://www.ligo.org/

GW170817

Credit: NASA's Goddard Space Flight Center/CI Lab

90 Gravitational Wave Detections!!



Credit: Zoheyr Doctor / CIERA / LIGO-Virgo Collaboration

ABOUT ME

WHAT ARE WE SEARCHING FOR?

LIGO TECHNOLOGY

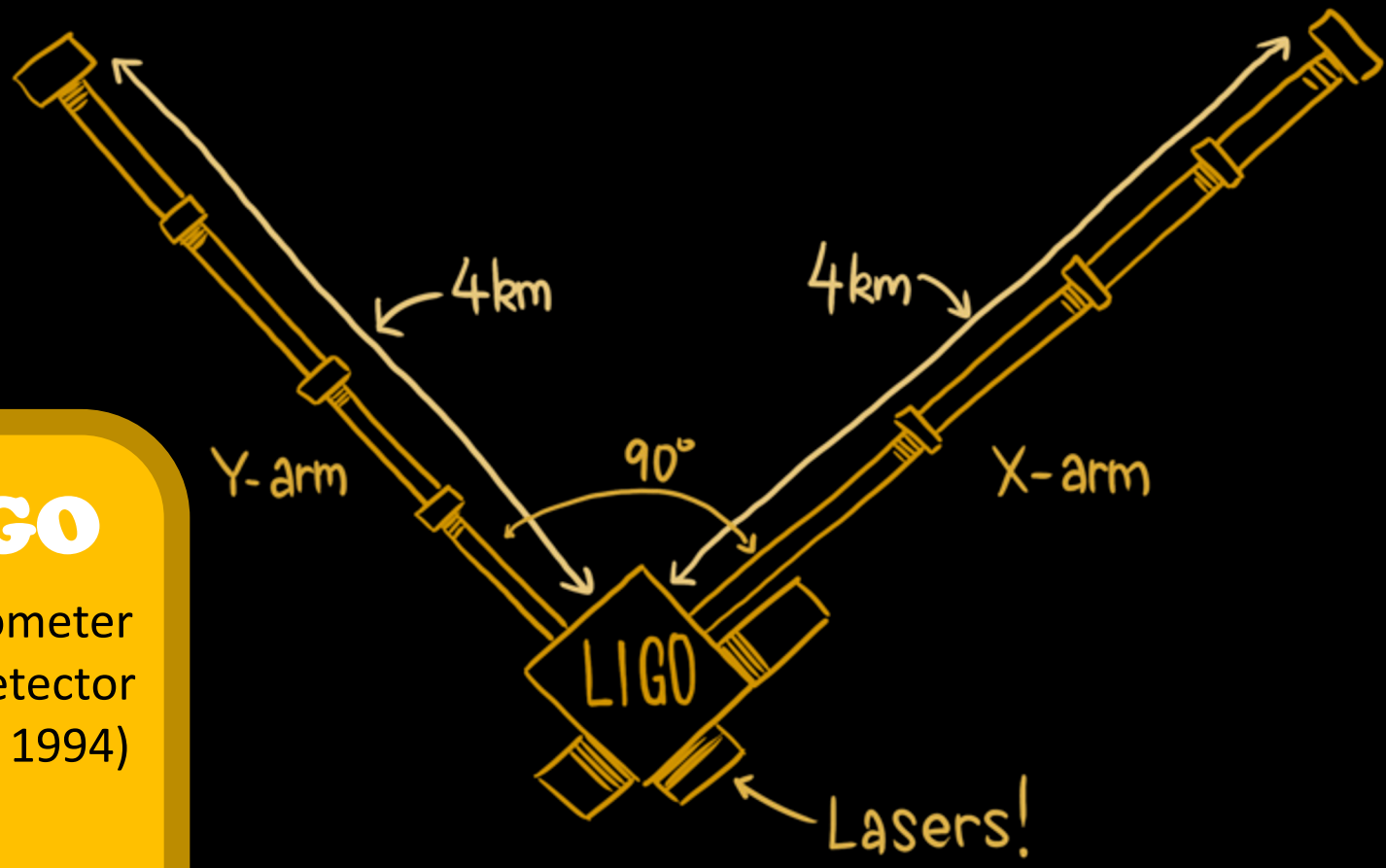
ABOUT ME

WHAT ARE WE SEARCHING FOR?

