GR 16: GR and Astrophysics II

Zeit: Freitag 11:30–12:45 Raum: HS 4

GR 16.1 Fr 11:30 HS 4

The Role of Electric Charge in Relativistic Accretion onto Compact Objects — •Kris Schroven — Universität Bremen, Bremen, Germany

The role of electric charge in relativistic accretion onto compact objects is discussed by means of analytic models. Many high-luminosity phenomena in the observed universe can be traced back to accretion processes, in which electromagnetic fields play an important role. These fields are either produced within the accreted matter or they enter the stage as external fields like interstellar magnetic fields or fields, produced by the accreting object.

Two analytic models are applied to examine the effects of a realistically small electric BH charge and the effects of a charge distribution in the accreted matter onto the accretion process and accretion disc structure.

GR 16.2 Fr 11:45 HS 4

Charged fluids around black hole — •Trova Audrey — ZARM, University of Bremen

Studies of equilibrium of toroidal structures of a perfect fluid are important to understand the physics of accretion disks in active galactic nuclei (AGN). Our interest is about equilibrium of electrically charged-perfect fluid surrounding a rotating or non rotating compact object, embedded in magnetic field. The structure of the torus is influenced by the balance between the gravitational, the rotational and the magnetic force. Previous study of rotating charged test fluid around a non rotating black hole showed that according to the spin of the black hole the existence of such structures change. We focus on orbiting structures in the equatorial plane, as single or double tori, and structures above as levitating tori. Our interest is about their existence, shape and how the various forces (electromagnetic, centrifugal and gravitational) influence their physics.

GR 16.3 Fr 12:00 HS 4

Bardeen black hole chemistry — •Athanasios Tzikas — Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

We connect the Bardeen black hole with the concept of the recently proposed black hole chemistry. We study thermodynamic properties of the regular black hole with an anti-deSitter background. The negative cosmological constant plays the role of the positive thermodynamic pressure of the system. After studying the thermodynamic variables, we derive the corresponding equation of state and we show that a neutral Bardeen-anti-deSitter black hole has similar phenomenology to the chemical Van der Waals fluid. This is equivalent to saying that the system exhibits criticality and a first order small/large black hole phase transition reminiscent of the liquid/gas coexistence.

GR 16.4 Fr 12:15 HS 4

r-process nucleosynthesis from matter ejected in binary neutron star mergers — Luke Bovard[2], Dirk Martin[1,3], •Federico Guercilena[1], Almudena Arcones[1,3], Luciano Rezzolla[2,4], and Oleg Korobkin[5] — [1]IKP, TU Darmstadt — [2]ITP, Uni Frankfurt — [3]GSI, Darmstadt — [4]FIAS, Frankfurt — [5]LANL, Los Alamos

We perform full GR simulations of binary neutron-star mergers employing three different nuclear-physics EOS, considering both equal- and unequal-mass configurations, and adopting a leakage scheme to account for neutrino radiative losses. Using a combination of techniques, we carry out an extensive and systematic study of the hydrodynamical, thermodynamical, and geometrical properties of the matter ejected dynamically, employing a nuclear-reaction network to recover the relative abundances of heavy elements produced by each configurations. Three results are particularly important. First we find that within the sample considered here, both the properties of the dynamical ejecta and the nucleosynthesis yields are robust against variations of the EOS and masses. Second, using a conservative but robust criterion for unbound matter, we find that the amount of ejected mass is less than 1e-3 solar masses, hence at least one order of magnitude smaller than the standard assumptions in modelling kilonova signals. Finally, using a simplified and gray-opacity model we assess the observability of the kilonova emission, finding that for all binaries the luminosity peaks around ~1/2 day in the H-band, reaching a maximum magnitude of -13, and decreasing rapidly after. Supported by European Research Council Grant No. 677912 EUROPIUM

GR 16.5 Fr 12:30 HS 4

An integral spectral representation of the massive Dirac propagator in the Kerr geometry in Eddington–Finkelstein-type coordinates — •Christian Röken — University of Granada, Faculty of Sciences, Department of Geometry and Topology, 18071 Granada, Spain

An integral spectral representation of the massive Dirac propagator in the non-extreme Kerr geometry in horizon-penetrating coordinates, which describes the dynamics of Dirac particles outside and across the event horizon, up to the Cauchy horizon, is presented. To this end, the Kerr geometry is described in the Newman–Penrose formalism by a regular Carter tetrad in advanced Eddington–Finkelstein-type coordinates and the massive Dirac equation is given in a chiral Newman–Penrose dyad representation in Hamiltonian form. The essential self-adjointness of the Hamiltonian is shown employing a new method of proof for non-uniformly elliptic mixed initial-boundary value problems on a specific class of Lorentzian manifolds that combines results from the theory of symmetric hyperbolic systems with near-boundary elliptic methods. The resolvent of this operator is computed via the projector onto a finite-dimensional, invariant spectral eigenspace of the angular operator and the radial Green's matrix stemming from Chandrasekhar's separation of variables. By applying Stone's formula to the spectral measure of the Hamiltonian in the spectral decomposition of the Dirac propagator, that is, by expressing the spectral measure in terms of this resolvent, one obtains an explicit integral representation of the propagator.