Introduction to GWOSC (Gravitational Wave Open Science Center)

Lupin C. C. Lin (林峻哲)

On behalf of IGWN

Department of Physics, National Cheng-Kung University

INTERNATIONAL GRAVITATIONAL-WAVE NETWORK (IGWN)

Motivation for IGWN

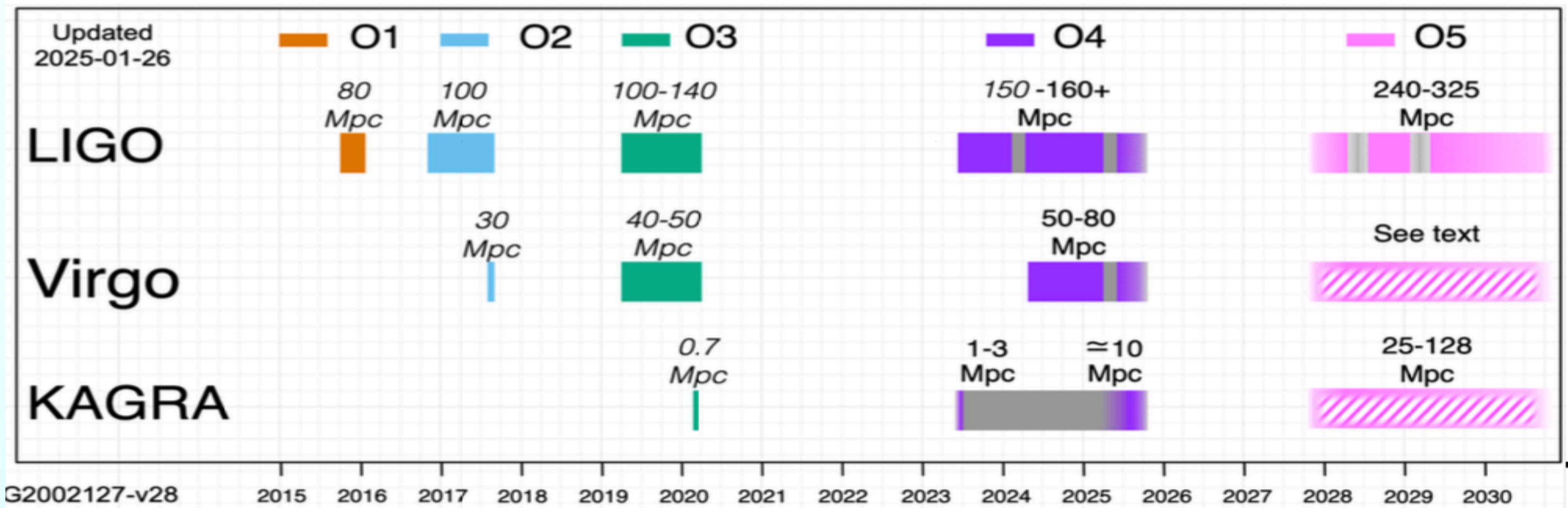
- LIGO-Virgo-KAGRA leadership recognizes that a new organizational structure is needed to fully exploit the scientific potential of the LVK network
- We require a coordinated network to achieve our scientific goals:
  - A single program that establishes our scientific goals and prioritizes them according to scientific merit and resource availability
- We seek to eliminate parallel and independent (often redundant and inefficient) decision-making processes
- There are many activities that can be shared, rather than duplicated
- IGWN seeks to: :
  - To support operations of a unified network by acquiring more resources
  - To enable equitable and efficient sharing of resources
  - To seamlessly integrate infrastructure and operations across the network

Motivation for IGWN

- LIGO-Virgo-KAGRA 領導層認識到，需要一個新的組織結構才能充分發揮 LVK 網路的科學潛力。
- 我們需要一個協調一致的組織來實現我們的科學目標:
    - 一個統一的計劃，用於確立我們的科學目標並根據其科學價值和資源可用性進行優先排序
- 大家力求消除並行且獨立的（通常是冗餘且低效的）決策過程。
- 有很多活動可以分享，而不是重複進行。
- IGWN 的目標是:
    - 透過取得更多資源來支援統一架構的運行
    - 實現資源的公平與高效共享
    - 實現組織架構內基礎設施和營運的無縫集成

Future surveys to study the GW

- LIGO/VirgoはO5、O6以降に向けアップグレード
- 10-40 km級の次世代計画も進行中



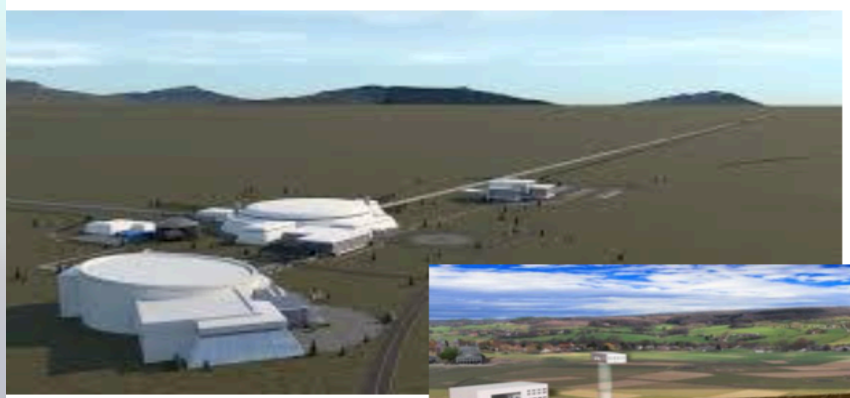
A# (and/or LIGO Voyager)
500-700 Mpc

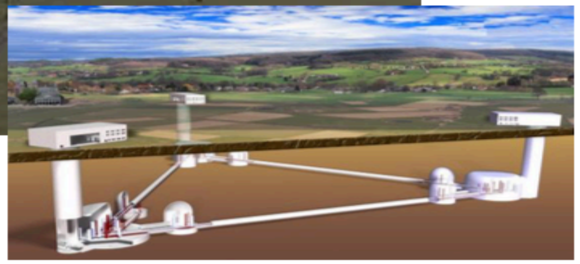
Virgo_nEXT

2030s
2040s

建設予算$320M確保済み LIGO India (4 km計画)

z~7 for BNS
z>10 for BBH





Cosmic Explorer
(米国、20-40 km計画)

Einstein Telescope
(欧州、10-15 km計画)

※2030年代にはLISA、DECIGOも

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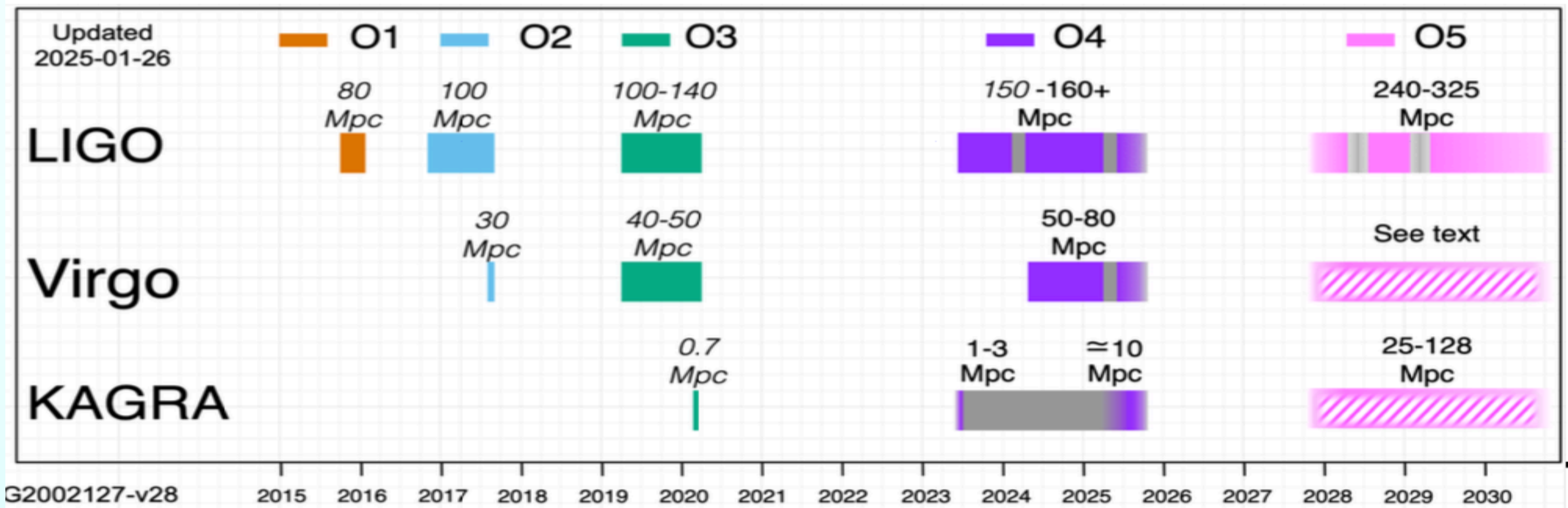

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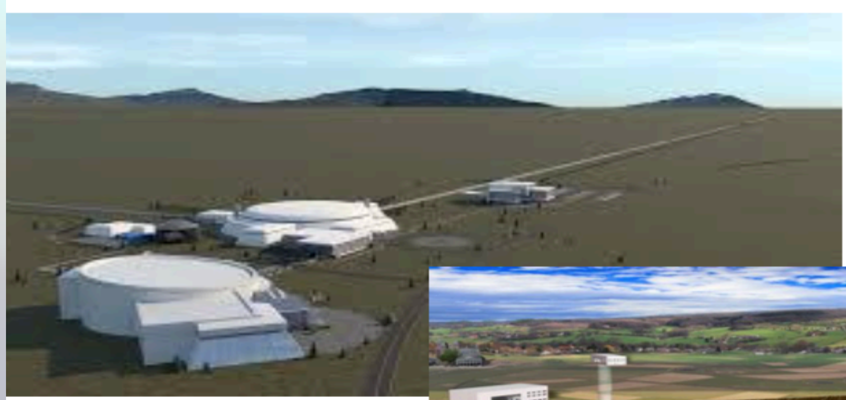

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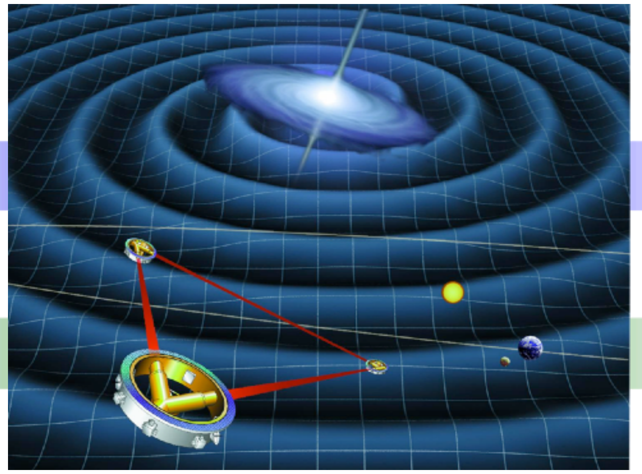

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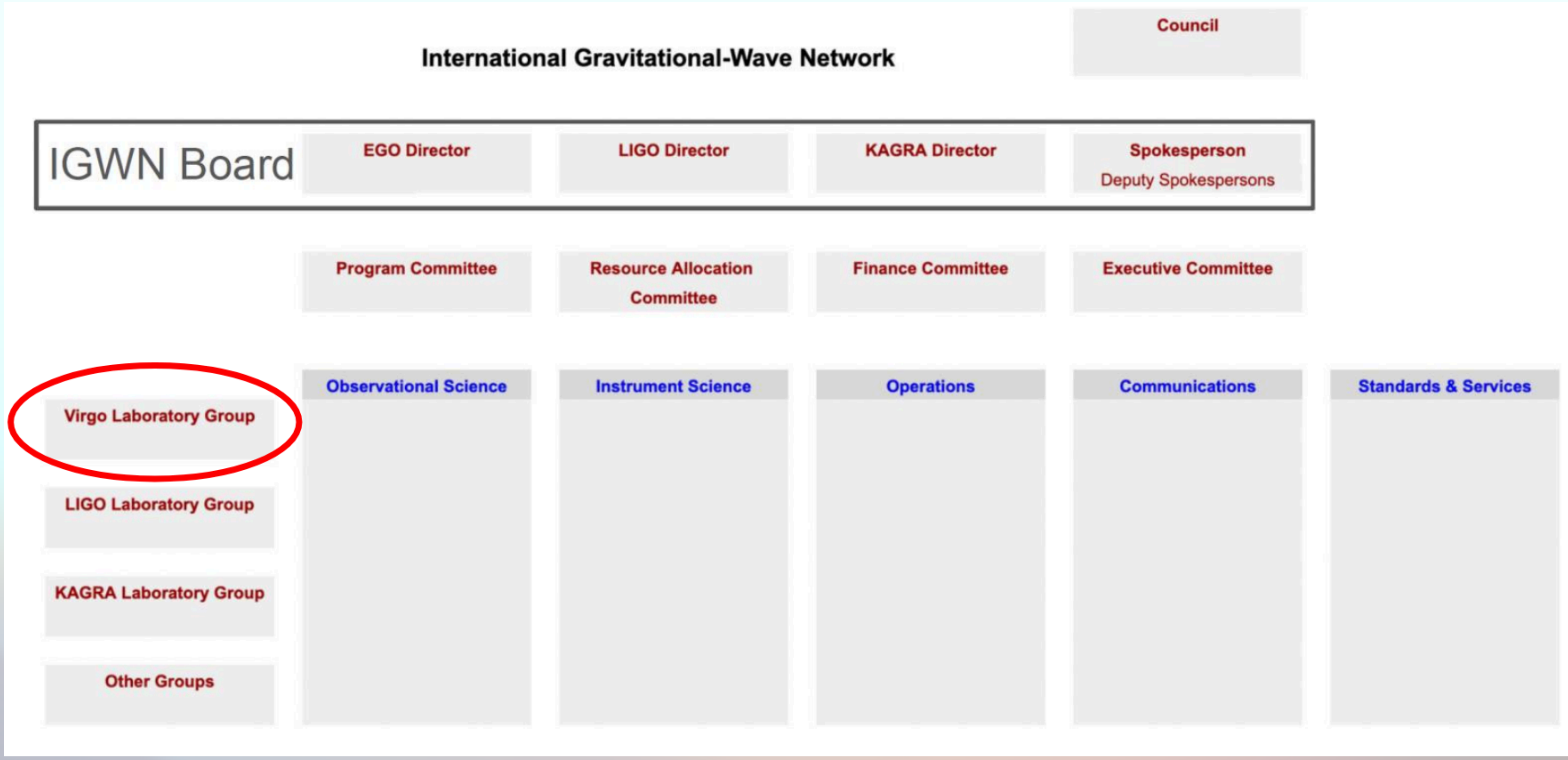
The IGWN Design Committee

- Virgo members:
  - Gianluca Gemme (Virgo Spokesperson), Massimo Carpinelli (EGO Director), Viola Sordini, Franco Carbognani, Andreas Freise, Mario Martinez, Viviana Fafone, Matteo Barsuglia, Chris van den Broeck
- LSC members:
  - Patrick Brady(LSC Spokesperson), Dave Reitze (LIGO Laboratory Principal Investigator), Albert Lazzarini, Jess McIver, Stephen Fairhurst, Stuart Anderson, Sheila Rowan, David McClelland, K G Arun
- KAGRA members:
  - Masaki Ando (KAGRA Spokesperson), Takaaki Kajita (KAGRA Principal Investigator), Shinji Miyoki, Nobuyuki Kanda, Sungho Lee, Masatake Ohashi, Jun’ichi Yokoyama, Hideyuki Tagoshi, Hyung Won Lee, Ray-Kuang Lee

IGWN Organization Chart (Current Concept)



IGWN Organization Chart (Current Concept)

KAGRA

KAGRA council	PI Kajita, T	Program Advisory Board
International Board of Representatives	Vice PI Ohashi, M	

Executive Office
Kajita, T

System Engineering Office
Miyoki, S

Auxiliary Opt. SG Akutsu, T	**Laser SG** Mio, N
Analog Electronics SG Miyakawa, O	**Main IFO SG** Aso, Y
Cryogenics SG Ushiba, T	**Mirror SG** Leonardi, M
Digital Syst. SG Miyakawa, O	**Physical Env. SG** Yokozawa, T
Facility SG Miyoki, S	**Vacuum SG** Uchiyama, T
Geophysics IFO SG Araya, A	**Vibration Isolation SG** Takahashi, R
Input/Output Opt. SG Miyakawa, O	**Installation Scheduler** Uchiyama, T

Operations Division
Sawada, T

- **Calibration WG** — Chen, D; Sawada, T
- **Computing & Software WG** — Kanda, N
- **Detector Characterization WG** — Yamamoto, T; Yuzurihara, H
- **Low-latency WG** — Morisaki, S
- **Open Data WG** — Lin, T. ~~Park, J~~
- **Run Planning Committee** — Miyoki, S

KAGRA Scientific Congress
Ando, M

Data Analysis Group
Tagoshi, H

- **Burst WG** — Kong, A
- **Compact Binaries WG** — Lee, H
- **Continuous Waves WG** — Yamamoto S., T
- **Stochastic WG** — Nishizawa, A

