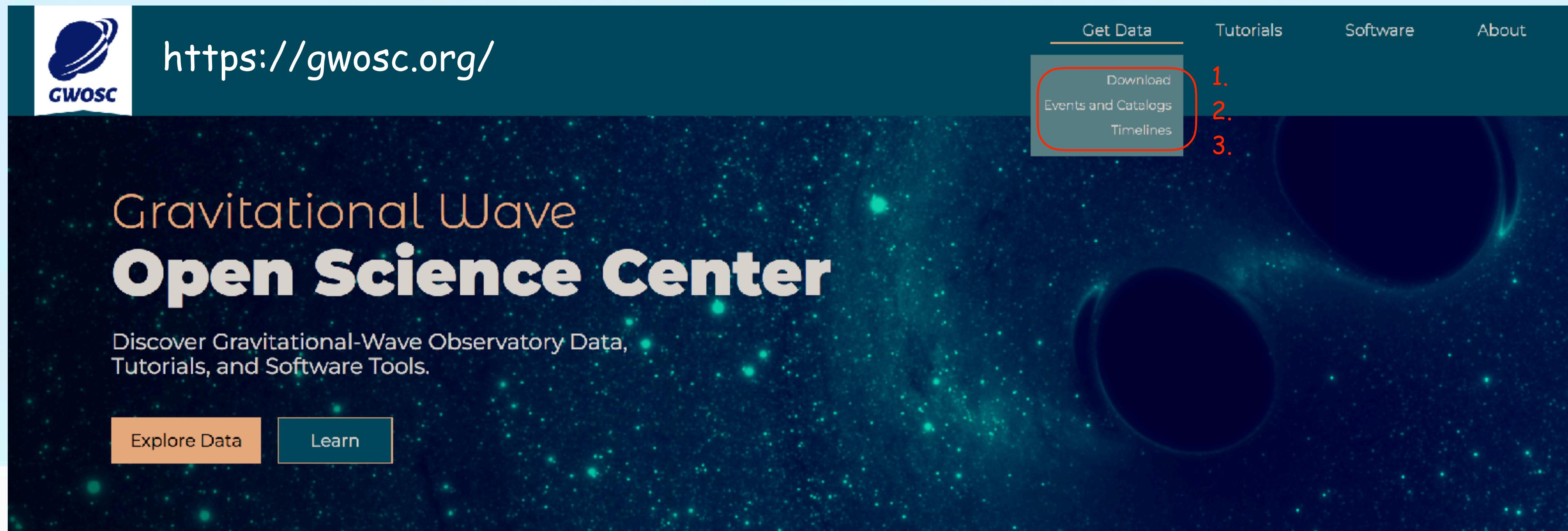


Access the Open Data



The screenshot shows the Gravitational Wave Open Science Center (GWOSC) website. At the top left is the GWOSC logo with the URL <https://gwosc.org/>. The top navigation bar includes links for Get Data, Tutorials, Software, and About. The 'Get Data' menu is open, showing options: Download, Events and Catalogs, and Timelines, with 'Events and Catalogs' highlighted by a red box. To the right of the menu, a numbered list (1, 2, 3) is partially visible. The main content area features a dark background with a starry field and a large circular light effect. The title 'Gravitational Wave Open Science Center' is prominently displayed in white. Below the title is a subtitle: 'Discover Gravitational-Wave Observatory Data, Tutorials, and Software Tools.' Two buttons are present: 'Explore Data' (orange) and 'Learn' (teal). The bottom section contains three cards: 'Event Catalog' (with a magnifying glass icon), 'Open Data Workshop' (with a workshop icon), and 'Tutorials' (with a book icon). Each card has a brief description and a detailed paragraph below it.



Event Catalog

The Gravitational-wave Transient Catalog (GWTC) is a cumulative set of events detected by LIGO, Virgo, and KAGRA.

Participants will receive a crash-course in gravitational-wave data analysis that includes lectures, software tutorials, and a data challenge.

Learn with tutorials that will lead you step-by-step through some common data analysis tasks.



Open Data Workshop

Participants will receive a crash-course in gravitational-wave data analysis that includes lectures, software tutorials, and a data challenge.

Learn with tutorials that will lead you step-by-step through some common data analysis tasks.

