Group IGR

Project name Realisation of a Sagnac Speedmeter to beat the Heisenberg Uncertainity Principle

Supervisor Stefan Hild

Backup Supervisor Sabina Huttner

Suitability 20 credit no 30 credit yes 40 credit yes

Suitable for "theoretical physics" no

Project description (length should not exceed remainder of page)

Gravitational wave detectors can measure the distance between 2 test masses to a precision of about a 1/1000 of a proton diameter. The next generation of these detectors, such as Advanced LIGO, will be limited entierly by quantum noise which is a maifestation of the Heisenberg Uncertainty Principle. A novel interferometer configuration, a so-called 'Sagnac speedmeter' has the potential to increase the sensitivity of gravitational wave detectors even beyond the Heisenberg limit. The world's first Sagnac speedmeter is currently under construction in the IGR cleanroom labs.

This project will deal with setting up a Sagnac speedmeter inteferometer as a table top experiment. The project will include the following activities: Setting up and characterising (beam shape, polarisation, beam profile, etc) a new laser source, assembly of a zero-area Sagnac interferometer and building and implementation of the readout. Once the Sagnac speedmeter setup is completely installed the student will use this setup to explore interesting effects and the undelying physics of this novel interferometer configuration, such as coupling of the Earth rotation signal via beam position fluctuations or potential readout options (homodyne and RF heterodyne techniques). The ulitmate step will include the measurement of the achievable sensitivity and the identification of the limits of the experiment.

This project offers the student to acquire a wide range of experimental skills, including laser interferometry, high-power lasers, optical resonantors, opto-mechanics, electro-optics and electronics. The student needs to bring lots of enthusiasm for experimental work and a curiosity for laser-optics.