GdR ondes gravitationnelles: groupe de travail ”analyses de données”

Report of Contributions

https://indico.ijclab.in2p3.fr/e/6452

Contribution ID: **1** Type: **not specified**

Introduction

Monday, November 30, 2020 9:30 AM (10 minutes)

Presenters: CHASSANDE MOTTIN, Eric; ROBINET, florent (LAL)

Contribution ID: **2** Type: **not specified**

Table ronde: fonctionnement du groupe de travail

Monday, November 30, 2020 3:10 PM (40 minutes)

Presenters: CHASSANDE MOTTIN, Eric; Dr ROBINET, florent (IJCLab - Orsay)

Contribution ID: **3** Type: **not specified**

Conclusions

Monday, November 30, 2020 3:50 PM (10 minutes)

Presenters: CHASSANDE MOTTIN, Eric; ROBINET, florent (LAL)

Contribution ID: **14** Type: **Présentation**

Sparse data inpainting for the recovery of gapped gravitational waves signals

Monday, November 30, 2020 11:05 AM (20 minutes)

The detection of galactic binaries as sources of gravitational waves promises an unprecedented wealth of information about these systems, but also raises several challenges in signal processing. In particular, the variety of sources and the presence of both planned and unplanned gaps call for the development of robust methods. We describe here an original non-parametric reconstruction of the imprint of galactic binaries in measurements affected by instrumental noise and data gaps both typical of the space-based gravitational wave observatory LISA. We carefully show that a sparse data representation gives a reliable access to the physical content of the interferometric measurement, even when the data is gapped. In particular we check the successful extraction of the gravitational wave signal on a simple yet realistic example involving verification galactic binaries recently proposed in LISA data challenges.

Primary authors: BLELLY, Aurore (CEA/IRFU); Dr MOUTARDE, Hervé (CEA/IRFU); Dr BOBIN, Jérôme (CEA/IRFU)

Presenter: BLELLY, Aurore (CEA/IRFU)

Session Classification: Présentations

Contribution ID: **15** Type: **Présentation**

PyCBC Live: a realtime search for compact binary mergers in the advanced detector era

Monday, November 30, 2020 11:25 AM (20 minutes)

PyCBC Live is a low-latency search for compact binary mergers based on frequency-domain matched filtering. It has been used during the second and third observing runs of Advanced Virgo and LIGO, together with other low-latency analyses, to generate rapid alerts from the gravitational-wave strain data. I will describe the basic operating principles behind PyCBC Live, the improvements made before and during the third observing run of Advanced Virgo and LIGO, and some recent developments towards achieving premerger alerts for binary neutron star systems.

Primary author: DAL CANTON, Tito (IJCLab - Orsay)

Presenter: DAL CANTON, Tito (IJCLab - Orsay)

Session Classification: Présentations

Contribution ID: **16** Type: **Présentation**

Observations of stellar-mass black holes with LISA

Monday, November 30, 2020 9:40 AM (20 minutes)

Stellar-mass black hole binaries, like those currently being detected with the ground-based gravitational wave (GW) observatories LIGO and Virgo, are also an anticipated GW source in the Laser Interferometer Space Antenna (LISA) band.
LISA will observe them during the early inspiral stage of evolution; some of them will chirp through the LISA band and reappear some time later in the band of third generation ground-based GW detectors.
In this talk, we discuss LISA's ability to infer the parameters of those systems and the potential of such observation to inform us on putative deviations from General Relativity as well as the environment of the sources.