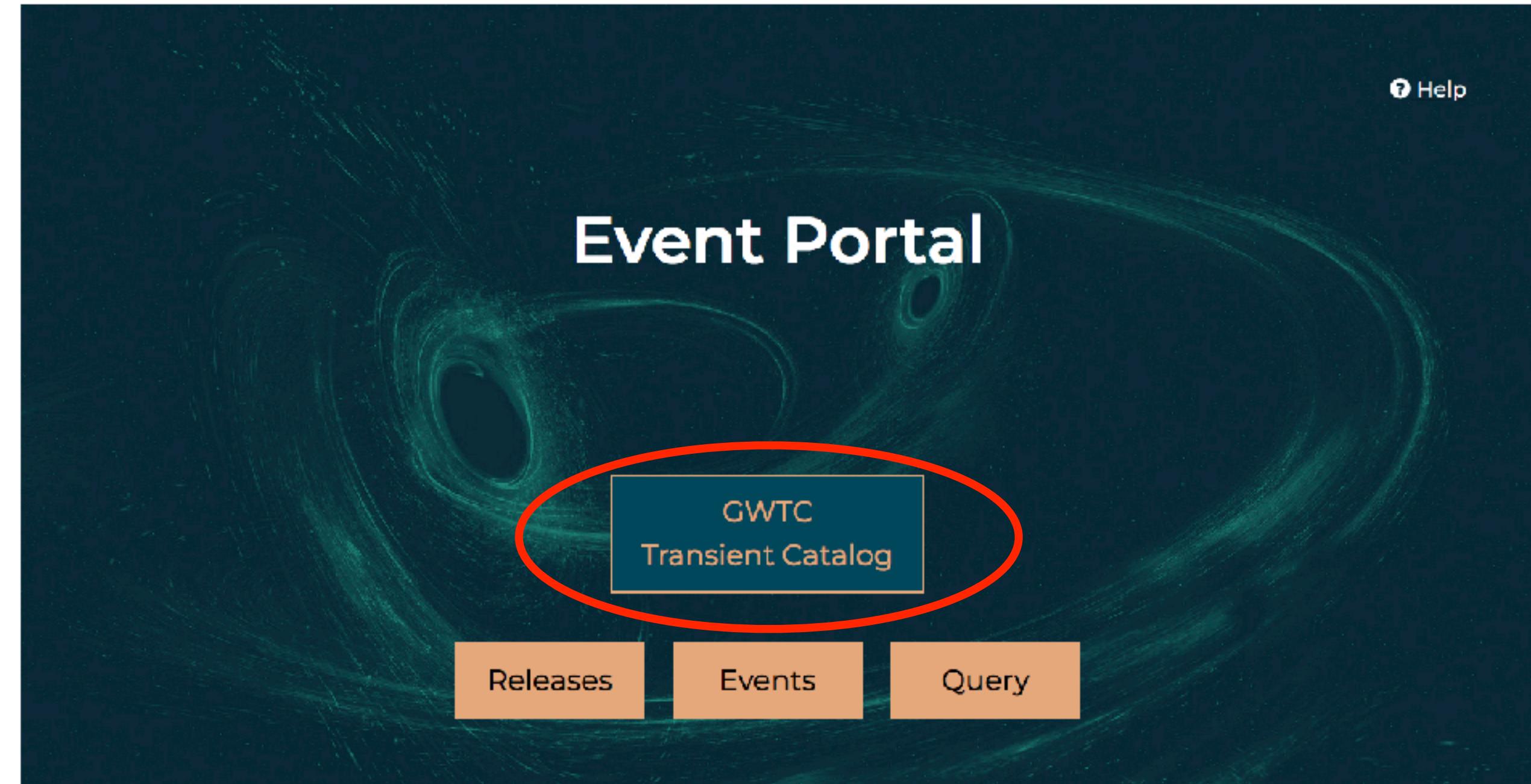


Tutorials

Participants will receive a crash-course in gravitational-wave data analysis that includes lectures, software tutorials, and a data challenge.

Learn with tutorials that will lead you step-by-step through some common data analysis tasks.

Events and catalog

[Get Data](#)[Tutorials](#)[Software](#)[About](#)

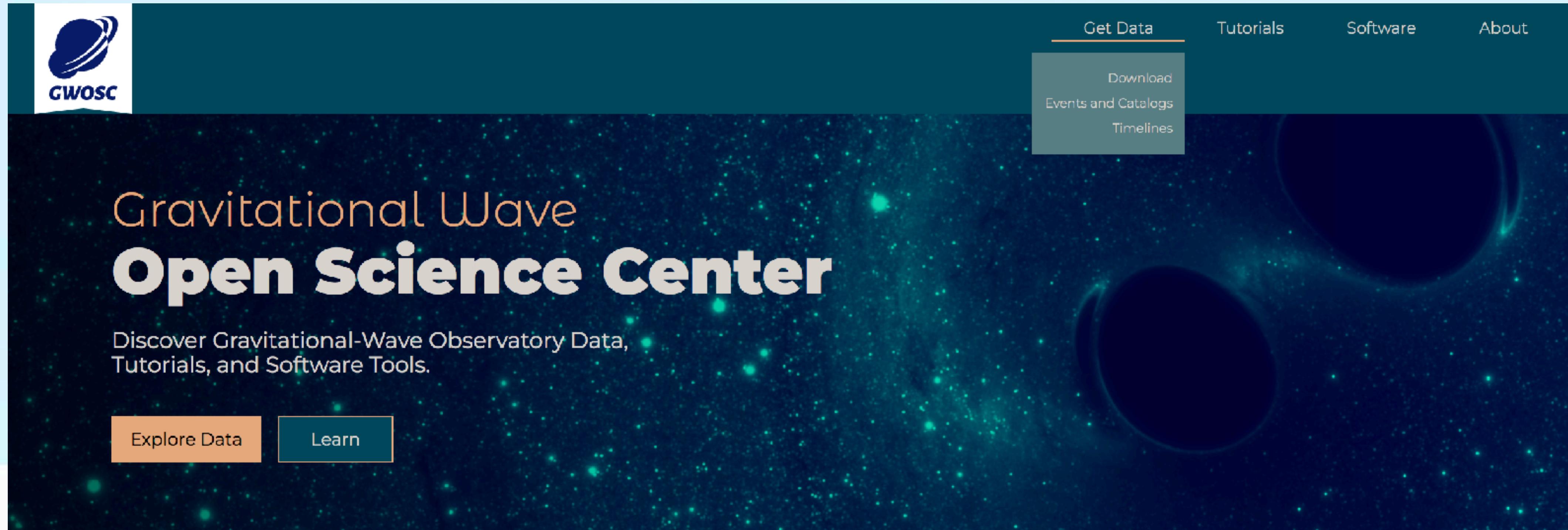
Other Related Sites

[Detector Status](#)[Low Latency Alerts](#)[Analysis Results on Zenodo.org](#)[The gravitational wave community forum](#)[Join our email list](#)

Data released under a CC BY 4.0 License.

