BNS2015

Workshop on Binary Neutron Star Mergers
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List of Abstracts

Name: Ardevol-Pulpillo, Ricard
Title: Nucleosynthesis constraints on the neutron star-black hole merger rate

Abstract: We derive constraints on the time-averaged event rate of neutron star-black hole (NS-BH) mergers by using estimates of the population-integrated production of heavy rapid neutron-capture (r-process)elements with nuclear mass numbers A > 140 by such events in comparison to the Galactic repository of these chemical species. Our estimates are based on relativistic hydrodynamical simulations convolved with theoretical predictions of the binary population. This allows us to determine a strict upper limit of the average NS-BH merger rate of ~6×10^{-5} per year. We quantify the uncertainties of this estimate to be within factors of a few mostly because of the unknown BH spin distribution of such systems, the uncertain equation of state of NS matter, and possible errors in the Galactic content of r-process material. Our approach implies a correlation between the merger rates of NS-BH binaries and of double NS systems. Predictions of the detection rate of gravitational-wave signals from such compact-object binaries by Advanced LIGO and Advanced Virgo on the optimistic side are incompatible with the constraints set by our analysis.

Name: Bauswein, Andreas
Title: Revealing the neutron star EOS from the post-merger GW spectrum

Abstract: We explore the equation-of-state dependence of neutron-star mergers and the gravitational-wave signal of the postmerger phase. The oscillation frequency of the forming postmerger remnant sensitively depends on the stellar properties of neutron stars. Thus, a measurement of this dominant gravitational-wave postmerger frequency by the upcoming gravitational-wave detectors accurately determines neutron-star radii. In addition, we discuss a possibility to infer the maximum mass of nonrotating neutron stars by the detection of the main postmerger frequency. Also the radius of the maximum-mass configuration can be deduced. The same approach tightly constrains the maximum central density of neutron stars. We finally describe how the consideration of different features in the gravitational-wave spectrum results in a unified picture of the dynamics and gravitational-wave emission of the postmerger phase.

Name: Bose, Sukanta
Title: How well can gravitational wave observations of coalescing binaries involving neutron stars constrain the neutron star equation of state?

Abstract: As the advanced gravitational wave detectors gear up to begin observation runs in mid-2015, relativists and astronomers are preparing to use gravitational waves to improve our understanding of a variety of astronomical objects and phenomena. In this talk I will examine how well gravitational wave observations of coalescing binaries involving neutron stars might constrain the neutron star (NS) equation of state. I will study the effects of different NS equations of states in both NS-NS and NS-Black Hole systems, with and without spin, on these constraints.

Name: Ciolfi, Riccardo
Title: Short gamma-ray bursts in the "time-reversal" scenario

Abstract: Short gamma-ray bursts (SGRBs) are among the most luminous explosions in the Universe and their origin still remains uncertain. Observational evidence favors the association with binary neutron star or neutron star-black hole (NS-BH) binary mergers. Leading models relate SGRBs to a relativistic jet launched by the BH-torus system resulting from the merger. However, recent observations have revealed a large fraction of SGRB events accompanied by X-ray afterglows with durations ~10^2-10^5 s, suggesting continuous energy injection from a long-lived central engine, which is incompatible with the short (<1 s) accretion timescale of a BH-torus system. The formation of a supramassive NS, resisting the collapse on much longer spin-down timescales, can explain these afterglow durations, but leaves serious doubts on whether a relativistic jet can be launched at merger. Here we present a novel scenario accommodating both aspects, where the SGRB is produced after the collapse of a supramassive NS. Early differential rotation and subsequent spin-down emission generate an optically thick environment around the NS consisting of a photon-pair nebula and an outer shell of baryon-loaded ejecta. While the jet easily drills through this environment, spin-down radiation diffuses outwards on much longer timescales and accumulates a delay that allows the SGRB to be observed before (part of) the long-lasting X-ray signal. By analyzing diffusion timescales for a wide range of physical parameters, we find delays that can generally reach ~10^5 s, compatible with observations. The success of this fundamental test makes this "time-reversal" scenario an attractive alternative to current SGRB models.