LIGO TECHNOLOGY

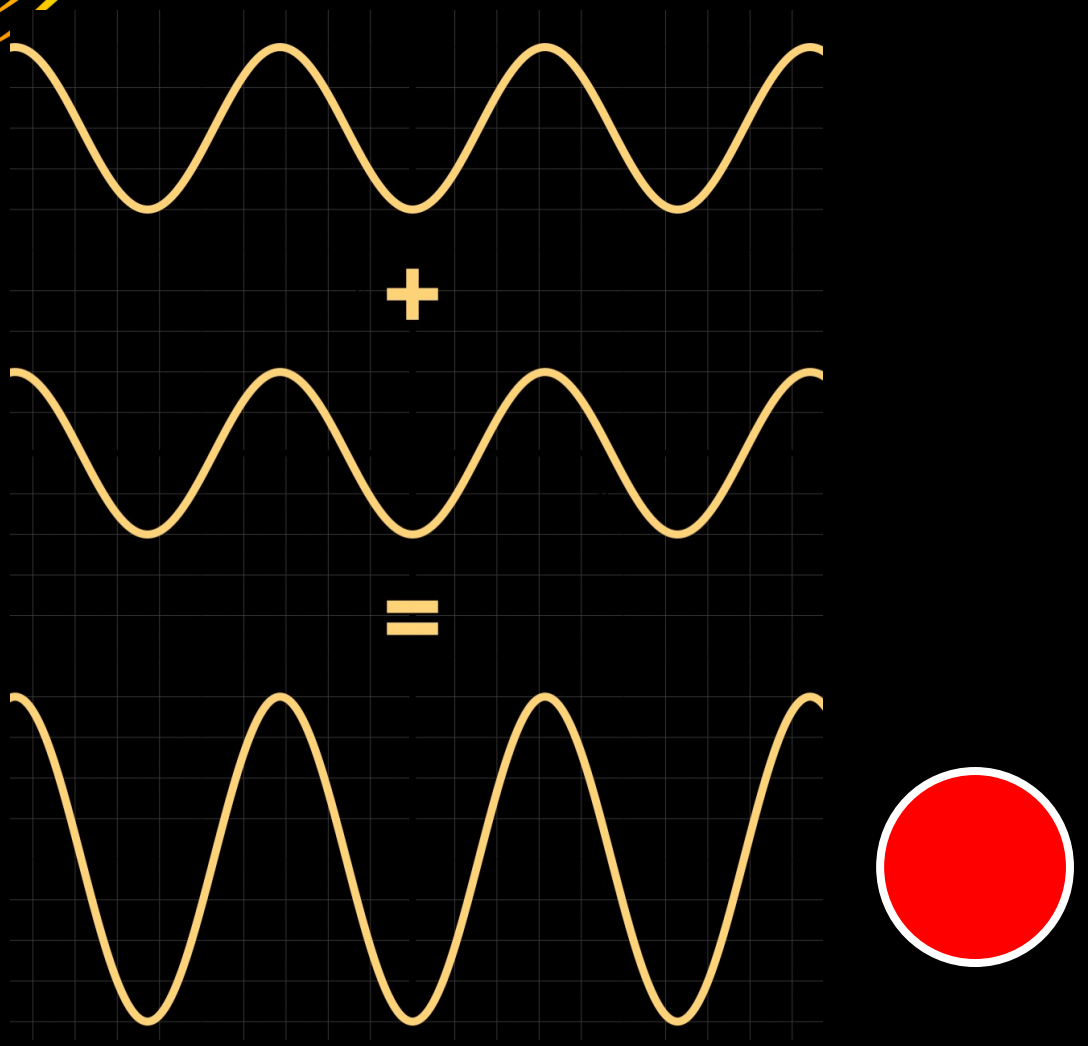
ABOUT LIGO

Name: Laser Interferometer Gravitational-wave Detector
Age: 28 (build started 1994)
Cost: $1 billion
Signals detected: 90
Size: 2.5 miles

