

WORKING WITH LISA DATA

Quentin Baghi , on behalf of the LISA Data Challenge Working Group

Gravitational Wave Physics and Astronomy Workshop - December 2nd, 2018 - College Park, Maryland

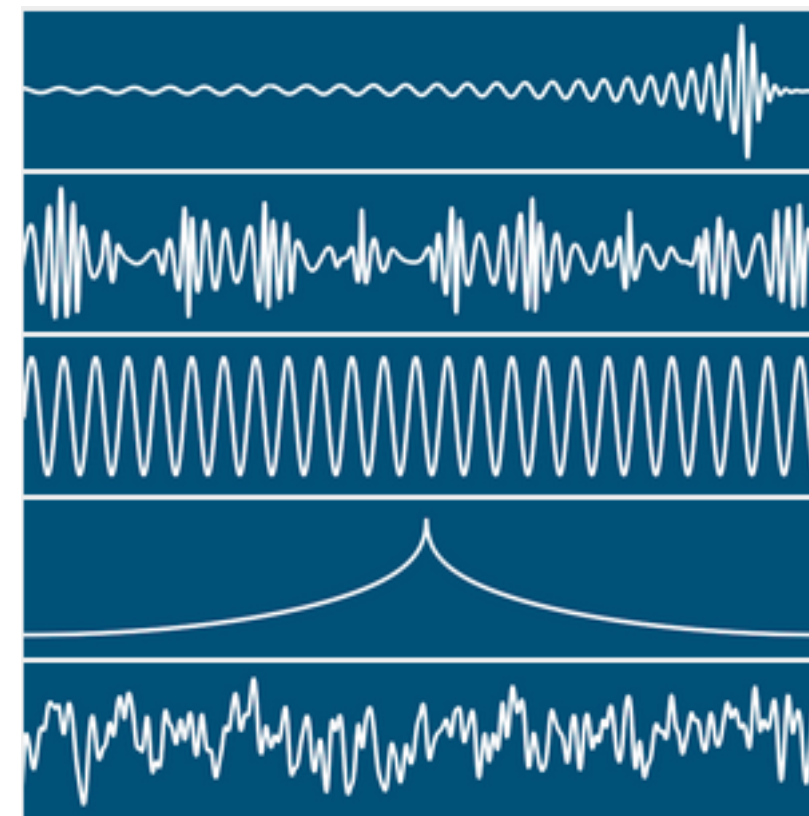
OUTLINE

1. Presentation of the LISA data challenge
2. Tutorials:
 1. compact galactic binaries waveform generation
 2. massive black hole binaries

1. PRESENTATION OF THE LISA DATA CHALLENGE

PRESENTATION OF THE LISA DATA CHALLENGE

- ▶ The LISA Data Challenge has been resurrected last July. The aims of this initiative are:
 - ▶ Project-oriented: demonstrate proof-of-concepts for LISA Data analysis and capability to deliver science requirements (as a working group), develop software standards and pipelines
 - ▶ Research-oriented: foster development of data analysis methods and new algorithms
 - ▶ Community-oriented: get new actors involved in the challenge of the LISA data analysis and provide tools