Name: Clark, James
Title: Weakly-modelled analyses of post-merger gravitational-wave bursts from binary neutron star coalescence

Abstract: The advanced gravitational wave detector era is almost upon us, with advanced LIGO likely to commence observations later this year. The inspiral and merger of binary neutron star systems (BNS) is likely to be the most frequently observed source, with detection rates of the inspiral signal somewhere in the range 0.2—200 events per year, once the detector network reaches full design sensitivity. While the inspiral signal offers a probable first detection, the high-frequency gravitational wave burst from the merger and, in particular, post-merger neutron star oscillation signal may be observable for nearby events. Observation of gravitational wave burst from the post-merger oscillations would have important implications for the neutron star equation of state. I discuss the plans and prospects for detecting and characterising the high-frequency gravitational wave burst from BNS coalescence and methods for the measurement of the dominant post-merger oscillation frequency.

Name: Constantinou, Constantinos
Title: Thermal and adiabatic indices of hot and dense matter of relevance to binary neutron star mergers

Abstract: The modeling of neutron stars, core-collapse supernovae, and binary mergers requires knowledge of the equation of state of dense matter at finite temperature. In the case of binary mergers, thermal effects are important in the post-merger evolution of the remnant and are often characterized by a thermal index Γ_{th}. We study the behavior of this quantity in the context of homogeneous matter using non-relativistic potential models as well as mean-field theoretical ones, mainly focusing on the degenerate and non-degenerate limits where simple, closed-form expressions are attainable. We carry out a similar analysis for the adiabatic index which features prominently in the pre-merger evolution of a binary system, being that in hydrodynamics, compression and rarefaction are isentropic. In this framework, we also highlight the role of leptons in the removal of the low-density spinodal instability of nuclear matter.

Name: Dionysopoulou, Kyriaki
Title: Towards a general relativistic resistive-MHD modelling of binary neutron star mergers

Abstract: We study the dynamics of an equal-mass magnetised binary neutron star system within a resistive-MHD implementation matching the highly-conductive stellar interiors to an electrovacuum exterior. A close comparison with simulations performed using a standard ideal-MHD code reveal similarities as well as differences associated to the dynamics in the post-merger and post-collapse phases. In particular, the differences in the post-merger phase are mainly related to the efficiency of the magnetic braking mechanism affecting the specific angular momentum profiles of the object formed after the merger. This results in a slightly extended lifetime of the hyper-massive neutron star in the resistive-MHD implementation due to resistive effects. Even though the properties of the final black hole-torus system formed after the collapse are similar we notice some differences in the magnetic field topology. The magnetic field in the resistive-MHD implementation is predominantly toroidal in the highly conducting region of the torus as expected, however, it is predominantly poloidal in the nearly evacuated funnel region. Reconnection processes occurring in the evacuated funnel region could potentially accelerate particles and launch a relativistic outflow.

Name: Endrizzi, Andrea
Title: GR simulations of binary neutron star mergers with piecewise polytropic equations of state

Abstract: We will present new results on general relativistic magneto-hydrodynamic (GRMHD) simulations of binary neutron star (BNS) mergers. For all our simulations we used the Whisky-MHD code and described the NS matter with a piecewise polytropic equation of state (EOS). We took into account two different mass ranges, so that we obtained both prompt collapse to black hole (BH) and the formation of supramassive NSs. We treated the problem of both magnetized and unmagnetized NSs, as well as equal- and unequal-mass configurations. For all models we studied both the gravitational wave emission and the dynamics of matter and magnetic fields. We deemed the addition of magnetic fields important both for the BH remnant case, due to its possible connection with short Gamma-Ray burst (sGRBs), but also for the supramassive NSs, where the characteristic frequency of the gravitational wave signal emitted by the remnant (which can be used to infer the EOS) could be affected by the presence of magnetic fields.