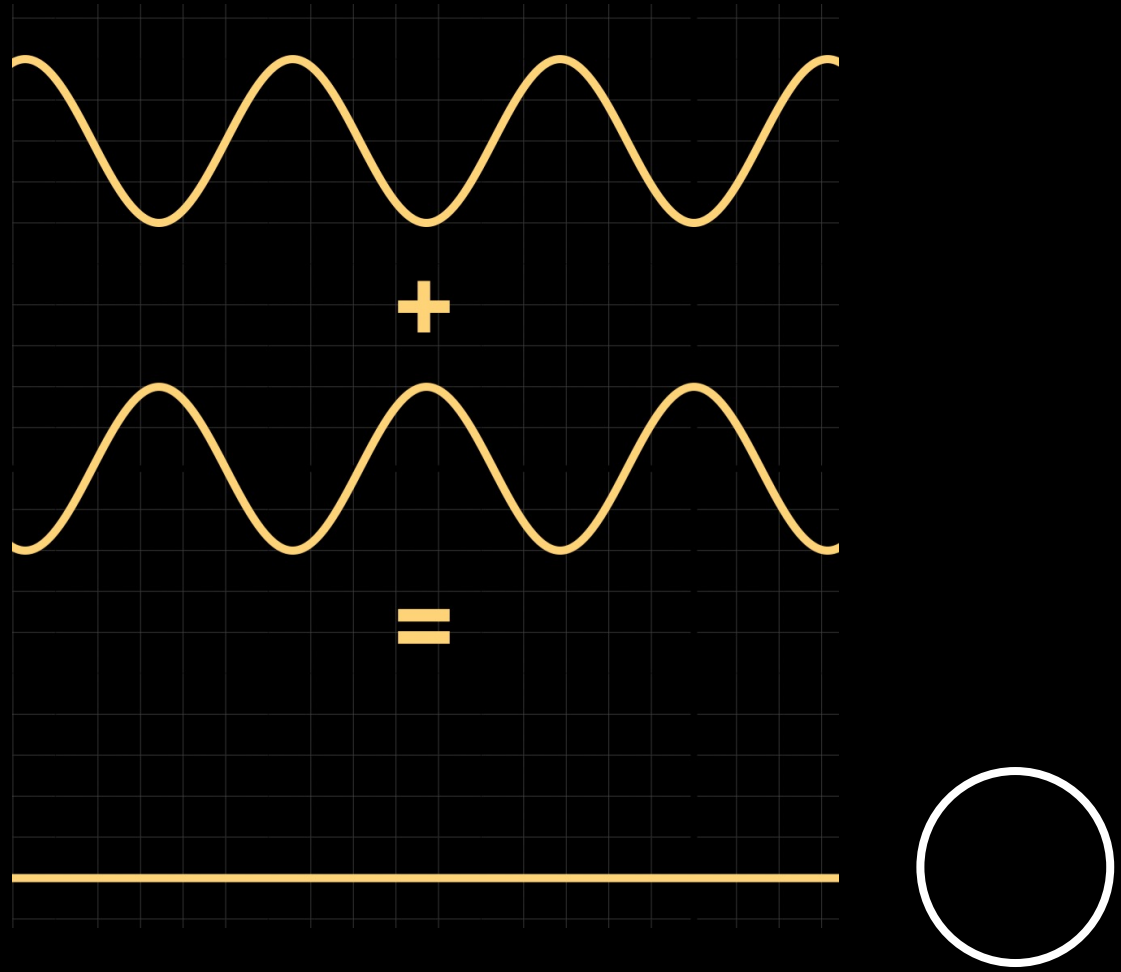


Credit: Jakaya, CleanPNG

THE BASICS OF AN INTERFEROMETER

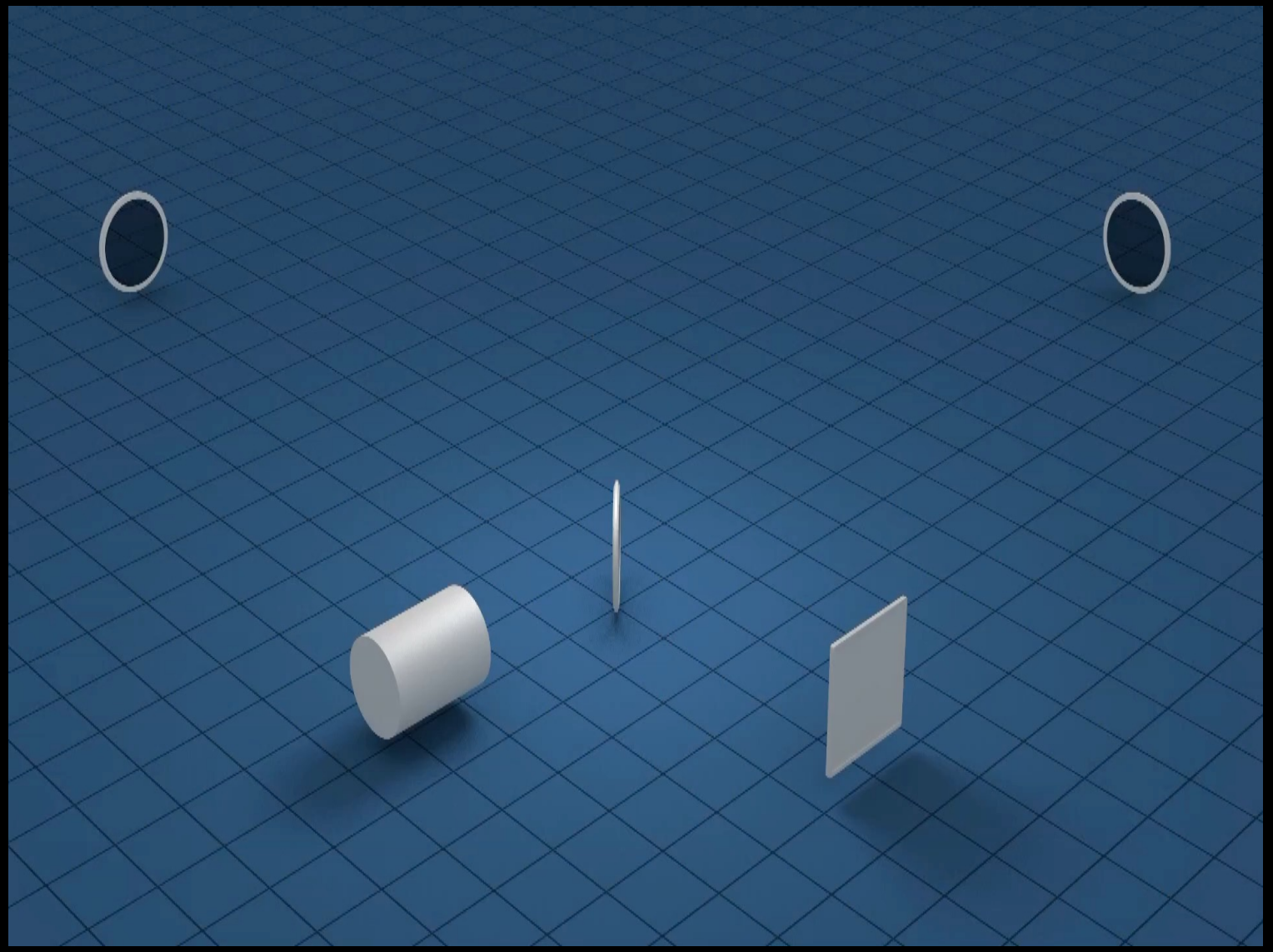


Constructive Interreference



Destructive Interreference

THE BASICS OF AN INTERFEROMETER



Credit: LIGO/T. Pyle

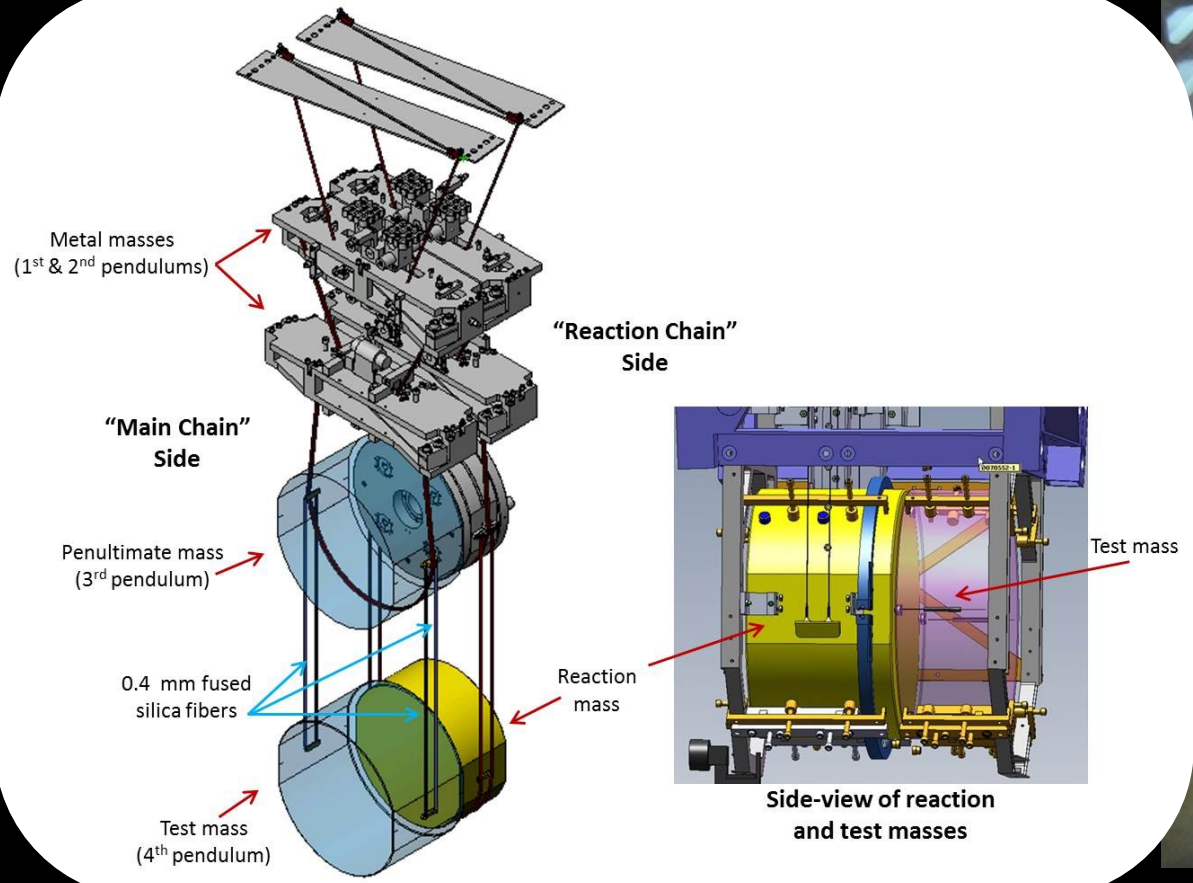
$\Delta L = 10^{-18}m = 0.00000000000000001m$