PRESENTATION OF THE LISA DATA CHALLENGE

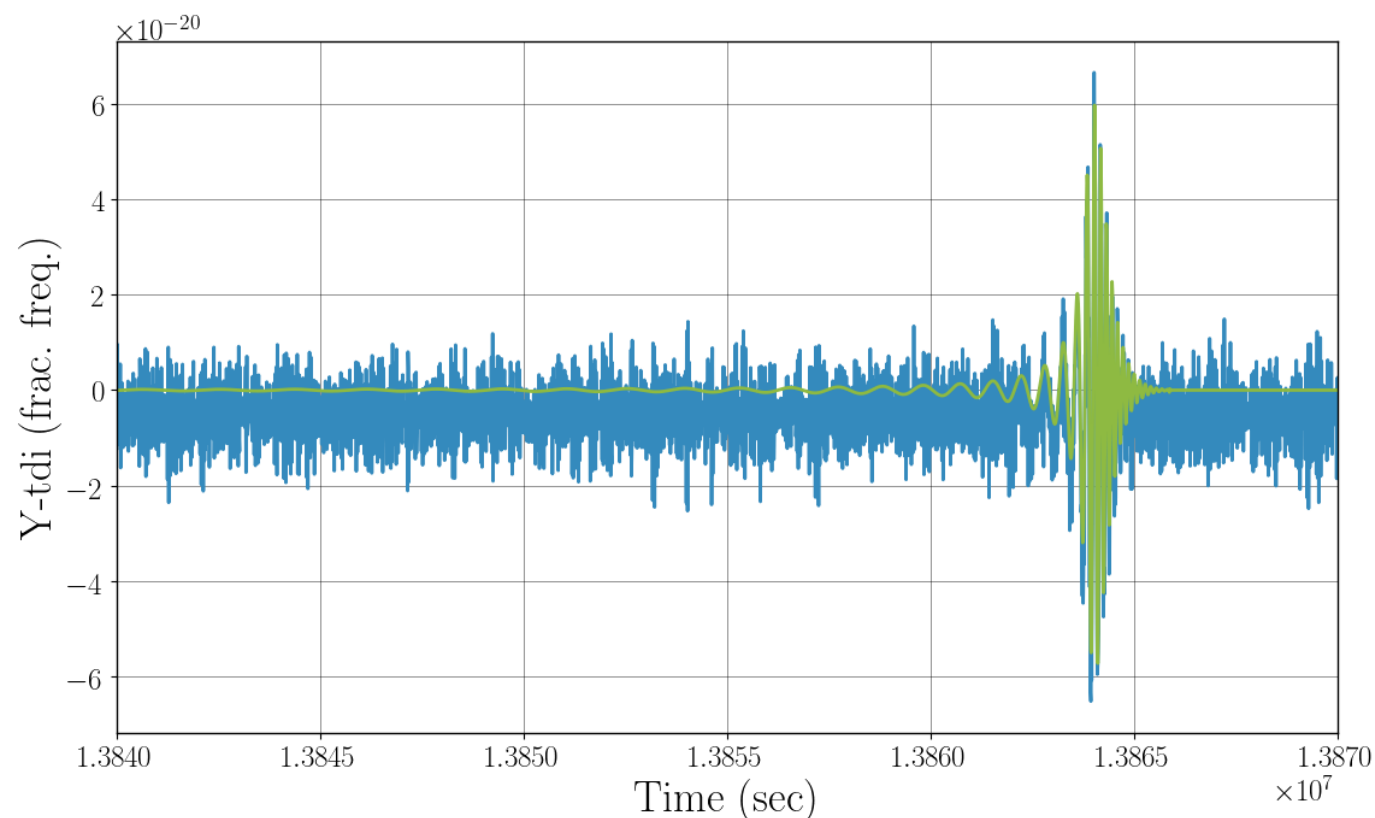
- ▶ The LISA Data Challenge is open to all, you can subscribe here <https://lisa-ldc.lal.in2p3.fr/>
- ▶ A new set of simulated LISA data has been released, dubbed “Radler”
- ▶ Its goals are:
 - ▶ Establish basic components of LISA data infrastructure
 - ▶ Provide accessible single-source type sub-challenges to re-start from the basic problems

PRESENTATION OF THE LISA DATA CHALLENGE

Overview of the sub-challenges:

► **LDC1-1**. A single GW signal from a merging massive-black-hole binary.

- represented with a frequency-domain inspiral-merger-ringdown phenomenological model (IMRPhenomD)
- Includes black hole spins