Please follow acknowledgement guidelines.

Events and catalog



The image shows the homepage of the Gravitational Wave Open Science Center (GWOSC). The header features a logo with a blue planet and the text "GWOSC". The main title "Events and catalog" is displayed prominently in large blue letters. Below the title, there is a navigation bar with links: "Get Data" (underlined), "Tutorials", "Software", and "About". A dropdown menu under "Get Data" includes "Download", "Events and Catalogs", and "Timelines". The central content area has a dark background with a starry field and a large circular event visualization. It features the text "Gravitational Wave Open Science Center" and "Discover Gravitational-Wave Observatory Data, Tutorials, and Software Tools." Below this are two buttons: "Explore Data" and "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.



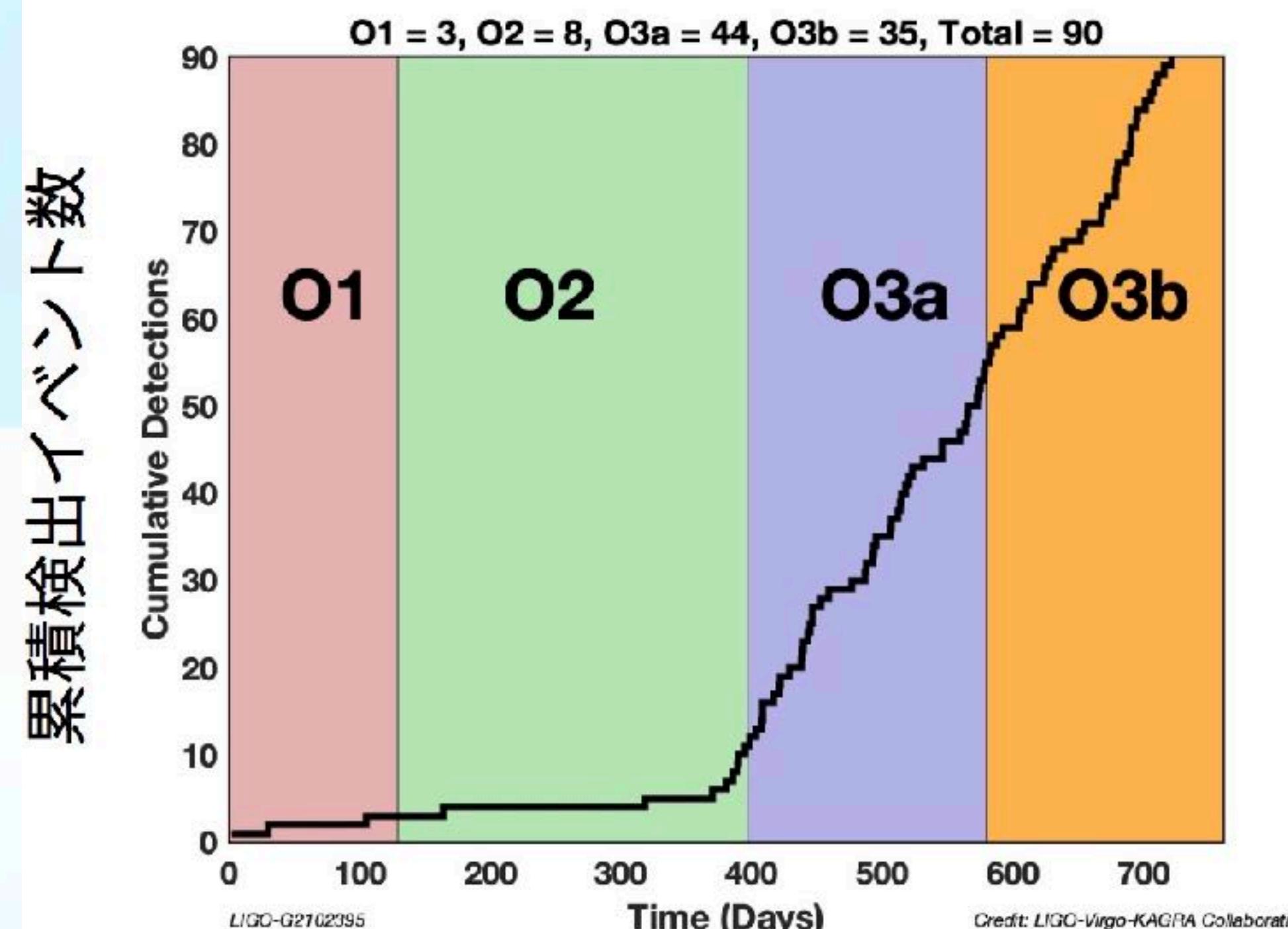
Tutorials

Learn with tutorials that will lead you step-by-step through some common data analysis tasks.

