Multimessenger astronomy and source populations: joint WG meeting, GdR Gravitational Waves

Rapport sur les contributions

https://indico.in2p3.fr/e/20771

ID de Contribution: **2** Type: **Invited talk**

The Gaia stellar binary population

jeudi 11 mars 2021 15:20 (30 minutes)

The Gaia DR3 release, planned for mid 2022, expects to present a large range of new kind of data, among which Non-Single Stars, detected through the astrometric, photometric and spectroscopic instruments, i.e. a Catalogue of astrometric, eclipsing or spectroscopic binaries, plus combined solutions. We will give a summary of the current Gaia capabilities and limitations that are currently foreseen.

Author: Dr ARENOU, Frédéric (CNRS/GEPI, Observatoire de Paris)

Orateur: Dr ARENOU, Frédéric (CNRS/GEPI, Observatoire de Paris)

Classification de Session: Source catalogues and cross-identifications

ID de Contribution: **3** Type: **Contributed talk**

Discriminating between different scenarios for the formation and evolution of massive black holes with LISA

mercredi 10 mars 2021 14:30 (18 minutes)

Different scenarios for the formation and evolution of massive black holes lead to different predictions for the population of massive black holes in the Universe. By reverse engineering the problem, we can use LISA observations to discriminate between different scenarios. However, the Universe is unlikely to be described by a single model. This can be accounted for by introducing mixing fractions between the different models.
In this talk, I will present simulated results for the inference of the mixing fraction between two models from LISA observations using a hierarchical Bayesian framework. I will also discuss of the robustness of this approach by using different models to generate the simulated data.

Author: TOUBIANA, Alexandre (APC/IAP)

Orateur: TOUBIANA, Alexandre (APC/IAP)

Classification de Session: Massive black holes

ID de Contribution: **4** Type: **Contributed talk**

X-ray active lifetime of BH+O binaries - implications for natal kicks of black holes

jeudi 11 mars 2021 15:50 (18 minutes)

Within a few kiloparsecs around the Sun, we have access to a complete sample of ~20 Wolf-Rayet+O-star binaries. On the other hand, only one BH+O binary, Cygnus X-1, is detected in the solar neighbourhood thanks to the X-ray emission produced by the wind accretion process. If the former binaries are the progenitors of the latter, this discrepancy can be explained either by large natal kicks at BH formation which disrupted most binaries or by short X-ray active lifetimes.

In this talk, I will present new results on the fraction of time BH+O binaries spend emitting X-rays at a detectable level. We evolved the sample of observed Wolf-Rayet+O binaries up to the collapse of the Wolf-Rayet star into a BH. Assuming a zero natal kick, we continue the evolution of the binary and monitor the moment when conditions are matched for a formation of a wind-captured disk around the BH and for an X-ray emission detectable within a few kiloparsecs. We find that the formation of accretion disk is very sensitive to the wind velocity of the O star companion. With revised values for the wind speed thanks to an accurate description of the line-acceleration, we find little to no X-Ray active lifetime for the BH+O star systems. It implies a large reduction in the predicted number of observable wind-fed high-mass X-Ray binaries hosting a BH and an O-star compared to what was recently found by Vanbeveren et al. (2020). High natal kicks or direct collapse of the Wolf-Rayet star into a neutron star are thus not necessary to reproduce the scarcity of systems like Cygnus X-1 in the solar neighbourhood.

Author: EL MELLAH, Ileyk (IPAG - CNRS)

Co-auteurs: M. SEN, Koushik (Bonn); M. XU, Xiao-Tian (Bonn); Prof. LANGER, Norbert (Bonn); M. SCHÜRMANN, C. (Bonn); M. QUAST, Martin (Bonn)

Orateur: EL MELLAH, Ileyk (IPAG - CNRS)

Classification de Session: Source catalogues and cross-identifications

ID de Contribution: **5** Type: **Contributed talk**

Monitoring the transient hard X-ray sky with 3UTransat

mercredi 10 mars 2021 16:10 (18 minutes)

We present the 3UTransat space mission under study at IRAP for the surveillance of the hard X-ray sky with a constellation of cubesats.
The talk will quickly go through the science goals of the mission, the design of the satellites and constellation, the preliminary results of on-going phase-0 study at CNES and science simulations at IRAP, and the planned agenda for the development of the mission, which aims at flying 3 prototypes during the run O5 of the Advanced LIGO, Advanced Virgo and KAGRA collaborations.