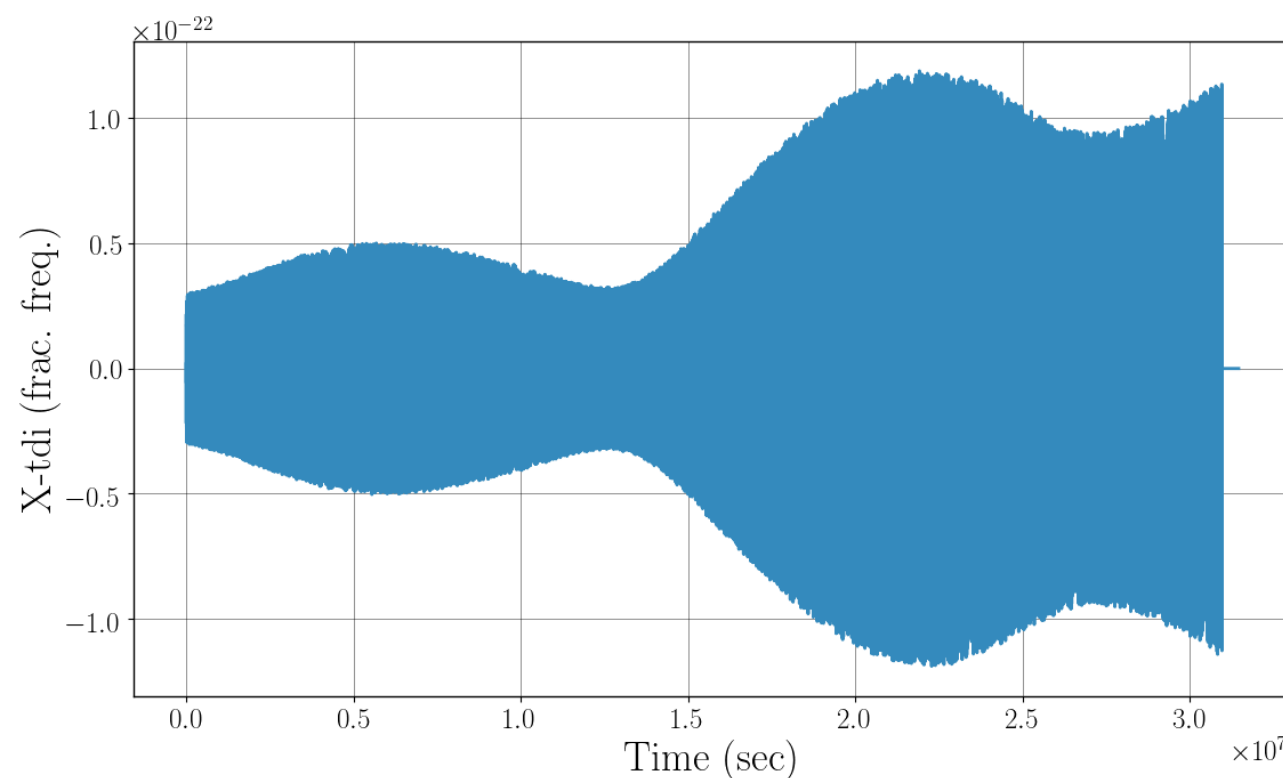


PRESENTATION OF THE LISA DATA CHALLENGE

Overview of the sub-challenges:

► **LDC1-2.** A single GW signal from an extreme-mass-ratio inspiral.