Theory Group
Tanaka, T

Future Strategy Comm.
Yuta, M

- **Project R&D comm.** — Somiya, K
- **Advanced R&D** — Somiya, K
- **White paper writing team** — Haino, S
- **KSC newsletter editorial team** — Kuroyanagi, S
- **Overleaf maintenance** — Eisenmann, M

Standards & Services
#N/A

- **Author-list comm.** — Tagoshi, H
- **Collaborator-list manager** — Tagoshi, H
- **Comm. of publication control** — Somiya, K
- **Diversity comm.** — Lee, R
- **Intl cooperation WG** — Tomaru, T

LIGO-Virgo-KAGRA Committees

Joint Run Planning comm. Miyoki, S	**Joint Computing and Software comm.** Kanda, N	**Joint Editorial Board** Yamamoto, K
Detector Characterization and Data Quality comm. Yamamoto, T; Yuzurihara, H	**Joint Meeting comm.** Ando, M	**LVK Climate Change WG** Lan, N
Calibration comm. Chen, D; Sawada, T	**Joint Detection comm.** Kanda, N	**Education & Public Outreach** Shinkai, H

2024/Jun. 2nd

Gravitational Wave Open Science Center (GWOSC)

The Team

LIGO Lab

Jonah Kanner - GWOSC director & Open Data co-chair

Kent Blackburn - GWOSC developer, lead on catalog production

Martin Beroiz - GWOSC developer, lead on API development and unit testing

Virgo

Agata Trovato - Open Data co-chair

Mathieu Dubois - GWOSC developer, lead on tutorial development

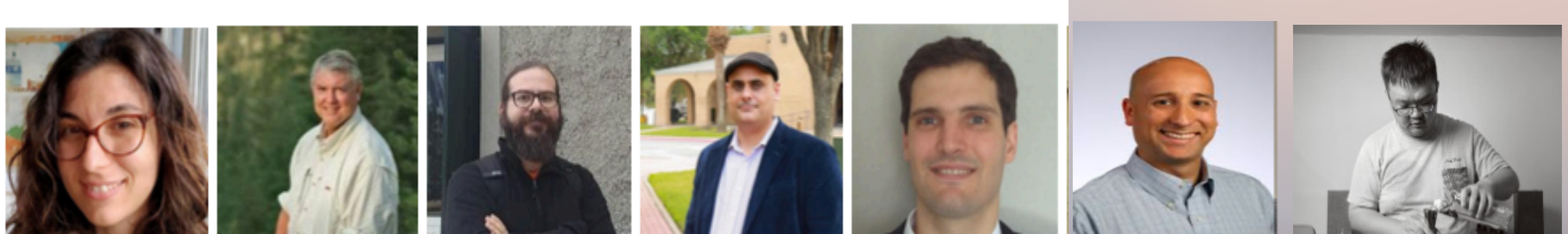
Panagiotis Iosif - GWOSC developer, lead on the GW Plotter app

Daniel Sentenac - GWOSC developer, joining the team at the end of 2024

KAGRA

Tyler Lin - Open Data co-chair

Lupin Lin - Past Open Data co-chair, organized 2024 GW Open Data Workshop



- GWOSC is maintained by the Open Data Working Group of the LIGO/Virgo/KAGRA collaboration (IGWN).

- GWOSC majorly serves a broad community by providing data, tutorials, documentation, web services for public data from L-V-K (IGWN), and apps development for users to extend their experience to use the open data and the discovery of the new science

- Each year our team organizes an Open Data Workshop to collect those researchers/ students who are interested in GW open data to study how to use them and produce more related scientific contributions.

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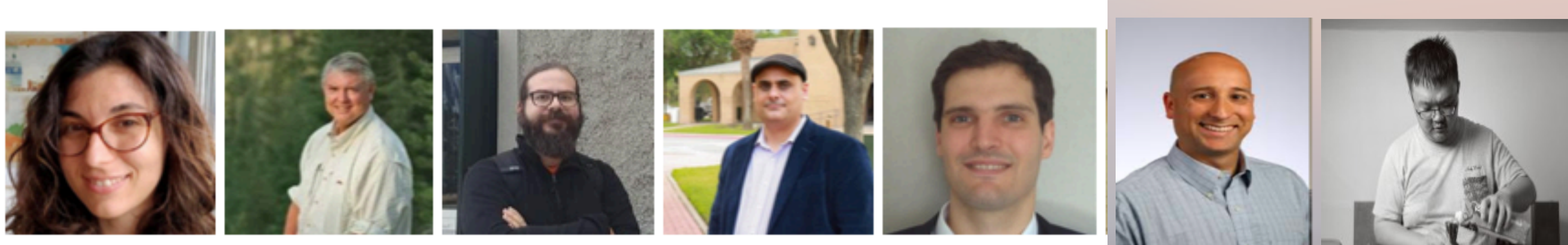


- GWOSC 由 LIGO/Virgo/KAGRA (IGWN) 底下的開放資料小組來維持。
- 主要的任務包含建構網站提供公開資料，提供基本的資料分析教程以及相關文件，針對使用者的疑問提出答覆，以及開發各式各樣的小軟體增加使用者對於使用公開資料和科學發現的體驗等。
- GWOSC會於每年定期舉辦開放資料研討會，聚集對重力波資料有興趣的學者一起學習並研究如何使用公開資料，讓已公開的資料可以產出更多科學貢獻。

Gravitational Wave Open Data Workshop

Gravitational Wave Open Data Workshop #5 (2022)

May 23-25, 2022

Workshop

Gravitational Wave Open Data Workshop #4 (2021)

Remote workshop, May 10-14, 2021

Online Course Workshop

Gravitational Wave Open Data Workshop #3 (2020)

Lecture videos and tutorials from 2020 workshop

Course Material

Gravitational Wave Open Data Workshop #2 (2019)

Lecture videos and tutorials from 2019 workshop

Course Material

Gravitational Wave Open Data Workshop #1 (2018)

Lecture videos and tutorials from 2018 workshop

Course Material

Gravitational Wave Open Data Workshop #9 (2026)

April 20-23, 2026

Workshop

Gravitational Wave Open Data Workshop #8 (2025)

May 12-14, 2025

Workshop

Gravitational Wave Open Data Workshop #7 (2024)

April 18-20, 2024

Workshop

Gravitational Wave Open Data Workshop #6 (2023)

May 15-17, 2023

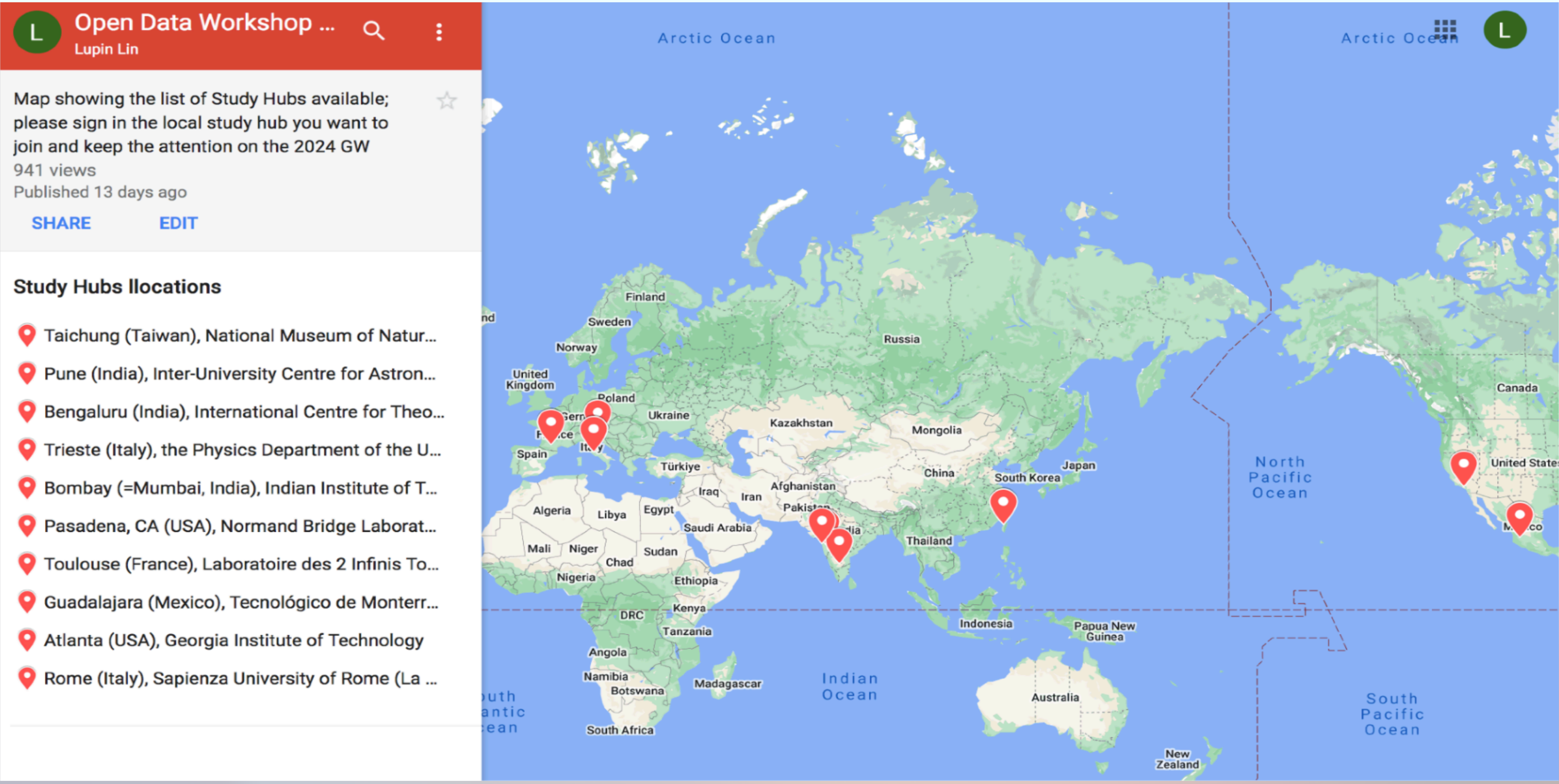
Workshop

Gravitational Wave Open Data Workshop

Open Data Workshop in Taiwan

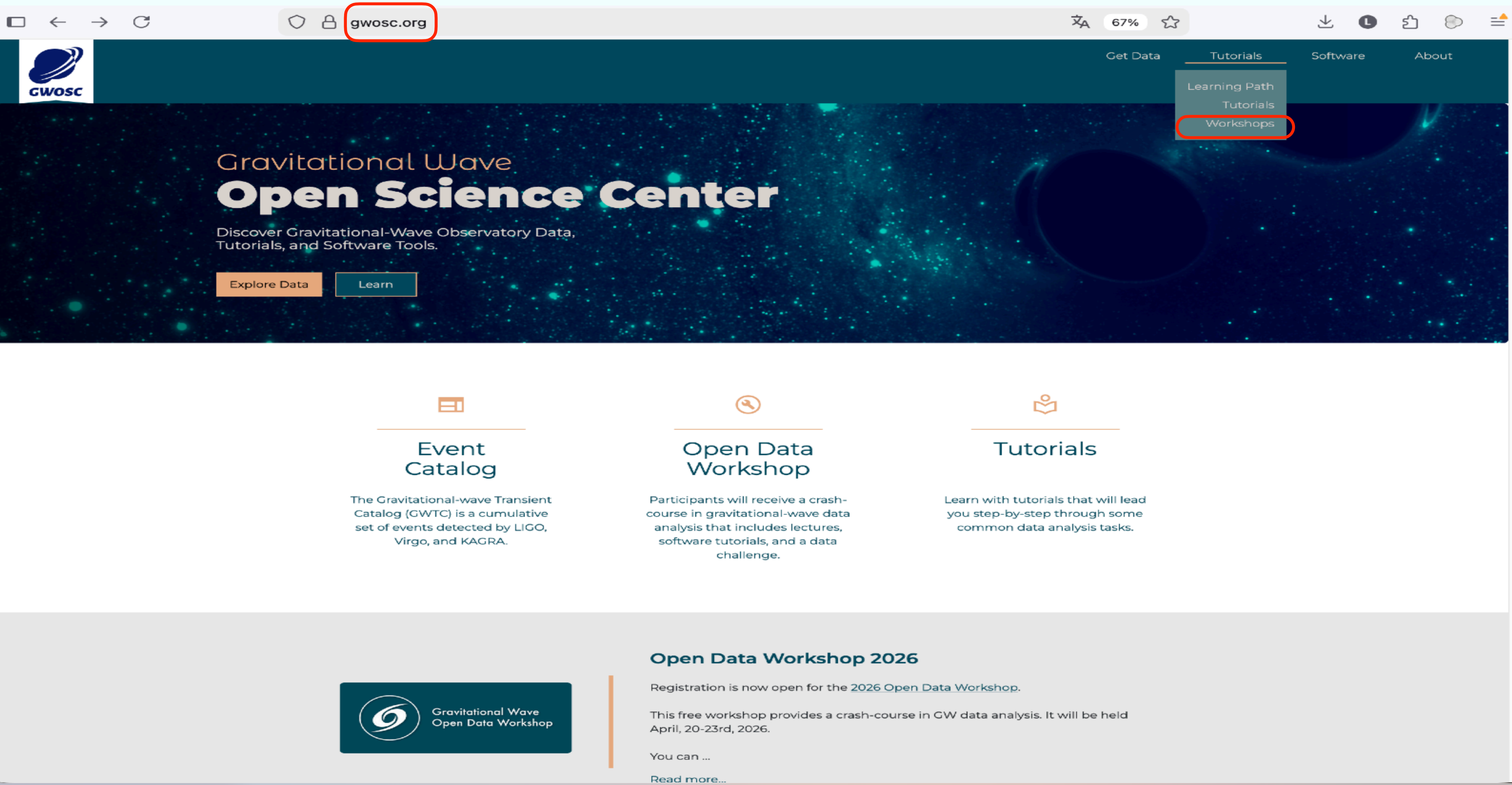
This year's GW Open Data Workshop was hosted at Taiwan's beautiful National Museum of Natural Science in the city of Taichung.

Distributions of the Study Hubs



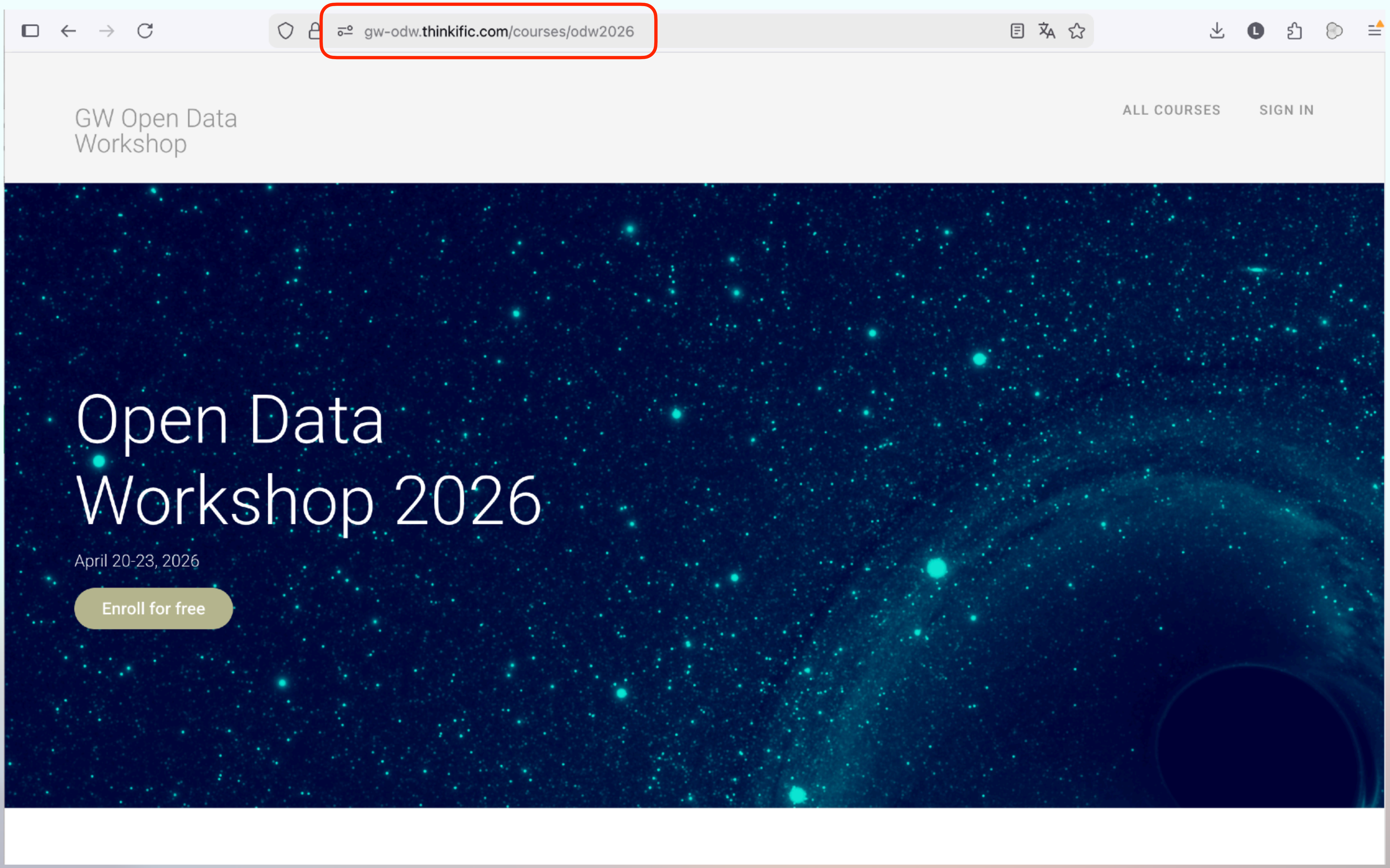
Distributions of the Study Hubs

GWOSC Website



2026 GWOSC Open Data Workshop

2026 GWOSC Open Data Workshop



2026 GWOSC Open Data Workshop

Lecture Schedule

Times are given in Central European Summer Time (CEST). Click the link to convert to your time zone.