Primary authors: TOUBIANA, Alexandre (APC/IAP); Dr MARSAT, Sylvain (APC); Dr BABAK, Stanislav (APC); Dr JOHN, Baker (NASA-Goddard); Dr DAL CANTON, Tito (LAL)

Presenter: TOUBIANA, Alexandre (APC/IAP)

Session Classification: Présentations

Contribution ID: **17** Type: **Demo / tuto**

Estimating the Hubble constant with GWcosmo and GW170817

Monday, November 30, 2020 2:35 PM (30 minutes)

GWcosmo is a python-based package developed to estimate the Hubble constant from gravitational-wave events. In this tutorial, I will show how to install and run some basic functions of this package that can be of general interest for managing LIGO and Virgo data products for cosmological inference. Therefore, I will use the GWcosmo package to reproduce the Hubble constant measurement from the Binary neutron star event GW170817 in association with its hosting galaxy NGC4993.

Primary author: MASTROGIOVANNI, Simone (APC Paris diderot)

Presenter: MASTROGIOVANNI, Simone (APC Paris diderot)

Session Classification: Demo / tuto

Contribution ID: **18** Type: **Présentation**

Neural networks for gravitational-wave trigger selection in single-detector periods

Monday, November 30, 2020 12:05 PM (20 minutes)

The search for gravitational waves transient sources with LIGO and Virgo is limited by non-Gaussian transient noise artefacts coming from a wide variety of provenances, such as seismic, acoustic and electromagnetic disturbances. The contamination by these "instrumental glitches" can be partially mitigated by requesting temporal coincidence in two or more detectors as their accidental co-occurrence probability is low. When only one detector is operating this strategy cannot be used. During the past science runs, the single-detector time corresponds to a significant amount of observing time and we are focusing on this special condition.

Glitches vary widely in rate, duration, frequency range and morphology. For this reason, the statistical modelling of the non-Gaussian and non-stationary component of the noise has not been feasible, so far. We propose machine learning strategies, and in particular deep learning, to separate the glitches from the astrophysical signal. In this presentation, we show the performances of deep learning algorithms to select triggers and reduce the impact of transient noise during single-detector data taking periods.

Primary author: TROVATO, Agata (CNRS)

Co-authors: CHASSANDE MOTTIN, Eric; Dr BEJGER, Michal

Presenter: TROVATO, Agata (CNRS)

Session Classification: Présentations

Contribution ID: **19** Type: **Présentation**

Spectral Separation of the Stochastic Gravitation Wave Background In the LISA Band

Monday, November 30, 2020 10:20 AM (20 minutes)

In the context of the orbital modulated waveforms from the white dwarf binary gravitational foreground and the stochastic gravitational wave background (SGWB) in the LISA observation band, the Fisher Information and Markov Chains Monte Carlo methods give an estimation of the LISA noise and the parameters of the three backgrounds (galactic, astrophysical, cosmological). We simulate a complex waveform of the galactic foreground with 35 000 000 binaries. We extract an understanding of the effect of the distribution population across masses and positions in our galaxy, the stellar core type, and the orbital frequency distribution. We also predict the detectable limits for the future LISA measurement of the SGWB in the spectral domain with the three LISA channels A, E and T. We predict detectable limits for the future LISA measurement of the SGWB. Adaptive Markov chain Monte-Carlo methods are used to produce estimates with the simulated data from the LISA Data challenge (LDC). We also calculate the Cramer-Rao lower bound on the variance of the SGWB parameter uncertainties based on the inverse Fisher Information using the Whittle Likelihood. We simultaneously estimate the noise using a LISA noise model. Assuming the expected astrophysical background, a cosmological background and a galactic foreground energy density of around Ω_{GW} ≈ 1×10−12 to 1×10−13 can be detected by LISA.

Primary author: BOILEAU, Guillaume (Artemis, Observatoire de la Côte d'Azur, Université de la Côte d'Azur)

Co-authors: CHRISTENSEN, Nelson; Dr LAMBERTS, Astrid (Artemis, Observatoire de la Côte d'Azur, Université Côte d'Azur,); Dr MEYER, Renate (Department of Statistics, University of Auckland, Auckland, New Zealand)

Presenter: BOILEAU, Guillaume (Artemis, Observatoire de la Côte d'Azur, Université de la Côte d'Azur)