Gravitational-Wave Transient Catalogs; GWTCs

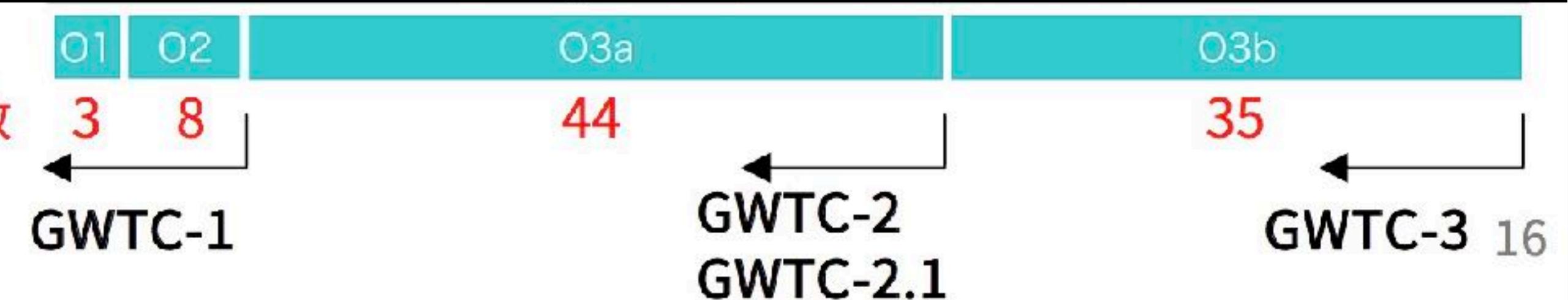
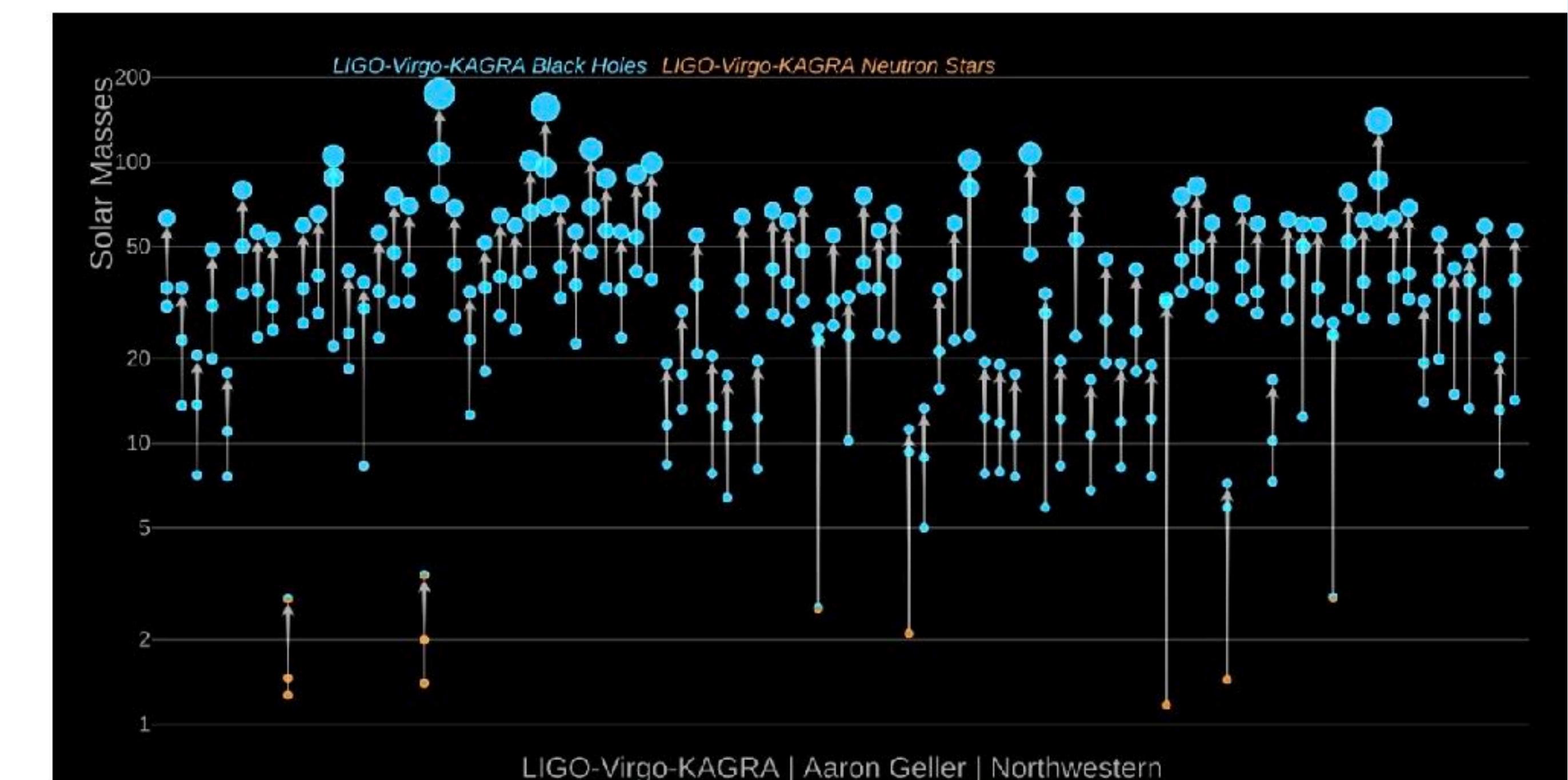
2015年に重力波が初検出されて以降、現在までに90イベントを検出

* 天体物理学的起源である確率が 50 % を超える候補重力波源の数.



