GR 7: Relativistic Astrophysics II

Time: Wednesday 11:00–12:00 Location: KH 01.016

Invited Talk GR 7.1 Wed 11:00 KH 01.016

Electromagnetic jets as strong-gravity probe for rapidly spinning black holes — •Filippo Camilloni and Luciano Rezzolla — Goethe University, Frankfurt am Main, Germany

The environment around astrophysical black holes is characterised by an abundance of plasma and intense electromagnetic fields subject to strong-gravity conditions. As indicated from analytic computations and numerical simulations this rich phenomenology range from magnetic reconnection, that can trigger a Penrose process involving structures called plasmoids, to the Blandford-Znajek (BZ) mechanism, an electromagnetic form of energy extraction that is currently considered the best theoretical candidate to explain the launching of powerful relativistic jets. We discuss the quasi-universal nature of the BZ jet power and how the higher-order perturbative corrections bear signatures of the underlying theory of gravity, thus enabling one use the jet power as a strong-gravity signature to test general relativity on future horizon-scale observations when black holes are rapidly spinning.

GR 7.2 Wed 11:30 KH 01.016

Construction of a 2d neutrino sky map — •Lukas Liland for the IceCube-Collaboration — TU Dortmund

The IceCube collaboration has during the last 15 years made important discoveries concerning high-energy astrophysical neutrinos. IceCube first presented evidence of the flux of these neutrinos in 2013, and in 2023 the collaboration presented evidence of an excess neutrino flux from the Milky Way Galaxy. This talk presents a project with the aim of constructing a 2D sky map of the astrophysical neutrino flux. A relatively new sample of IceCube neutrino events are processed with a transformer neural network, a state-of-the-art machine learning algorithm used by the famous large language models, to yield improved reconstructions of the energies and the directions of the neutrinos. A neutrino sky map is then produced using the technique of unfolding, which recovers the real neutrino flux from the calculated estimations with the help of MC simulations.

GR 7.3 Wed 11:45 KH 01.016

QCD in the cores of Neutron Stars — •Oleg Komoltsev — Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main

Rapid advancements in neutron-star (NS) observations allow unprecedented empirical access to cold, ultra-dense Quantum Chromodynamics (QCD) matter. The combination of these observations with theoretical calculations reveals previously inaccessible features of the equation of state and the phase diagram of QCD. In this talk, I demonstrate how perturbative-QCD calculations at asymptotically high baryon density provide robust constraints on the equation of state at neutron-star densities, based solely on causality and stability. By comparing the calculations to multimessenger neutron-star observations using a Bayesian framework, I show that QCD input softens the equation of state at neutron-star densities, supporting the hypothesis of a first-order phase transition or a crossover to quark matter cores in the most massive neutron stars.