GR 10: Relativistic Astrophysics I

Time: Wednesday 14:00–15:20 Location: HBR 14: HS 2

GR 10.1 Wed 14:00 HBR 14: HS 2

Timing of pulsars in extreme mass ratio systems — •Eva Hackmann — ZARM, Universität Bremen

Binary systems of a pulsar and a black hole are very promising laboratories to determine the features of the combined gravitational field and to test General Relativity. A pulsar orbiting Sagittarius A*, the supermassive galactic center black hole, should allow for the determination of its mass and spin to unprecedented accuracy and to test e.g. the no-hair theorem. It is therefore of great importance to accurately model the effects of General Relativity. Different from the usual post-Newtonian treatment, we present an analytical timing formula based on the test particle limit in the extreme mass ratio system. The resulting relativistic delays of the pulsar signal are discussed.

GR 10.2 Wed 14:20 HBR 14: HS 2

Radiation-hydrodynamics simulations of kilonovae with nuclear networks — •Fabio Magistrelli — Friedrich-Schiller-Universitaet Jena, TPI

I will present a new technique to simulate the long-term evolution of the material ejected during binary neutron star mergers. For the first time, we provide radiation-hydrodynamic simulations with complete nuclear network calculations to compute in real-time the energy released by nuclear reactions and keep track of the detailed matter composition. I will then describe the results obtained by applying this pipeline to a new set of numerical relativity simulations run for hundreds of milliseconds after merger. In particular, I will discuss the features induced by different equations of states for the neutron star matter on kilonovae lightcurves and r-process nucleosynthesis yields. Finally, I will consider the effects of including extra energy in the simulation in the form of a polar jet mimicking a short gamma-ray burst.

GR 10.3 Wed 14:40 HBR 14: HS 2

Accretion Induced Collapse of Rotating White Dwarfs Progenitors — •Luís Felipe Longo Micchi — Friedrich-Schiller Universitat

Studies have proposed accretion-induced collapse (AIC) of white dwarfs (WDs) as possible power engines of short GRBs with extended emission (sGRB+EE). Aware of the recent turmoil around GRB211211A (a known sGRB+EE) origins, we revisited the science case of AICs. In this talk, we will discuss the results of three models of WDs that collapse due to electron capture. Parameterized by their initial angular momentum, we study the influence of rotation in our AIC models. A careful characterization of the multi-messenger emission of these events will be dis- cussed. With a particular focus on gravitational radiation, we will examine their gravitational wave (GW) morphology and their detectability in current and future ground-based GW detectors. We provide estimates of their electromagnetic and neutrino radiation profile and compare them against other supernova-like events. All our models are fully general-relativistic three-dimensional numerical simulations containing a moment-based neutrino radiation transport. The inclusion of magnetic fields is an undergoing extension of our work.

GR 10.4 Wed 15:00 HBR 14: HS 2

Constraining the Properties of Dark Matter With Gravitational Lensing on Subgalactic Scales — •Felix Heinze — Friedrich-Schiller-Universität Jena, Theoretisch-Physikalisches Institut, Fröbelstieg 1, 07743 Jena

Gravitational lensing is a powerful tool for investigating the distribution and the total content of both luminous and dark matter in galaxies and galaxy clusters. Even small substructures in the form of subhalos can be detected by the perturbative effects they have on the lensing observables, even if no luminous matter is associated with them. It is crucial to understand the lensing effects of these subhalos in detail, as they can be used to infer the structural properties and the abundance of substructures, which in turn allow for constraining the properties of dark matter. A substantial portion of the subhalos that have been detected in the past seem to exhibit concentrations that significantly exceed the predictions made by the cold dark matter model. One possible explanation for this discrepancy that does not invoke alternative dark matter models lies in the potential inadequacy of the theoretical models that have underpinned prior analyses. State-of-the-art cosmological simulations that include the effects of baryons, such as TNG50, indicate that previously used models of subhalo density profiles might not provide an adequate description in the presence of baryons. These studies, implications for future lensing analyses and their ability to constrain dark matter models are going to be discussed in this talk.