Name: Friedman, John L.
Title: Measuring the neutron-star equation of state with gravitational waves from binary inspiral

Abstract: Information about the neutron-star equation of state is encoded in the gravitational waves emitted in the inspiral and coalescence of double neutron stars and neutron star-black hole (NS-BH) binaries. A stiff equation of state (EOS) has larger pressure at a given density, and yields a neutron star with larger radius, a star on which the tidal force of its companion is much larger. By deforming the stars, the tidal interaction takes energy from their orbit: The rate of energy loss for binaries with neutron stars is thus faster than for black-hole binaries, their inspiral waveform moves more quickly to higher frequencies, and they coalesce sooner. The departure of the waveform from that of two spinless black holes is almost entirely determined by the tidal deformability of the neutron star and that, in turn, is very nearly determined by the neutron star radius. In contrast to the radii inferred from electromagnetic observations, the gravitional-wave measurement is model-independent – independent of the composition of the neutron-star's atmosphere.

Name: Gaitanos, Theodoros
Title: Momentum dependent mean-field dynamics of compressed nuclear matter and neutron stars

Abstract: Nuclear matter and compact neutron stars are studied in the framework of the non-linear derivative (NLD) model which accounts for the momentum dependence of relativistic mean-fields. The generalized form of the energy-momentum tensor is derived which allows to consider different forms of the regulator functions in the NLD Lagrangian. The NLD approach describes the bulk properties of the nuclear matter and compares well with microscopic calculations and Dirac phenomenology. We further study the high density domain of the nuclear equation of state (EoS) relevant for the matter in β-equilibrium inside neutron stars. It is shown that the low density constraints imposed on the nuclear EoS and by the momentum dependence of the Schroedinger-equivalent optical potential lead to a maximum mass of the neutron stars around $M \simeq 2M_{\odot}$ which accommodates the observed mass of the J1614-2230 millisecond radio pulsar.

Name: Galeazzi, Filippo
Title: Dynamical mass ejection from eccentric binary neutron star mergers

Abstract: An interesting class of neutron star binaries are those formed in dense stellar environments which may merge with a significant eccentricity. We have performed several general relativistic simulations of merging binary neutron stars including nuclear equation of states and the effects of neutrino emission on the shock-heated material. We study the effects of the orbital parameters of the neutron star binary system on the properties of the ejected material in particular as possible site for r-process nucleosynthesis.

Name: Giacomazzo, Bruno
Title: Magnetar formation from the merger of binary neutron stars

Abstract: I will present results of recent investigations about the possibility to form long-lived or even stable magnetars after the merger of a binary neutron star (BNS) system. BNSs are among the most powerful sources of gravitational waves (GWs) that will be detected by advanced LIGO and Virgo. While the inspiral GW signal is the main target for the first detections, the formation of a long-lived or even stable NS remnant after the merger can produce a long post-merger GW emission that could also be detected. Moreover magnetic fields can be strongly amplified during the merger and this can lead to the formation of a magnetar. Large magnetic fields can have an impact on the GW emission after merger and also lead to electromagnetic counterparts, such as the X-ray plateaus that are observed in short gamma-ray bursts. I will describe the dynamics that can lead to the formation of magnetars from BNS mergers, their GW emission, and the possibility of detecting them.

Name: Haas, Roland
Title: Binary neutron star simulations with SpEC .

Abstract: NSNS binaries are expected to be one of the major sources of gravitational radiation detectable by Advanced LIGO. Together with neutrinos, gravitational waves are our only means to learn about the processes deep within a merging pair of NS, shedding light on the as yet poorly understood, equation of state governing matter at nuclear densities and beyond. I report on binary neutron star simulations using the Spectral Einstein Code (SpEC) developed by the Caltech-Cornell-CITA-WSU collaboration.

Name: Hotokezaka, Kenta
Title: The expected radio signals from binary neutron star mergers.

