ABSTRACTS

MONDAY 11TH

Alicia M Sintes - ***Recent results from LIGO***

The last century has witnessed tremendous progress thanks to the observation of electromagnetic radiation. Gravitational waves, ripples in the space-time, are now the new messengers that allow us to open a new window to the Cosmos that could revolutionize our understanding of the Universe in which we live. The gravitational waves were detected, directly, for the first time by the LIGO detectors on the 14 September 2015. These waves came to Earth from a catastrophic event in the distant Universe. This confirms an important prediction of the theory of General Relativity of Albert Einstein from 1915 and opens an unprecedented new window in the Cosmos. This talk will explain how was the first discovery of Advanced LIGO, and our participation in this detection.

Mark Hannam - ***How to measure black holes: numerical relativity and gravitational waves***

Gravitational waves have been directly detected for the first time, from the collision of two black holes. Measuring the properties of the black holes (their masses and spins) required theoretical models of the signal, calculated by combining analytic approximation techniques with numerical solutions of the full Einstein equations for the last orbits and merger. I will discuss how the models were produced that were used in measuring the properties of the first black-hole-binary ever observed, and the challenges ahead as we enter the era of gravitational wave astronomy.

Alberto Sesana - ***Massive BH along the cosmic history: formation, dynamics and gravitational waves***

The low frequency gravitational wave Universe is likely dominated by signals emitted by a cosmological population of massive black hole binaries (MBHBs). In this talk I will review several aspect of MBH physics, including their formation, evolution, interaction with their environment and gravitational wave (GW) emission. I will then discuss prospect of GW detection with pulsar timing arrays and/or future space based interferometers such as the evolving laser interferometer space antenna (eLISA).

Enrique García-Berro Montilla - ***The gravitational wave radiation of the core-degenerate scenario for Type Ia supernovae***

Thermonuclear supernovae, also known as Type Ia supernovae (SNe Ia), are the result of the explosion of carbon-oxygen white dwarfs. Given that they are one of the most powerful events in the universe, they can be seen at very large distances. Moreover, the homogeneity of their observed light curves allows us to use them as standardizable cosmological candles. However, despite their intrinsic importance and their extraordinary relevance, the nature of the progenitor systems that give rise to SNe Ia has not been hitherto elucidated. Possible scenarios leading to a SN Ia outburst include the dynamical merger of a double white dwarf binary system (the so-called DD scenario), and the merger of an AGB star and a white dwarf (known as the CD scenario). There exists observational evidence favoring these channels, although these theoretical paradigms are not exempt of problems either. In this talk I will discuss the gravitational wave patterns emitted in these two scenarios.

Juan García-Bellido - ***Gravitational waves from mergers of primordial black holes as dark matter***

20 years ago, we predicted that primordial black holes would form via the gravitational collapse of matter associated with peaks in the spectrum of fluctuations, and that they could constitute all of the dark matter today. More recently, we predicted the mass distribution of PBH, which peaks at 50 Msun and whose tails could be responsible for the seeds of galaxies.
LIGO has recently detected gravitational waves from the inspiraling of two 30 Msun black holes. In arXiv:1603.05234, we propose that LIGO has actually detected dark matter in the form of PBH, and predict that within 10 years, an array of GW detectors (i.e. LIGO, VIRGO, KAGRA, INDIGO, etc.) could be used to determine the mass distribution of PBH dark matter with 10% accuracy.

Alejandro Torres García - ***Dictionary learning algorithms have been extensively developed in the last years***

We have developed a machine learning algorithm based in dictionaries and we have applied successfully in the context of gravitational wave denoising. These dictionaries has been obtained from numerical relativity templates of binary black holes mergers (BBH) and from burst of magnetorotational core collapse. Our results show how these techniques can remove noise successfully in the case of a signal embedded in non-white Gaussian noise.

Xisco Jimenez Forteza - ***BBH simulations: From data post-processing to phenomenological fits.***

On September 14, 2015 a binary black hole (BBH) gravitational wave signal was registered in both LIGO detectors. Those compact binary systems are expected to be the most dominant source of detections by ground-based gravitational waves detectors. Neither Post-Newtonian approximants nor non-calibrated EOB models are sufficient to describe the late inspiral and merger of BBH coalescences; large sets of accurate numerical relativity (NR) simulations are needed to cover this gap. Different codes and waveforms are used to calibrate phenomenological fits which require a detailed NR data post-processing to get accurate waveforms. In this talk we briefly describe what are the main issues in the NR data post-processing and how phenomenological fits of physical quantities as the peak luminosity, final mass and final spin are constructed by means of NR simulations.

TUESDAY 12TH

Carlos F. Sopuerta - ***Gravitational Wave Astronomy from Space and the Status of the LISA Pathfinder mission***

In this talk I will summarize the status of the LISA Pathfinder mission of the European Space Agency (ESA) and I will discuss the prospects for the future ESA-L3 Gravitational-Wave observatory.

Sascha Husa - ***The Phenomenological waveform modelling program***

I will give a status report on the phenomenological waveform modelling program for compact binary coalescence, and discuss future challenges to model generic black hole mergers.

Daniel G. Figueroa - ***Gravitational Waves from the Early Universe***

I will review the various sources of Gravitational Waves expected from the very Early Universe.