Monday, April 20th

- 2PM CEST: Introduction to Gravitational waves (45mn), Viola Sordini
- 3PM CEST: Accessing Open Data (30mn), Agata Trovato
- 4PM CEST: Signal Processing (45mn), Quentin Baghi

Tuesday, April 21st

- 2PM CEST: CBC Science (45mn), Frédérique Marion
- 3PM CEST: DetChar (30mn), Francesco Di Renzo
- 4PM CEST: CBC Searches (45mn), Tito Dal Canton

Wednesday, April 22nd

- 2PM CEST: Parameter Estimation (45mn), Charlie Hoy
- 3PM CEST: Introduction to hierarchical inference (30mn), Vasco Gennari
- 4PM CEST: Challenges in future detectors 3G/LISA (30mn), John Baker

2026 GWOSC Open Data Workshop

Speakers

Charlie Hoy

Charlie is the Dennis Sciama Research Fellow at the University of Portsmouth, UK. Charlie primarily works on Bayesian inference: the process of inferring the source properties from the observed gravitational-wave signal. Charlie's recent interests include investigating model systematics, leveraging physical insights to reduce the computational cost of Bayesian inference, and using Bayesian techniques to learn about the properties of compact-object mergers in the universe.

Vasco Gennari

Vasco is a PhD student at the Laboratoire des 2 Infinis (L2IT), a joint research unit of CNRS and the University of Toulouse, France. His research explores gravity in extreme regimes through gravitational-wave observations, from the strong-field dynamics of black-hole mergers to the large-scale evolution of the Universe, leveraging astrophysical black-hole populations. Outside the office, he enjoys playing the piano, photography, and hiking.

Quentin Bagh

Quentin is an Assistant Professor at the Astroparticle and Cosmology Laboratory (APC) at Université Paris Cité in France. His researcl focuses on developing dat analysis methods for gravitational-wave detectors. In particular, he interested in stochastic gravitational-wave background searches and their connection with instrumental noise modelling. He is involved ir (and excited about) the LISA space mission project and the development of its data processing centre.

Tito Dal Canton

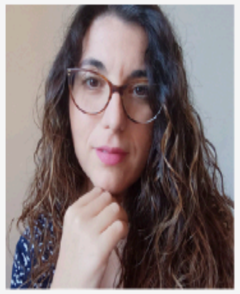
Tito is a researcher at the Laboratoire de Physique des 2 Infinis Irène Joliot-Curie (IJCLab) in France. His main interest is using gravitational waves to study the mergers of black holes and neutron stars. Tito started his journey in the mid-2000s working with resonant-bar detectors. Then, he pursued a PhD on the preparation of search methods for the first observing run of advanced ground-based detectors. After his PhD he extended his interests to multimessenger astronomy with gravitational-waves and gamma-ray bursts, as well as LISA's science and data analysis in the context of black hole mergers. Currently he contributes mainly to the data analysis for the LIGO/Virgo/KAGRA network and the conception of the data analysis for ET.

Viola Sordini

Viola Sordini is a researcher at the Institut de Physique des Deux Infinis de Lyon (France). She has worked in particle physics at accelerator facilities for over 15 years, the field in which she earned her PhD in 2008. Since 2019, her research has focused on gravitational waves. Her expertise lies primarily in data analysis, and she is currently involved in the search for gravitational-wave signals from the coalescence of black holes and neutron stars using data from the LIGO-Virgo-KAGRA interferometer network.

Francesco Di Renzo

Francesco is a researcher a the Department of Physics and Astronomy of the University of Florence, Italy. His research focuses on gravitational waves, a field he has pursued since his Master's thesis, which investigated the detectability of non-standard polarizations in the stochastic gravitational-wave background. Since the beginning of his PhD, he has been working on detector characterization and currently serves as chair of the Virgo Detector Characterization group. During the O4 observational campaign of LIGO, Virgo and KAGRA, he coordinated the Rapid Response Team for transient gravitational-wave alerts, and served as co-chair of the Event Validation group.



Agata Trovato

Agata Trovato is an Associate Professor at the Physics Department of the University of Trieste. Her research interests lie in astroparticle physics, and since 2017 she has focused on gravitational waves, with particular expertise in data analysis. She is co-chair of the working group responsible for the Gravitational Wave Open Science Center and contributes to preparing the LIGO-Virgo-KAGRA data releases.

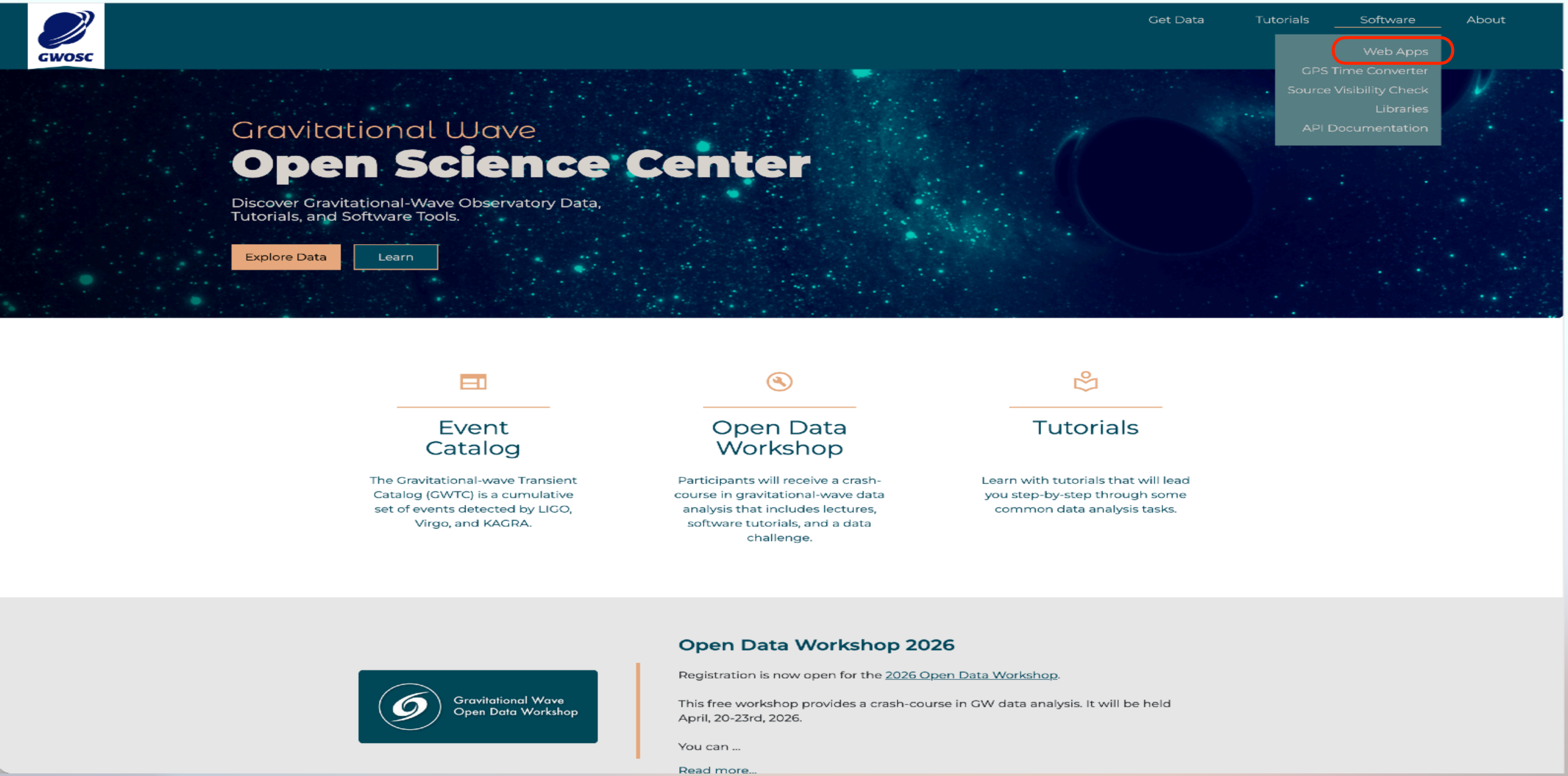
Frédérique Marion

Bio.

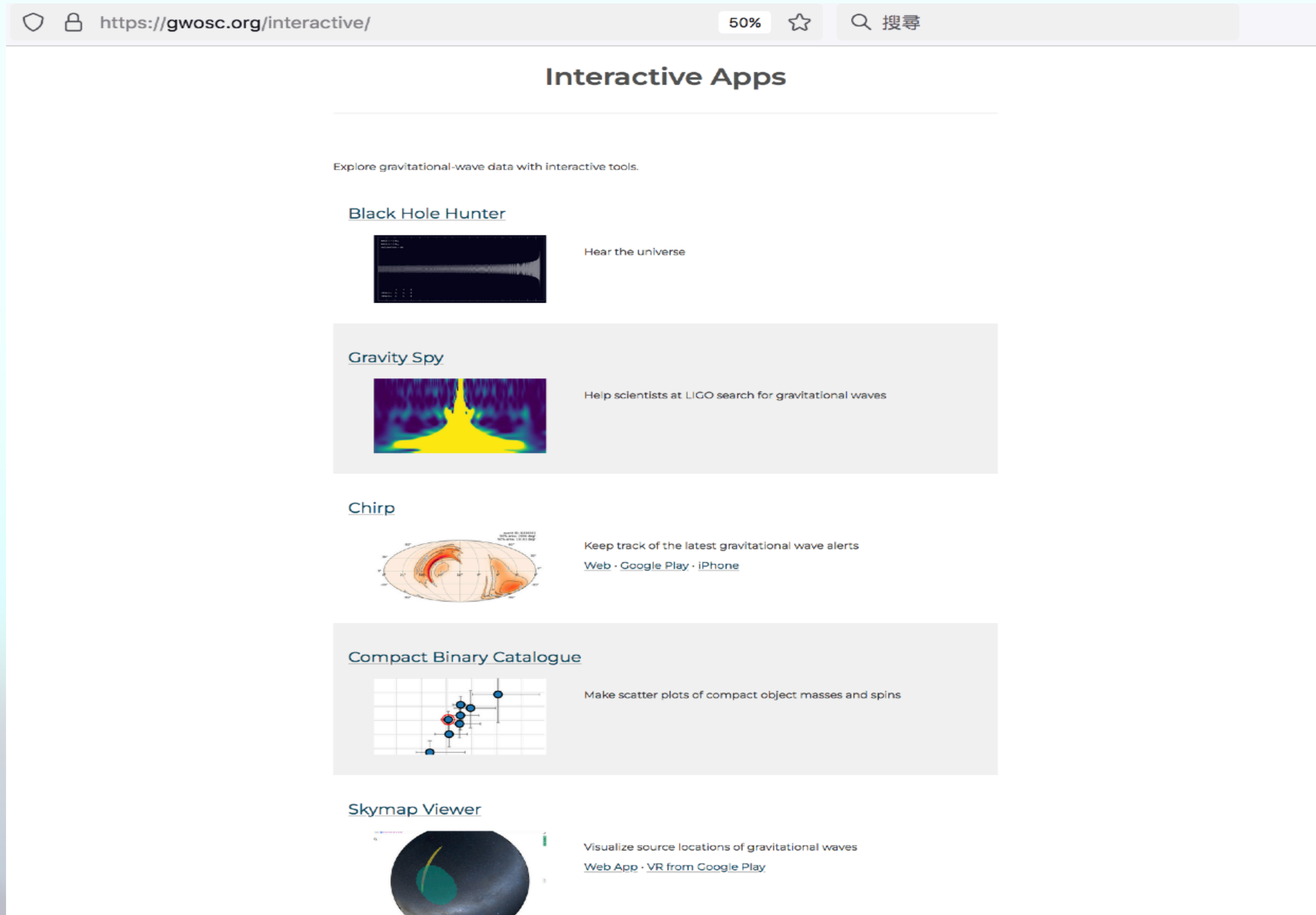
John Baker

Bio.

GWOSC Website



Simple Apps provided by GWOSC.ORG



Sounds of Spacetime (彎曲時空發出的聲音)

Welcome!

Our purpose is to explore the physics of gravitational waves via an analogy to audible sounds. Gravitational waves (GW) are ripples in the fabric of spacetime produced by colliding black holes, neutron stars, supernovae, and other astrophysical phenomena.

There is a worldwide effort to detect these waves using giant laser interferometers (like LIGO) or by monitoring pulsars using radio telescopes (like NANOGrav). **This effort had its first major success with the detection of a gravitational-wave signal by the twin LIGO observatories on September 14, 2015.** This was followed with additional detections in December 2015 and January 2017. These events represent the beginning of gravitational-wave astronomy. We are now able to perceive the universe in an entirely new way--by "listening" to the *sounds of spacetime*.

To learn more about gravitational waves, click on What are Gravitational Waves? More information about the first detection can be found at our Detection page.

When black holes merge or other energetic cosmic events perturb spacetime, the gravitational waves they produce act as a complicated signal that encodes information about the source (like its mass, spin, and location). *If* we understand the signal well, we can pick out this information. Here, we'll learn how different sources produce different gravitational-wave signals, and we'll see how those signals vary with the parameters that describe the source (masses, spins, orientation, etc).

We've been observing the distant universe with visible light since the time of Galileo, and with other kinds of electromagnetic radiation (radio, x-rays, infrared) for over a century. We can't see x-rays with our eyes, but we can produce photographs using x-rays. In this sense x-rays are similar to visible light. But gravitational-waves are very different--they are not photons. While it is possible to make crude images using gravitational-waves, their properties are more easily understood by converting the detected signals to sound waves rather than visible images. (In a similar way, while we can make radio images of the distant universe, other kinds of radio signals---like those produced by your local radio station---are best converted to sounds, a function performed by your car stereo).

The different types of predicted GW signals and their properties are explored in detail under Sources & Sounds. But first you should realize that there are limitations on the sounds you'll hear that are set by your ear, your computer speakers, and the gravitational-wave detectors that we are considering. Learn about this at About GW Sounds.

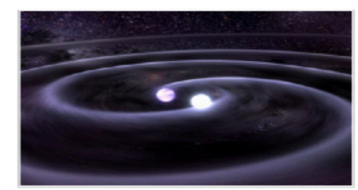
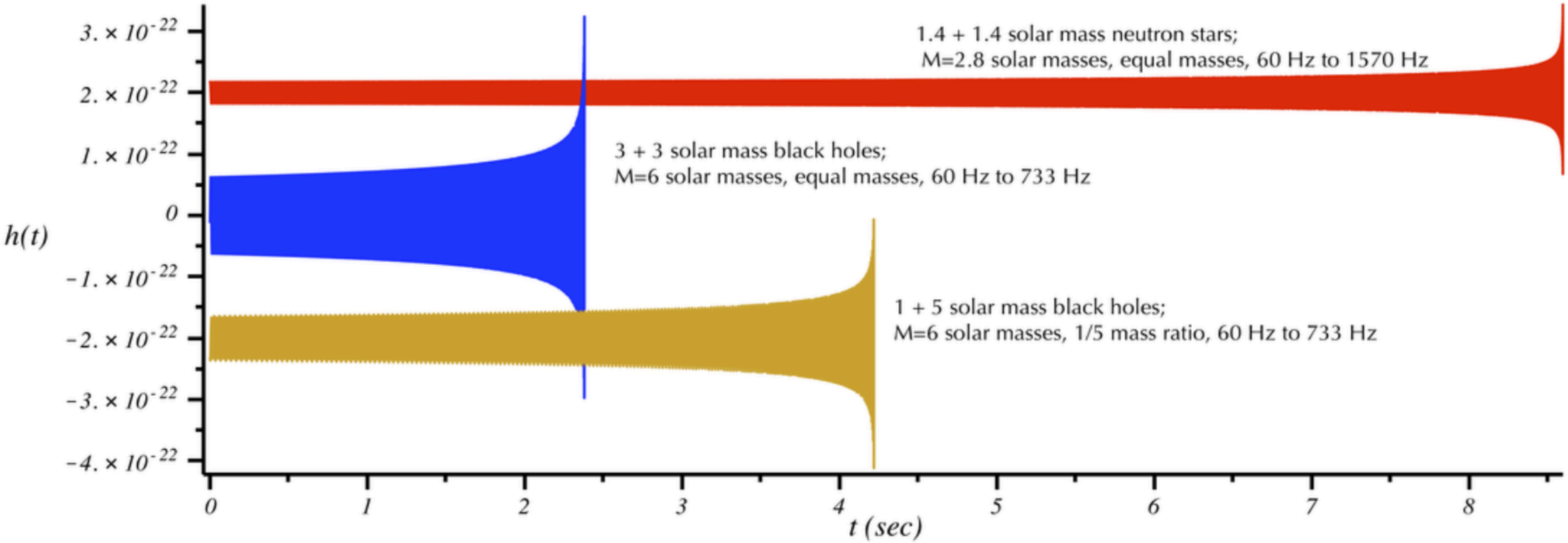


Figure credits: NASA (above & top), LIGO Lab/Caltech, Green Bank Telescope/NRAO.