Abstract: A neutron star merger ejects masses at significant kinetic energies. This mass ejection takes place via dynamical mass ejection and a GRB jet but other processes also have been suggested: a shock breakout material, a cocoon, and winds from the accretion dick or the central remnant. The different components of ejected masses include up to a few percent of a solar mass and some of them is ejected at relativistic velocities. The interaction of these ejecta with the surrounding interstellar medium will produce a long lasting radio flare. The relative strength of the signals from the different components depends strongly on the viewing angle. For a generic observer at a lager viewing angle, the dynamical ejecta will generally dominate. We also discuss the detectability of the radio signals as an electromagnetic counterpart of gravitational waves. Finally, we show that the radio flare associated with the short GRB 130603B might be detectable at this stage with the LOFAR and EVLA for the higher range of external densities.

Name: Iosif, Panagiotis
Title: Accuracy of the IWM-CFC approximation in differentially rotating relativistic stars

Abstract: A possible outcome of a binary neutron star merger is the formation of a compact remnant, supported by strong differential rotation. Recently, a triplet of oscillation frequencies of the merger remnant has been identified in the gravitational waves emitted in the post-merger phase, in simulations employing the spatially conformally flat spacetime approximation (IWM-CFC). Evaluating the accuracy of the IWM-CFC approximation for the case of single, but strongly differentially rotating relativistic stars is therefore crucial in order to better understand the limits within which it can be applied. We study the deviation of the IWM-CFC approximation from full general relativity (GR) by evaluating and comparing different error indicators and find that for the fastest rotating and most relativistic polytropic models, the deviation from full GR is below 5% for integrated quantities and below 10% for local quantities. Furthermore, we construct a simple, linear empirical relation that allows for the estimation of the error made by the IWM-CFC approximation and which only involves the flattening of the star due to rotation and the minimum value of the lapse function.

Name: Janka, H.-Thomas
Title: Mass ejection, outflows, and r-process nucleosynthesis in compact binary mergers

Abstract: Binary neutron star mergers and neutron-star black-hole mergers can eject considerable amounts of neutron-rich matter. Current numerical models therefore support the possible role of these events as main, if not only, source of r-nuclei in the Galaxy. I will review our current understanding of mass loss and nucleosynthesis during the merging phase of compact binaries and during their remnant evolution. Effects of neutrinos will also be highlighted.

Name: Just, Oliver
Title: Dynamics of neutron-star merger ejecta

Abstract: During the process of a neutron-star merger various types of outflows can be generated of which each will exhibit characteristic expansion timescales and energetics as well as an individual nuclear composition and electromagnetic signature. In the talk I will present and discuss our recent studies of neutron-star merger ejecta, which aim to understand not only the properties of the individual ejecta types but also the dynamics of different ejecta types interacting with each other.

Name: Kastaun, Wolfgang

Title: Influence of initial spin in binary neutron star mergers

Abstract:
Recently, we performed simulations of binary neutron star mergers which included both nuclear physics equations of state and stars with initial spin for the first time. The focus was on systems resulting in hyper-massive neutron stars. I will discuss the influence of realistic amounts of spin on the outcome, in particular regarding the gravitational wave signal. We also investigated the structure and dynamics of the remnant in detail, revealing some interesting new aspects. For example, we observe rotational profiles not fitting the standard notion of a rapidly rotating core, and show that strong quasi-radial oscillations in the post merger phase have an impact on the gravitational wave spectrum via a modulation of the m=2 mode frequency, offering an alternative to recent interpretations of high frequency side-peaks as nonlinear combination frequencies. Finally, we discuss a possible mechanism in which the initial neutron star spins can influence the amount of ejected matter in some cases.

Name: Kiuchi, Kenta
Title: Numerical relativity simulation of the merger of black hole - magnetized neutron star binaries

Abstract: We perform a high-resolution numerical-relativity simulation for the merger of black hole-neutron star binaries on the Japanese supercomputer K. We focus on a binary that is subject to tidal disruption and subsequent formation of the massive accretion torus. During the torus formation, the non-axisymetric magnetorotational instability as well as the Kelvin-Helmholtz instability set in and induce a magnetohydrodynamical turbulence. The turbulent eddies work as an agent to transfer the mass accretion energy and to subsequently launch a torus wind. We will introduce this result.

