GR 8: Experimentelle Tests 1

Zeit: Mittwoch 8:30–10:30 Raum: SFG 0140

Hauptvortrag GR 8.1 Mi 8:30 SFG 0140

Radio pulsars – unique gravity laboratories in space — •Norbert Wex — Max-Planck-Institut für Radioastronomie, Bonn, Germany

The discovery of the Hulse-Taylor binary pulsar in 1974 has opened up a completely new field of experimental gravity. In two aspects, pulsars have taken precision gravity tests qualitatively beyond the weak-field slow-motion regime of the Solar system: They provided the first experimental evidence for the existence of gravitational waves, and they allowed for the first time to test the gravitational interaction of strongly self-gravitating bodies. To date, we know several radio pulsars that can be utilized for precise measurements of different gravitational phenomena in a strong-field context. In particular, the so-called 'Double Pulsar' has more than lived up to our early expectations. In many aspects, pulsar experiments are also complementary to present and upcoming gravity experiments with terrestrial gravitational-wave observatories.

The talk gives an introduction to gravity tests with radio pulsars, highlights some of the most important results, and gives a brief outlook into the future of this exciting field of experimental gravity.

Hauptvortrag GR 8.2 Mi 9:10 SFG 0140

MICROSCOPE: The first space-based test of the Weak Equivalence Principle in orbit — •Stefanie Bremer[1], Meike List[1], Benny Rievers[1], Hanns Selig[1], and Manuel Rodrigues[2] — [1]ZARM, University of Bremen, Bremen, Germany — [2]ONERA, The French Aerospace Lab, Palaiseau, France

After more than 15 years of planning, developing, building, and testing, MICROSCOPE has finally been launched in April 2016. After the commissioning phase, scientific measurements started in December and are planned to be continued at least for 18 month. The goal of this satellite mission is ambitious: The Weak Equivalence Principle is being tested with a precision never achieved before yielding the determination of the Eötvös parameter η with an accuracy of 10^{-15}.

Developed, built and now operated by the French space agency CNES, MICROSCOPE is the first satellite in a low Earth orbit using a drag-free attitude control system. This technology forms the foundation for the scientific payload T-SAGE, developed and built by ONERA. The payload comprises two differential accelerometers, each containing two test masses. Due to the drag-free system non-gravitational disturbances are cancelled out thus allowing the test masses to follow a pure gravitational orbit. The accurate analysis of the test mass motion will finally result in a quantity of η.

First scientific results are expected in June 2017. This talk will summarize MICROSCOPE's road to space and highlight some features of the challenging data analysis procedure.

GR 8.3 Mi 9:50 SFG 0140

Testing the gravitational redshift with Galileo satellites 5 and 6 — •Sven Herrmann, Felix Finke, Daniela Knickmann, Claus Lämmerzahl, Meike List, and Benny Rievers — ZARM, Center of Applied Space Technology and Microgravity, University Bremen

The satellites Galileo 5 and 6 of the European GNSS launched in August 2014 have not reached their targeted circular orbit at around 22.000 km height. Instead, their orbits possess an eccentricity of about 0.16 and the satellites undergo a change in height of about 8000 km each orbit. While this is of some disadvantage for navigation purposes it offers a unique possibility to perform a precise test of the gravitational redshift predicted by General Relativity. Thus, with support from DLR (RELAGAL) and ESA (GREAT), we have started an activity to analyze the clock and orbit data from these two Galileo satellites, to investigate whether an improved test over the result from Vessot and Levines GPA experiment can be obtained. Here we report on the current status of our data analysis and give an outlook on the achievable accuracy of this test.

GR 8.4 Mi 10:10 SFG 0140

Atom-chip gravimetry with Bose-Einstein condensates — •Martina Gebbe[1], Sven Abend[2], Matthias Gersemann[2], Hauke Müntinga[1], Holger Ahlers[2], Wolfgang Ertmer[2], Ernst M. Rasel[2], Claus Lämmerzahl[1], and The QUANTUS Team[1,2,3,4,5,6] — [1]ZARM, Uni Bremen — [2]Institut für Quantenoptik, LU Hannover — [3]Institut für Physik, HU Berlin — [4]Institut für Quantenoptik, Uni Ulm — [5]Institut für angewandte Physik, TU Darmstadt — [6]Institut für Physik, JGU Mainz

Due to their small spatial and momentum width ultracold Bose-Einstein condensates (BEC) or even delta-kick collimated (DKC) atomic ensembles are very well suited for high precision atom interferometry. We generate such an ensemble in a miniaturized atom-chip setup where BEC generation and delta-kick collimation can be performed in a fast and reliable way. Using the chip as retroreflector we have realized a compact gravimeter and determined local gravitational acceleration g with an accuracy of $10^{-5}\,g$ limited by seismic noise. We demonstrate that the device's sensitivity can be enhanced with the help of an optical lattice to relaunch the atoms. Our atom-chip gravimeter opens up the way for compact and robust portable sensors that are interesting for various applications. This work is supported by the German Space Agency (DLR) with funds provided by the Federal Ministry for Economic Affairs and Energy (BMWi) due to an enactment of the German Bundestag under grant numbers DLR 50WM1552-1557 (QUANTUS-IV-Fallturm).