WORKING WITH LISA DATA

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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


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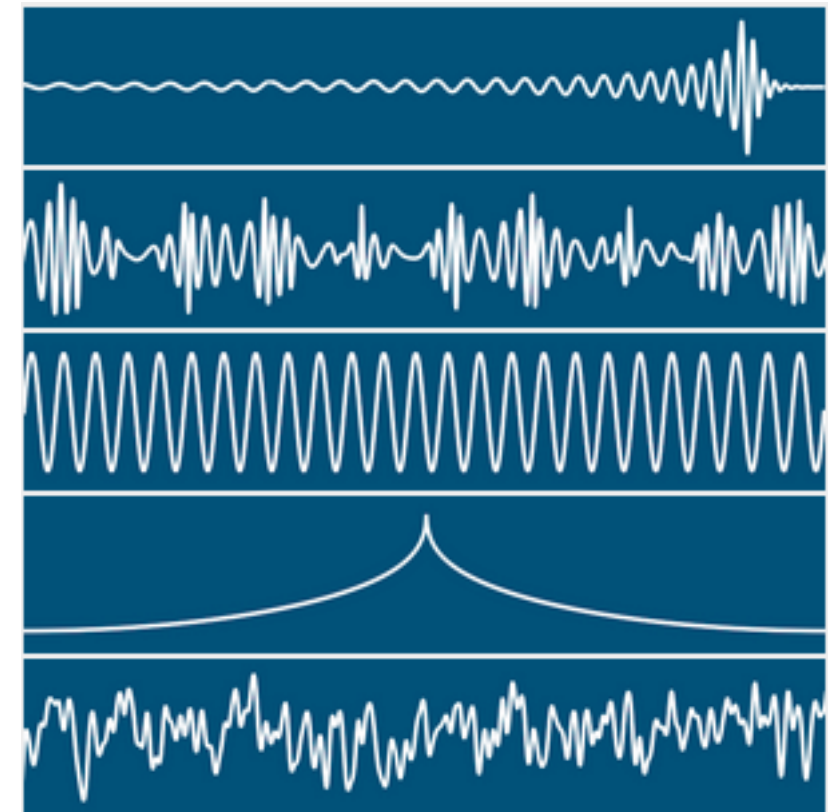
PRESENTATION OF THE LISA DATA CHALLENGE

