GR 10: Relativistic Astrophysics

Zeit: Donnerstag 11:00–12:40 Raum: VMP6 HS A

GR 10.1 Do 11:00 VMP6 HS A

About the internal structure of neutron star merger products — •Matthias Hanauske[1,2], Kentaro Takami[2], Luciano Rezzolla[1,2], and Horst Stöcker[1,2] — [1]Institut für Theoretische Physik, Max-von-Laue-Straße 1, 60438 Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Straße 1, 60438 Frankfurt, Germany

Gravitational waves emitted from merging neutron star binaries are on the verge of their first detection with advanced gravitational-wave interferometers. Depending on the initial masses of the system, the binary merger product could generate a hypermassive neutron star (HMNS) or promptly form a black hole surrounded by a hot and dense torus. Fully general relativistic numerical simulations of merging neutron star binaries are able to describe the overall evolution ranging from the inspiral and merger phase up to the post merger, collapse and ring-down phase. The emitted gravitational-wave signal from the produced HMNS is composed of specific characteristics of the equation of state of matter which can be analysed from its spectral features. This talk will focus on the internal HMNS properties (e.g. differential rotation profiles, structure of the space-time metric, particle composition and hadron-quark phase transition) and their connection with the emitted gravitational-wave signal.

GR 10.2 Do 11:20 VMP6 HS A

A large-scale dynamo and magnetoturbulence in rapidly rotating core-collapse supernovae — Philipp Mösta[1,2], Christian Ott[2], David Radice[2], Luke Roberts[2], Erik Schnetter[3,4,5], and •Roland Haas[6] — [1]Department of Astronomy, 501 Campbell Hall #3411, University of California at Berkeley, Berkeley, California 94720, USA — [2]TAPIR, Walter Burke Institute for Theoretical Physics, Mailcode 350-17, California Institute of Technology, Pasadena, California 91125, USA — [3]Perimeter Institute for Theoretical Physics, Waterloo, Ontario N2L 2Y5, Canada — [4]Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1, Canada — [5]Center for Computation & Technology, Louisiana State University, Baton Rouge, Louisiana, 70803, USA — [6]Max Planck Institute for Gravitational Physics, Am Mühlenberg 1, 14476 Potsdam-Golm, Germany

We report on a recent simulation of magnetohydrodynamics turbulence resolving the MRI in a global, three-dimensional core collapse supernova simulation.

MRI and the dynamo mechanism are expected to be the engine to supply energy to hypernovae, yielding the most energetic explosions observed in the Universe. Using very high resolution simulations we observe the development of a large-scale toroidal magnetic field generated through MRI and dynamo action. We observe an inverse cascade of energy to larger scales suitable to drive outflows along the axis of rotation.

GR 10.3 Do 11:40 VMP6 HS A

Rapidly rotating neutron stars in Einstein-Gauss-Bonnet dilaton theory — •Sindy Mojica[1], Burkhard Kleihaus[1], Jutta Kunz[1], and Marco Zagermann[2] — [1]University of Oldenburg — [2]University of Hannover

Motivated by string theory, we studied neutron stars in Einstein Gauss Bonnet dilaton theory (EGBD). Neutron stars are considered as laboratories to test general relativity and theories beyond. We calculated observables such that: mass, angular momentum, moment of inertia and quadrupole moment for rapidly rotating neutron stars in EGBD gravity.

In order to determine the dependence on neutron stars matter constituents and the coupling parameter from the EGBD approximation, we have proven that universal relations for neutron stars may exist in EGBD theory, when the angular momentum is fixed and the moment of inertia and quadrupole moment are scaled.

GR 10.4 Do 12:00 VMP6 HS A

Quantifying the Kelvin-Helmholtz instability in interstellar jets with radiation observable on Earth — •Richard Pausch[1,2], Alexander Debus[1], Axel Huebl[1,2], Klaus Steiniger[1,2], René Widera[1], and Michael Bussmann[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

We present a new diagnostic method to both identify the presence of the Kelvin-Helmholtz instability (KHI) in interstellar plasma jets and determine its growth rate by measuring the emitted radiation.

Based on the electron dynamics inside the KHI vortices, we derive the emitted radiation power and polarization and show their correlation to the magnetic field evolution, driving the instability. These correlations are verified against simulations of the relativistic KHI using the 3D3V particle-in-cell code PIConGPU. It determines the angularly resolved radiation spectra for billions of electrons using generally valid Liénard-Wiechert potentials. The simulation shows that the growth rate correlation between radiation power and magnetic field agrees over orders of magnitude for the entire linear phase of the KHI while the polarization signature allows a clear identification of this phase.

The method presented can resolve the question whether the KHI occurs in astro-physical particle jets and furthermore provides quantitative insides to the jet dynamics by analyzing the radiation observable on Earth.

GR 10.5 Do 12:20 VMP6 HS A

Quasi-normal modes of realistic neutron stars in Einstein-Gauss-Bonnet-dilaton theory — •Jose Luis Blazquez Salcedo — Oldenburg University ,Oldenburg, Germany

In this talk we present our results on quasi-normal modes (QNM) of realistic neutron stars in Einstein-Gauss-Bonnet-dilaton (EGBd) gravity. We consider 8 realistic equations of state for nuclear, hyperonic, and hybrid matter. We focus on the fundamental curvature mode of the axial component, and compare the results with those of pure Einstein theory. Our results show that the QNM of neutron stars in EGBd theory present higher frequencies than the QNM of stars in Einstein theory. On the other hand, the impact on the damping time of the Gauss-Bonnet-dilaton term is typically smaller. We study universal relations for the QNM spectrum of these configurations, and obtain that relations valid in pure Einstein theory are also valid in EGBd gravity. We will explain how these results could be used to constraint the EGBd parameters using gravitational wave detections.