Technische Universität Wien
Atominstitut der Österreichischen Universitäten
Vienna University of Technology
Atomic Institute of the Austrian Universities
ATOMINSTITUT *www.ati.ac.at* Stadionallee 2, 1020 Wien, Austria
TU WIEN

Diploma thesis

Installation of a micron-accurate calibrating system for the qBounce neutron mirror setup

- Tests for deviations from Newton's Inverse Square Law at submillimitre distances and the question of extra dimensions of space time -

qBounce is a project of the Neutron & Quantum Physics Group at the Atomic Institute of the Austrian Universities. The aim is to realize gravitation experiments with ultracold neutrons. The experiments are planned here at the Atomic Institute and carried out at the European Neutron Source at the Institute Laue-Langevin in Grenoble/ France.

Motivation

The experiments are highly sensitive to Non-Newtonian gravity at a length scale below ten microns, where our previous experiments already place limits.
By realizing a quantum bouncing ball and resolving the time evolution of the system, we expect to constrain the existing limits further, because Newtonian gravity and hypothetical fifth forces evolve with different phase information.
As such hypothetical fifth forces can be mediated from gauge bosons propagating in a higher dimensional space, the experiments can test speculations on large, submillimeter sized extra dimensions of space-time or the origin of the cosmological constant in the universe, where effects are predicted in the interesting range of this experiment and might give a signal in our setup.

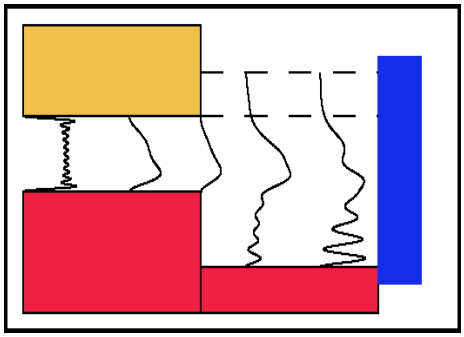

Fig.1: Quantum states in the earth's gravitational potential

Future planning

The goal of the measurements will be the determination of the time evolution of a quantum bouncing ball with high precision and accuracy for a search for Non-Newtonian gravity.
For these measurements, we would like to improve our setup by installing an easy-to-handle system which allows a calibration of neutron mirrors on the submicrometre range.
Realizing distance measurements in the order of a few ten microns with an accuracy of around 1 micron is crucial for our experiment. The diploma thesis contains the planning and installation of such a system.

Contact

Prof. Dr. Hartmut Abele, +43 158801 14147, abele@ati.ac.at