Name: Kokkotas, Konstantinos
Title: Neutron stars: oscillations, instabilities and gravitational waves

Abstract: We will review recent progress in the study of neutron star seismology, the excitation of rotational instabilities and the associate emission of gravitational waves. We will show the detectability limits of such instabilities for neutron stars emerging from collapse or the aftermath of binary mergers (afterglow). Finally, we will discuss recent progress in the study of neutron stars in alternative theories of gravity.

Name: Lattimer, James
Title: Neutron star constraints from theory, experiment and observations

Abstract: Neutron stars are sensitive to the equation of state of matter both near the saturation density and at several times higher densities. Three important recent developments are the discovery of two-solar mass neutron stars, refined experimental determinations of the behavior of the symmetry energy of nuclear matter near the saturation density, and new theoretical studies of the properties of pure neutron matter. Two-solar mass neutron stars and measurements of the nuclear symmetry energy, combined with the assumptions of general relativity and causality, imply that the radii of observed neutron stars are in the range of 11 to 13 km and largely independent of their masses. This is consistent with the accumulating observations of both bursting and cooling neutron stars. These studies furthermore severely limit the existence and properties of quark matter inside neutron stars. In the future, continued X-ray, gamma-ray, radio and gravitational radiation observations will further refine our knowledge.

Name: Markakis, Charalampos
Title: Hamilton-Jacobi irrotational hydrodynamics for binary neutron star inspiral

Abstract: Although development of black-hole gravitational-wave templates in the past decade has been revolutionary, the corresponding work for double neutron-star systems has lagged. Neutron stars can be well-modelled as simple barotropic fluids during the part of binary inspiral most relevant to gravitational wave astronomy, but the crucial geometric and mathematical consequences of this simplification have remained computationally unexploited. In particular, Carter and Lichnerowicz have described barotropic fluid motion as conformally geodesic. Moreover, Kelvin's circulation theorem implies that initially irrotational flows remain irrotational. Applied to numerical relativity, these concepts lead to novel Hamiltonian or Hamilton-Jacobi schemes for evolving relativistic fluid flows. Hamiltonian methods can conserve not only flux, but also circulation and symplecticity, and moreover do not require addition of an artificial atmosphere typically required by standard conservative methods. These properties can allow production of high-precision gravitational waveforms at low computational cost. This canonical hydrodynamics approach is independent of the underlying gravity theory and is applicable to a wide class of problems involving theoretical or computational fluid dynamics.

Name: Menezes, Manuel
Title: Equation of State Effects in Post-Newtonian Numerical Simulations of Neutron Star-Black Hole Mergers

Abstract: We investigate the dynamics of neutron star-black hole mergers using a pseudo-Newtonian, three-dimensional Godunov-type hydrodynamics code, which includes a GR-mimicking potential, gravitational wave generation, a neutrino production and leakage scheme, and realistic EOS. We have used both the NL3 and the FSUGold formulations of the EOS of G.Shen et al (2011) as well as the H.Shen et al (2011) EOS to construct neutron star models. Currently in the process of running the hydrodynamic simulations with a black hole of 10 solar masses and spin 0.9, we present our initial results. In future we intend to double the resolution in our simulation code and explore a wider range in parameter space, to include different BH-NS mass ratios and black hole spins.

Name: Meidam, Jeroen
Title: Probing the neutron star equation of state with second-generation gravitational wave detectors

Abstract: Fisher matrix and related studies have suggested that with second-generation gravitational wave detectors, it may be possible to infer the equation of state of neutron stars using tidal effects in binary inspiral. Here we present the first fully Bayesian investigation of this problem. We simulate a realistic data analysis setting by performing a series of numerical experiments of binary neutron star signals hidden in detector noise, assuming the projected final design sensitivity of the Advanced LIGO-Virgo network. With an astrophysical distribution of events (in particular, uniform in co-moving volume), we find that only a few tens of detections will be required to arrive at strong constraints, even for some of the softest equations of state in the literature. Thus, direct gravitational wave detection will provide a unique probe of neutron star structure.