Sounds of Spacetime (彎曲時空發出的聲音)



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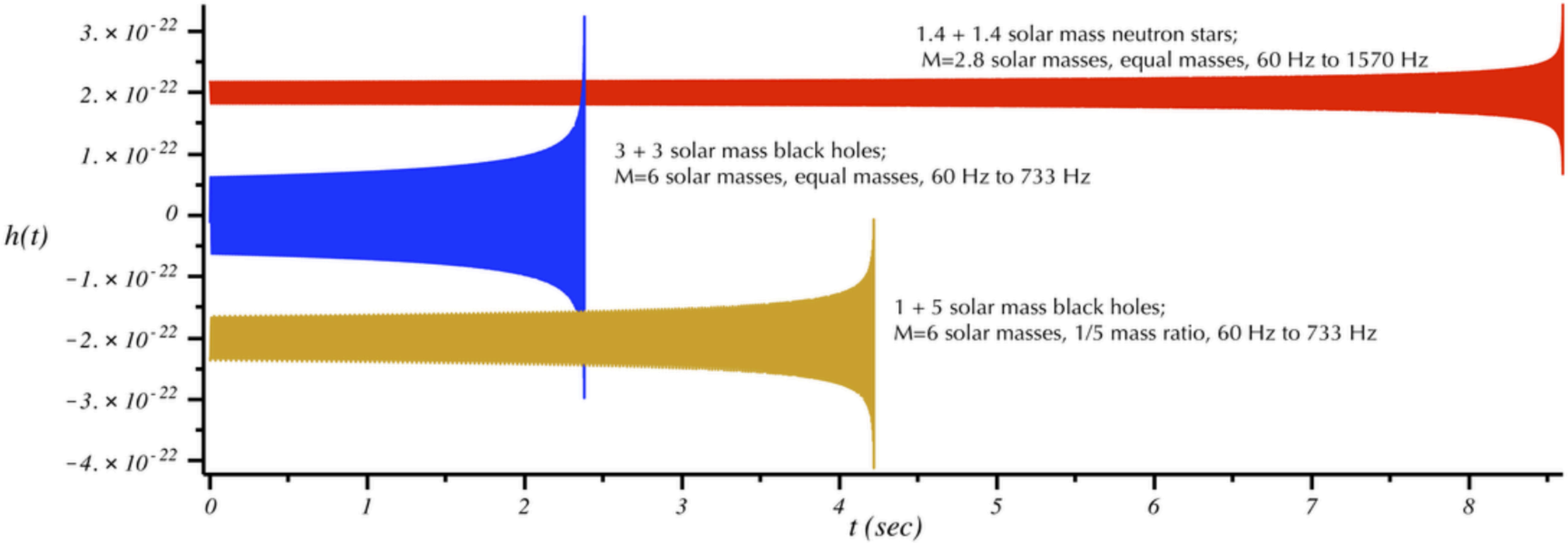
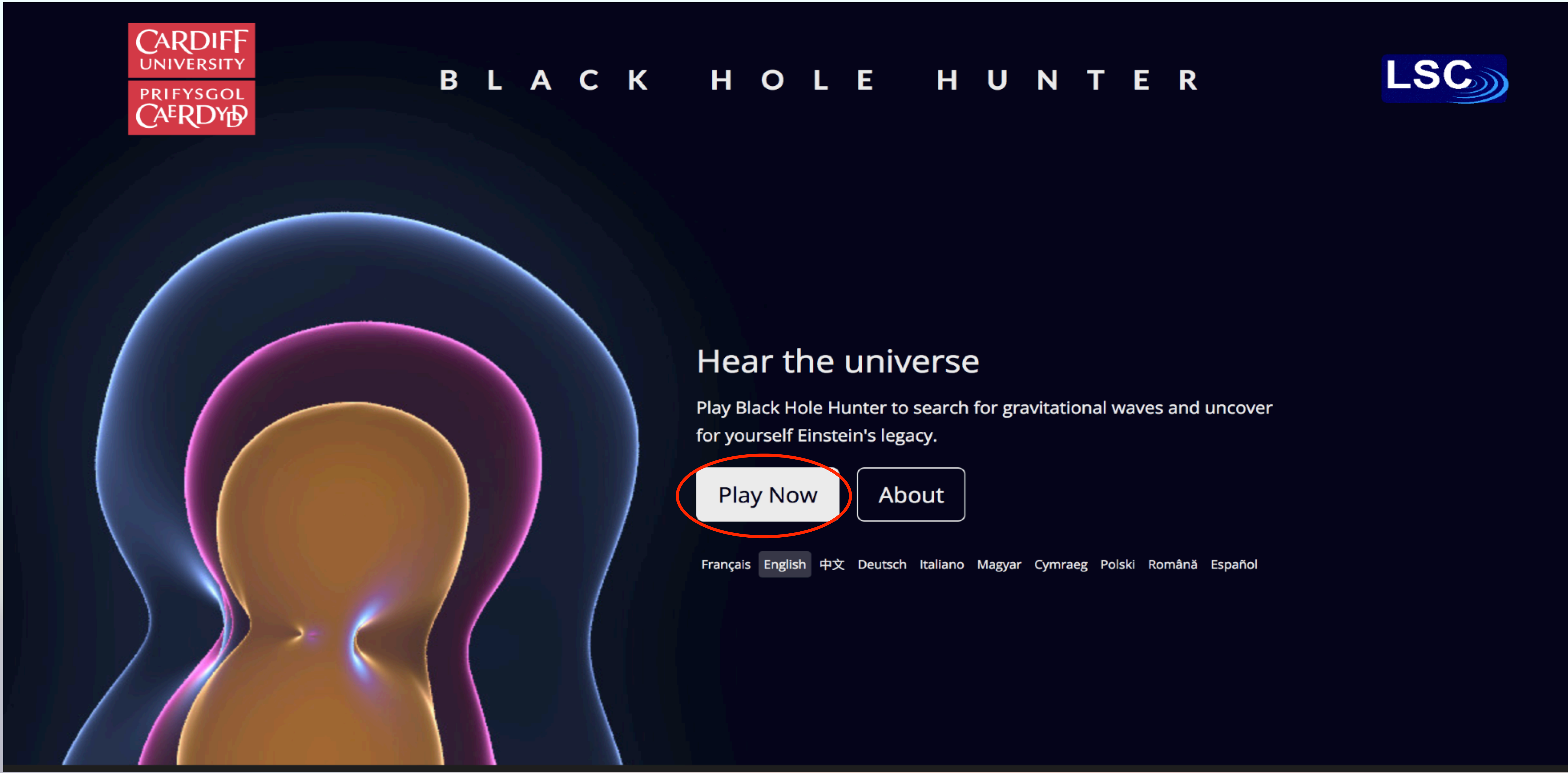


BLACK HOLE HUNTER (尋找重力波)



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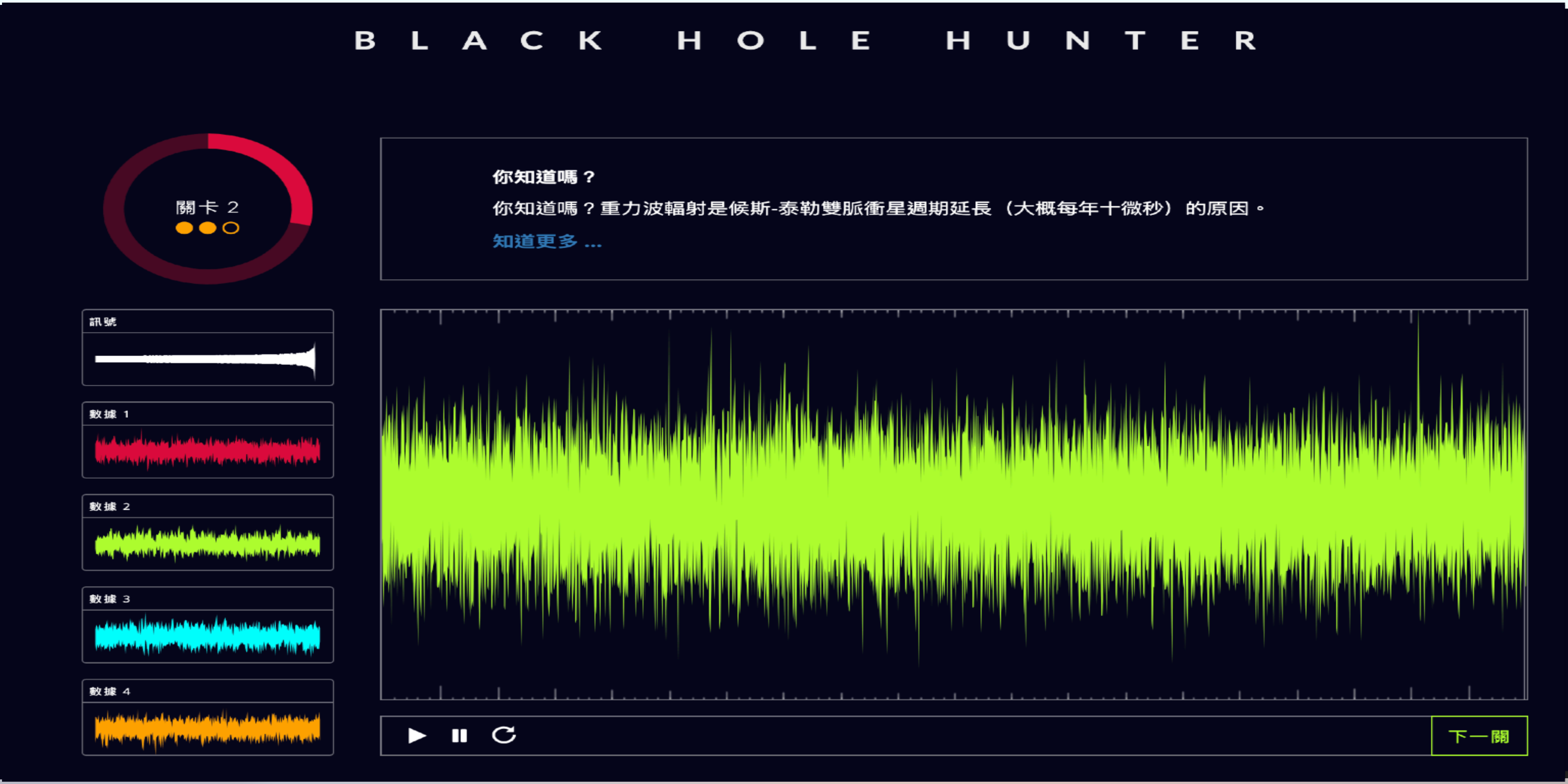
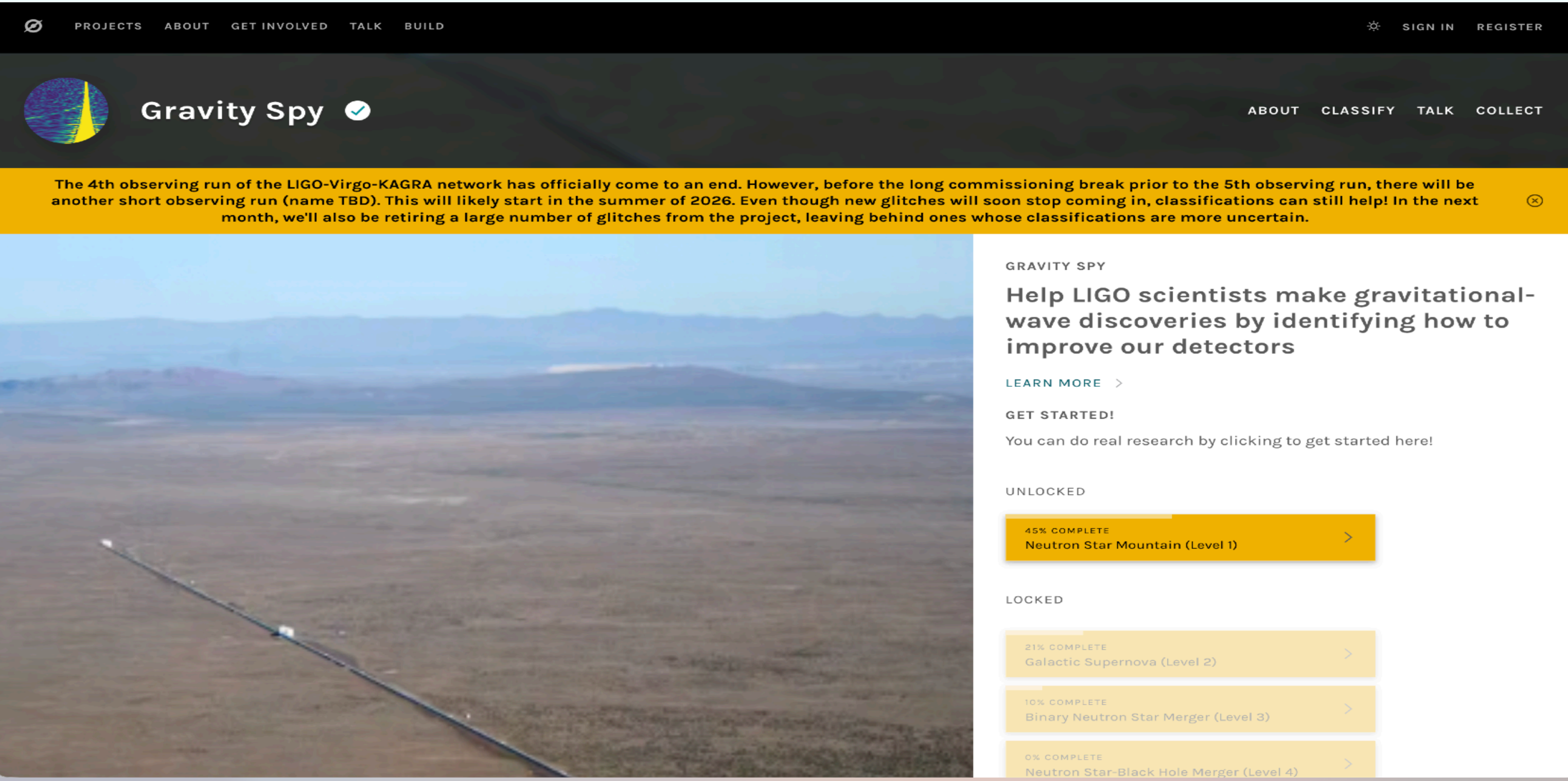


Gravity Spy (重力間諜)



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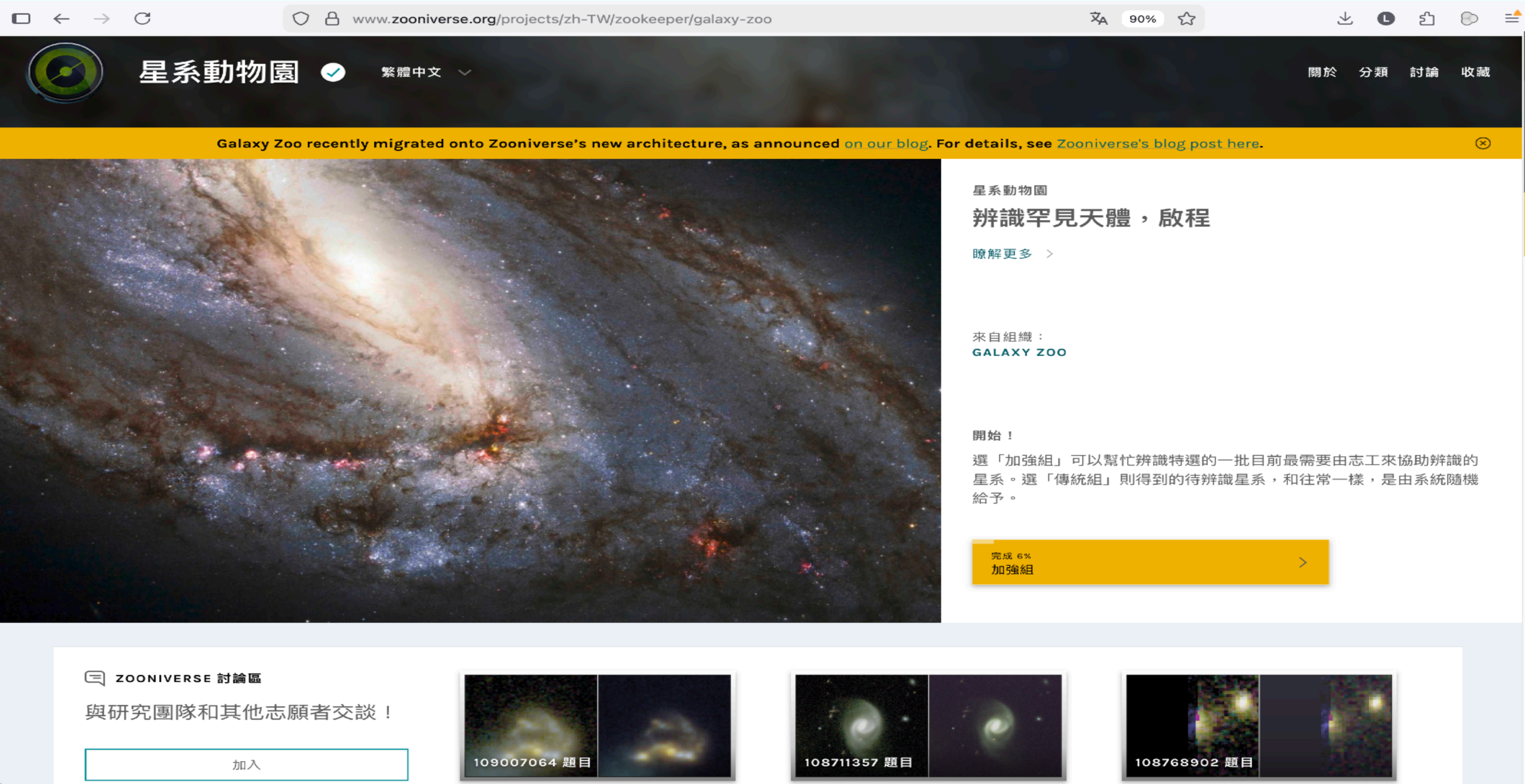