<u>Jose Juan Blanco-Pillado</u> - *Gravitational Waves from Cosmic Strings*

Recent developments in cosmic string simulations have allowed us to reach a better understanding of the statistical properties of the string networks. In this talk, I will explain how to use these new results to give a better estimate of the gravitational wave signals from cosmic strings.

<u>Arttu Rajantie</u> - *Gravitational waves from inflation and reheating*

Gravitational waves produced during inflation and reheating provide a promising way to probe and test different theories of inflation. I review their production mechanisms, predicted properties, and prospects and challenges of observing them, as well as what information about inflation could be extracted from them.

<u>Juan Pedro López Zaragoza</u> - *Magnetic diagnostics in the LISA Pathfinder mission*

In this talk, I would like to explain how the magnetic field inside the LISA Pathfinder spacecraft produces a noise that we need to characterize. I will show how we are modelling this noise, and how it affects the noise budget of LISA Pathfinder. Also, I would like to show how are we organizing ourselves to analyze the data we are receiving from the spacecraft, and finally, how we are experiencing the operations phase of the mission in ESOC.

<u>Carlos Palenzuela Luque</u> - *Can we measure the equation of state of neutron stars by using gravitational wave observations?*

It is well known that some properties of neutron star equations of state can be computed by measuring departures from the point-particle limit of the gravitational waveform produced during the coalescence of a binary neutron star. We study numerically the merger of binary neutron stars with different mass ratios adopting three different realisti

<u>Francisco Torrentí</u> - *Gravitational Waves from the Standard Model Higgs decay after inflation*

During or towards the end of inflation, the Standard Model (SM) Higgs forms a condensate with a large amplitude. Following inflation, the condensate oscillates, decaying non-perturbatively into the rest of the SM species. The resulting out-of-equilibrium dynamics converts a fraction of the energy available into gravitational waves (GW). We study this process using classical lattice simulations in an expanding box, following the energetically dominant electroweak gauge bosons $W^{\pm}$ and Z. We characterize the GW spectrum as a function of the running couplings, Higgs initial amplitude, and post-inflationary expansion rate. As long as the SM is decoupled from the inflationary sector, the generation of this background is universally expected, independently of the nature of inflation.

<u>Isabel Cordero-Carrión</u> - *Excision scheme for black hole numerical simulations*

We will present recent developments of the excision technique in the case of the Fully Constrained Formalism. We will focus on spherically symmetric spacetimes representing the collapse of a neutron star to a black hole. We will present boundary conditions to be imposed at the excised surface, an arbitrary coordinate sphere inside the apparent horizon, in which a new parameter governs the final physical radius of the excised surface. We will show exponential convergence toward the stationary solution and stable long-term evolution of the newly formed black hole.

WEDNESDAY 13TH

Chiara Caprini - ***GW from phase transitions***

First order phase transitions occurring in the early universe can generate a stochastic background of gravitational waves. Three processes are involved in the gravitational wave production: the collision of the bubble walls itself, and both the sound waves and the magnetohydrodynamic turbulence present in the plasma after the bubble collisions. We will discuss the characteristics of the gravitational wave spectrum together with its detection prospects.

Francisco Rivas García - ***Thermal experiments in LISA Pathfinder***

In this talk, i will talk on the diagnostic thermal experiments in the mission LISA Pathfinder. The Barcelona team is working in three experiments: - Electrode Housing experiment: We want to see how the pressure inside of the electrode housing (there are two electrode housings, one for each test mass) is changing with the fluctuations in the temperature. - Struts experiment: Variations in the thermal gradient can produce distortions in the struts that can affect to the measures. - Optical Window experiment: The optical window is the interface between the laser and the test masses (we have two optical windows, one optical window for each test mass). Thermal variations can produce changes in the optical path of the laser light.

Stanislav Babak - ***EPTA: Searching for gravitational waves in nano-Hertz band***

Population of supermassive Black Hole binaries in the local universe creates a gravitational wave signal in the nano-Hertz band. This signal comes as a superposition of the individual (almost) monochromatic signals, and can be treated as a stochastic signal with potentially few individually resolvable sources. Here we discuss techniques used for analyzing the data obtained by European Pulsar Timing Array collaboration and present upper limits on the strength of gravitational wave signal.

Rafael Garrido Haba - ***Are LIGO GW150914 data connected?***

The analysis of ultra-precise data of stellar light variations observed with satellites (CoRoT, Kepler, SoHO, etc.) has revealed unexpected results that cannot be explained by theory. This hampers and, in some cases, even prevents from interpreting the stellar oscillations. We have tackled this problem from the data analysis side, testing the mathematical conditions necessary to properly apply harmonic analysis techniques to the data. In particular we have developed and algorithm to calculate what we have called ?connectivities? for testing the analyticity of the underlying function from which the time series is a discrete sample. For the cases studied the result of the analyticity test is negative providing a counterexample of the overextended paradigm based on the assumption that any sequence of measures can be interpreted as the Fourier expansion of an analytic function. Here we present the results of the analyticity test performed to the data of the event GW150914 in which, the data analysis, as delivered by the Advanced LIGO instrument team, relies upon the previously cited paradigm. We found that both raw and filtered data are not connected, i.e. the function underlying the sampled data is non-analytic. We discuss the mathematical and physical consequences of this result.