MP 7: Classical and Quantum Gravity

Time: Wednesday 14:00–15:20 Location: ZEU/0250

MP 7.1 Wed 14:00 ZEU/0250

Geometry of charged rotating discs of dust in Einstein-Maxwell theory — •David Rumler — Friedrich-Schiller-Universität Jena, Germany

Within the framework of Einstein-Maxwell theory geometric properties of charged rotating discs of dust, using a post-Newtonian expansion up to tenth order, are discussed. Investigating the disc's proper radius and the proper circumference allows us to address questions related to the Ehrenfest paradox. In the Newtonian limit there is an agreement with a rotating disc from special relativity. The charged rotating disc of dust also possesses material-like properties. A fundamental geometric property of the disc is its Gaussian curvature. The result obtained for the charged rotating disc of dust is checked by additionally calculating the Gaussian curvature of the analytic limiting cases (charged rotating) Maclaurin disc, electrically counterpoised dust-disc and uncharged rotating disc of dust. We find that by increasing the disc's specific charge there occurs a transition from negative to positive curvature.

MP 7.2 Wed 14:20 ZEU/0250

A geometric view on local Lorentz transformations in teleparallel gravity — •Manuel Hohmann — University of Tartu, Estonia

Local Lorentz transformations play an important role in teleparallel gravity theories, in which a tetrad is conventionally employed as a fundamental field variable describing the gravitational field. It is commonly understood that modifications of general relativity in the teleparallel framework break a certain notion of local Lorentz invariance, which is present in the pure tetrad formulation of such theories, while another notion present in the covariant formulation is preserved. We illuminate these different notions from a geometric perspective, and distinguish them from what is commonly understood as breaking of local Lorentz invariance in the context of gravity phenomenology. Based on physical arguments, we present a geometric interpretation of the dynamical fields in teleparallel gravity, which unifies and refines the conventional approaches.

MP 7.3 Wed 14:40 ZEU/0250

Investigating Quantum Field Theory on Curved Spaces through Quantum Simulation — •Christian Friedrich Schmidt — Theoretisch-Physikalisches-Institut, Jena, Deutschland

In recent years, high-energy-phenomena like Hawking radiation or cosmological particle creation have been successfully simulated in laboratories by means of so-called quantum simulators. A prominent example among these are Bose-Einstein condensates, in which low-energetic (acoustic) fluctuations of the condensate wavefunction behave like a scalar quantum field on a curved spacetime. Excitations of this field are realized as phonons, which experience an effective, gravitational field set by the condensate background. The curved geometry is essentially realized through a time- and space-dependent speed of sound. In particular, a stationary background condensate yields an FLRW metric. Hence, this analogy gives an exciting opportunity to study phenomena of quantum fields in cosmological and also more general spacetimes in a controllable, experimental setup.

MP 7.4 Wed 15:00 ZEU/0250

Wilson Line approach to gravitational scattering of spinning particles — Domenico Bonocore[1], Anna Kulesza[2], and •Johannes Pirsch[2] — [1]Theoretische Elementarteilchenphysik, TUM, München, Germany — [2]Institut für Theoretische Physik, WWU Münster, Münster, Germany

Wilson lines provide a useful tool to reveal the all-order structure of scattering amplitudes. Recently it has been shown how a generalization that takes into account subleading eikonal effects (hence known as Generalized Wilson Line or GWL) clarifies the connection between the soft expansion in the Regge limit and the Post-Minkowskian expansion in the classical limit.

In this talk I will discuss the derivation of the spin 1/2 GWL starting from a N=1 supersymmetric worldline model. The resulting path integral expression exhibits a clear separation between purely classical and quantum contributions, which can conveniently be computed using Feynman diagrams in position space. Using this result, we are able to derive Low's soft theorem for off-shell gravitons and compute classical observables for spinning compact binaries.