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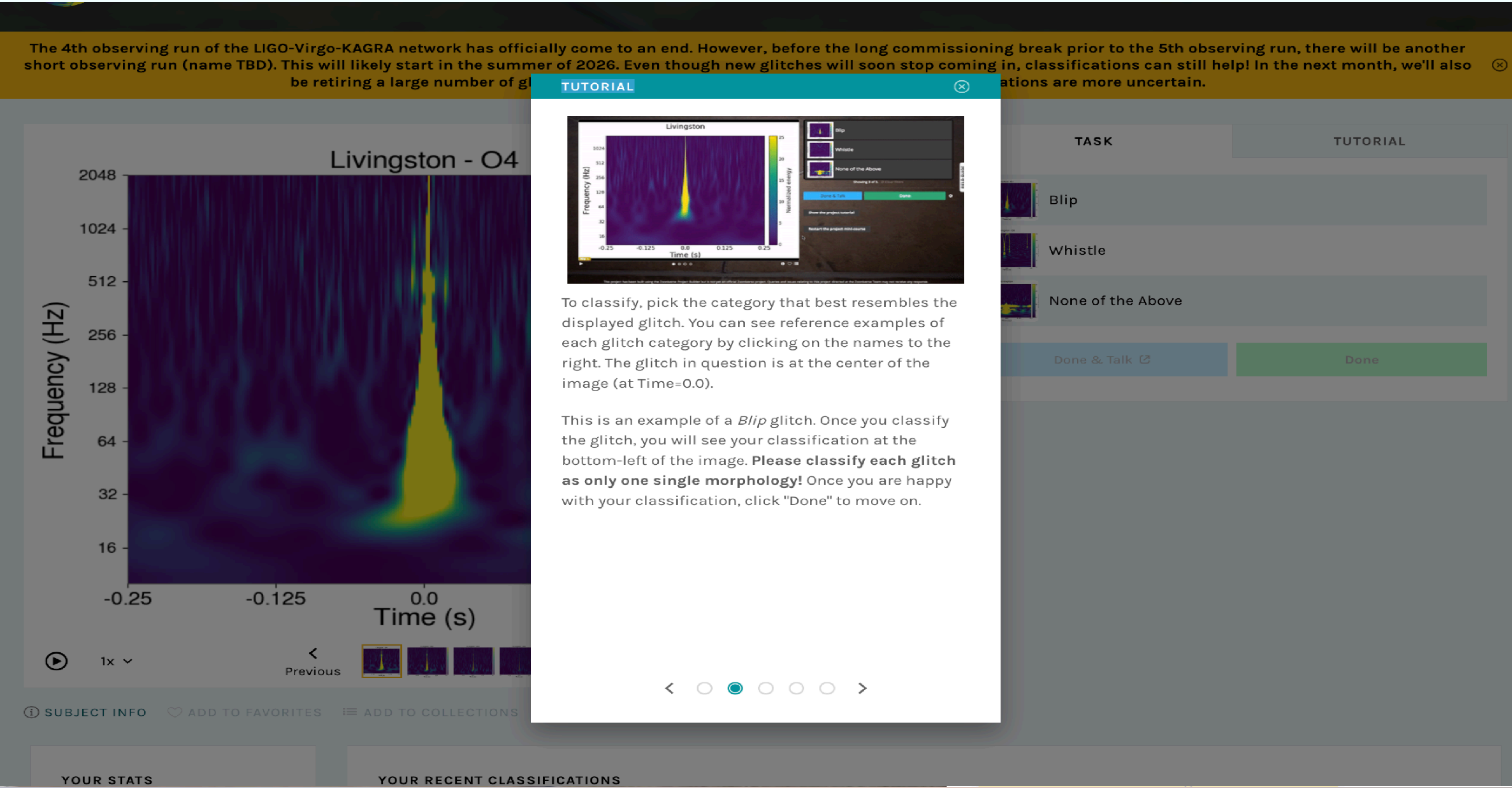


Tutorial Resources

gw-odw.thinkific.com/courses/odw2026 80%

GW Open Data Workshop

ALL COURSES SIGN IN

Structure

This will be a hybrid workshop, which means that it will have *in-person* and *online* elements.

There are 3 ways to attend the workshop:

- You can join the in-person in Toulouse (France). This event includes the lectures and hands-in sessions were participants will work on the software tutorials. Lectures will be streamed *online* and recordings will be made available after each session for online participants. See the schedule below. We will send an email to all registered participants with instructions for joining the lecture sessions on zoom or the recordings.
- Study Hubs are in-person or online events where you can work along with other participants. You are welcome to join a Study Hub, or start your own. The detailed organization may vary from one study hub to the other so please refer to the study hub organizers.
- You can participate online on Thinkific.

In all case, you must enroll on Thinkific to access the lectures, the quiz and the challenge.

Tutorials

This workshop uses software tutorials to introduce practical GW data analysis. Please be aware that the tutorials will be under some development before the start of the workshop, so they are subject to change.

These tutorials will be used during the hands-in sessions and are needed to answer the quiz on Thinkific.

- You'll need a computer and internet connection. Any operating system will do.
- Tutorials may be run locally on your computer, or online in the browser.
- Some previous experience with the Python language is recommended.

Visit the software tutorial repo page and setup instructions page to learn how to run them.

Optional: Introductory Tutorials

If you're new to python or signal processing, you may wish to explore some introductory material in advance of the workshop:

- Learning Path
- Introductory Tutorials

Tutorial Resources

github.com/gw-odw/odw?tab=readme-ov-file

README | Contributing | GPL-3.0 license

Gravitational Wave Open Data Workshop

Gravitational Wave Open Data Workshop

Welcome to the Gravitational Wave Open Data Workshop. Here you will find the support material for the Gravitational Wave Open Data Workshop (ODW) organized by the Gravitional Wave Open Science Center (GWOSC). This material consists on several interactive Jupyter notebooks in the Tutorials folder, divided into topics, grouped into folders for each day of the workshop. There are also some quiz questions that you are asked to complete at the end of each topic. Lastly, test yourself with the GW Data Challenge!

For questions concerning the software setup, the tutorials, the workshop in general, or even for GW science questions, join our community at the ask.igwn.org forum. Before posting new questions, check first if a similar question was already asked in the *Open Data Workshop* category.

Software setup

Before you dive into the notebooks, we recommend first taking a look at the setup guide, where you will find information to configure the workspace where you will be executing the tutorials.

We describe in the setup guide several options on how to run the notebooks. Each option is marked according to their difficulty and OS dependency. Feel free to pick the one that best suits your needs.

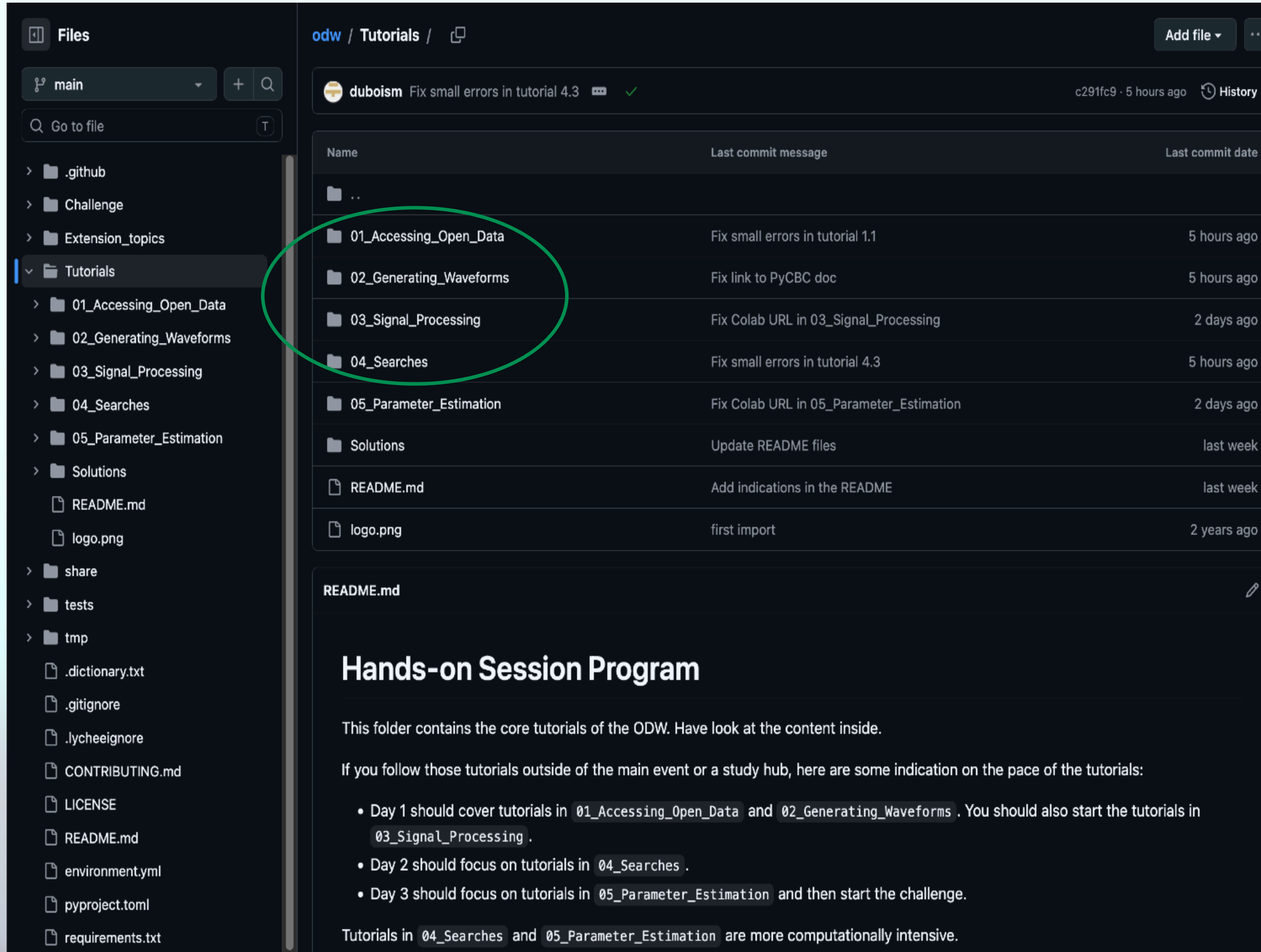
Hands-on sessions

The tutorials are divided in three folders for each day of hands-on sessions. In there, you can find a summary of their topics.

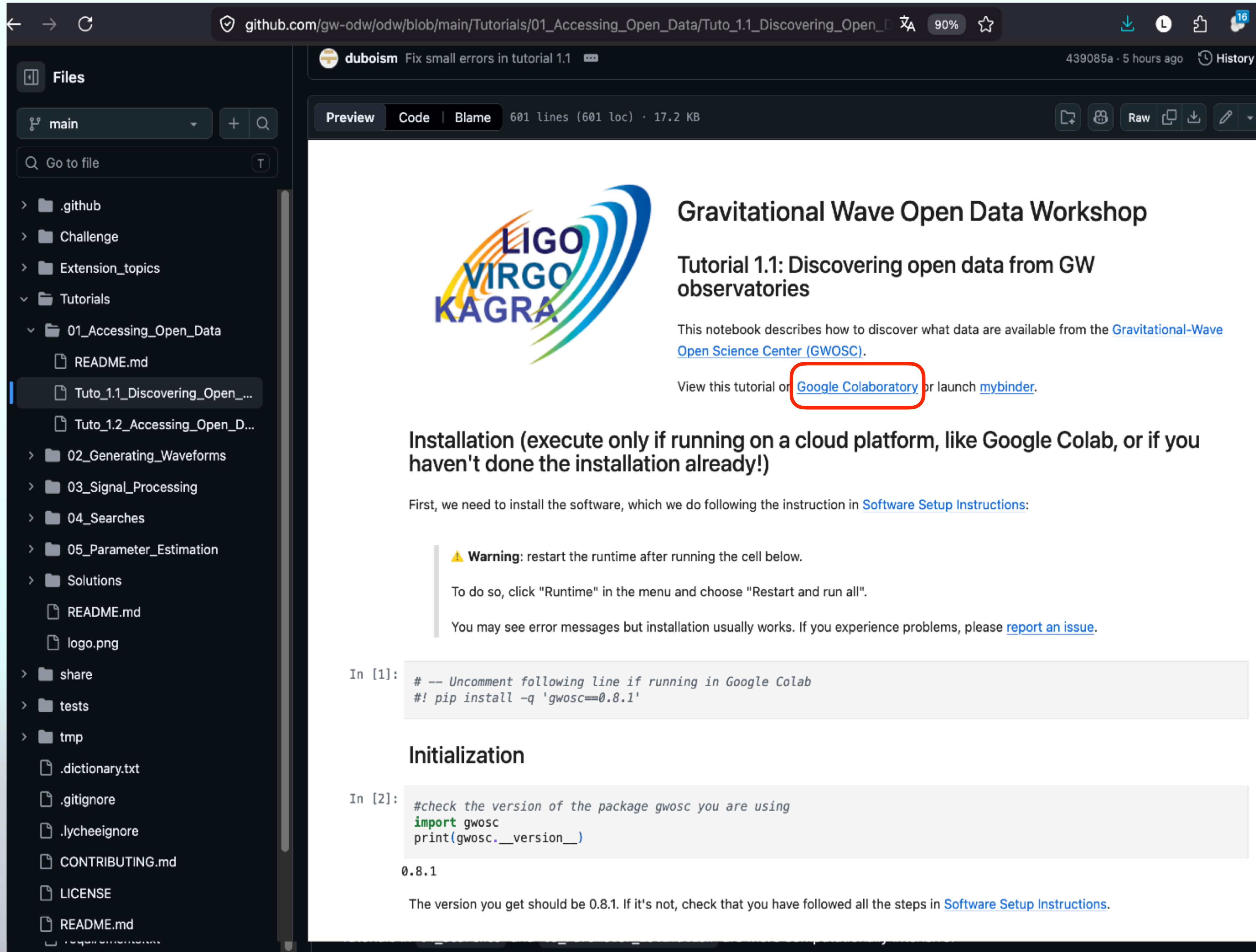
Data Challenge

In the Challenge folder you can find a list of *challenges*, ordered by difficulty. Participants can complete them