▸ 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)
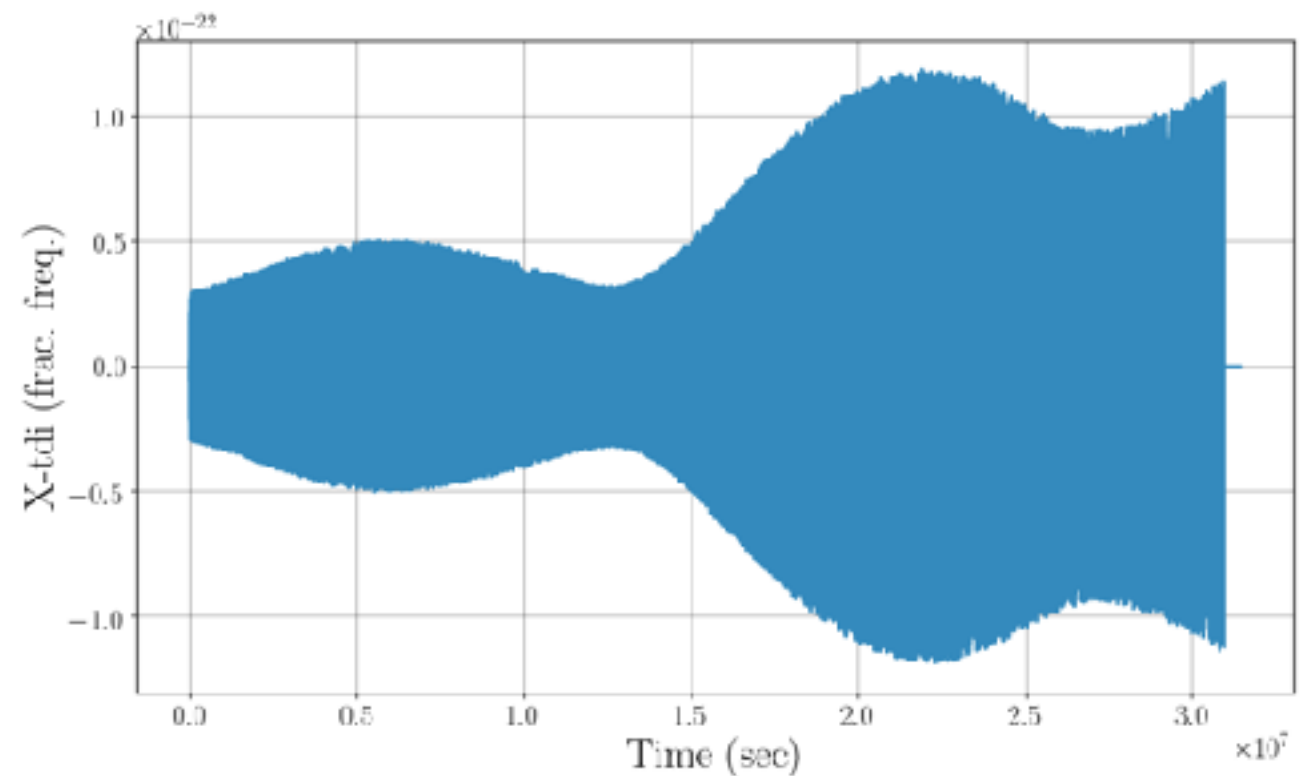
● Includes black hole spins
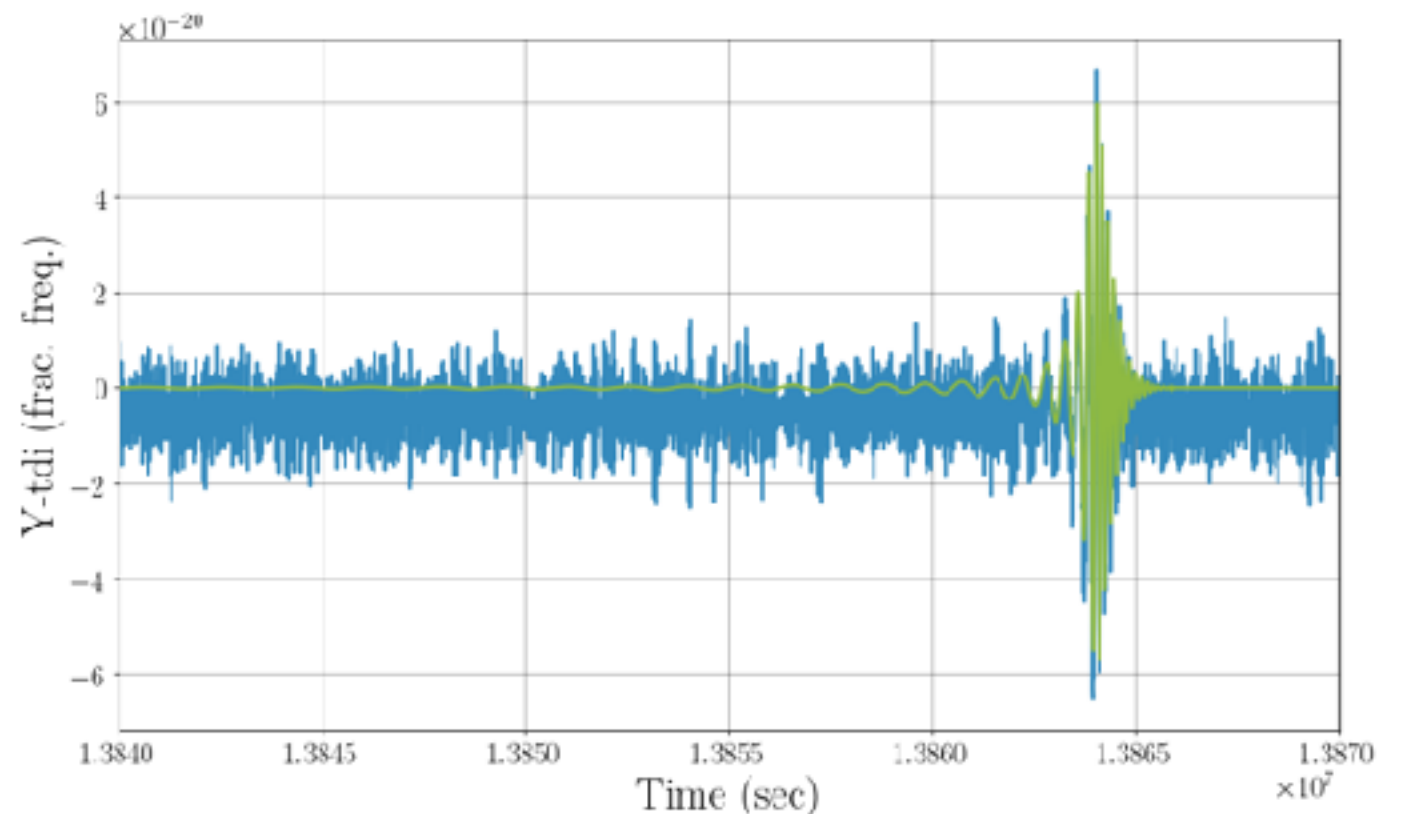
PRESENTATION OF THE LISA DATA CHALLENGE

