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Dynamics of fast rotating neutron stars: Time evolution of linear perturbations in full general relativity

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We present a code that evolves perturbations of a rapidly rotating compact object in equilibrium in linearised full general relativity in time. We derive the perturbation equations for the spacetime in the Hilbert gauge leading to wave equations, while the hydrodynamical evolution is based on perturbations of the energy-momentum tensor. We use Kreiss-Oliger dissipation in order to achieve a stable time evolution. The code is parallelised using MPI and features favourable scaling with the number of threads. A modified version of the code employs individual grids for spacetime and perfect fluid in order to exploit the CFL criterion allowing for considerably larger time steps. The code features high accuracy at comparably low computational expense and we are able to extract the frequencies of nonaxisymmetric modes of compact objects with rotation rates up to the Kepler limit.

Primary author: KRUEGER, Christian (University of Tuebingen)

Presenter: KRUEGER, Christian (University of Tuebingen)

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