NewCompStar School 2017 - “Neutron stars: theory, observations and gravitational waves emission”

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Book of Abstracts

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Constraining the equation of state of dense matter through thermal emission of neutron stars

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Neutron stars are one of the most compact objects in the universe. They are made of a totally degenerated fermion gas, but their interior composition remains unknown. Several scenarios exist and some of them predict phase transitions from ordinary nuclear matter to mesons condensates, hyperonic matter, quark gluon plasma in the core, or even absolutely stable strange quark matter. In order to investigate the possibility of a phase transition, we present a new empirical model for purely nucleonic matter which is able to mimic several existing nuclear model. We show the possibility to put some constraints on the equation of state describing a purely nucelonic interior in order to reproduce observational data coming from thermal emission of low mass X-ray binaries (using Chandra and XMM-Newton observatories). We simultaneously analyse 6 sources with a stretch move algorithm from Monte Carlo by Markov Chains Methods.

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Stability Criterion for Differentially Rotating Neutron Stars

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Uniformly rotating neutron stars have been part of many studies in theoretical astrophysics. While a stability criterium against gravitational collapse to a black hole is well known for this type of star, it is not for differentially rotating neutron stars, which are thought to be the outcome of binary neutron star mergers. The stability of the merger remnant has important implications on the expected gravitational wave signal. This study indicates, that a stability criterion for differentially rotating neutron stars exists similar to the one of their uniformly rotating counterparts: along a sequence of constant angular momentum dynamical instability sets in for central rest mass densities below the one of the equilibrium solution at the turning point. Together with this, a universal relation will be shown, which for a given angular momentum and degree of differential rotation allows to determine the turning point independently of the used equation of state.

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Papaloizou-Pringle instability suppression by the Magnetorotational Instability in relativistic accretion discs

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Geometrically thick tori with constant specific angular momentum have been widely used in the last decades to construct numerical models of accretion flows onto black holes. Such discs are prone to a global non-axisymmetric hydrodynamical instability, known as Papaloizou-Pringle instability (PPI), which can redistribute angular momentum and also lead to an emission of gravitational waves. It is, however, not clear yet how the development of the PPI is affected by the presence of a magnetic field and by the concurrent development of the magnetorotational instability (MRI). We present the first non-linear analysis using three-dimensional GRMHD simulations of the interplay between the PPI and the MRI and compare results between simulations of non-magnetized and magnetized tori. In the purely hydrodynamic case, the PPI selects the $m = 1$ azimuthal mode as the fastest growing and non-linearly dominant mode. We show that, for tori with a weak toroidal magnetic field, the development of the MRI leads to the suppression of large-scale modes and redistributes power across smaller scales. For strong enough (but still subthermal) magnetic fields the $m = 1$ mode is no longer dominant, and the PPI appears to be completely inhibited.

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Equation of state of nuclear matter using AV8’and AV6’potentials

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Equation of state of nuclear matter using AV8’and AV6’potentials

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The equation of state (EOS) of asymmetric nuclear matter have long been realized as a crucial param
In this work, we have calculated the equation of state of asymmetric nuclear matter using lowest

[1] S. Gandol, A. Lovato, J. Carlson, and Kevin E. Schmidt Phys. Rev. C 90,061306(R) (2014).

[2] J. C. Owen, R. F. Bishop and J. M. Irvine, Nucl. Phys. A 277 (1977) 45.

[3] B. S. Pudlineret al., Phys. Rev. C56, 1720 (1997).

[4] R. B. Wiringa and S. C. Pieper, Phys. Rev. Lett. 89, 182501 (2002).

[5] Z. Asadi, M. Bigdeli, Submitted to PRC.