- Produced with Analytic Kludge waveforms
- Will be updated in future challenges



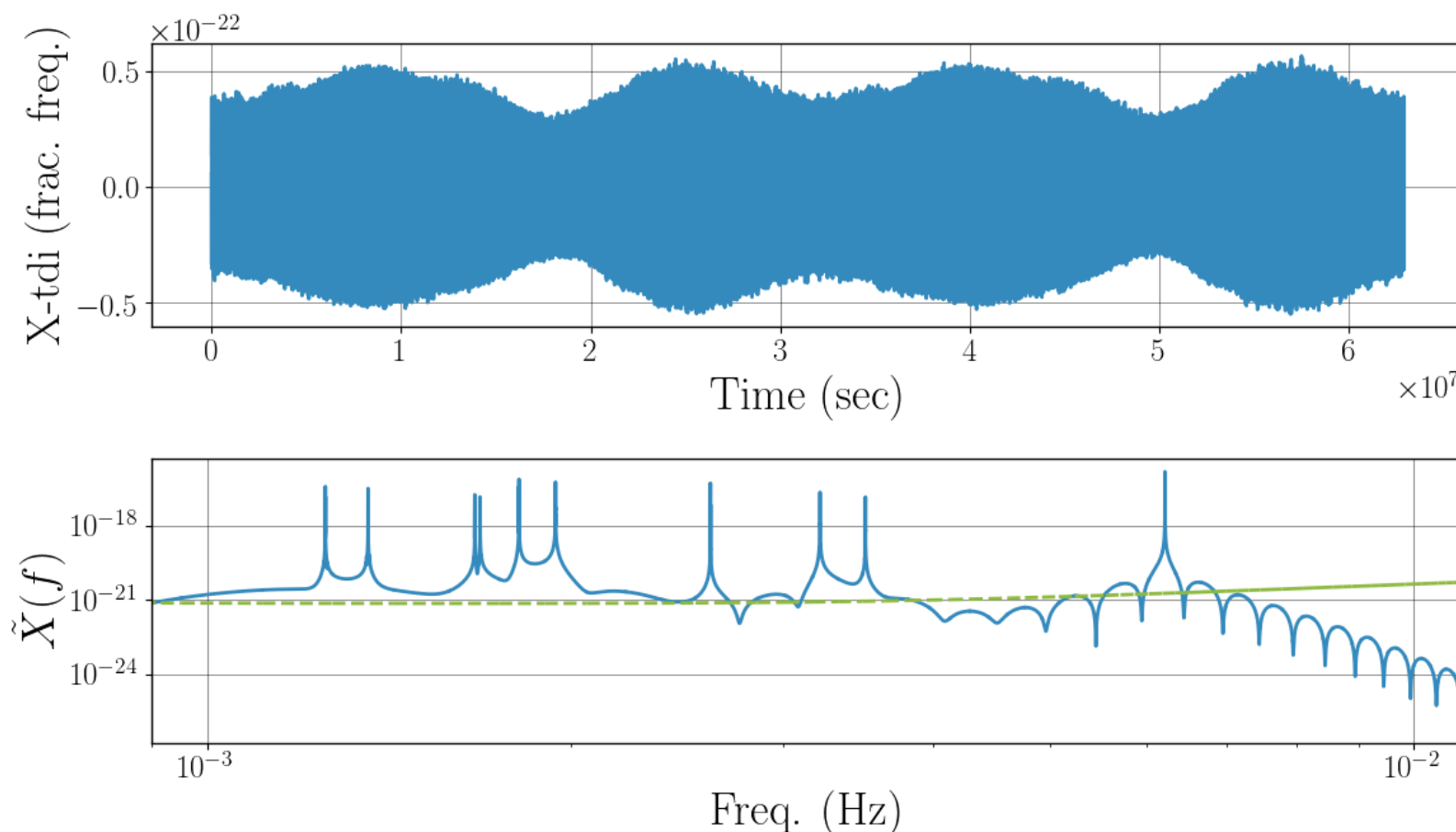
PRESENTATION OF THE LISA DATA CHALLENGE

Overview of the sub-challenges:

- ▶ **LDC1-3.** Superimposed GW signals from several verification Galactic white-dwarf binaries.