Authors: GODET, Olivier (IRAP); ATTEIA, Jean-Luc (IRAP - CNRS/UPS/CNES); BARRET, DIDIER (IRAP); BOUCHET, laurent (IRAP, Toulouse); ORTTNER, Guillaume (IRAP); LAURENS, André (CNES); ESTEVE, Frédéric (CNES); VALENZUELA, Irène (CNES)

Orateur: ATTEIA, Jean-Luc (IRAP - CNRS/UPS/CNES)

Classification de Session: Multi-messenger astrophysics

ID de Contribution: **6** Type: **Contributed talk**

Fink: harnessing LSST's optical time-domain data to study extreme astrophysical events

mercredi 10 mars 2021 15:50 (18 minutes)

In the next decade, the Vera Rubin Observatory Legacy Survey of Space and Time (LSST) will provide an unprecedented volume of optical data of the southern sky. Its public alert stream will communicate the detection of millions of potential transient objects every night. The key to use this stream for GW and high-energy science is to be able to select the small number of extreme astrophysical transients within this large dataset. I will introduce Fink, a broker developed on high-end technology and designed for fast and efficient analysis of big data streams. Fink enables the selection of promising transients by providing preliminary classifications and combining information from multiple channels (multi-messenger and multi-wavelength surveys and catalogues). Within minutes, Fink is able to communicate these candidates to teams and follow-up facilities. Fink opens a new way of combining data from LSST and other time-domain surveys and will be key to study the most extreme astrophysical transients in the next decade.

Authors: MOLLER, Anais (CNRS / LPC Clermont); Dr PELOTON, Julien (CNRS-IJCLab); Dr ISHIDA, Emille (LPC-UCA)

Orateur: MOLLER, Anais (CNRS / LPC Clermont)

Classification de Session: Multi-messenger astrophysics

ID de Contribution: **7** Type: **Contributed talk**

StarTrack predictions of the stochastic gravitational-wave background from compact binary mergers

jeudi 11 mars 2021 14:30 (18 minutes)

Nowdays we are able to resolve more and more compact binary merger events as our detector sensitivities improve. However the detected sources are loud and close events, suggesting a large number of non-resolved binary mergers participating to a background. I will present this background computed from the StarTrack population synthesis in a large frequency range (1μHz - 2kHz). For the first time the calculation includes the redshift and orbital evolution of binary systems as well as new merger channels : the stars from population III and the non-merging systems population. For several detector networks scenario (2G : LIGO, Virgo, KAGRA; 3G : Einstein Telecope, Cosmic Explorer and the space antenna : LISA) we compute the residual background by substracting the corresponding resolved sources and evaluate its detectability.

Authors: Dr REGIMBAU, Tania ({CNRS}UMR5814); BULIK, Tomasz (University of Warsaw); BELCZYNSKI, Chris; PERIGOIS, Carole

Orateur: PERIGOIS, Carole

Classification de Session: Stellar binaries

ID de Contribution: **8** Type: **Contributed talk**

Binary neutron star mergers as multimessenger sources: population prospects and applications

mercredi 10 mars 2021 15:30 (18 minutes)

The binary neutron star merger GW170817 was a gravitational-wave event rich with electromagnetic counterparts: a short gamma-ray burst, a kilonova, afterglow radiation from the relativistic outflow and—if further data confirms—afterglow radiation from the slowly expanding nebula. However, this richness is due to the proximity and favorable inclination of this historic event. During upcoming gravitational-wave observing runs, which electromagnetic counterparts should we expect to observe? We will focus on the kilonova and the relativistic afterglow and rely on state-of-the-art modelling for the emission and detection of these signals. For various gravitational-wave and electromagnetic follow-up instrument sensitivities, we will predict detection rates and brush a portrait of the multimessenger population to come: distances, inclination angles, magnitudes and afterglow flux levels, etc. Finally, we will present the insight that this population model provides on the viability of using these counterparts for multimessenger cosmology, and how it allows to constrain the sources detected during the latest O3 run of the Ligo-Virgo-Kagra network.