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The movement of pulsars in the Galaxy and determination of their kinematic ages

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Knowing neutron star (NS) ages is important to better understand the formation and evolution of the Galactic NS population. The characteristic age is only a rough estimate, based on assumptions like pure magnetic dipole braking and a negligible birth period. Since these assumptions are not justified for many pulsars, we use kinematic simulations for 162 non-recycled pulsars and are able to determine unambiguous kinematic ages for 92 of them. The applied method requires knowledge of the pulsar's current position, proper motion and distance to calculate the trajectory and find its intersections with an area of ±100 Parsec around the Galactic plane, which is assumed as the birth place. The distribution of logarithmic kinematic ages roughly follows a Gaussian, with a peak around 10ˆ6 years. We obtain large differences between kinematic and characteristic ages and a smaller median for the kinematic ages. The method is problematic for the youngest and oldest NSs. We compare our results to Tetzlaff (2013), who determined pulsar ages by identifying individual birth associations, like supernova remnants, stellar clusters or runaway stars. Our method is mainly applicable for middle-aged NSs, while for young NSs it is better to search for individual birth associations. For the youngest ones we can still see the supernova remnant (SNR), so we can precisely locate the birth place. We try to find runaway stars inside SNRs (see Dinçel et al. 2015) to determine the exact time and place of the SN and constrain pre-SN binary properties. Considering runaway stars of all spectral types will help to estimate, how often the binary SN ejection scenario (Blaauw 1961) happens.

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High-frequency noise in GRO J1744–28: Evidence for a radiation-pressure dominated accretion disk

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Neutron stars accreting matter via an accretion disk offer a unique way to examine the interaction of radiation and matter under extreme conditions. If the neutron star has an ultra-strong magnetic field, the disk is truncated at the so-called magnetospheric radius and matter is guided onto the neutron star surface where its energy is released in X-rays (so-called X-ray pulsars). The properties of the fast flux variability carry an imprint of the geometrical and physical conditions of the system.

In the current work we examined the low-mass X-ray pulsar GRO J1744—28 which is the only source showing both regular pulsations and type-II X-ray bursts. The source is accreting via an accretion disk, whose inner regions are expected to become radiation-pressure dominated during observed super-Eddington outbursts. We traced the evolution of its power spectra with luminosity during the outbursts and report the discovery of the high-frequency break which can be ascribed to the inner radius of the accretion disk. We find that the dependence of the inner radius on the luminosity differs from the standard relation for the gas-pressure dominated disk. Following the perturbation propagation model, we were able to create a model for the power spectra generated in an accretion disk with a radiation-pressure dominated inner region. The proposed model demonstrates a strong qualitative match with the observations.

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Study of equation of state for eletron capture in core-collapse supernovae

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In the last decades the numerical simulations of core-collapse supernovae have greatly improved, treating now general relativity and multi-dimensional hydrodynamic phenomena such as convection, rotation, instabilities, neutrino transport and shock wave propagation. Although the remarkable advances, the best 3D models still fail to reproduce the characteristics of observed core-collapse supernovae. Furthermore, the nuclear inputs such as the equation of state (EoS) and electro-weak processes play a fundamental role in these simulations. In particular, the electron-capture process governs the neutronization of matter and determines the position of the formation of the shock wave, which ultimately leads to the supernova explosion. In the early stage of the core-collapse the electron-capture rate on nuclei dominates. The proper way to obtain the total electron-capture rate is to fold the individual rates with the nuclear distribution. This is however not trivial, because most of the core-collapse codes use EoSs based on single nucleus approximation. This motivated us to implement a perturbative treatment of the extended Nuclear Statistical Equilibrium (NSE) model into the widely used Lattimer and Swesty (LS) EoS. The NSE calculations depend on the masses of different nuclei, determined either experimentally or using a mass model; it is thus essential to know as precisely as possible the nuclear masses. The nuclei that play the most important role during the core collapse because of their electron-capture rates are located around 78Ni and 128Pd. An experiment, which aims to measure the masses of the nuclei of interest located around 78Ni with the JYFLTRAP Penning trap mass spectrometer at IGISOL, has been recently accepted. The precise experimental values of the masses thus obtained will be used then in the model. It constitutes the second and complementary part of my thesis.
During the school, I will present nuclear distributions obtained with this modified LS EoS for some points of the collapse trajectory, using on the one hand the original finite temperature liquid-drop model and on the other hand a more sophisticated mass functional. I will also present the online results of the first experimental run performed in June 2017.