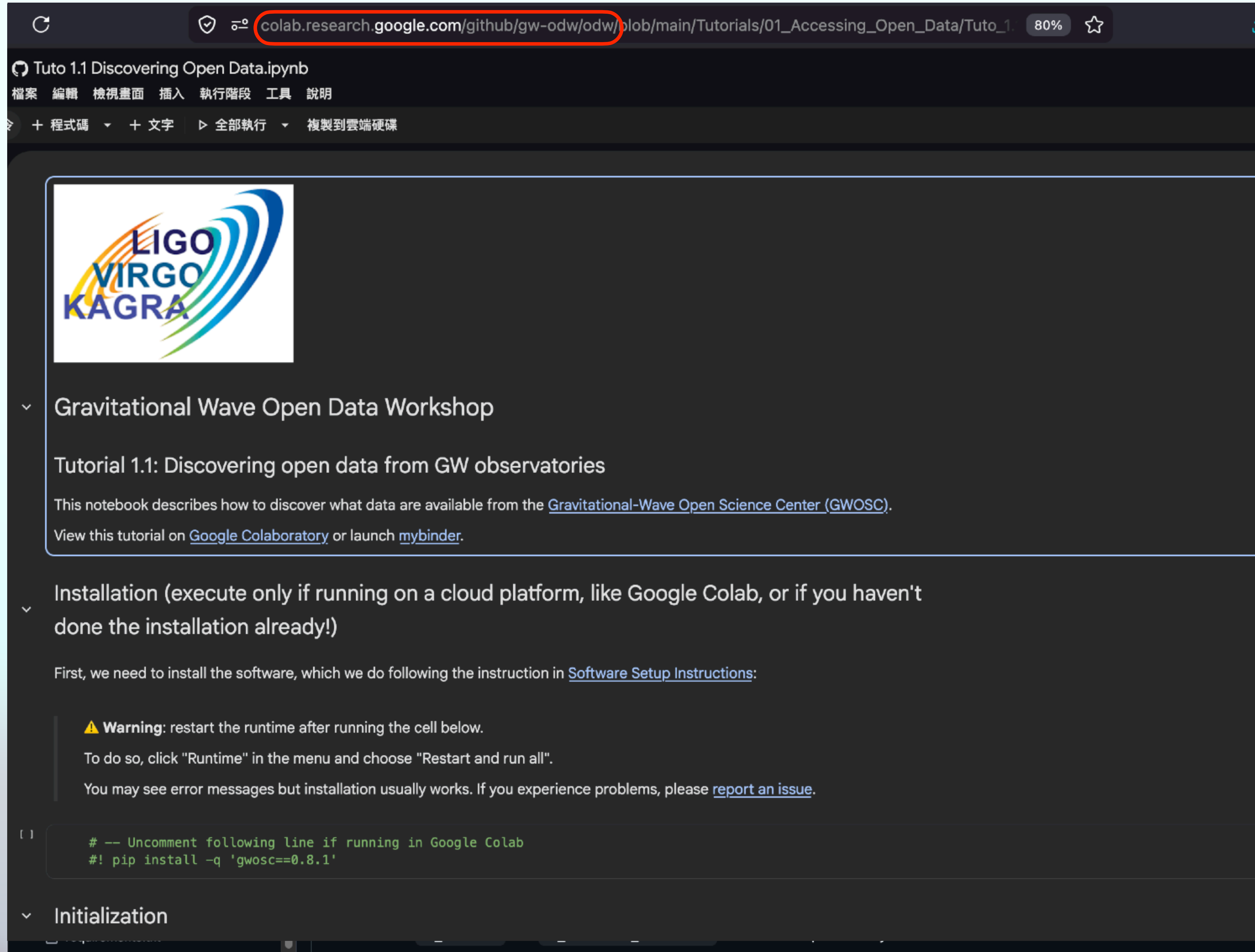
Tutorial Resources



Tutorial Resources



Tutorial Resources



Auxiliary Channels and Glitches

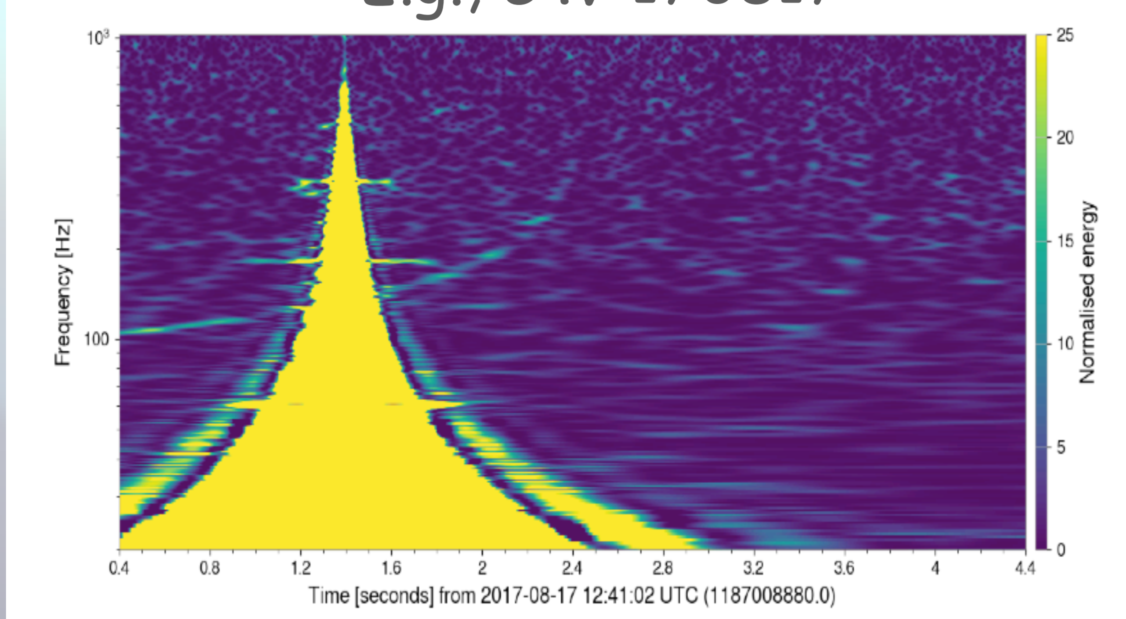
★ Glitches (also known as transients triggers) : the frequency of one signal increase abruptly in a short duration. Most of them are from the instrumental artifacts to add excess noise on the stain data.

Common source of glitches:

- Scattered laser light
- Thunder claps
- Earthquakes

★ A large number of sensors are used to record the state of the LIGO instruments and their environment. This data release contains sensor data recorded in around 500 channels at each LIGO site.

E.g., GW 170817



Channel Name	Desired Sample Rate [Hz]	notes	calibration	units	cal ref	Total (MB / s)	0.58
IMC-PWR_IN_OUT_DQ	512	Total laser power input to the IMC	1.0E+00	W		Total (GB / hr)	2.10
IMC-MC2_TRANS_SUM_OUT_DQ	512	power transmitted by the IMC		mW			
LSC-POP_A_LF_OUT_DQ	512	power in the Power Recycling Cavity		uW		Total data pts per sec	145811
ASC-X_TR_A_NSUM_OUT_DQ	512	Power transmitted through ETMX		W			
ASC-X_TR_B_NSUM_OUT_DQ	512	Power transmitted through ETMX		W			
ASC-Y_TR_A_NSUM_OUT_DQ	512	Power transmitted through ETMY		W			
ASC-Y_TR_B_NSUM_OUT_DQ	512	Power transmitted through ETMY		W			
ASC-AS_A_DC_NSUM_OUT_DQ	512	Power transmitted to the anti-symmetric port		W			
LSC-POPAIR_B_RF18_I_ERR_DQ	512	RF 9 MHz sideband buildup in PRC		W			
LSC-POPAIR_B_RF18_Q_ERR_DQ	512	RF 9 MHz sideband buildup in PRC (Q-phase, should be 0)		W			
LSC-POPAIR_B_RF90_I_ERR_DQ	512	RF 45 MHz sideband buildup in PRC		W			
LSC-POPAIR_B_RF90_Q_ERR_DQ	512	RF 45 MHz sideband buildup in PRC (Q-phase, should be 0)		W			
PSL-ENV_ANTERM_TEMP_DEGC	1	laser ante room temperature	1.0E+00	C			

Auxiliary Channels and Glitches

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K1:
main channel

```
K-K1_HOFT_C20-1270287328-32.gwf  K-K1_HOFT_C20-1270293472-32.gwf
K-K1_HOFT_C20-1270287360-32.gwf  K-K1_HOFT_C20-1270293504-32.gwf
K-K1_HOFT_C20-1270287392-32.gwf  K-K1_HOFT_C20-1270293536-32.gwf
K-K1_HOFT_C20-1270287424-32.gwf  K-K1_HOFT_C20-1270293568-32.gwf
K-K1_HOFT_C20-1270287456-32.gwf  K-K1_HOFT_C20-1270293600-32.gwf
```

K1:
Full channel

```
K-K1_C-1230024768-32.gwf*  K-K1_C-1230049856-32.gwf*
K-K1_C-1230024800-32.gwf*  K-K1_C-1230049888-32.gwf*
K-K1_C-1230024832-32.gwf*  K-K1_C-1230049920-32.gwf*
K-K1_C-1230024864-32.gwf*  K-K1_C-1230049952-32.gwf*
K-K1_C-1230024896-32.gwf*  K-K1_C-1230049984-32.gwf*
K-K1_C-1230024928-32.gwf*  K-K1_C-1230050016-32.gwf*
```

Channel Name	Desired Sample Rate [Hz]	notes	calibration	units	cal ref	Total (MB / s)	0.58
IMC-PWR_IN_OUT_DQ	512	Total laser power input to the IMC	1.0E+00	W		Total (GB / hr)	2.10
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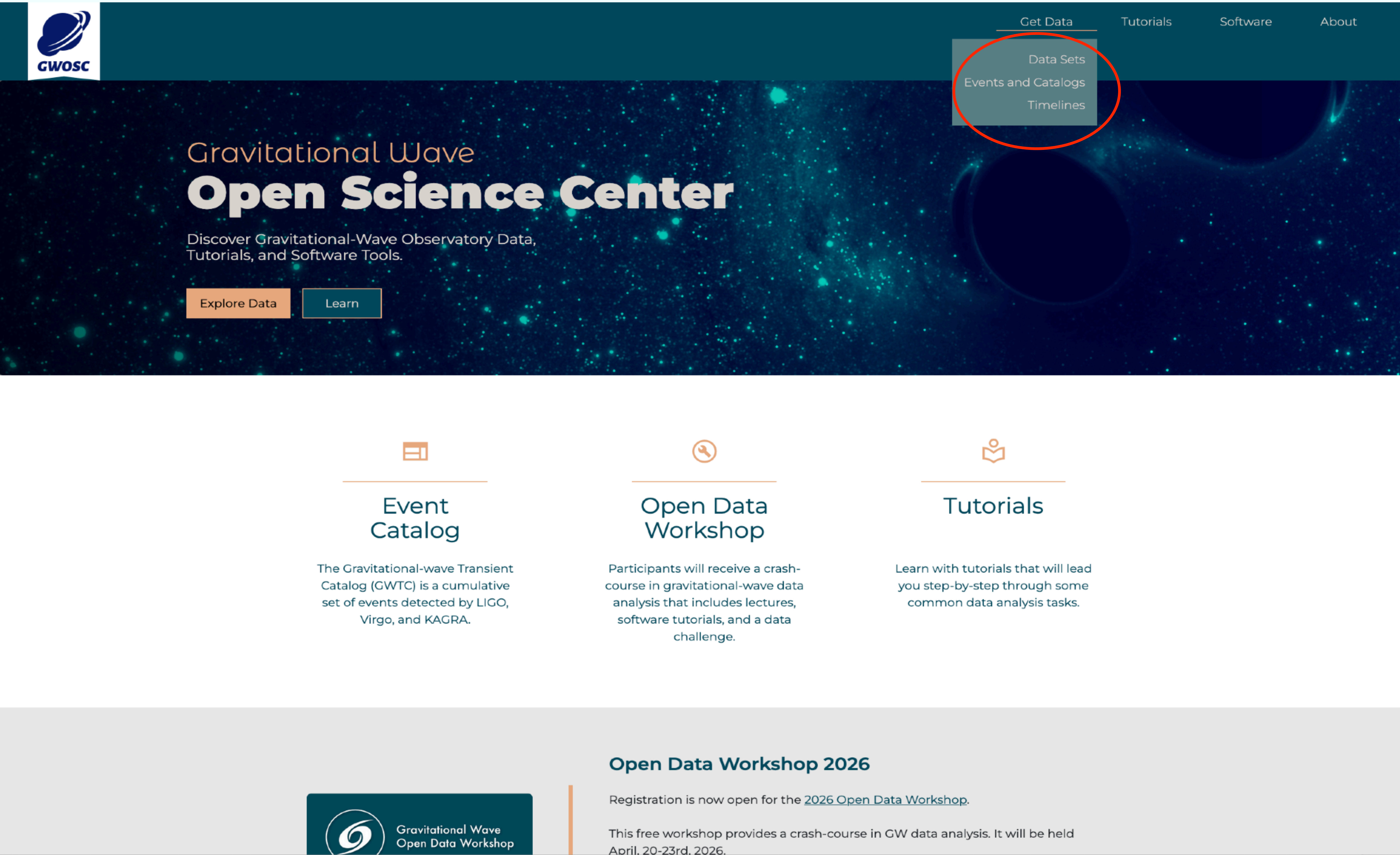
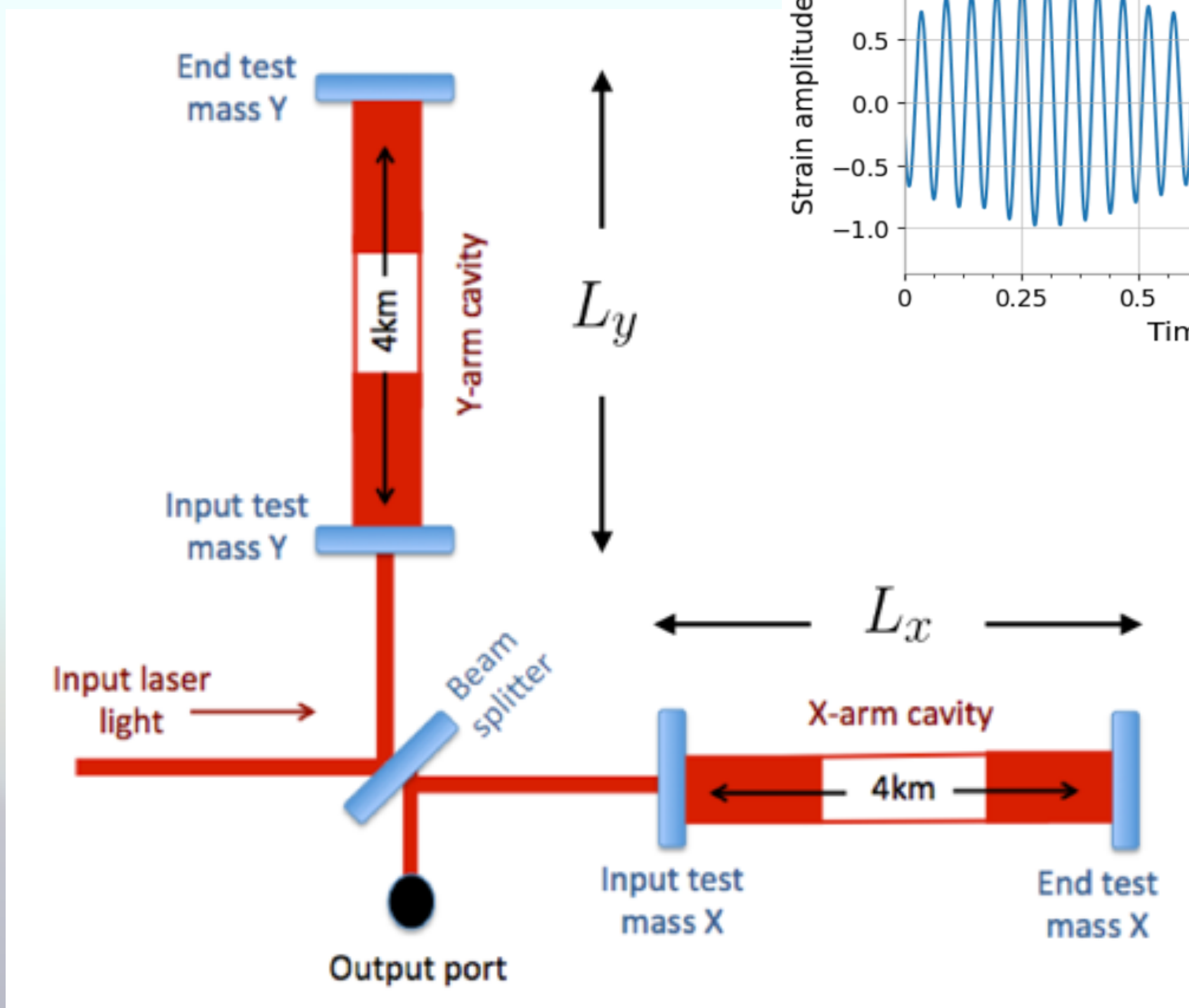
ASC-X_TR_A_NSUM_OUT_DQ	512	Power transmitted through ETMX		W			
ASC-X_TR_B_NSUM_OUT_DQ	512	Power transmitted through ETMX		W			
ASC-Y_TR_A_NSUM_OUT_DQ	512	Power transmitted through ETMY		W			
ASC-Y_TR_B_NSUM_OUT_DQ	512	Power transmitted through ETMY		W			
ASC-AS_A_DC_NSUM_OUT_DQ	512	Power transmitted to the anti-symmetric port		W			
LSC-POPAIR_B_RF18_I_ERR_DQ	512	RF 9 MHz sideband buildup in PRC		W			
LSC-POPAIR_B_RF18_Q_ERR_DQ	512	RF 9 MHz sideband buildup in PRC (Q-phase, should be 0)		W			
LSC-POPAIR_B_RF90_I_ERR_DQ	512	RF 45 MHz sideband buildup in PRC		W			
LSC-POPAIR_B_RF90_Q_ERR_DQ	512	RF 45 MHz sideband buildup in PRC (Q-phase, should be 0)		W			
PSL-ENV_ANTERM_TEMP_DEGC	1	laser ante room temperature	1.0E+00	C			

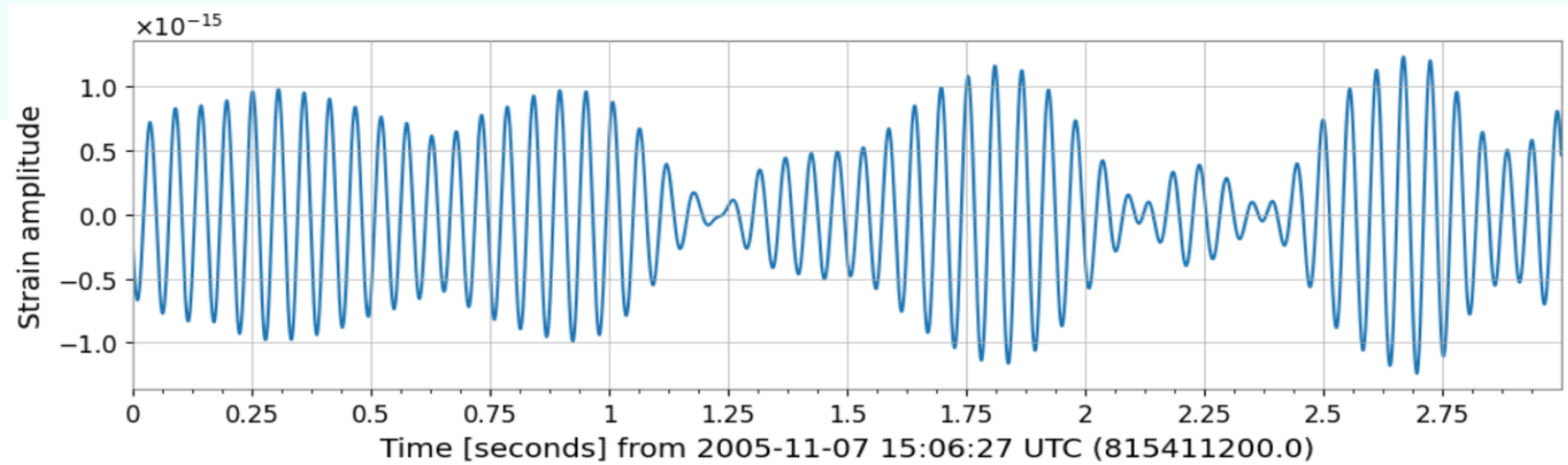
取得開放資料



GWOSC
Get Data
Tutorials
Software
About
Data Sets
Events and Catalogs
Timelines
Gravitational Wave
Open Science Center
Discover Gravitational-Wave Observatory Data, Tutorials, and Software Tools.
Explore Data
Learn
Event Catalog
The Gravitational-wave Transient Catalog (GWTC) is a cumulative set of events detected by LIGO, Virgo, and KAGRA.
Open Data Workshop
Participants will receive a crash-course in gravitational-wave data analysis that includes lectures, software tutorials, and a data challenge.
Tutorials
Learn with tutorials that will lead you step-by-step through some common data analysis tasks.
Open Data Workshop 2026
Gravitational Wave Open Data Workshop
Registration is now open for the 2026 Open Data Workshop.
This free workshop provides a crash-course in GW data analysis. It will be held April, 20-23rd, 2026.

