GR 14: Relastro III

Time: Friday 9:00–10:20 Location: ZHG008

GR 14.1 Fri 9:00 ZHG008

Magnetic field configurations in Binary Neutron Star Mergers — •William Cook — Theoretisch-Physikalisches Institut, Friedrich-Schiller Universitat, Fröbelstieg 1, 07743 Jena

Magnetic field configurations inside isolated neutron stars are poorly constrained, and purely poloidal configurations are known to suffer from instabilities. We perform simulations of isolated neutron stars to investigate the development of these instabilities and the growth of toroidal field components. We then investigate the impact of the magnetic field configurations that develop in isolated stars in the context of binary neutron star mergers. Simulations are performed using the exascale-ready numerical relativity codes GR-Athena++ and AthenaK, the designs of which we also discuss

GR 14.2 Fri 9:20 ZHG008

^{56}Ni production in neutrino-driven winds from long-lived binary neutron star merger remnants — •Maximilian Jacobi[1], Fabio Magistrelli[1], Eleonora Loffredo[2], Giacomo Ricigliano[3], Sebastiano Bernuzzi[1], David Radice[4], Almudena Arcones[3,5], Albino Perego[6], and Domenico Logoteta[7] — [1]Friedrich-Schiller-Universität Jena, Germany — [2]INAF - Osservatorio Astronomico d'Abruzzo, Teramo, Italy — [3]Technische Universität Darmstadt, Germany — [4]The Pennsylvania State University, USA — [5]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [6]Universitá di Trento, Italy — [7]Università di Pisa, Italy

We investigate the nucleosynthesis and kilonova light curve based on long-term binary neutron star merger simulations incorporating a two-moment neutrino-transport scheme. The ejecta are evolved up to 100 days using axisymmetric radiation-hydrodynamics simulations coupled in-situ to a complete nuclear network. We find that the neutrino-driven wind from the post-merger remnant is proton-rich, resulting in the production of iron-group elements. We explore the consequences of the altered nucleosynthesis on the kilonova light curve and spectrum. The observation of features associated with proton-rich nucleosynthesis could serve as a smoking gun for the presence of a long-lived neutron-star remnant in future kilonova observations.

GR 14.3 Fri 9:40 ZHG008

Simulations of BNSM ejecta with online nuclear calculations and atomic opacities — •Fabio Magistrelli — TPI, FSU Jena

Understanding the details of r-process nucleosynthesis in binary neutron star mergers (BNSM) ejecta is key to interpreting kilonova observations and identifying the role of BNSM in the origin of heavy elements. I will present predictions for light curves and composition results obtained from ray-by-ray radiation-hydrodynamic simulations of BNSM ejecta (extracted from hundreds-of-ms long ab-initio numerical relativity simulations) with an online nuclear network. The ejcta evolution includes charged particles and gamma-rays thermalization, and composition-dependent opacities obtained from atomic calculations. Comparing the results with other initialization procedures and opacity models, I will discuss the correspondent systematic uncertainties on the final predictions for kilonova light curves and element production.

GR 14.4 Fri 10:00 ZHG008

Robustness of the FO-CCZ4 Formulation Compared to GHG — •Mads Sørensen[1], Daniela Cors[2], David Hilditch[3], and Bernd Brügmann[1] — [1]Theoretisch-Physikalisches Institut , Jena, Germany — [2]Department of Applied Mathematics and Theoretical Physics (DAMTP), University of Cambridge, Cambridge, United Kingdom — [3]Center for Astrophysics and Gravitation (CENTRA), Instituto Superior Técnico, University of Lisbon, Lisbon, Portugal

Numerical relativity relies on robust formulations of Einstein's field equations to simulate strong gravitational fields, like black-hole mergers, and for example extract gravitational-wave signals from them. We are interested in the stability of our simulations and thus on the hyperbolicity of the formulations we use. A first-order conformal covariant Z4 (FO-CCZ4) formulation has shown to succesfully manage to simulate moving puctures in 3 dimensions with a higher-order discontinuous Galerkin (DG) scheme. Making the FO-CCZ4 of high interest for various simulations. In this work, we focus on testing the robustness of this formulation by comparing it with the Generalised Harmonic Gauge (GHG) formulation. We have implemented FO-CCZ4 in the pseudo-spectral code *bamps*, with different shift and slicing conditions. We then compare the behaviour of FO-CCZ4 versus GHG for simple initial data.