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Mass and radius constraints for neutron stars from pulse shape modeling

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We present a method that can be used to constrain masses and radii of neutron stars. The method is suitable for accreting millisecond pulsars, where a rapidly rotating neutron star accretes matter from a relatively low mass companion star onto the magnetic poles of the neutron star. Because of the accretion, we observe radiation from two "hot spots"on the neutron star surface. This radiation is pulsating coherently at the spinning frequency of the neutron star. We model the exact shape of the pulses using "Schwarzschild-Doppler"approximation, which takes the general and special

relativistic effects into account. An empirical model is used to describe the oblate shape of the star caused by the fast rotation. The spectrum of the radiation is obtained from an empirical model of Comptonization in which a fraction of photons in a seed blackbody spectrum is scattered into a power-law component.

The pulse profiles carry information about the mass and radius of a neutron star since e.g., the light bending and thus pulse shape depends strongly on the compactness of the star. Also many other physical parameters and observing angles affect the light curves. Therefore, we use Bayesian analysis and a novel Monte Carlo sampling method, called "ensemble sampler", to obtain probability distributions for the different parameters, especially for the mass and the radius. To test the robustness of our method, we have generated synthetic data and fitted the pulse profiles to these. The synthethic data is as closely as possible resembling the real observations of SAX J1808.4 − 3658 observed by Rossi X-ray Timing Explorer. The results of our samplings show that obtaining new constraints for radius and mass is possible. However, prior information obtained from polarization measurements may be used the get significantly tighter constraints.

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Quasi-radial instability of differentially rotating relativistic stars

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The stability against gravitational collapse of the remnant left by a merger of binary neutron stars is of great interest in gravitational-wave astronomy. This property can be explored with simulations in full general relativity, which are often computational extremely demanding. A well-established result in this landscape is that the rotation of the remnant is a crucial factor in determining its stability. In the case of uniform rotation, the turning-point method by Friedman, Ipser and Sorkin (1988) provides a shortcut to study physical properties regarding the stability of neutron stars in a more computational-affordable way. This method is based on the study of the *turning points*, which are particular equilibrium models that satisfy a specific condition and that can be found without performing full simulations. The turning-point method detects the onset of secular instability, which is, in general, close to the dynamical instability to collapse. Here, we applied the turning-point method to differentially rotating neutron stars, obtaining an estimation of the location of the instability region in the parameter space, for different equations of state and rotation laws. To validate this approach we performed three-dimensional simulations of select models to find the onset of dynamical instability. Furthermore, we report on universal relations among some of the physical properties of interest along the sequence of turning-point models.

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A Markov Chain Monte Carlo approach to the relativistic inverse stellar problem

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The lack of information on the nature of the neutron star (NS) core at supra-nuclear densities, has so far prevented a unique description of its equation of state (EoS). Future gravitational wave (GW) detections by second and third-generation of ground-based interferometers will shed new light on

this open problem. The income of new and detailed experimental data will help to reconstruct the fundamental properties of the NS EoS by measurements of its macroscopic observables, within the so called *inverse stellar problem* [1,2].

In this work we propose a method to determine the EoS features using GW signals produced by coalescing binary systems. This approach can be combined with experimental data obtained through astrophysical observations or nuclear physics experiments, leading to a genuine multi-messenger framework.

We parametrize the EoS using phenomenological piecewise polytropic models [3], which accurately fit a large class of realistic EoS, representing an effective way to discriminate among them. Adopting a Bayesian scheme of inference, we determine the posterior probability distribution of the EoS parameters, for a given set of NS masses and tidal deformabilities, within their experimental uncertainties measured by GW detections.

