GR 14: Gravitational Wave Detectors

Time: Thursday 16:15–18:15 Location: GR-H2

GR 14.1 Thu 16:15 GR-H2

Options for ultra-high-frequency gravitational wave detection at DESY — Axel Lindner, Krisztian Peters, •Christoph Reinhardt, Andreas Ringwald, and Aaron Spector — DESY, Hamburg, Germany

Fueled by recent achievements of km-scale gravitational-wave observatories, efforts towards the development of "down to lab-scale" detectors are currently gaining momentum. By virtue of their smaller dimensions, these detectors target gravitational-waves above the established observation window (i.e., 10 to 10^4 Hz) at "ultra-high-frequencies" (i.e., 10^4 to 10^{19} Hz). The sources proposed for generating potentially observable signals in this frequency range are of cosmological origin or require new physics beyond the Standard Model.

Current work at DESY towards three on-site experiments for axion searches (ALPS II, BabyIAXO, and MADMAX) provides the unique opportunity to exploit synergies with regard to the development of ultra-high-frequency gravitational wave detectors: On the one hand, these axion experiments are also sensitive to gravitational waves via "graviton-to-photon conversion" in the presence of a magnetic field. On the other hand, the underlying infrastructure of the axion experiments, comprising, e.g., a distribution system for liquid helium, can be a prerequisite for implementing dedicated detectors. This talk will present options for ultra-high-frequency gravitational wave searches at DESY, Hamburg.

GR 14.2 Thu 16:35 GR-H2

The implementation of stray light simulation tool for the Einstein Telescope — •Hanna Marozava and Thomas Bretz — RWTH Aachen University

The Einstein Telescope will be the first gravitational wave detector of the third generation. Stray light is a severe problem for modern interferometers with high sensitivity, as another noise source contributing to the interferometer output. Simulation is requied to optimize detector settings to avoid undesirable light paths. Stray light simulation can be done with special optical analysis software, but existing tools are not ideally suited for general application, or require expensive licences. Therefore ET optical simulation task is still urgent.

The goal of this work is development of dedicated free tool for stray light simulation, easy to use and including higher precision and different aspects of stray light. Simulation involves modelling the system design, calculating the intersection points of the rays with the surfaces and simulating of stray light paths, and algorithms for some of this steps are already found.

This talk will present the progress of stray light simulation tool development, including the analysing of existing optical software, implementation of simulation and first results.

GR 14.3 Thu 16:55 GR-H2

Development and testing of composite vacuum tubes for Einstein Telescope — •Purnalingam Revathi[1], Ralf Schleichert[2], Achim Stahl[1], Tim Kuhlbusch[1], Robert Joppe[1], and Oliver Pooth[1] — [1]III. Physikalisches Institut B, RWTH Aachen — [2]Institut für Kernphysik, Forschungszentrum Jülich

The Einstein Telescope, a proposed third generation gravitational wave detector, requires 120 km long vacuum tubes in total with a diameter of 1 m. Due to the vacuum requirements and mechanical integrity, stainless steel tubes are the standard for ultra high vacuum applications. Composite vacuum tubes are a promising alternative that could reduce material cost and opens possibilities for easier on site production.This talk presents the details of development and testing of prototypes made of Glass Fiber Reinforced Plastic wound around a stainless steel liner. Pressure stability and aging tests are performed and the possibility of integrating sensors to measure temperature and pressure will be discussed.

GR 14.4 Thu 17:15 GR-H2

Test setup for cryogenic sensors and actuators working towards the Einstein Telescope — •Robert Joppe[1], Tim Kuhlbusch[2], Thomas Hebbeker[1], Vivek Pimpalshende[2], Oliver Pooth[2], Achim Stahl[2], and Franz-Peter Zantis[1] — [1]III. Physikalisches Institut A, RWTH Aachen — [2]III. Physikalisches Institut B, RWTH Aachen

The Einstein Telescope will be the first gravitational wave detector of the third generation. The sensitivity goal, especially in the low frequency region, will be achieved among other improvements by cooling the main parts of the interferometer. The required electronic components, sensors and actuators needed for mirror alignment and active dampening of suspension resonances have to perform at cryogenic temperatures.

The talk presents the progress on the development of electronics and mechanics within the E-TEST project. The performance of our cryogenic ultra high vacuum test setup will be furthermore explicated.

GR 14.5 Thu 17:35 GR-H2

A cryogenic displacement sensor and actuator for the E-TEST project — •Kuhlbusch Tim[1], Thomas Hebbeker[2], Robert Joppe[2], Vivek Pimpalshende[1], Oliver Pooth[1], Achim Stahl[1], and Franz-Peter Zantis[2] — [1]III. Physikalisches Institut B, RWTH Aachen — [2]III. Physikalisches Institut A, RWTH Aachen

The Einstein Telescope will be the first third generation gravitational wave detector. In achieving a sensitivity increase of more than one order of magnitude at low frequencies compared to current detectors, mitigating thermal noises is essential. Cooling the mirrors to cryogenic temperatures is thus required. This also creates the need for parts of the vibration isolations systems of the mirrors to be working at low temperatures.

This talk will present the developement of an actuator with an integrated absolute displacement sensor operating below 20 K as part of the E-TEST project. The sensitivity of the sensor, the forces of the actuator and the thermal design will be discussed.

GR 14.6 Thu 17:55 GR-H2

Commissioning and characterization of a shadow sensor — •Vivek Pimpalshende[1], Thomas Hebbeker[2], Robert Joppe[1,2], Tim Kuhlbusch[1], Oliver Pooth[1], Achim Stahl[1], and Franz-Peter Zantis[2] — [1]III. Physikalisches Institut B, RWTH Aachen — [2]III. Physikalisches Institut A, RWTH Aachen

The Einstein Telescope will be the first gravitational wave detector of the third generation. It will extend the detection sensitivity in the low frequency domain by more than an order of magnitude compared to current second generation detectors. An essential factor in achieving the sensitivity goals is to mechanically decouple the optic system from the ground. For this, a seismic isolation system is in place in the interferometric gravitational wave detectors. This talk will discuss one of the essential position sensors in this system: a shadow sensor.

Displacement sensors are a part of a control loop that monitors the relative motion of the components of the suspension system and controls the absolute motion of these components. This talk will present the commissioning of a shadow sensor along with its characteristics at room temperature.