GR 21: Numerische Relativitätstheorie

Zeit: Freitag 14:00–15:20 Raum: ZHG 002

GR 21.1 Fr 14:00 ZHG 002

Conservation laws and evolution schemes in geodesic, hydrodynamic and magnetohydrodynamic flows — •Charalampos Markakis[1,2], Koji Uryu[3], Eric Gourgoulhon[4], and Jean-Philippe Nicolas[5] — [1]Theoretical Physics Institute, University of Jena, Germany — [2]Department of Physics, University of Wisconsin - Milwaukee, USA — [3]Department of Physics, University of the Ryukyus, Okinawa, Japan — [4]LUTh, Paris Observatory, Meudon, France — [5]Department of Mathematics, University of Western Brittany, Brest, France

Carter, Arnold and others have shown that the elements of a perfect barotropic fluid obey particle-like laws of motion that can be expressed in covariant form and derived from simple variational principles. This framework can accommodate neutral or poorly conducting charged fluids. We extend this framework to perfectly conducting fluids via the Bekenstein-Oron description of ideal MHD. This allows one to cast the ideal MHD equations into a circulation-preserving hyperbolic form. In this framework, conserved circulation integrals, such as those of Alfven, Kelvin and Bekenstein-Oron, emerge simply as special cases of the Poincare-Cartan integral invariant of Hamiltonian systems. Such scheme can be used to evolve oscillating stars or radiating binaries with magnetic fields in numerical relativity.

Synge and Lichnerowicz have further shown that barotropic fluid flow may be represented as geodesic flow in a conformally related manifold. By extending the notion of a metric to allow for Finsler geometries, we generalize this result to ideal MHD.

GR 21.2 Fr 14:20 ZHG 002

Constraint Damping for the Z4 formulation of general relativity — •Andreas Weyhausen, David Hilditch, and Sebastiano Bernuzzi — TPI Friedrich-Schiller-Universität Jena

The Z4 formulation of general relativity provides a built-in damping scheme which promises to damp away constraint violations during free evolution. In this talk I present the results of a numerical study on the damping system in Z4c, a conformal decomposition of Z4. I will discuss the effect of the damping on low-frequency and on high-amplitude perturbations of flat space-time as well as on the long-term dynamics of puncture and compact star initial data in the context of spherical symmetry.

GR 21.3 Fr 14:40 ZHG 002

Self-gravitating Bose-Einstein-Condensates — Kris Schroven[1], Betti Hartmann[2], •Claus Lämmerzahl[1], and Meike List[1] — [1]ZARM, University Bremen — [2]Jacobs-University Bremen

Self-gravitating quantum systems serve as model for a variety of issues like Boson stars, gravitationally induced decoherence, or quasi-classical Einstein equations. Here we are considering self-gravitating Bose-Einstein-Condendates which are described by the Newton–Gross–Pitaevskii equation. We solve these equations for stationary spherically symmetric configurations and discuss the dependence of the solutions and their energy from the particle number and the value of the nonlinearity parameter. Also higher energy states will be presented. We close with an outlook describing possible issues which can be discussed within this formalism.

GR 21.4 Fr 15:00 ZHG 002

Multiple Solutions of the Gross-Pitaevskii-Equation in a gravitational field — •Zelimir Marojevic and Claus Lämmerzahl — Center of Applied Space Technology and Microgravity, Bremen

A new numerical method is used to treat the problem of a Bose-Einstein-Condensate in 3D trapped by a gravitational field along the axial direction and by a harmonic trap along the radial direction. We call this setup gravito-optical surface trap. This new algorithm gives us access to excited states, which belong to monkey type saddle points of the Lagrangian. In order to find a measure for gravitational acceleration the emerging pattern for different parameter sets are studied.