GR 6: Gravitational waves

Time: Monday 16:30–17:30 Location: SPA SR220

GR 6.1 Mon 16:30 SPA SR220

LISA Pathfinder: A mission status — •Martin Hewitson — Albert Einstein Institute, Callinstr 38, Hannover, 30167

LISA Pathfinder (LPF) is a precursor and technology validation mission for LISA-like gravitational wave observatories in space. Some of the key technology needed for this kind of observatory, such as micro-Newton propulsion, space-based optical metrology, drag-free control, and inertial sensing, will be directly tested on LPF. With a scheduled launch date of July 2015, the mission is at an advanced stage of integration and testing. This talk will give an overview of the overall mission, giving the status of the various key components, a discussion on the key noise sources, and a brief introduction to the experiments that will be carried out during mission operations.

GR 6.2 Mon 16:50 SPA SR220

Birefringence Measurements of Laser Mirrors from Crystaline Silicon — •Christoph Krüger, Roman Schnabel, and Harald Lück — Albert-Einstein-Institut, Institut für Gravitationsphysik Leibniz Universität Hannover

Laser interferometric gravitational wave detectors (GWD) are using high light powers in order to achieve a high sensitivity of measurement. Future detectors of the so called 3rd generation - like the Einstein Telescope (ET) - will furthermore make use of optics cooled to cryogenic temperatures to improve the sensitivity. The current fused silica optics used at room temperature are not suited for operation at cryogenic temperatures, hence alternative optical materials have to be investigated. The baseline design of the Einstein Telescope foresees silicon as test-mass material.

The optical birefringence of a test-mass, however, may limit the GWD or cause additional optic losses. Transmitting light through a medium with birefringence can cause conversion of light from one polarization state into the other one and act as an undesired optical loss channel.

We developed a measurement technique with a sensitivity for birefringence $n_1 - n_2 = \Delta n$ as low as 10^{-8}. The talk presents the measurements of silicon birefringence obtained from different mono-crystalline silicon samples and its dependence on experimental parameters such as mechanical load, orientation and suspension of the crystals.

GR 6.3 Mon 17:10 SPA SR220

Gravitational wave constraints on the shape of neutron stars — •Nathan K. Johnson-McDaniel — Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität Jena

The gravitational wave observatories LIGO and Virgo have placed interesting upper bounds (below the limits from electromagnetic observations of the spin-down) on the gravitational radiation emitted by certain known pulsars, notably the Crab and Vela pulsars. We show how to convert these upper bounds into upper bounds on the $l = m = 2$ deformation of the star's surface, in full general relativity, to first order in the deformation. This relation only depends on the star's mass and radius, with reasonable assumptions about the matter at its surface. We then apply this relation to stars that have direct LIGO/Virgo bounds below the spin-down limit and compare with the expected surface deformation due to rotation. In particular, we find that the latest LIGO/Virgo observations have constrained the $l = m = 2$ deformation to be smaller than the rotational deformation for the Crab pulsar for all equations of state considered and for the Vela pulsar for the equations state with larger radii. These statements could not have been made using only the bounds on the $l = m = 2$ deformation from electromagnetic observations of the spin-down.