GR 16: Gravitational Waves I

Time: Thursday 14:45–15:25 Location: HBR 14: HS 2

GR 16.1 Thu 14:45 HBR 14: HS 2

Intersatellite Ranging and Clock Synchronization for the Laser Interferometer Space Antenna — •Jan Niklas Reinhardt — Max-Planck-Institut für Gravitationsphysik, Callinstraße 38, 30167 Hannover

Ground-based gravitational wave detectors are blind below 10 Hz due to gravity gradient noise, etc. The Laser Interferometer Space Antenna (LISA) avoids these difficulties by going to space. Hence, it extends gravitational wave astronomy to the sub-hertz frequency band. LISA consists of 3 satellites in a triangular constellation trailing Earth by 20 degrees on its orbit around the sun. Gravitational waves cause pico meter variations in the 2.5 million km arm lengths. To detect them the satellites are connected by six infrared laser links, and heterodyne interferometry is performed between received and local lasers, respectively. The LISA measurements are swamped by laser frequency noise. An on-ground data processing technique called time-delay interferometry (TDI) is applied, which combines the beatnotes from the different satellites with the correct delays to virtually form equal-optical-path-length interferometers, in which laser frequency noise naturally cancels. To obtain the required delays, we combine the four LISA ranging observables in a ranging sensor fusion: PRN ranging, ranging information from the clock sideband beatnotes, TDI ranging, ground-based observations. Each satellite has its own on-board timer. We combine the intersatellite ranges with ground observations to estimate their desynchronisations from the barycentric coordinate time (TCB). Hence, we synchronize the on-board timers to TCB.

GR 16.2 Thu 15:05 HBR 14: HS 2

Systematic Differences in the Source Properties of Gravitational Wave Signals — •Max Melching — Max-Planck-Institut für Gravitationsphysik (Albert Einstein Institut), Callinstraße 38, 30167 Hannover, Deutschland

Measurements of gravitational wave source properties are conducted in the framework of parameter estimation, utilizing Bayes' theorem to compute posterior probability distributions for all parameters. In this process, one predicts gravitational wave signals for certain parameter combinations and compares them to detector data in order to infer whether the modeled signal is contained in the data. However, the waveform models are not entirely faithful representations of numerical relativity because of the high computational cost involved in generating accurate simulations. Instead, several approximate models are used, which may lead to systematic differences in the inferred results. Consequently, being able to describe and understand model-induced uncertainties is crucial.

To date, however, no universal way of doing that exists. In this talk, I will explore a data-driven approach to identify significant systematic differences between models and apply this method to confident detections of the third gravitational-wave transient catalog GWTC-3 that has been published by the LIGO-Virgo-KAGRA collaborations. Additionally, I will talk about geometric ideas from the Fisher-matrix formalism that allow for interpreting signal differences as measurement uncertainties in the associated parameter space.