LIGO
VIRGO
KAGRA

Shhhhh……

Isolated from noise

SUSPENSIONS and VACUUM



Credit: Matt Heintze/Caltech/MIT/LIGO Lab

TRENDING

'Tumblegeddon': Cars trapped under '30 feet' of tumbleweeds in Washington state

By Josh K. Elliott · Global News
Posted January 2, 2020 12:26 pm · Updated January 2, 2020 12:33 pm

WATCH: Cops in Washington state reportedly spent about 10 hours trying to dig vehicles out from a pile of tumbleweeds that was blocking State Route 240 near Richland on Dec. 31, 2019 – Jan 2, 2020

-A A+

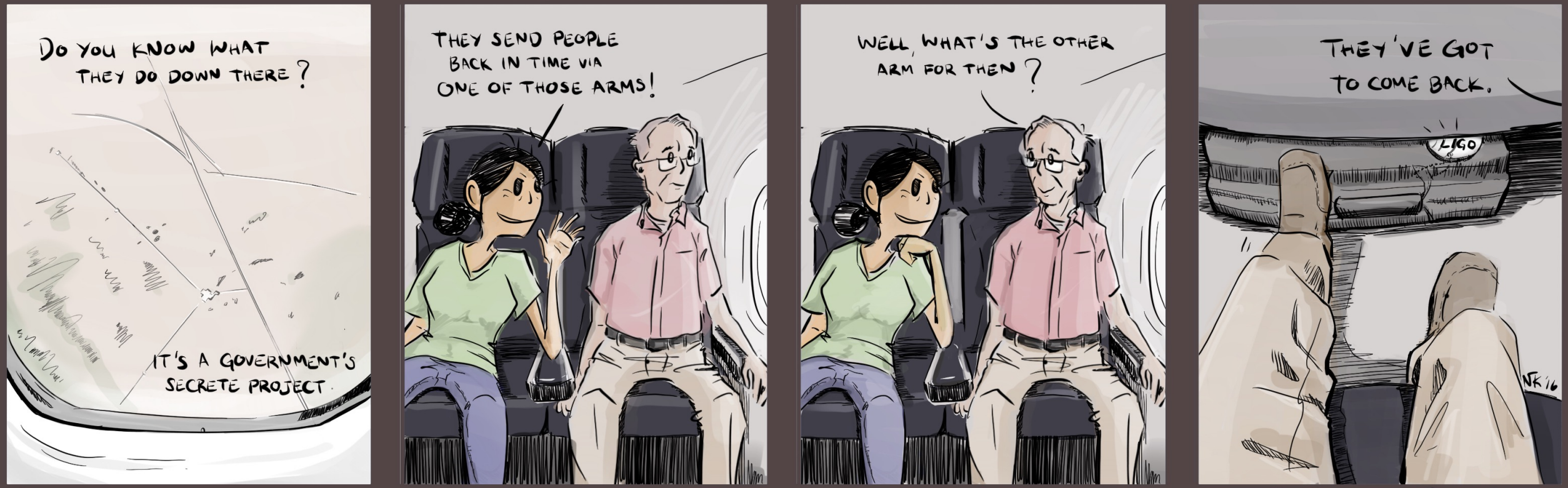
Perhaps no one had a stranger New Year's Eve than mot
troopers who spent the night on a lonel
state where a freak