Overview of the sub-challenges:

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

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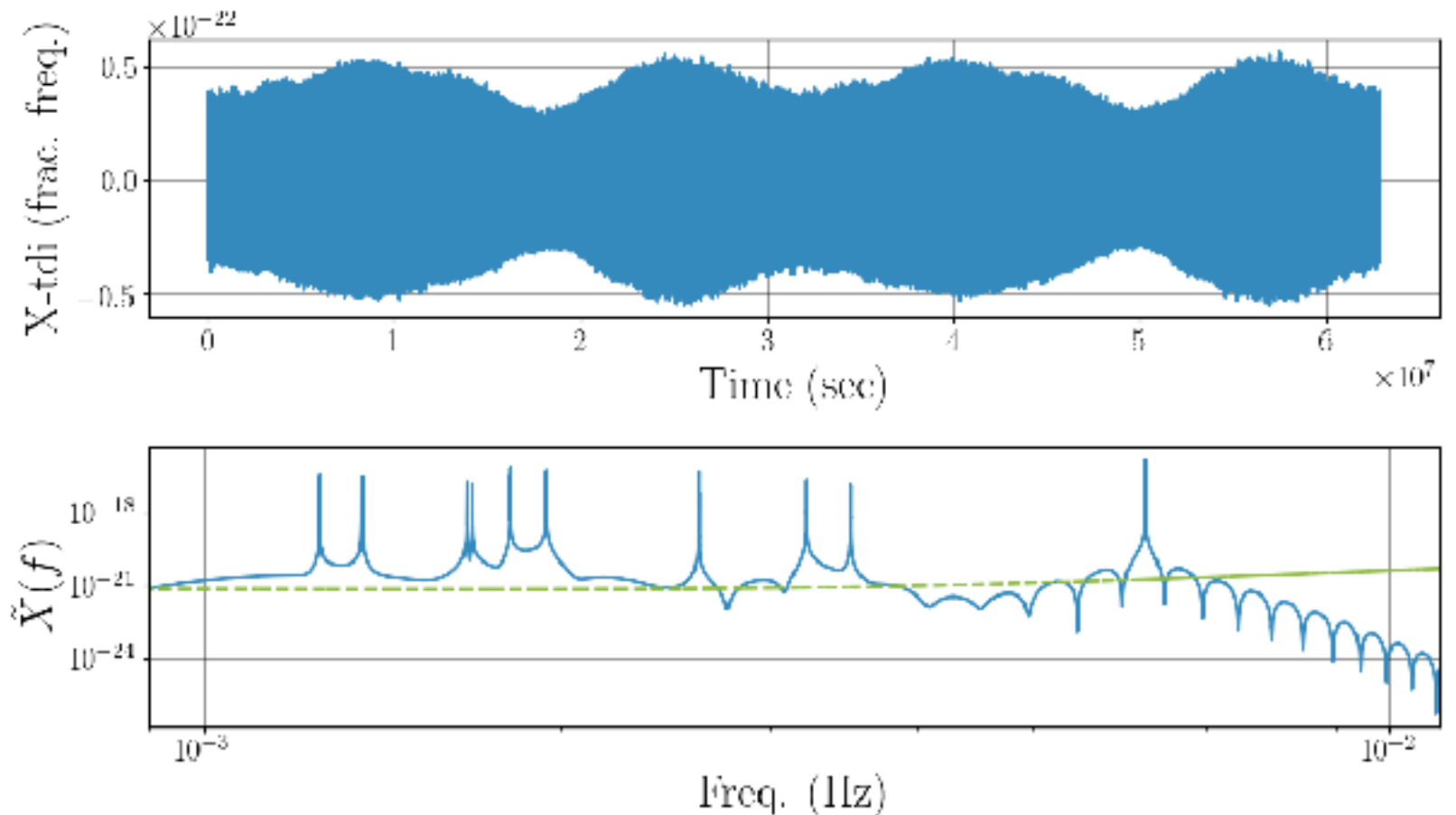
● Will be updated in future challenges

