Q 52: Precision Measurement and Metrology 3

Time: Thursday 14:30–16:00 Location: HÜL 386

Q 52.1 Thu 14:30 HÜL 386

Fluorescent Nanodiamonds for Fluorescence Resonance Energy Transfer Imaging and Magnetometry — •Julia Tisler[1], Gopalakrishnan Balasubramanian[1], Jean-Paul Boudou[2], Patrick Curmi[2], Rolf Reuter[1], Boris Naydenov[1], Anke Lämmle[1], Fedor Jelezko[1], and Jörg Wrachtrup[1] — [1]3.Physikalisches Institut, Universität, Germany — [2]Université d'Evry, France

Matchless photostability, magnetic resonance at room temperature combined with chemical inertness and excellent biocompatibility, put nanodiamonds with color centers in the focus of interest for new high resolution microscopy methods. An example for such color center is the NV-center. Through progress in irradiation and milling we achieved fluorescent nanodiamonds with sizes below 4 nm [1]. Recent research showed that even very small nanodiamonds with NV-center retain their optical and spin properties [2]. Based on these new findings novel high resolution imaging could be performed by field gradient magnetometry and FRET. With the new particles it is now within reach for magnetometry to get below the already achieved magnetic field limit of 5 mT [3]. Also first successful experiments of FRET between fluorescent nanodiamonds (FRET donator) and quencher molecules of fluorescent dyes (FRET acceptor) have been done.

[1] Boudou J.P. (2009) Nanotechnology [2] Tisler J. (2009) ACS Nano [3] Balasubramanian G. (2008) Nature

Q 52.2 Thu 14:45 HÜL 386

Readout of satellite-satellite interferometer with 200km arms and nm precision — •Oliver Gerberding, Benjamin Sheard, Ioury Bykov, Joachim Kullmann, Gerhard Heinzel, and Karsten Danzmann — Max-Planck Institut for Gravitational Physics (Albert-Einstein Insitut) Hannover and QUEST, Leibniz University Hannover

In current geodesy mission like GRACE, Earth's gravity field is determined by measuring the precise variations in distance between two satellites in low Earth orbit. To improve this distance measurement, laser interferometry is the most promising candidate. A heterodyne interferometer between the satellites allows to measure their relative pointing and their distance variations with nm precision. The core of such an interferometer is the electronic phase readout system, called phasemeter. It tracks the phase with the required precision, while the heterodyne frequency is changing due to Doppler shifts introduced by relative satellite movements. The design of such a phasemeter is a very challenging task, since it needs to be able to handle technical noise, laser frequency noise and shot noise from receiving only a small amount of light.

Here we present our prototype design for such a phasemeter, able to measure heterodyne frequencies between 1 and 40MHz, and we show results from performance simulations and experiments.

Q 52.3 Thu 15:00 HÜL 386

Enhancing the angular tolerance of resonant waveguide gratings — •Stefanie Kroker, Frank Brückner, Ernst-Bernhard Kley, and Andreas Tünnermann — Friedrich-Schiller-Universität, Institut für Angewandte Physik, Max-Wien-Platz 1, 07743 Jena

We present a novel concept to increase the angular tolerance of resonant waveguide gratings by stacking two resonant structures on top of each other. It is demonstrated that reflectivites close to unitiy can be reached over the entire angular spectrum by this double T-shaped grating configuration. The principles of our new approach can be used for gratings made of two different materials but also to realize monolithic silicon structures with similar properties. We illustrate that the functionality of the device can be understood by a decomposition into separated elements. Our concept might have applications as new diffractive-reflective optical components with low coating thermal noise in the field of high precision metrology.

Q 52.4 Thu 15:15 HÜL 386

Michelson-interferometer with 3-port-grating-coupled arm-resonators — •Maximilian Wimmer, Michael Britzger, Daniel Friedrich, Björn Hemb, Karsten Danzmann, and Roman Schnabel — Albert-Einstein-Institut Hannover, Max- Planck-Institut für Gravitationsphysik und Centre for Quantum Engineering and Space-Time Research (QUEST), Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover, Germany

In high precision interferometers such as gravitational wave detectors the maximization of circulating light power is one way to increase the signal to noise ratio. Stronger light fields will also increase thermooptic effects in the transmissive beamsplitters and cavity-couplers that are used in these interferometers. The direct approach to avoid these effects is the change to all-reflective optics. We present the realization of an Interferometer with diffractively coupled arm-resonators using so-called 3-port diffraction gratings and the first results of the signal response measurements.

Q 52.5 Thu 15:30 HÜL 386

The AEI 10m Prototype Interferometer — •Tobias Westphal for the 10m prototype team — A. Einstein Inst., QUEST, Leibnitz Univ. Hannover

A 10m Prototype Interferometer is currently being set up at the AEI in Hannover, Germany. Among the main objectives are the demonstration of novel techniques for future generations of GW detectors, as well as building an instrument operating at and beyond the standard quantum limit of interferometry for 100g test masses.

For the pre-isolation of the experimental setup three seismically isolated optical tables inside a large (ca. $100m^3$) ultra-high vacuum envelope are set up. The differential motion of these tables will be stabilised via a set of Mach-Zehnder interferometers. All relevant optical components will be mounted on top of these isolated tables by means of multiple-cascaded pendulum suspensions. A suspended triangular ring cavity with a finesse of ca. 7300 will, in conjunction with a molecular iodine reference, serve as a frequency reference for the stabilisation of the 35W Nd:YAG laser. The main instrument is a 10m Michelson interferometer with Fabry-Perot cavities in the arms. The end mirrors will be made of Khalili-style Fabry-Perot cavities to minimise the effective coating thermal noise. The design of the interferometer is done such that the sum of all classical noises lies well below the sum of quantum noise in a frequency band around 100Hz. The layout, status, and progress of the AEI 10m prototype will be given in this talk.

Q 52.6 Thu 15:45 HÜL 386

LISA Pathfinder: Flight Model testing of the Optical Metrology System — •Heather Audley, Antonio Garcia Marin, Jens Reiche, Miquel Nofrarias, Anneke Monsky, Ingo Diepholz, Martin Hewitson, Frank Steier, Gerhard Heinzel, and Karsten Danzmann — AEI/Leibniz Universitaet Hannover, Deutschland

The Laser Interferometer Space Antenna (LISA) is a joint ESA-NASA mission for the first space-borne gravitational wave detector. LISA aims to detect sources in the 0.1 mHz to 1 Hz range. Core technologies required for the LISA mission that cannot be tested on-ground will be tested with a precursor satellite, LISA Pathfinder. The past year has seen great progress towards the expected 2013 launch of LISA Pathfinder. This contribution presents an overview of the results of the successful Flight Model test campaigns. These results and associated test procedures will be utilised directly in planning the in-flight operations and the mission Experimental Master Plan. Additionally, they allow valuable testing of data analysis methods using the custom developed MATLAB based LTP data analysis (LTPDA) toolbox.