LIGO
VIRGO
KAGRA
E1936

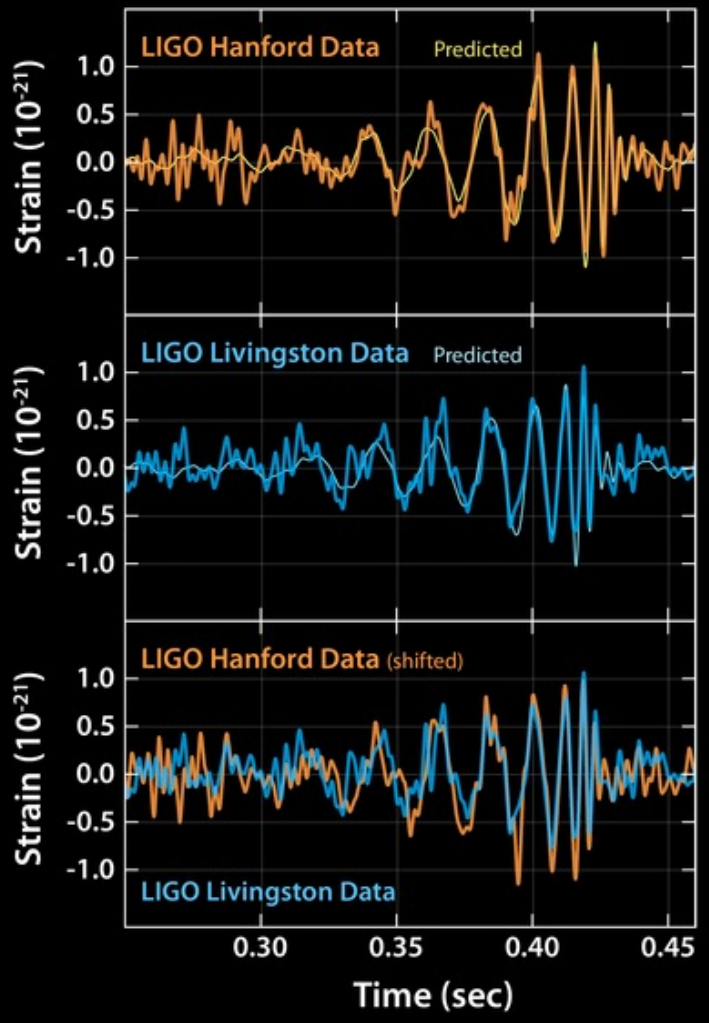
LIGO Scientific Collaboration

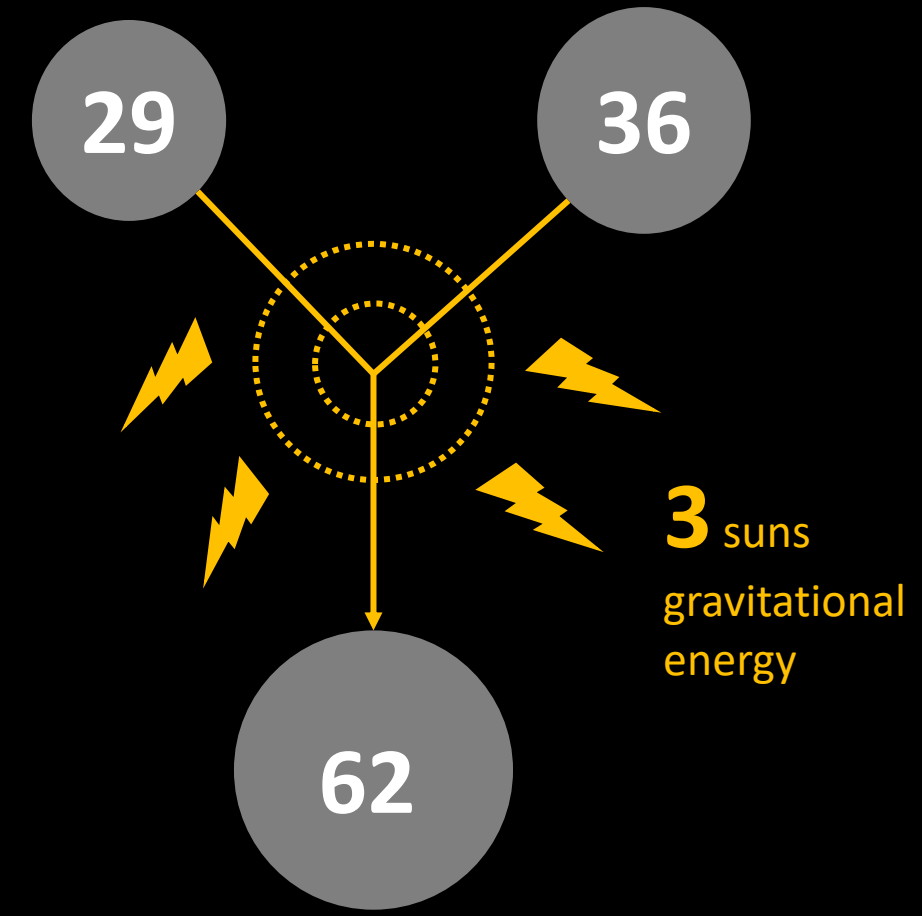
LIGO
VIRGO
KAGRA

Have you got any Questions?



FIRST DECTECTION – GW150914

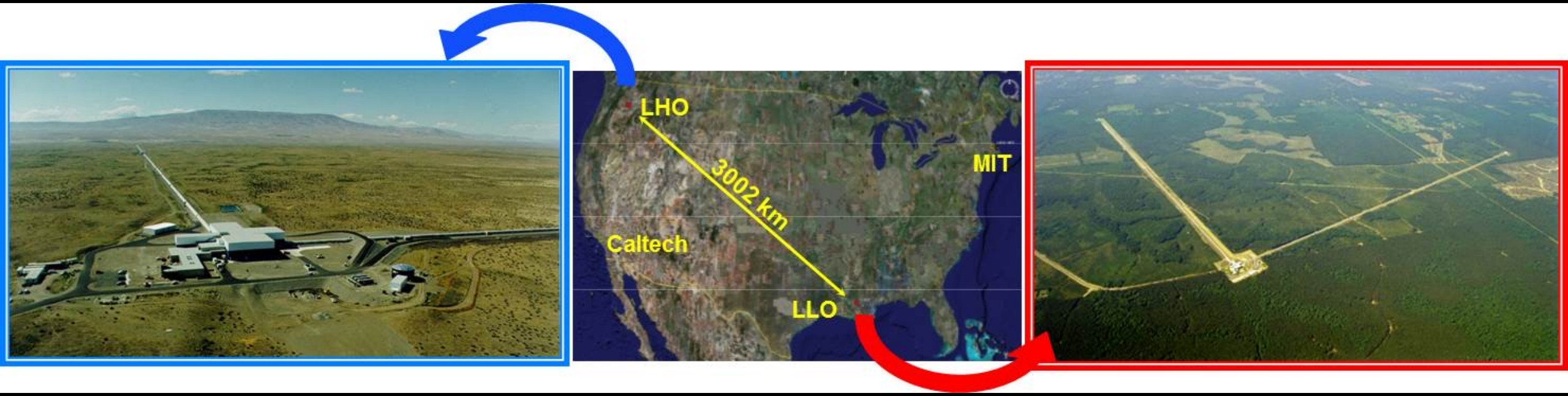




GW150914 Blackholes with $36M_{solar}$ and $29M_{solar}$ combine to make a bigger Blackhole with $62M_{solar}$. Remaining $3M_{solar}$ ejected as energy.

http://data.cardiffgravity.org/waveform-fitter/

LOCATING GRAVITAIONAL WAVE ORIGIN



time = distance ÷ speed
= 3002km ÷ speed of light
= 3,002,000m ÷ 300,000,000m/s
= 10ms between detections.