Name: Metzger, Brian
Title: Electromagnetic Signatures of Binary Neutron Star Mergers

Abstract: Coalescing binary neutron stars (NSs) are promising sources for the direct detection of gravitational waves by Advanced LIGO and Virgo in the next few years. Maximizing the scientific return from such a discovery will require identifying a coincident electromagnetic counterpart. One possible counterpart is a short gamma ray burst, powered by the accretion of a centrifugally supported

torus onto the central black hole. I will discuss the standard short GRB-merger paradigm in the context of proposed variations (e.g. long-lived magnetar remnants) and alternatives (e.g. NS accretion-induced collapse). NS mergers are also accompanied by a thermal optical/IR transient, powered by the radioactive decay of neutron-rich r-process elements synthesized in the merger ejecta ('kilonova'). I will describe recent work showing how the delay until black hole formation following the merger may be imprinted in the light curves and colors of kilonovae. Finally, I will describe how free neutrons in the outermost layers of the ejecta power a bright 'precursor' to the main kilonova emission, which could greatly enhance the prospects for its detection.

Name: Moustakidis, Charalampos
Title: R-mode constraints on neutron star equation of state

Abstract: One of the open problems in Astrophysics is why neutron stars do not spin up to the theoretically allowed limit called Kepler frequency. In particular there is a sharp cutoff for spins above 700 Hz which are well below the theoretically allowed upper limit. The gravitational radiation has been proposed as an explanation for the observed relatively low spin frequencies of young neutron stars and of accreting neutron stars in low-mass X-ray binaries as well. In the present work we study the effects of the neutron star equation of state on the r-mode instability window of rotating neutron stars by employing a variety of analytical solution of the TOV equations. We found that the critical angular velocity Ω_c is sensitive mainly on the neutron star radius. The effects of the gravitational mass and the mass distribution are almost negligible. The effect of the solid crust is also taken into account and compared with the simplified normal fluid model case. Moreover, we propose an expression which directly relates the macroscopic quantity Ω_c with the slope of the nuclear symmetry energy at the saturation density. Finally, we investigate the possibility to measure the radius of a neutron star with the help of accurate measures of Ω_c and the neutron star temperature and vice versa.

Name: Paschalidis, Vassilios
Title: Dynamical capture binary neutron star mergers: effects of the NS spin

Abstract: We will present results from general-relativistic hydrodynamical simulations of dynamical capture binary neutron star-neutron star mergers focusing on the effects of the neutron star spin. These events may arise in dense stellar regions, such as globular clusters, where the majority of neutron stars are expected to be rapidly rotating. We find that even moderate spins can significantly increase both the amount of mass in unbound material and the ejecta average velocity. When the NS spins are unequal very high velocity ejecta can be produced with speeds of up to 0.8c. These results demonstrate that these events should be accompanied by brighter electromagnetic signals such as kilonovae or radio waves arising from the interaction of the ejecta with the interstellar medium.

Name: Pnigouras, Pantelis
Title: Saturation of the f-mode instability

Abstract: As a result of the Chandrasekhar-Friedman-Schutz (CFS) instability, the f-mode in a newborn neutron star can grow and produce a significant gravitational wave signal. This star is usually the result of a core-collapse supernova explosion, but may also be the aftermath of a binary neutron star merger, where a rapidly rotating, supramassive configuration is formed, before its prompt collapse to a black hole. The gravitational wave signal could possibly be detected by the next generation gravitational-wave detectors and, thus, provide useful information about the neutron star equation of state. However, non-linear mode coupling suppresses the growth of the f-mode and saturates it. The saturation amplitude

determines the strength of the signal, as well as the evolutionary route of the star inside the so-called instability window.