We apply this approach to two realistic EoS, APR4 and MS1, which represent extreme examples of soft and stiff NS matter, respectively. Our results suggest that a network of second-generation interferometers will be already able to rule out such extreme cases by means of a relatively small number of binary NS detections. Moreover, future instruments, like the Einstein Telescope, will further increase our ability to infer the properties of nuclear matter at high densities, and will ultimately lead to a complete identification of the NS EoS at 3σ level.

References
[1] L. Lindblom, *Determining the nuclear equation of state from neutron-star masses and radii*, Astrophys. J. **398**, 569 (1992).
[2] L. Lindblom and N. M. Indik, *Spectral approach to the relativistic inverse stellar structure problem II*, Phys. Rev. D **89**, 064003 (2014).
[3] J. S. Read, B. D. Lackey, B. J. Owen and J. L. Friedman, *Constrains on phenomenologically parametrized neutron-star equation of state*, Phys. Rev. D **79**, 124032 (2009).

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Compact objects in torsion-based extended theory of gravity

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We study the static spherically symmetric configurations of the perfect fluid described by the polytropic equation of state (EoS) in the $f(T)$ extended theory of gravity. For $f(T) = T$, where T is the torsion scalar, this gravity theory is equivalent to GR and is known as its teleparallel equivalent (TEGR). In this work, we provide numerical evidence for the existence of the polytropic solutions in $f(T) \neq T$. For certain parameters of the EoS, we obtain sharply vanishing fluid energy density and pressure at finite radius (stellar surface) as in the GR solutions where we can join the interior spacetime with the exterior vacuum spacetime appropriate for the considered variant of the $f(T)$ theory. This result should be seen within the context of the recently formulated no-go theorems for the polytropic spheres in modified gravity theories involving higher order derivatives such as the Palatini $f(R)$ theory or the $\omega = -3/2$ scalar-tensor theory. We think it is important to inspect well konwn GR solutions in the framework of the new modified theories as this theories can serve as a test in which direction the new fundamental theories and notions should go.

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Toward a unified description of the crust and the core of neutron stars

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We recently developed a density functional theory based empirical approach using the extended Thomas-Fermi theory, allowing an analytical evaluation of the energy functional of the different components of stellar matter. The main advantage of this unified approach is that the crust-core transition is consistently treated, allowing to estimate upper bounds on observables such as pulsar glitches which are supposed to be sensitive on the crust-core interface. In our poster, we present some preliminary results in the case of non-accreting cold neutron stars.

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From Compact Objects to Quasi-Normal Modes and Back

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With the repeated detection of gravitational waves by LIGO, new frontiers in astrophysics and gravitational physics are waiting to be explored. The work we present is dedicated to the theoretical description of ultra compact objects, more recently also called exotic compact objects (ECOs). Using analytic and semi-analytic techniques we focus on gravitational perturbations, where the associated quasi-normal mode spectrum contains important information of the source and is therefore a promising object of further research.

In a first project [1] we have successfully shown how different versions of the Bohr-Sommerfeld rule, a WKB result, can be used to compute the so-called trapped axial modes of ECOs. For these objects it was also possible to develop and solve analytically a toy model, which allows a simple and quick estimation of their trapped modes.

In the subsequent project [2] we have worked on the inverse problem, where one reconstructs the potential of gravitational perturbations from the knowledge of the QNM spectrum. The inverse problem is of great interest because it allows to study a source mainly model independently. In general it is not possible to find a unique solution, but a quite generous additional assumption allows it for many objects.

References:

[1] S. H. Völkel and K. D. Kokkotas, Class. Quantum. Grav., 34, 12, 2017
[2] S. H. Völkel and K. D. Kokkotas, accepted in Class. Quantum. Grav., 2017

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Scalarization of neutron stars with realistic equations of state.