Gravitational data obtained at the site





應變震幅(Strain amplitude)可以定應為:

$$h(t) = \frac{\Delta L_y - \Delta L_x}{L}$$

我們可以得到上面的長度(應變)隨時間變化示意圖

Retrieve the data from the known event

GW170817

Version 1 | Version 2 | Version 3

Documentation

Release: O1_O2-Preliminary

Event UID: GW170817-v1

Names: GW170817

GPS: 1187008882.4

UTC Time: 2017-08-17 12:41

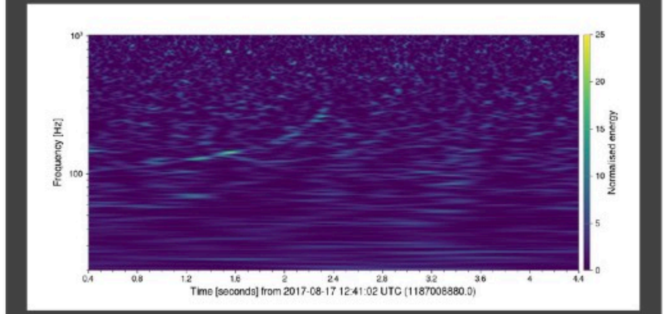
Timeline: Query for segments

DOI: https://doi.org/10.7935/K5B8566F

https://doi.org/10.7935/K5B8566F

These data files represent the C00 data, including a large glitch in the L1 data. These data are the "Strain data before noise subtraction" as described in the linked reference.

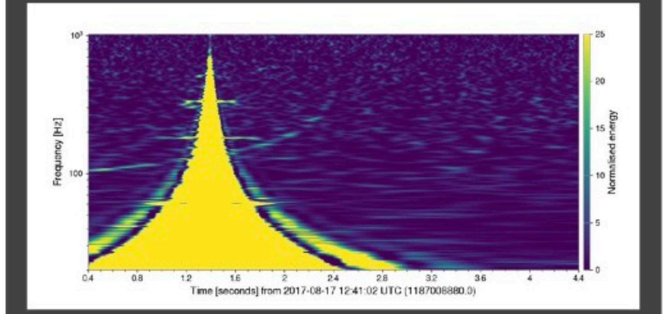
H1 strain



4096sec • 16KHz: GWF HDF TXT

4096sec • 4KHz: GWF HDF TXT

L1 strain



4096sec • 16KHz: GWF HDF TXT

4096sec • 4KHz: GWF HDF TXT

Retrieve the data from the known event

GW170817

Version 1 | Version 2 | Version 3

Documentation

Release: O1_O2-Preliminary

Event UID: GW170817-v2

Names: GW170817

GPS: 1187008882.4

UTC Time: 2017-08-17 12:41

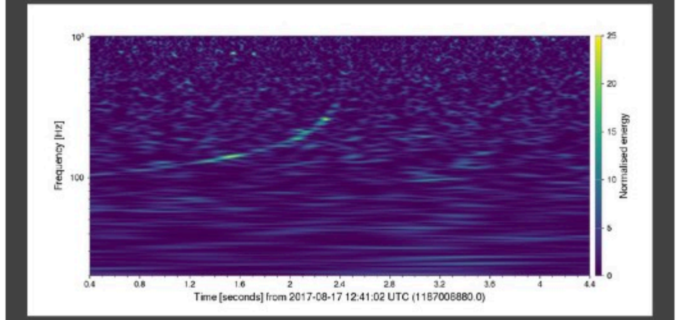
Timeline: Query for segments

DOI: https://doi.org/10.7935/K5B8566F

https://doi.org/10.7935/K5B8566F

These data files represent the "cleaned" data, after a glitch was removed from the L1 data. These data are the "Strain data after noise subtraction" as described in the linked reference.

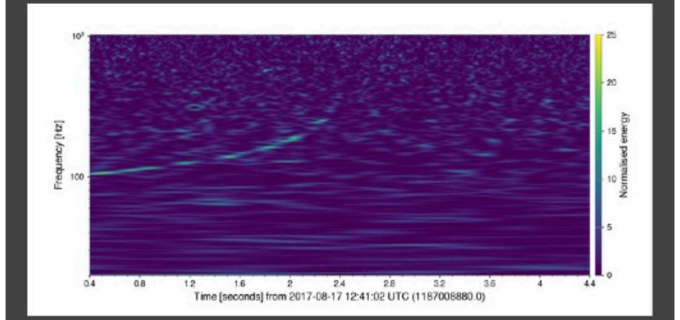
H1 strain



2048sec • 16KHz: GWF HDF TXT

2048sec • 4KHz: GWF HDF TXT

L1 strain



2048sec • 16KHz: GWF HDF TXT

2048sec • 4KHz: GWF HDF TXT

Retrieve the data from the known event

GW170817

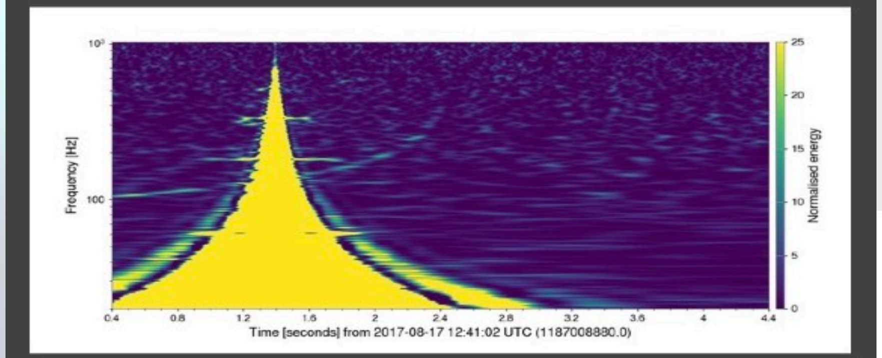
Strain data after noise subtraction

After data collection, several independently-measured terrestrial contributions to the detector noise were subtracted from the LIGO data using Wiener filtering. This subtraction removed calibration lines and 60 Hz AC power mains harmonics from both LIGO data streams. At times near GW170817, the sensitivity of LIGO-Hanford was particularly improved by the subtraction of laser pointing noise; several broad peaks in the 150 - 800 Hz region were effectively removed, increasing the Binary Neutron Star horizon distance of that detector by 26%.

In addition, a short instrumental noise transient appeared in the LIGO-Livingston detector 1.1 s before the coalescence time of GW170817. This transient noise, or glitch, produced a very brief (less than 5ms) saturation in a digital-to-analog converter. This glitch has been removed from the noise subtracted data. For reference:

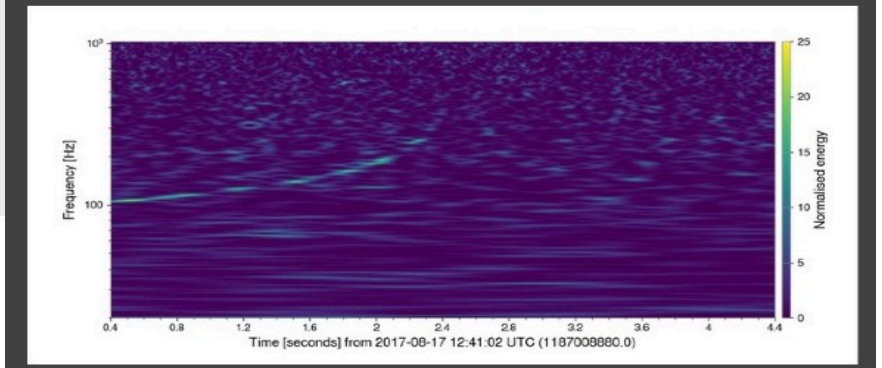
- Improving astrophysical parameter estimation via post-processing noise subtraction for Advanced LIGO
- GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral

L1 strain Version 1



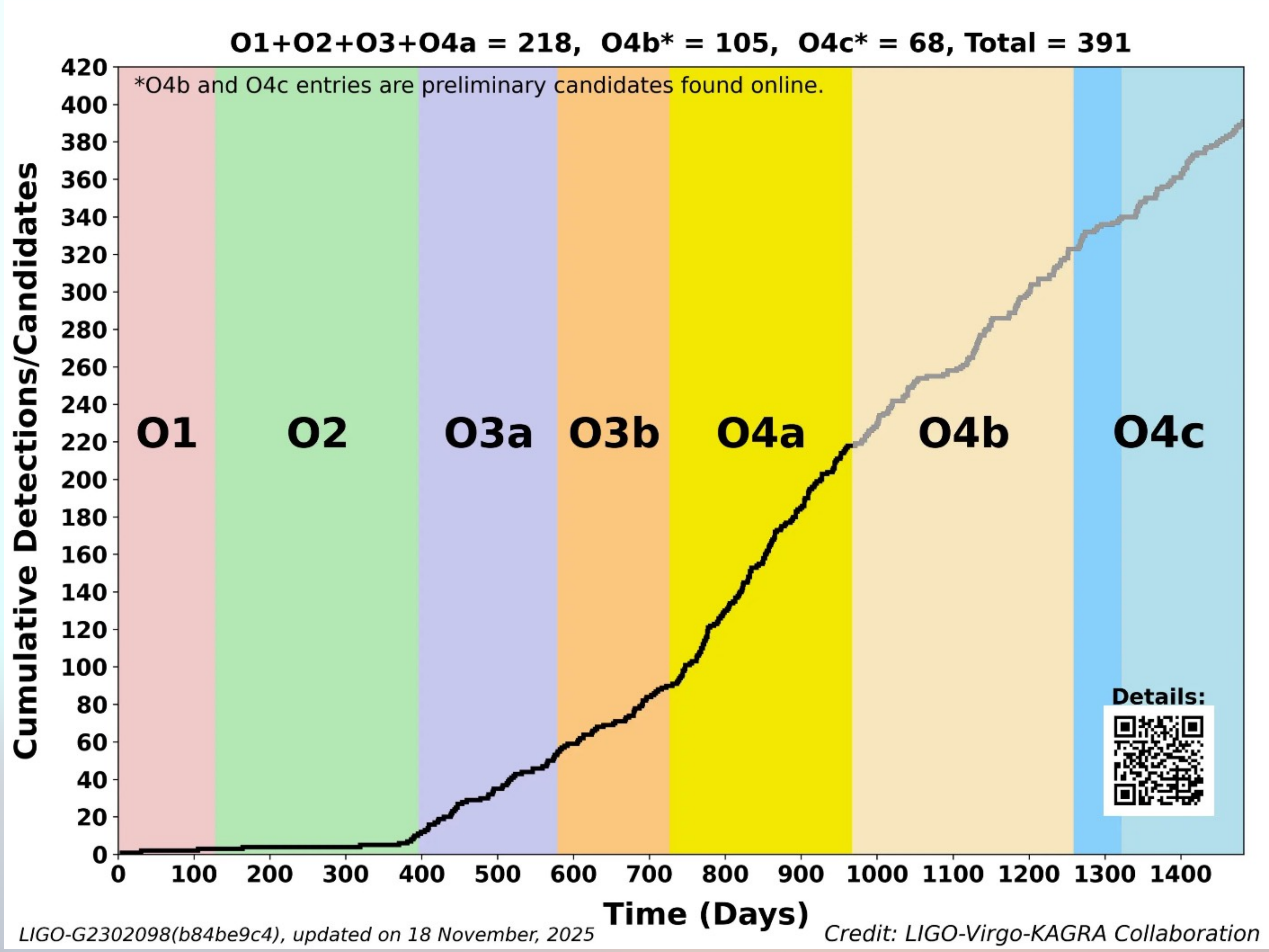
4096sec • 16KHz: GWF HDF TXT
4096sec • 4KHz: GWF HDF TXT