Name: Piran, Tsvi
Title: Radio flares - long term EM counterparts of NS mergers

Abstract: The interaction of the ejecta from a neutron star merger with the surrounding matter produces a long lasting radio flare. The physics of this flare is rather similar to the physics of SNR. The ejecta expands at a constant velocity until it accumulates enough external material and begins to slow down. The shock that forms between the ejecta and the external matter accelerates particles and amplifies the magnetic fields and those emit a radio flare. The typical duration of the flare depends on the velocity and mass of the ejecta, while the typical maximal frequency is around 1 Ghz. I discuss the physics of this flare and its detectability prospects.

Name: Prakash, Madappa
Title: Thermal properties of neutron stars
Abstract: The modeling of core-collapse supernovae, neutron stars fro their birth to old age, and binary mergers of compact stars requires a detailed knowledge of the equation of state (EOS) of matter at finite temperature. Thermodynamic state variables such as the free energy, energy per baryon, pressure, entropy per baryon, specific heats, chemical potentials of the various species and their derivatives with respect to number densities, thermal and adiabatic indices, *etc.*, all play distinct roles in large-scale computer simulations involving compact objects. In this talk, recent developments in the calculation of the thermal properties of dense matter will be reviewed.

Name: Rezzolla, Luciano
Title: Merging binary neutron stars: a progress report from Frankfurt

Abstract: I will review the progress made recently by the group in Frankfurt on the modelling of merging binary neutron stars. Special attention will be paid to the use of high-order methods to model the inspiral phase, to the spectral properties of the post-merger gravitational-wave signal, and to the dynamics of magnetic fields in fully resistive MHD simulations. Last but not least, I will discuss how a serious riddle in the modelling of short gamma-ray burst, can find a plausible explanation in terms of a two-winds scenarios.

Name: Sathyaprakash, Bangalore S.
Title: How well do we know waveforms from binary neutron star coalescences and is there a problem in modelling them?

Abstract: To measure the radius of neutron stars and infer their equation of state requires accurate modelling of the emitted waveforms during the inspiral and merger phases. Systematics in waveform modelling could bias our results and lead to erroneous conclusions about the nature of equation of state. In my talk I will review our current understanding of the two-body dynamics, what we know for sure, and where we need to focus in the coming years. It is customary to use unfaithfulness between waveforms as a measure of biases in parameter estimation. I will argue why this is not right and introduce a new figure-of-merit that is more appropriate for parameter estimation.

Name: Shibata, Masaru

Title: Gravitational waves and dynamical mass ejection from binary neutron star merger

Abstract:
I will present several results of our latest numerical-relativity simulations for the merger of binary neutron stars, focusing on long-term gravitational waveforms and dynamical mass ejection.

Name: Sotani, Hajime
Title: Effect of electron screening on the crustal torsional oscillations

Abstract: The crust torsional oscillations in neutron stars are considered as one of the candidates to explain the quasi-periodic oscillations observed in soft-gamma repeaters. Such oscillations are characterized by the shear modulus. In this talk, we consider the effect of electron screening in the shear modulus and examine such effects on the torsional oscillations. In particular, the charge number of the nuclei strongly depend on the density dependence of the nuclear symmetry energy (L). Thus, we also see the dependence of the frequencies on L, with which the possible identification of the observed QPO frequencies is considered.

Name: Tsokaros, Antonios
Title: Quasi-equilibrium solutions for slowly spinning binary neutron stars.

Abstract: We present the extension of our COCAL - Compact Object CALculator - code to compute general-relativistic initial data for binary compact-star systems. In particular, we construct quasi-equilibrium initial data for equal-mass binaries with spins that are either aligned or antialigned with the orbital angular momentum using the Isenberg-Wilson-Mathews formalism. Equilibria for spinning configurations with a nuclear-physics equation of state in a piecewise polytropic representation will be presented. Pointwise comparison with the spectral code LORENE making accurate comparisons is done and first simulations using the COCAL initial data will be shown.