Cf. T. Kupfer et al. 2018

- Produced with fast response code
- A good challenge to begin with

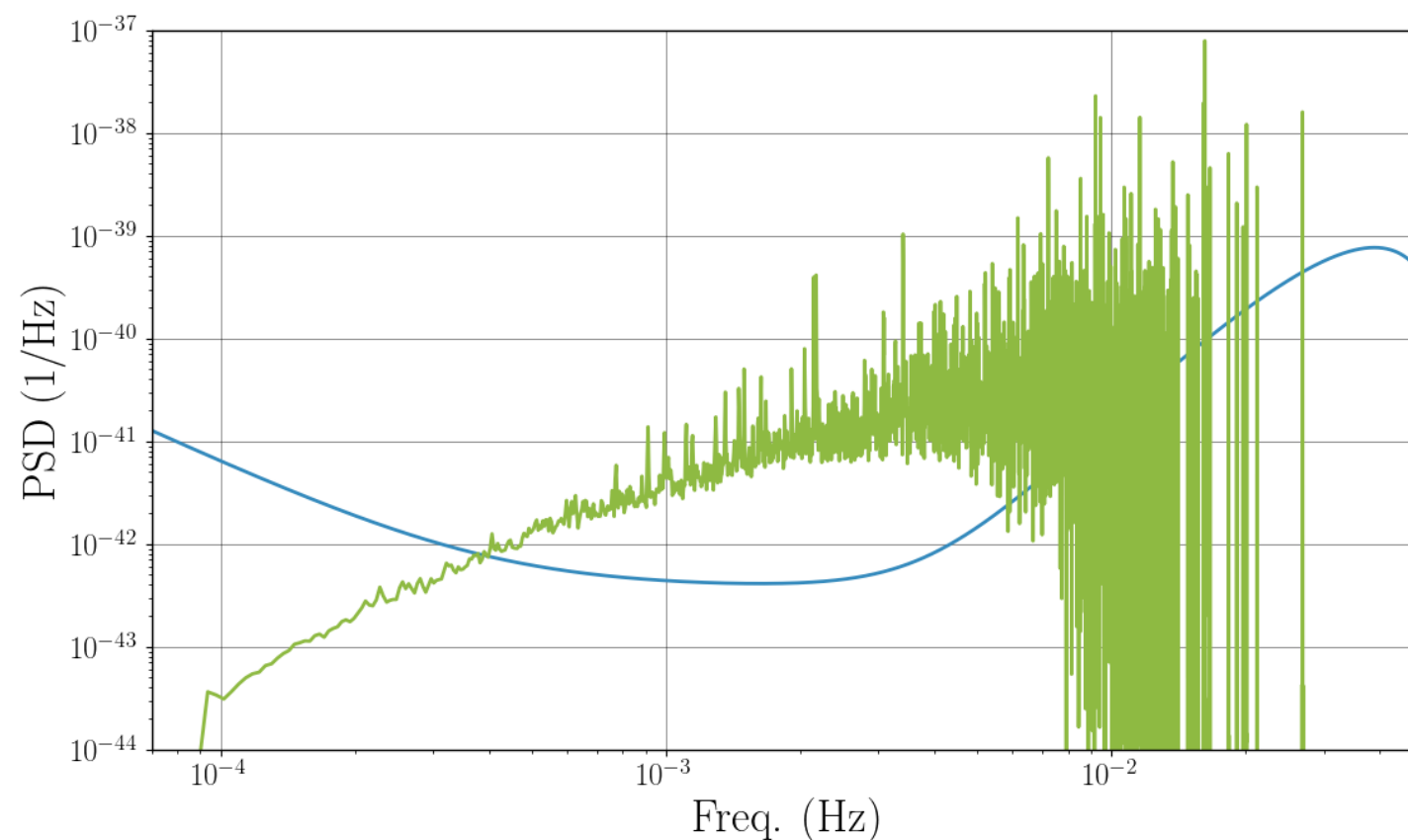


PRESENTATION OF THE LISA DATA CHALLENGE

Overview of the sub-challenges:

► **LDC1-4.** A GW signal from a population of galactic white-dwarf binaries

- Produced with fast response code
- 26 million signals



FUTURE CHALLENGES

In the future challenges, some “refinement” will be introduced, including:

- ▶ Source modeling:
 - Improvement of waveform models (e.g. MBHB precession)
 - Extension to astrophysical waveform catalogues
- ▶ Instrument modeling:
 - use numerical orbits
 - more realistic noise
- ▶ Source mixing (“mild enchilada”):
 - Galaxy + MBHB + EMRI
 - Galaxy + Stochastic + SOBHBs

2. TUTORIALS

TUTORIALS

1. Go to the LDC website <https://lisa-ldc.lal.in2p3.fr/> and create an account.
2. Download the codes from the site:
 - ▶ LDC source code
 - ▶ LISACode
3. Install the LDC codes following the README.md provided in the tarball, including all dependencies.
4. Download the data sets for challenges LDC1-1 and LDC1-3.
5. Download the tutorials from this repository:
<https://github.com/qbaghi/lisatutos>