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Neutron stars are some of the most fascinating objects in the universe. Due to their compactness and high density, they represent an ideal laboratory to test alternative theories of gravity. In addition, studying these compact objects will expand our limited knowledge of the properties and the physics of nuclear matter at the very high density found inside neutron stars.

We demonstrate the effect of scalarization on static and slowly rotating neutron stars in scalar-tensor theories of gravity, implementing various realistic Equations Of State (EOSs). Beside a polytropic EOS and some EOSs for pure nuclear matter and pure quark matter, we include several EOSs describing nuclear matter with hyperons and hybrid matter for the first time in this context.

We investigate the onset of scalarization for these different EOSs, presenting a universal (independent of the EOS) relation for the critical coupling parameter versus the compactness. We then recognize that the most significant universal feature of the onset and the magnitude of the scalarization is the correlation with the value of the the gravitational potential at the center of the star. We also analyze the moment-of-inertia–compactness relations and confirm universality for the nuclear matter, hyperon and hybrid equations of state.

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Constraining Dense Matter with QCD and Observations

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In this poster, I will present results from a recent study aimed at finding the most plausible Equation of State (EoS) for neutron star matter, combining available first principles calculations with up-to-date observational data. Our EoSs are composed of piecewise polytropes interpolating between known limits from quantum Monte Carlo at low densities and perturbative QCD at high densities. Further constraints are obtained from neutron star mass measurements as well as from observations of thermonuclear X-ray bursts that can be used to evaluate both the masses and the radii of certain neutron stars in binary systems. Our results indicate that neutron star observations can place constraints on the behavior of QCD matter even at very high densities.

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The spectral lines of the accretion tori

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Spectroscopic analysis of the radiation of binary stellar systems, which contain a neutron star or a black hole, is still among the most topical areas of relativistic high energy astrophysics. The strong dependence of the spectral profiles on the configuration of the source-observer system suggests that the spectral profiles can carry substantial information about the compact object and its surrounding area. We study the spectral lines of the accretion tori oscillating in the vicinity of the compact object as measured by an observer located at infinity.

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Thin accretion disc in strong gravity influenced by interaction with radiation field

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Accretion structures in the vicinity of neutron stars are significantly influenced by the radiation emitted from the surface of stars and from the boundary layer. Apart from the radiation pressure, the accreted matter is also affected by the Poynting-Robertson effect, which causes angular momentum loss and therefore acts as an additional source of viscosity in the disk. Using numerical simulations, we studied the influence of the Poynting-Robertson effect on the thin accretion disks in accreting binary systems with a neutron star. In the parallelized simulation code, we implement the complete general relativistic description of the Poynting-Robertson effect. The motion of matter in the disk thus results from a complex interplay of strong gravitational field, the Poynting –Robertson effect, radiation pressure and disk viscosity. The results demonstrate that the presence of even constant star's luminosity qualitatively influences the distribution of mass density in thin disks and can create strong inhomogeneous structures of the disk.

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Neutrino and magnetic effects on binary neutron star mergers

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Binary neutron star mergers are now thought to be a main source of r-process nucleosynthesis, by which most of the heavy elements in our universe have been produced. Furthermore, such systems also constitute a prime candidate for the formation of short gamma ray bursts, which can serve as important electromagnetic counterparts to future gravitational wave detections of such systems.
Using a recently developed microphysics framework we have been able to study the merger of binary neutron stars in full general relativity taking also into account neutrino cooling effects and magnetic fields. We will present initial findings for both a stable remnant hypermassive neutron star and a collapse to a black hole torus system. We will also comment on further developments to include neutrino heating.

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Magnetically driven winds from neutron star merger remnants

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The merger of binary neutron stars can result in the formation of a massive, highly magnetized neutron star as remnant.
We study the magnetically driven wind launched from those objects.
The remnant is modelled as an axisymmetric, differentially rotating supramassive neutron star. A realistic equation of state is employed and neutrino emission is taken into account via a leakage scheme.