累積観測日数

検出器の性能向上に伴い、検出頻度が加速
度的に増加している



Download the bulk data from timeline

Timeline Queries

The Timeline App shows times when data are available, as well as data quality and injection segments.

Use the [Event Portal](#) to access individual Events and request any of the Event Timeline or Segment Lists.

Data Set: O1

GPS Start: 1126051217
2015-09-12T08:00:00

GPS End: 1137254417
2016-01-20T00:00:00

Duration: 11203200

Strain Files

[Strain Data for H1](#) [Strain Data for L1](#)

Segments

Choose the output format below

Plot [JSON](#) [ASCII](#)

[Display ↻](#)

H1_BURST_CAT1
 H1_BURST_CAT2
 H1_BURST_CAT3
 H1_CBC_CAT1

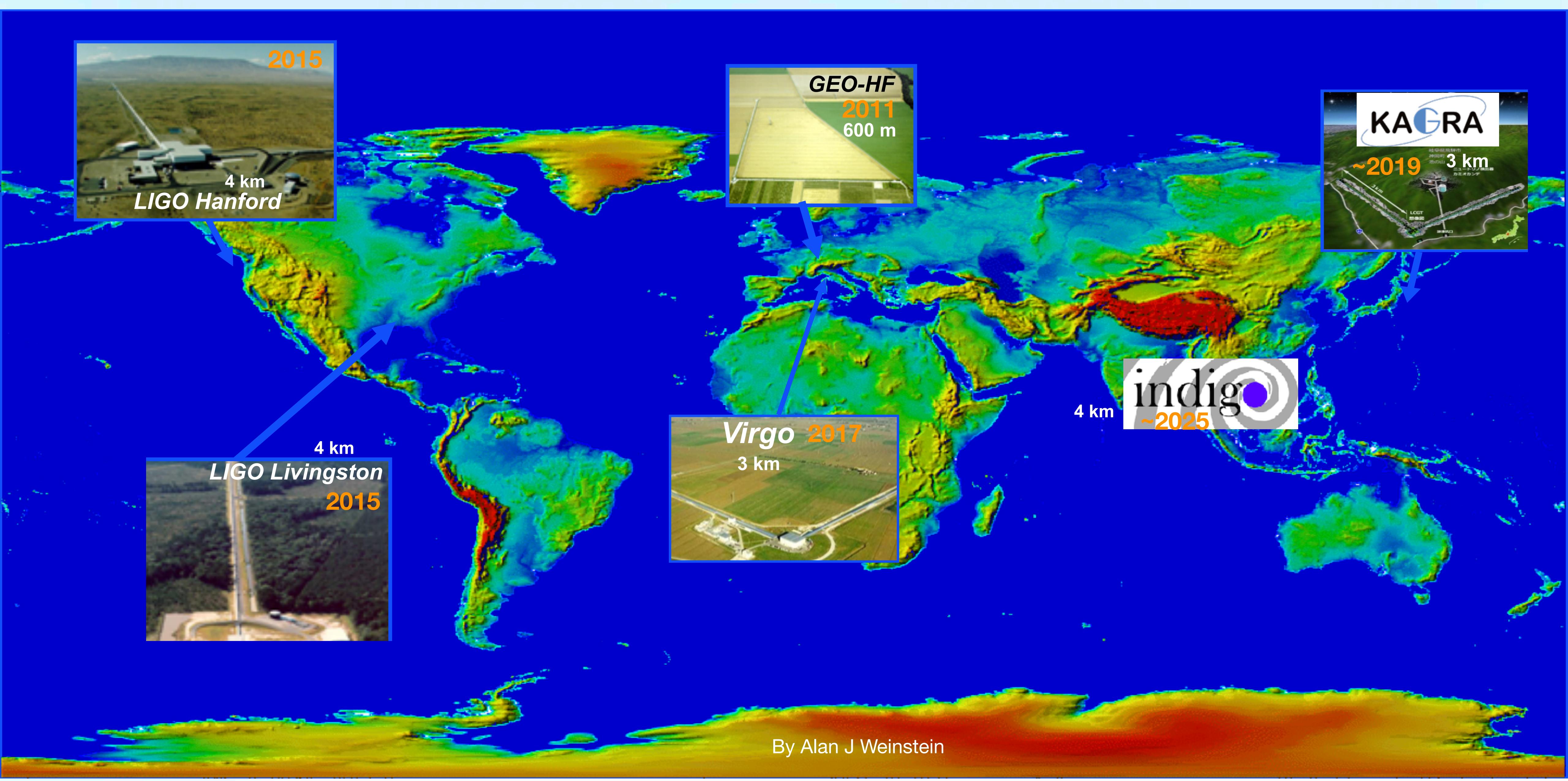
L1_BURST_CAT1
 L1_BURST_CAT2
 L1_BURST_CAT3
 L1_CBC_CAT1

Timeline Examples

- Science Mode History
- Five detectors since 2005
- Timelines from the O3GK run, 2020
- Data available over the O3GK run
- Passes O3GK Burst checks for G1, K1
- Passes O3GK CBC checks for G1, K1
- Times with no Continuous-Wave injections
- Timelines from the O3b run, 2019
- Data available over the O3b run
- Passes O3b Burst checks for H1, L1, V1
- Passes O3b CBC checks for H1, L1, V1
- Times with no Continuous-Wave injections
- Timelines from the O3a run, 2019
- Data available over the O3a run
- Passes O3a Burst checks for H1, L1, V1
- Passes O3a CBC checks for H1, L1, V1

H1: Handford
L1: Livingston
V1: Virgo
G1: GEO600
K1: KAGRA

The GW Detector Network



By Alan J Weinstein

Download the bulk data from timeline

Timeline O1

From: 2015-09-12T00:00:00 (GPS=1126051217)

To: 2016-01-19T16:00:00 (GPS=1137254417)

Duration: 11203200 s

Timeline Stats

| | Time Active | Duty Cycle | Segments |
|---------------|-------------|------------|----------|
| H1_BURST_CAT1 | 6626962 s | 59.15% | 655 |

Strain Data for H1

Strain Data for L1

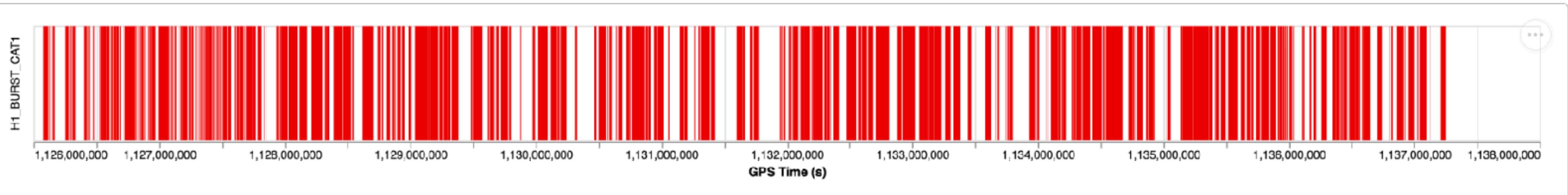
Download Segments

[JSON](#)

[ASCII](#)

H1_BURST_CAT1

H1_BURST_CAT1



Download the bulk data with specific option