Authors: DUQUE, Raphaël (Institut d'Astrophysique de Paris); CHASSANDE-MOTTIN, Eric (CNRS AstroParticule et Cosmologie); Prof. DAIGNE, Frédéric (Institut d'Astrophysique de Paris - Sorbonne Université); MASTROGIOVANNI, Simone (Astroparticule et cosmologie, Paris Diderot university); MOCHKOVITCH, Robert (IAP)

Orateur: DUQUE, Raphaël (Institut d'Astrophysique de Paris)

Classification de Session: Multi-messenger astrophysics

ID de Contribution: **9** Type: **Non spécifié**

Massive black hole astrophysics with gravitational waves

mercredi 10 mars 2021 14:00 (30 minutes)

I'll review the main astrophysical processes shaping the merger rate and the distributions of properties of merging massive black holes in the gravitational wave domain (LISA and PTAs), highlighting uncertainties and unknowns. Turning the question around, gravitational waves can inform us on poorly known processes in the cosmic history of massive black holes.

Orateur: VOLONTERI, Marta

Classification de Session: Massive black holes

ID de Contribution: **10** Type: **Non spécifié**

Electromagnetic observations of multi-messenger sources: successes and challenges

mercredi 10 mars 2021 15:00 (30 minutes)

Orateur: TANVIR, Nial (University of Leicester)

Classification de Session: Multi-messenger astrophysics

ID de Contribution: **11** Type: **Non spécifié**

Discussion

Classification de Session: Multi-messenger astrophysics

ID de Contribution: **12** Type: **Non spécifié**

The LOFAR Two Meter Sky Survey(s)

jeudi 11 mars 2021 16:08 (18 minutes)

The LOFAR Two-metre Sky Survey (LoTSS) is an ongoing sensitive, high-resolution 120-168MHz survey of the entire northern sky for which observations. LoTSS has a source density approximately 10 times higher than the most sensitive existing very wide-area radio-continuum surveys and we have already catalogued over 3,000,000 radio sources making it the largest survey to date. In this talk I will describe the current status of the survey and outline what can be expected from LoTSS in the near future.

Orateur: TASSE, Cyril (Observatoire de Paris)

Classification de Session: Source catalogues and cross-identifications

ID de Contribution: **13** Type: **Non spécifié**

O1/O2/O3 events fro LIGO/Virgo: astro perspective

jeudi 11 mars 2021 14:00 (30 minutes)

Is there one or many formation channels to BH-BH mergers detected by LIGO/Virgo? Have we learned anything about stellar evolution from binary BH detections? Do we really need LIGO/Virgo anymore, or the job is done? …

Orateur: BELCZYNSKI, Chris

Classification de Session: Stellar binaries

ID de Contribution: **14** Type: **Non spécifié**

The importance of population assumptions for gravitational-wave dark sirens cosmology

jeudi 11 mars 2021 14:48 (18 minutes)

Gravitational waves (GWs) from compact binary coalesce are cosmological standard sirens and provided with an electromagnetic (EM) counterpart can be used to probe cosmology. Unfortunately, with the rapid increase of GW detector sensitivity, it will be less and less likely that GW sources are accompagnied by an EM counterpart. Furthermore, the completeness of galaxy catalogs rapidily decreases and the statistical association of GW and EM data is less and less effective. In this talk, I will show how population assumptions on the formation channel for binary black holes can be used to study GW-based cosmology. I will discuss how population assumptions can impact, and possibly introduce systematics in GW cosmology and how it is possible by collecting more and more GW events to jointly infer population properties and cosmology.

Orateur: LEYDE, Konstantin (APC Université de Paris)

Classification de Session: Stellar binaries

ID de Contribution: **15** Type: **Non spécifié**

Discussion

mercredi 10 mars 2021 16:30 (30 minutes)

ID de Contribution: **16** Type: **Non spécifié**

Discussion

jeudi 11 mars 2021 16:30 (30 minutes)

ID de Contribution: **17** Type: **Non spécifié**

Pause