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
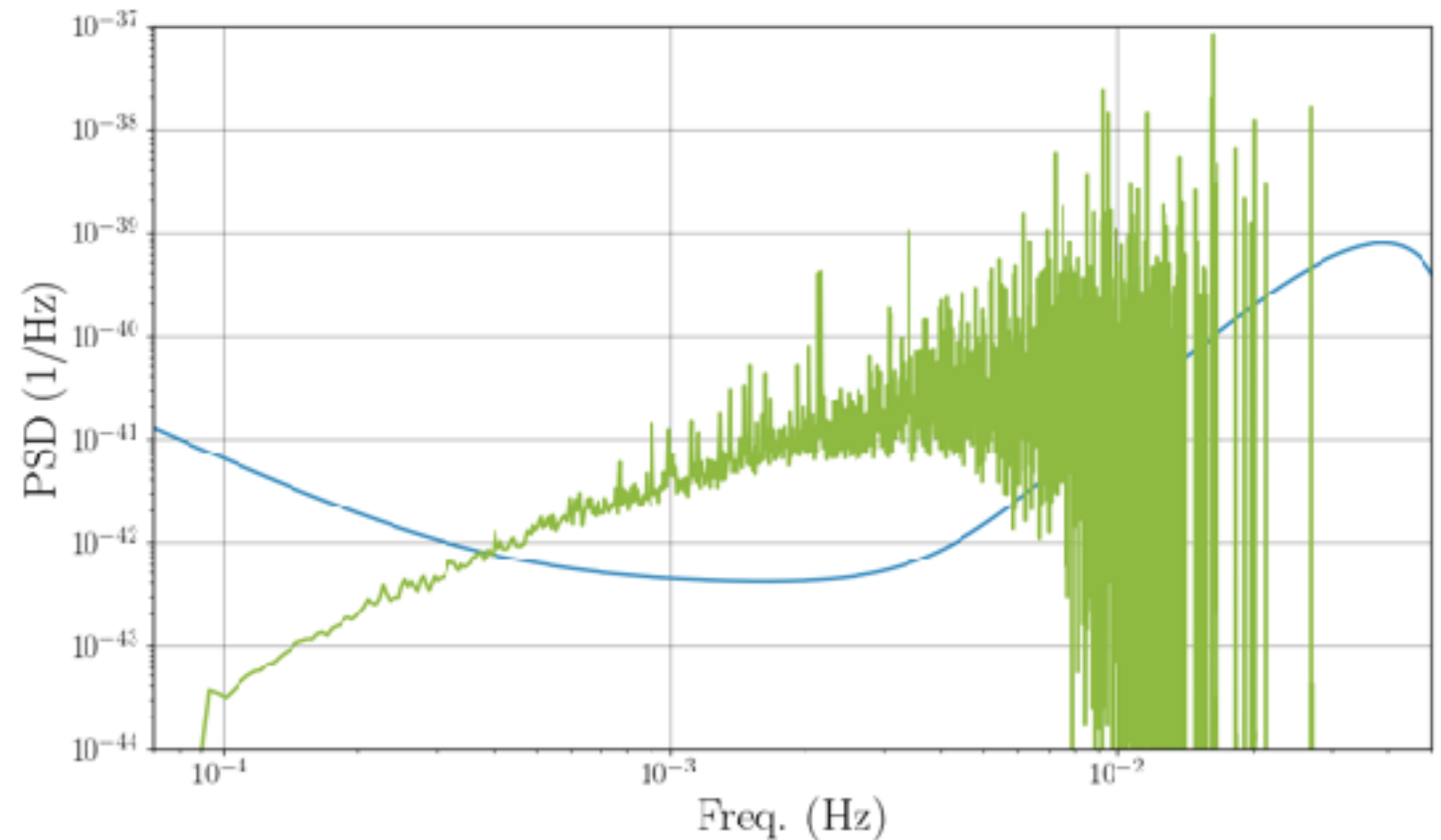
● A good challenge to begin with

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

‣ Go to the LDC website https://lisa-ldc.lal.in2p3.fr/ and create an account.

‣ Download the codes from the site:

  ‣ LDC source code

  ‣ LISACode

‣ Install the LDC codes following the README.md provided in the tarball, including all dependencies.

‣ Download the data sets for challenges LDC1-1 and LDC1-3.

‣ Download the tutorials from this repository:
  https://github.com/qbaghi/lisatutos