Observatory Data Sets

Please Read This First!

[Click for data usage notes](#)

The [LIGO Laboratory's Data Management Plan](#) describes the scope and timing of LIGO data releases.

Events and Catalogs

 Event Portal

Large Data Sets

 CVMFS Docs

For users of computing clusters or if accessing large amounts of data, CernVM-FS is the preferred method to access public data.

O3 Auxiliary Data Release

 Documents

Time Range: April 1, 2019 through March 27, 2020

Detectors: 86 channels from H1 and L1

O3GK Data Release

O3GK Time Range: April 7, 2020 through April 21, 2020

 4 kHz Data

 16 kHz Data

 Timeline

 Documents

Download the bulk data with specific option

Archive for O3GK_4KHZ_R1 dataset

Each data file corresponds to 4096 seconds of CPS time, and may contain up to half a GB. The file may be downloaded in either HDF5 or Frame format.

For documentation, see the [tutorials](#).

| | | |
|-------------------------|------------|--------------------------|
| O3GK_4KHZ_R1 start GPS: | 1270281618 | UTC: 2020-04-07T08:00:00 |
| O3GK_4KHZ_R1 end GPS: | 1271462418 | UTC: 2020-04-21T00:00:00 |

Next choose your gravitational wave detector:

- K1 **To download the KAGRA data**
 G1

Now choose the start and end time of the data that you want, either Universal time or GPS. Change either side and the other responds immediately.

| | Universal Time (ISO8601) | CPS Time | |
|------------|--------------------------|--------------|----|
| Start Time | 2020-04-07T08:00:00 | ↔ 1270281618 | OK |
| End Time | 2020-04-21T00:00:00 | ↔ 1271462418 | OK |

Choose your output format:

- Time series data in HDF5 and Frame files
 Time series data in HDF5 and Frame files, with data quality guide
 Includes statistics of each file: min/max, band-limited RMS, etc.
 JSON formatted table of files and data quality

Click the button to continue

Continue

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.