Session Classification: Présentations

Contribution ID: **23** Type: **Présentation**

PySTAMPAS - a long transient GW pipeline

Monday, November 30, 2020 11:45 AM (20 minutes)

Long transient gravitational waves refer to a class of signals with duration in the range of 1-1000s, which could be emited by a wide range of astrophysical processes such as accretion disk instabilities around black holes or deformations in magnetars. As these processes are still poorly modelized, searches for such kind of signals mostly rely on unconstrained detection methods that make few or no assumptions on the signal morphology.
PySTAMPAS is a new data analysis pipeline designed to search for long transient GW signals in ground-based interferometers data. This python-based pipeline relies on the STAMP detection method, which consists in identifying excess of power in cross-correlated ft-maps. It implements several new features that are intended to increase the detection sensitivity and to reduce the computational cost of background studies. Preliminary results obtained on both Monte-Carlo data and real data from the O2 run show an increase in sensitivity between 30% and 100%, while the reduced computational cost allows to simulate enough background noise to reach 5-sigma detection sensitivity. The pipeline can be used to perform a comprehensive, all-sky search for long-duration GW events over a whole observing run as well as targeted searches around specific promising events such as Gamma-Ray Bursts or binary neutron stars coalescence.

Primary author: MACQUET, Adrian (ARTEMIS)

Presenter: MACQUET, Adrian (ARTEMIS)

Session Classification: Présentations

Contribution ID: **24** Type: **Présentation**

Journal club

Monday, November 30, 2020 1:50 PM (45 minutes)

We will discuss the following paper:
PyROQ: a Python-based Reduced Order Quadrature Building Code for Fast Gravitational Wave Inference

Primary author: BAGHI, Quentin (NASA Goddard Space Flight Center - USRA)

Presenter: BAGHI, Quentin (NASA Goddard Space Flight Center - USRA)

Session Classification: Journal club

Contribution ID: **25** Type: **Présentation**

Inference and probabilistic modelling with machine learning for LISA data analysis

Monday, November 30, 2020 10:40 AM (20 minutes)

In my talk I am going to concentrate on the models of machine learning which allow us to learn the probability distributions and apply it to the important unsolved problems in the LISA data analysis. First I am going to talk about fast Bayesian parameter estimation for the Massive Black Hole Binaries (MBHBs) with the Normalising flows. This will solve an important problem of predicting MBHBs mergers, which can ensure the timely triggers for EM follow-ups. Afterwards I will focus on the source separation problem and the way to separate the mixed signal in the LISA data stream. Finally I will talk about the problem of the gaps in the LISA data and models which allow to estimate the joint probability distribution of the noise plus signal and generate the missing data without any assumptions on the signal model.

Presenter: Mrs KORSAKOVA, Natalia

Session Classification: Présentations

Contribution ID: **26** Type: **Présentation**

Simulating the parameter recovery of massive binary black holes with LISA

Monday, November 30, 2020 10:00 AM (20 minutes)

LISA is a future space-based gravitational wave detector that will complement the LIGO/Virgo observations at much lower frequencies, enabling the detection (among other targets) of coalescences of massive black hole binaries (MBHB). Most MBHB signals are expected to be short and merger-dominated. The development of data analysis tools for LISA is crucial to understand the scientific capabilites of LISA as an observatory. MBHB observations with LISA differ from LIGO/Virgo observations in the morphology of the signals, and in the instrument response that is both time- and frequency-dependent. We present a set of tools that allows fast likelihood computations for Fourier-domain waveform models, enabling Bayesian analyses exploring the full physical parameter space. We present examples of simulated parameter recovery for MBHBs. We highlight degeneracies in parameter space, and identify which features of the instrument response and signal break these degeneracies. We also discuss the sky localization of these systems and whether LISA is able to detect and localize them before the coalescence occurs, thus enabling advance warnings for EM observatories.

Primary author: MARSAT, Sylvain (APC)

Presenter: MARSAT, Sylvain (APC)

Session Classification: Présentations