GR 12: Relativistic Astrophysics and Scalar Fields

Time: Thursday 14:00–15:20 Location: ZEU/0260

GR 12.1 Thu 14:00 ZEU/0260

Testing scalar-tensor gravity with radio pulsars — •Alexander Batrakov[1], Huanchen Hu[1], Norbert Wex[1], Paulo Freire[1], Vivek Venkatraman Krishnan[1], and Michael Kramer[1,2] — [1]Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany — [2]Jodrell Bank Centre for Astrophysics, The University of Manchester, M13 9PL, United Kingdom

The talk will highlight some of the latest results in testing the strong-field aspects of scalar-tensor gravity (STG) with radio pulsars, which include spontaneous scalarization, dipolar radiation, and the violation of the universality of free fall by strongly self-gravitating bodies. Some of these results are based on a new timing model that provides a fully consistent analysis of pulsar timing data for certain classes of STG theories.

GR 12.2 Thu 14:20 ZEU/0260

Mergers of Dark Matter Admixed Neutron Stars — •Hannes Rüter[1], Violetta Sagun[1], Wolfgang Tichy[2], and Tim Dietrich[3] — [1]CFisUC, Department of Physics, University of Coimbra, 3004-516 Coimbra, Portugal — [2]Department of Physics, Florida Atlantic University, Boca Raton, FL 33431, USA — [3]Institut für Physik und Astronomie, Universität Potsdam, Haus 28, Karl-Liebknecht-Str. 24/25, Potsdam, Germany

We investigate mergers of neutron stars consisting of two non-interacting fluids minimally coupled to the gravitational field using the numerical relativity code BAM. The first fluid represents baryonic matter, whereas the second fluid models dark matter, which we describe using the equation of state of a degenerate Fermi gas.

We consider two different scenarios for the distribution of the dark matter. In the first scenario the dark matter is confined to the core of the star, whereas in the second scenario the dark matter extends beyond the surface of the baryonic matter forming a halo around the baryonic star.

We show how the dark matter impacts the binary dynamics and merger waveforms.

GR 12.3 Thu 14:40 ZEU/0260

Boson star head-on collisions — •Florian Atteneder[1], Daniela Cors[1], Hannes Rüter[2], Roxana Rosca-Mead[1], David Hilditch[3], and Bernd Brügmann[1] — [1]Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität Jena — [2]CFisUC, Department of Physics, University of Coimbra — [3]CENTRA, Instituto Superior Tecnico, The University of Lisbon

Colliding boson stars (BS) can be regarded as one potential source for astrophysical gravitational wave signals. Templates for the detection of such signals are now being constructed, which makes accurate calculations of such more important. In contrast to fluid matter, BS solutions are smooth, which makes them, in some sense, an optimal domain for the application of pseudospectral numerical methods. Simulations so far have been limited due to the difficulty in building initial data containing two BSs. Most groups undergoing such studies either use a simple superposition of two boosted BSs or an improved version thereof. In this talk I will present first results of BS head-on collisions that start from constraint solved initial data.

GR 12.4 Thu 15:00 ZEU/0260

Image of the thin accretion disk in gravity with a minimally coupled scalar field — •Galin Gyulchev — Faculty of Physics, Sofia University, James Bourchier Boulevard, Sofia 1164, Bulgaria

We study possible observable images of a black hole and naked singularity described by rotating geometry in Einstein gravity, minimally coupled to a scalar field. We consider a Kerr-like (KL) alternative to the rotating Fisher-Janis-Newman-Winicour solution. Our study includes analytical and numerical calculations of equatorial circular orbits, shadow images, and radiation from thin accretion disks for various values of the object's angular momentum and scalar charge. The KL solution cannot be ruled out by the observations for small values of the scalar charge either. As the scalar charge increases, the optical properties change dramatically. The photon region does not hide the singularity, so it should be classified as a strong singularity. The shadow of the compact object can become multiply connected and strongly oblate. This new qualitative feature can be used to distinguish observationally black holes from naked singularities via the contemporary Very Long Baseline Interferometry experiments at short wavelengths.