Download the bulk data with specific option

Dataset: O3GK_4KHZ_R1

GPS Time Interval: [1270281618, 1271462418]

Detector: K1

Note:

- Each file covers a 4096-second period, with strain data at either 16kHz or downsampled to 4 kHz.
- The time of the beginning of the file is shown as 'GPS start time', and is linked to a timeline showing which parts of the tile have science-mode data.
- The last column of the table shows the percentage of each file that has data.
- For instructions on downloading many files, see the [Automatic Download Tutorial](#).

| Timeline | UTC | Mbytes | HDFS | Frame | Percent |
|------------|---------------------|----------|------|-------|---------|
| 1270284288 | 2020-04-07T08:44:30 | 17.8 MB | HDFS | Frame | 13.8 |
| 1270288384 | 2020-04-07T09:52:46 | 45.6 MB | HDFS | Frame | 36.4 |
| 1270292480 | 2020-04-07T11:01:02 | 123.9 MB | HDFS | Frame | 100.0 |
| 1270296576 | 2020-04-07T12:09:18 | 90.0 MB | HDFS | Frame | 72.5 |
| 1270300672 | 2020-04-07T13:17:34 | 39.6 MB | HDFS | Frame | 31.6 |
| 1270304768 | 2020-04-07T14:25:50 | 97.7 MB | HDFS | Frame | 78.7 |
| 1270308864 | 2020-04-07T15:34:06 | 123.7 MB | HDFS | Frame | 99.9 |
| 1270312960 | 2020-04-07T16:42:22 | 123.9 MB | HDFS | Frame | 100.0 |
| 1270317056 | 2020-04-07T17:50:38 | 100.6 MB | HDFS | Frame | 81.1 |
| 1270321152 | 2020-04-07T18:58:54 | 123.9 MB | HDFS | Frame | 100.0 |
| 1270325248 | 2020-04-07T20:07:10 | 105.3 MB | HDFS | Frame | 84.9 |
| 1270329344 | 2020-04-07T21:15:26 | 123.8 MB | HDFS | Frame | 100.0 |
| 1270333440 | 2020-04-07T22:23:42 | 123.7 MB | HDFS | Frame | 100.0 |
| 1270337536 | 2020-04-07T23:31:58 | 123.7 MB | HDFS | Frame | 100.0 |
| 1270341632 | 2020-04-08T00:40:14 | 123.8 MB | HDFS | Frame | 100.0 |
| 1270345728 | 2020-04-08T01:48:30 | 110.5 MB | HDFS | Frame | 89.2 |
| 1270378496 | 2020-04-08T10:54:38 | 68.4 MB | HDFS | Frame | 55.0 |

Auxiliary channels and Glitches

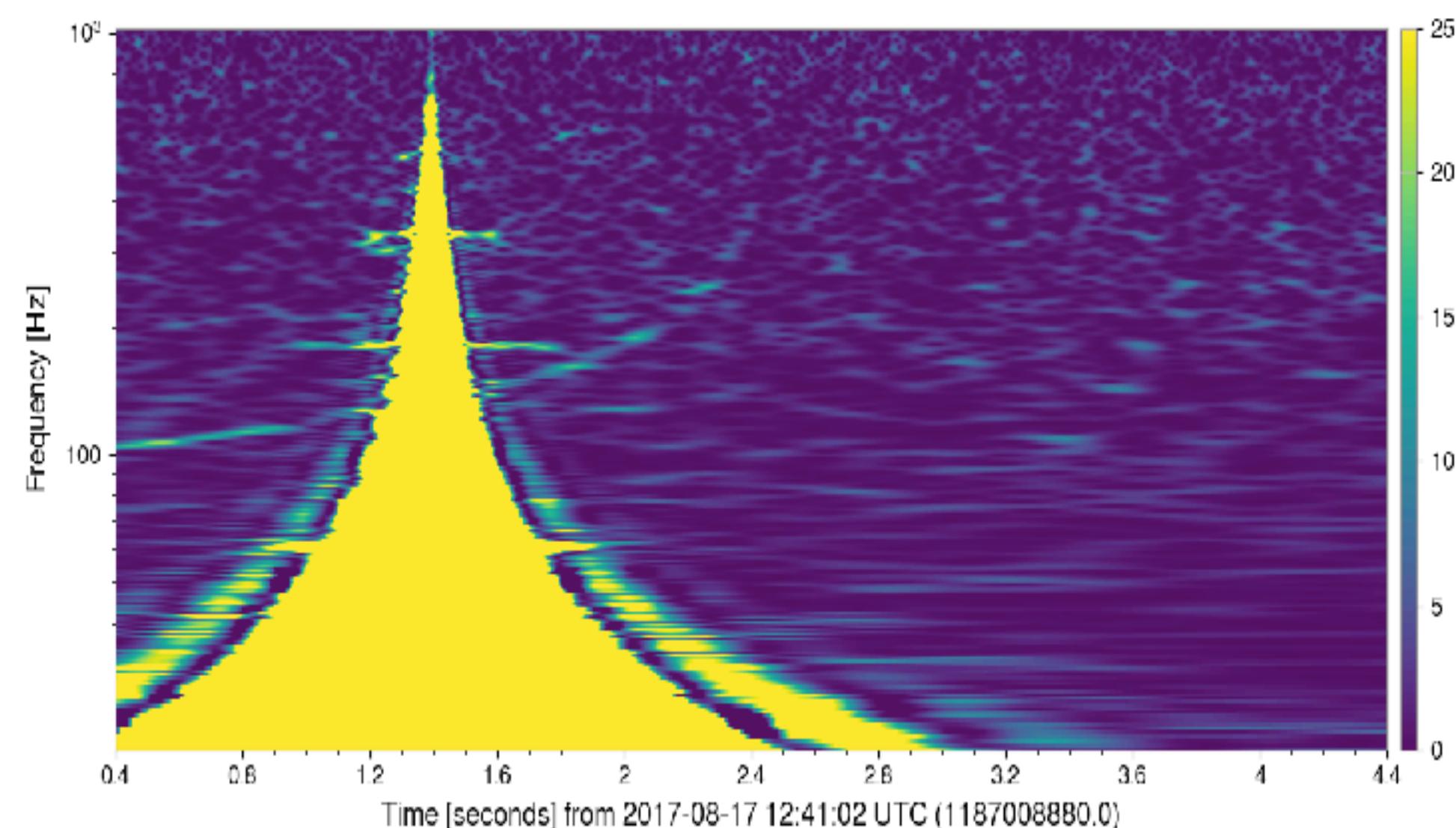
★ Glitches (also known as transients triggers) : the frequency of one signal increase abruptly in a short duration. Most of them are from the instrumental artifacts to add excess noise on the strain data.

