GR 11: BH Physics II, GW IV

Time: Thursday 14:15–15:35 Location: ZHG007

GR 11.1 Thu 14:15 ZHG007

Autoparallels around a Schwarzschild black hole with GM/r^2-torsion profile — •Jens Boos — KIT, Karlsruhe, Germany

We consider the autoparallel motion of test bodies around a Schwarzschild black hole endowed with a non-trivial torsion field scaling as GM/r^2, where M denotes the ADM mass of the black hole. By explicitly constructing a set of four orthogonal and commuting generalized Killing vectors and deriving their autoparallel conserved quantities we demonstrate the complete integrability of the equations of motion. Additionally, we study the qualitative orbital dynamics via effective potentials. Throughout, we compare the properties of the autoparallels (straightest possible paths) to that of the geodesics (shortest possible paths) and find notable discrepancies.

GR 11.2 Thu 14:35 ZHG007

Perturbations on Schwarzschild Geodesics — •Merlin Böschen and Eva Hackmann — ZARM, Universität Bremen

In binary systems with extreme or intermediate mass ratios, the motion of the secondary object is approximately geodesic. However, perturbations from the gravitational self force as well as from material in the vicinity of the central object can significantly influence the trajectory of the secondary particle. In this presentation we first discuss the framework of osculating geodesics in a Schwarzschild spacetime for different parametrisations of the worldline. Subsequently, we analyse several sources of perturbations in an astrophysical extreme mass ratio system, in particular perturbations due to an accretion disc.

GR 11.3 Thu 14:55 ZHG007

Investigation of the Impact of Wind Turbines on the Einstein Telescope — Marc Boxberg[2], •Tom Niggemann[1], Niklas Nippe[1], Achim Stahl[1], and Florian Wagner[2] for the Einstein Telescope-Collaboration — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]Geophysical Imaging and Monitoring RWTH Aachen University

Wind turbines, critical to renewable energy production, can generate seismic noise that may interfere with highly sensitive observatories, such as the planned Einstein Telescope (ET). Direct and gravitational couplings are a limiting factor for detection of gravitational waves in the low-frequency range. The importance of selecting and adapting wind turbine designs to minimize seismic noise is highlighted. This talk will discuss and evaluate the influence of various wind turbine tower constructions—namely, lattice (girder) masts, wooden towers, steel towers of different heights, and hybrid towers—on seismic noise propagation, with a particular focus on their impact on the ET.

GR 11.4 Thu 15:15 ZHG007

Forecasting Seismic Noise with Deep Learning for Gravitational Wave Detection — •Waleed Esmail[1], Alexander Kappes[1], Stuart Russell[2], and Christine Thomas[2] — [1]Institut für Kernphysik, Universität Münster, 48149 Münster, Germany — [2]Institut für Geophysik, Universität Münster, 48149 Münster, Germany

The Einstein Telescope (ET) is a third-generation gravitational wave observatory. As a ground-based detector, it is susceptible to seismic noise, particularly at low frequencies. Accurately predicting seismic waveforms can help mitigate the impact of seismic noise, thereby enhancing the detector's sensitivity. This study utilizes the power of deep learning algorithms for their ability to model complex systems, to precisely predict the 3-component seismic waveforms. Our approach focuses on training a model to use initial earthquake waves (P-waves) to predict subsequent, more destructive waves (S-waves and surface waves). The training process utilizes synthetic seismograms embedded in realistic noise, with the synthetic data generated using realistic source parameters and Green*s function databases derived from a 1D Earth model.