L1 strain Version 2

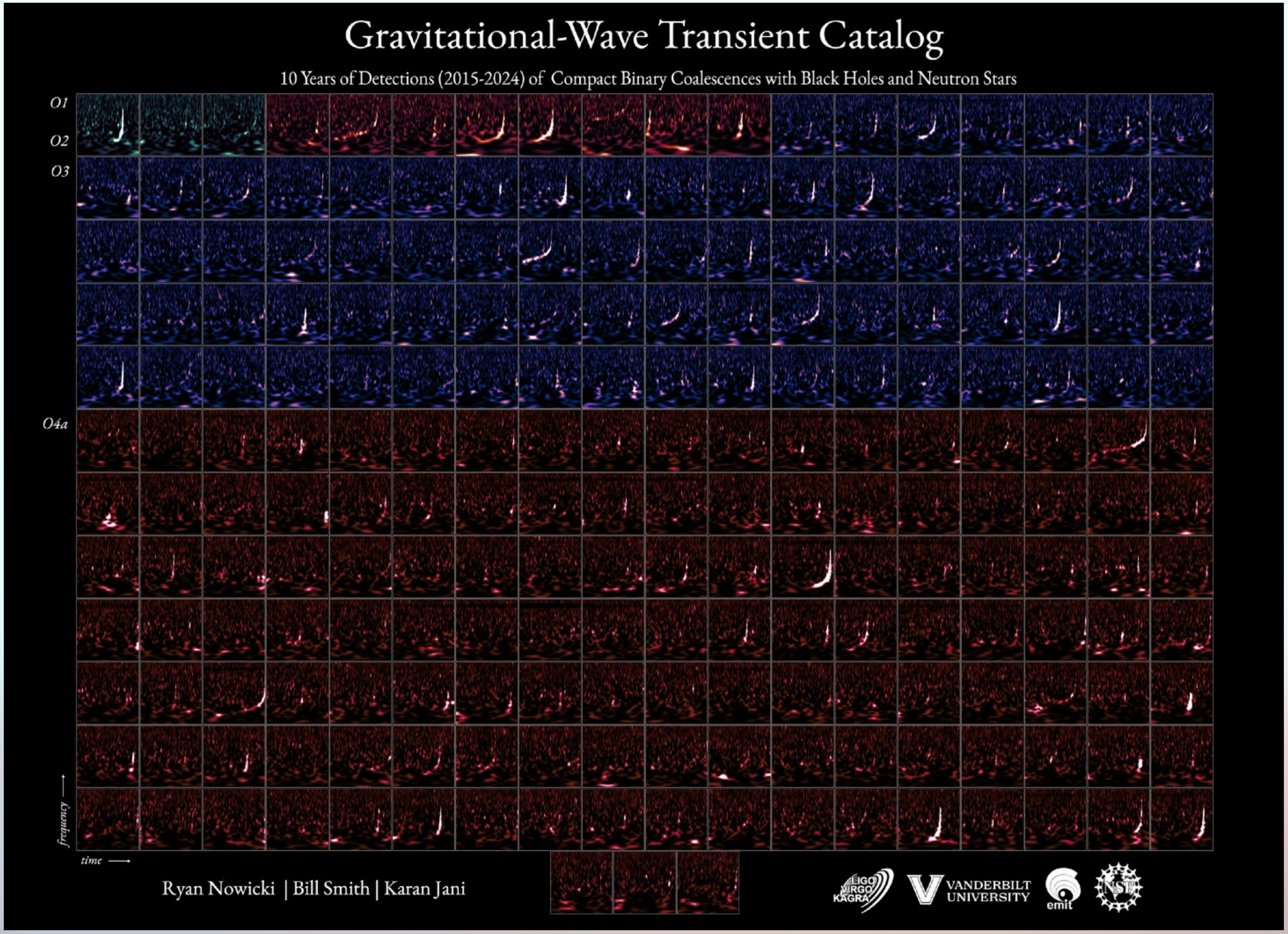


2048sec • 16KHz: GWF HDF TXT
2048sec • 4KHz: GWF HDF TXT

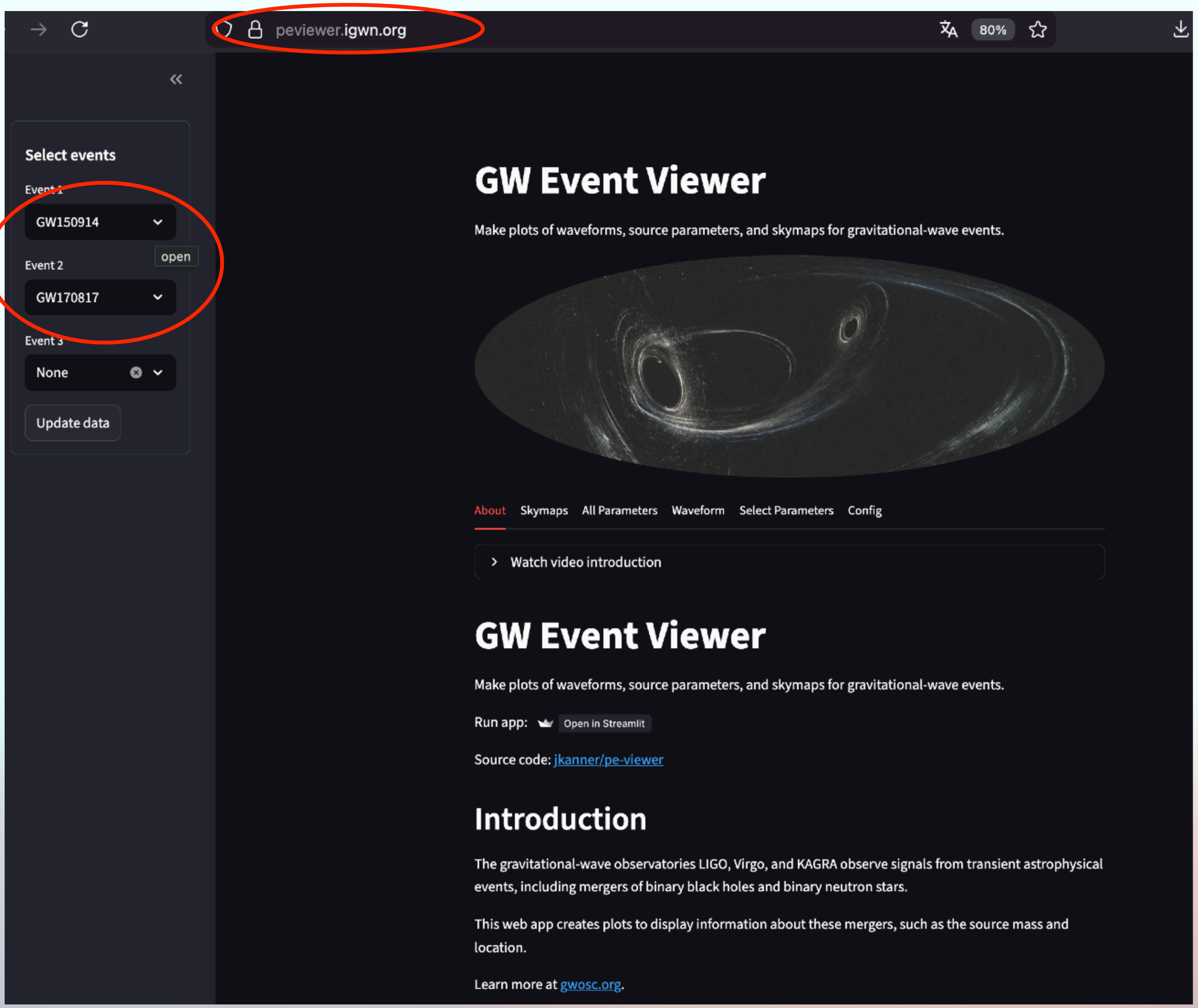
GWTC (Gravitational Wave Transient Catalogue) Events



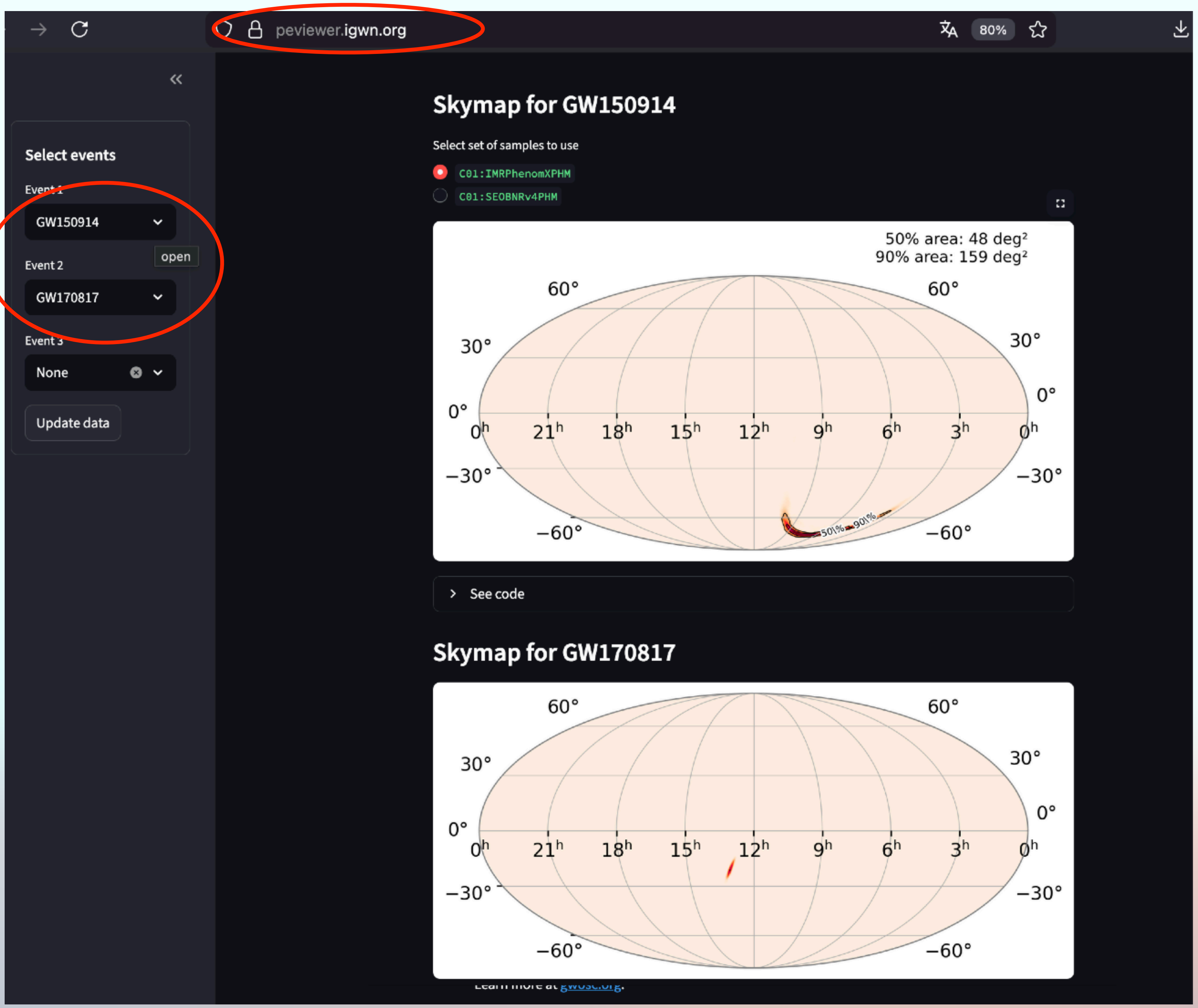
GWTC (Gravitational Wave Transient Catalogue) Events



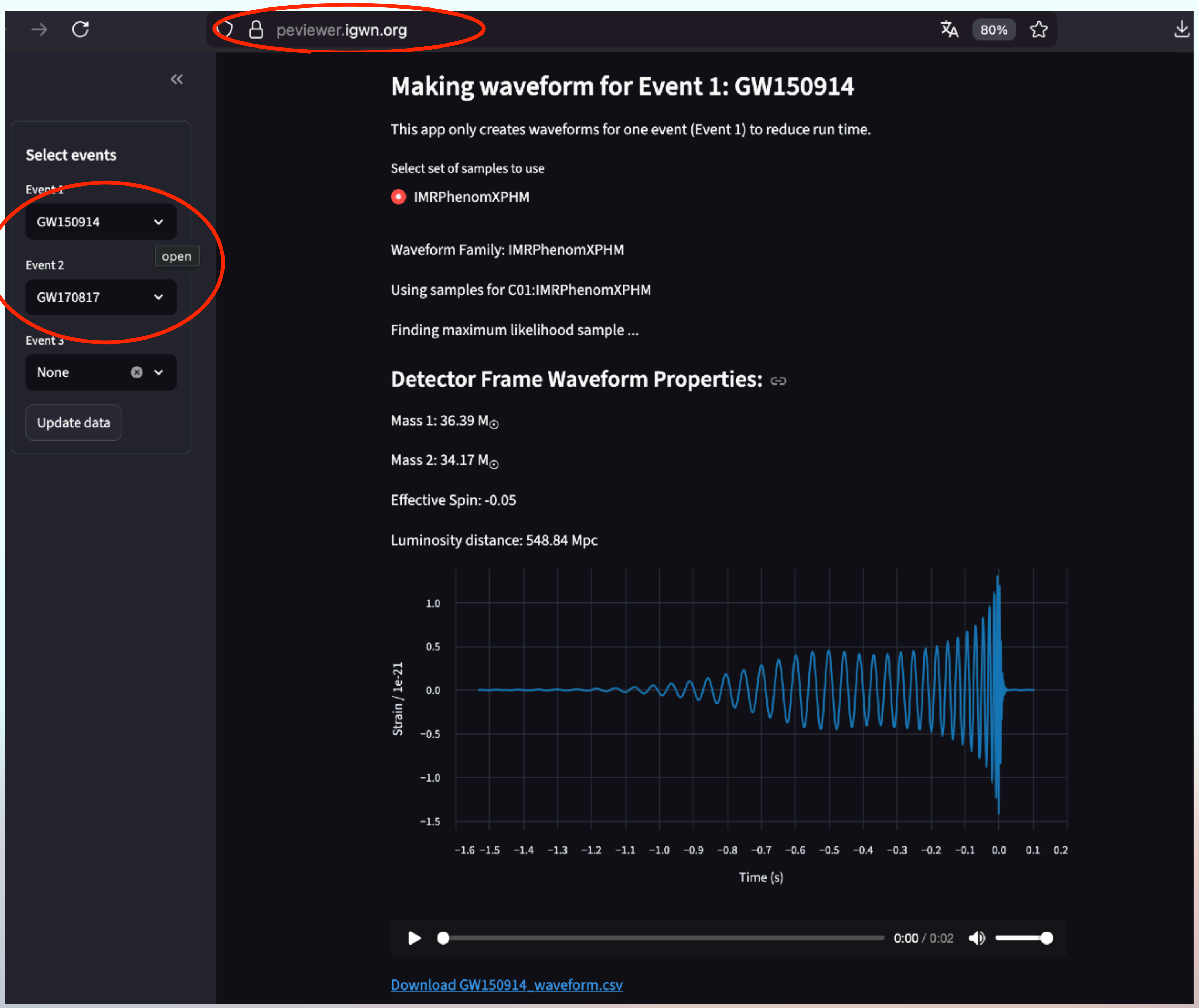
GW Event Viewer



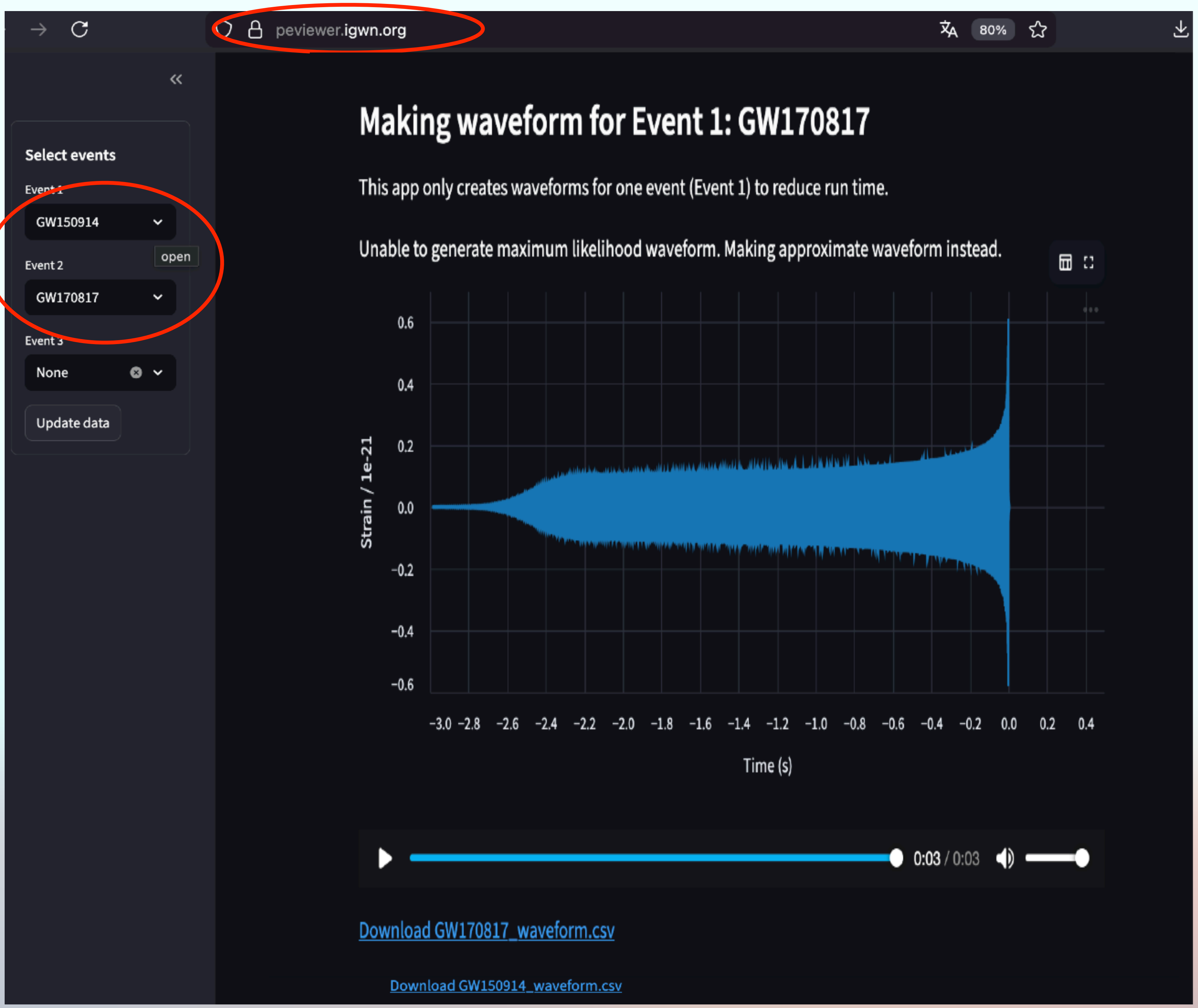
GW Event Viewer



GW Event Viewer



GW Event Viewer



Data format and Main Channel to Store the Strain

- Data are made available both as **frame files (GWF)** and **HDF5 (HDF)**.
- The strain data are made available both at **16384 Hz** and **4096 Hz** sampling rates.
- For studies involving frequencies of around 1700 Hz or above, the 16384 Hz data should be used instead. Advanced LIGO and advanced Virgo data are not calibrated or valid below 10 Hz or above 5 kHz. In most searches for astrophysical sources, data below **20 Hz** are not used because the noise is too high.
- "C00" to refer to data before noise subtraction, or the string "**CLN**" to indicate data after noise subtraction. The v2 (C02) data files were posted in October of 2016. They differ from v1 (C01) in that they use an updated version of the LIGO calibration. The v1 4096 Hz files included a minor time-offset, roughly 1 ms, introduced during the down-sampling process. This has been corrected in the v2 files.
- The channel names/frame types used to collect O3 data from the original files are:
  - ✦ "H1:DCS-CALIB_STRAIN_CLEAN-SUB60HZ_C01"/"H1_HOFT_CLEAN_SUB60HZ_C01" for H1,
  - ✦ "L1:DCS-CALIB_STRAIN_CLEAN-SUB60HZ_C01"/"L1_HOFT_CLEAN_SUB60HZ_C01" for L1 and
  - ✦ "V1:Hrec_hoft_16384Hz"/"V1Online" for V1.
- The channel names/frame types used to collect O3GK data from the original files are:
  - ✦ "G1:DER_DATA_HD_CLEAN"/"G1_RDS_C02_L3" for G1 and
  - ✦ "K1:DAC-STRAIN_C20"/"K1_HOFT_C20" for K1.