# GR 5: Gravitational Waves

Time: Tuesday 11:00–12:45 Location: H-HS IX

**Invited Talk** GR 5.1 Tue 11:00 H-HS IX

**Testing GR with gravitational waves: current status and future prospects** — •Collin Capano — Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Callinstraße 38, Hannover, Germany

The direct detection of gravitational waves from merging compact objects has opened up several new avenues for testing general relativity. I will discuss current results from these tests, as well as future prospects and challenges. In particular, I will touch on the possibility of testing the no-hair theorem using binary black hole mergers in the coming decade.

GR 5.2 Tue 11:45 H-HS IX

**Binary black hole dynamics from scattering** — •Jan Steinhoff — Albert Einstein Institute, Potsdam

The ongoing detections of gravitational waves by LIGO and Virgo open a new era for astro- and fundamental physics. With improvements in detector sensitivity, more accurate predictions for gravitational waves are needed, which presents a challenge for numerical relativity and approximation methods. In this talk, recent developments in the area analytic approximations for compact binaries are discussed which are based on scattering processes. This ranges from classical computations of scattering angles for binary black holes to (quantum) probability amplitudes for the gravitational scattering of particles. In the latter regime, modern techniques such as on-shell methods and the Bern-Carrasco-Johansson double copy provide powerful tools to push analytic (approximate) predictions to higher accuracy.

GR 5.3 Tue 12:00 H-HS IX

**Is there a mass-ratio gap between numerical relativity and gravitational self-force?** — •Harald Pfeiffer and Maarten van de Meent — Max Planck Institut für Gravitationsphysik, Am Mühlenberg 1, 14476 Potsdam

Future gravitational wave observatories —both in space and on the ground — will be sensitive to compact binary coalescences with mass-ratios between 1:10 and 1:1000. Numerical relativity simulations work very well for comparable mass binaries, but become increasingly challenging as the mass-ratio decreases, and are unlikely to cover this entire range. Gravitational self-force methods employ a systematic expansion in the mass-ratio to produce waveform models. Their natural regime of validity is therefore small mass-ratio binaries. We examine how accurate we can expect gravitational self-force models to be in the comparable mass regime. Is 1/4 a small number?

GR 5.4 Tue 12:15 H-HS IX

**Combining Greedy Approaches and Gaussian Process Regression in Gravitational-Waveform Modelling** — •Florian Wicke — Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Hannover, Germany — Leibniz Universität Hannover, Hannover, Germany

One of the goals of gravitational wave analysis is to estimate the source parameters of compact binary coalescence signals. This is done by comparing the measured signal to gravitational wave templates generated by a model. The most accurate templates are provided by numerical simulations. However, these are computationally expensive to produce. Varma et al. [Phys. Rev. D99, 2019] use a machine learning method called Gaussian Process Regression (GPR) to build a significantly less expensive surrogate model. GPR is an interpolation method that uses a limited number of numerically generated waveforms as a training set and predicts waveform templates for the surrounding parameter space. The training set is selected in a greedy manner using computationally inexpensive post-Newtonian waveforms. Here we evaluate whether the selection of the training set can be achieved solely by the GPR. To accomplish this, we use that GPR returns an uncertainty at each position in parameter space in addition to a predicted waveform. This uncertainty is then used as an error measure to select the next best training point position. We find that we achieve similar, if not better, convergence behaviour, but at the expense of worse computational efficiency.

GR 5.5 Tue 12:30 H-HS IX

**Multi-Messenger Gravitational Wave Signals: Expectations and Results** — •Alexander Unzicker — Pestalozzi-Gymnasium München

An overview of the LIGO/VIRGO and possibly KAGRA results on gravitational waves is given, based on the template-free statistical method proposed by Liu et.al. (arXiv:1802.00340, CJAP). Special attention is given to the recent concerns about high-false-alarm rates among trigger events. In particular, the multi-messenger results are discussed and compared with earlier predictions.