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) |
|----------------------------|--------------------------|--|-------------|-------|---------|-------------------------------|
| IMC-PWR_IN_OUT_DQ | 512 | Total laser power input to the IMC | 1.0E+00 | W | | 0.58 |
| IMC-MC2_TRANS_SUM_OUT_DQ | 512 | power transmitted by the IMC | | mW | | Total (GB / hr) 2.10 |
| LSC-POP_A_IF_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

★ 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 strain 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.

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 |
| IMC-MC2_TRANS_SUM_OUT_DQ | 512 | power transmitted by the IMC | | mW | | | |
| LSC-POP_A_IF_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 | | | |

Download the S5 data with specific option

The screenshot shows a web browser window with the URL <https://gwosc.org/data/>. The page displays three data release sections: O1 Data Release, S6 Data Release, and S5 Data Release. Each section includes a time range, detectors, and download links for 4 kHz Data, 16 kHz Data, Documents, and Timeline.

O1 Data Release
O1 Time Range: September 12, 2015 through January 19, 2016
Detectors: H1 and L1

S6 Data Release
S6 Time Range: July 7, 2009 through October 20, 2010
Detectors: H1 and L1

S5 Data Release
S5 Time Range: November 4, 2005 through October 1, 2007
Detectors: H1, H2, and L1

Buttons for download options are present in each section: 4 kHz Data, 16 kHz Data, Documents, and Timeline. The "Data" button in the S5 section is highlighted with a red oval.

Download the S5 data with specific option

Each data file corresponds to 4096 seconds of GPS time, and may contain up to half a GB. The file may be downloaded in either HDF5 or Frame format.

For documentation, see the [tutorials](#).

S5 start GPS: 815155213 UTC: 2005-11-04T16:00:00

S5 end GPS: 875232014 UTC: 2007-10-01T00:00:00

Next choose your gravitational wave detector:

- H2
- H1
- L1

Now choose the start and end time of the data that you want, either Universal time or GPS. Change either side and the other responds immediately.

| | Universal Time (ISO8601) | GPS Time | |
|------------|--------------------------|-----------|----|
| Start Time | 2005-11-04T16:00:00 | 815155213 | OK |
| End Time | 2007-11-05T00:00:00 | 878256014 | OK |

Choose your output format:

- Time series data in HDF5 and Frame files
- Time series data in HDF5 and Frame files, with data quality guide
- Includes statistics of each file: min/max, band-limited RMS, etc.
- JSON formatted table of files and data quality

Download the S5 data with specific option

Dataset: S5

GPS Time Interval: [815155213, 878256014]

Detector: H1

Note:

- Each file covers a 4096-second period, with strain data at either 16kHz or downsampled to 4 kHz.
- The time of the beginning of the file is shown as 'GPS start time', and is linked to a timeline showing which parts of the tile have science-mode data.
- The last column of the table shows the percentage of each file that has data.
- For instructions on downloading many files, see the [Automatic Download Tutorial](#).

| Timeline | UTC | Mbytes | HDF5 | Frame | Percent |
|---------------------------|---------------------|----------|----------------------|-----------------------|---------|
| 815398912 | 2005-11-07T11:41:39 | 3.3 MB | HDF5 | Frame | 2.0 |
| 815403008 | 2005-11-07T12:49:55 | 4.7 MB | HDF5 | Frame | 3.1 |
| 815407104 | 2005-11-07T13:58:11 | 11.1 MB | HDF5 | Frame | 8.4 |
| 815411200 | 2005-11-07T15:06:27 | 90.7 MB | HDF5 | Frame | 73.7 |
| 815493120 | 2005-11-08T13:51:47 | 93.2 MB | HDF5 | Frame | 75.7 |
| 815497216 | 2005-11-08T15:00:03 | 25.6 MB | HDF5 | Frame | 20.3 |
| 815562752 | 2005-11-09T09:12:19 | 92.3 MB | HDF5 | Frame | 75.0 |
| 815566848 | 2005-11-09T10:20:35 | 122.8 MB | HDF5 | Frame | 100.0 |
| 815570944 | 2005-11-09T11:28:51 | 88.2 MB | HDF5 | Frame | 71.7 |
| 815575040 | 2005-11-09T12:37:07 | 122.8 MB | HDF5 | Frame | 100.0 |
| 815579136 | 2005-11-09T13:45:23 | 56.1 MB | HDF5 | Frame | 45.3 |
| 815583232 | 2005-11-09T14:53:39 | 87.7 MB | HDF5 | Frame | 71.2 |

Download the S5 data with specific option

