GR 21: Experimental Gravitation III

Time: Thursday 14:45–15:45 Location: SPA SR220

GR 21.1 Thu 14:45 SPA SR220

Gravity resonance spectroscopy constrains dark energy and dark matter scenarios — •Tobias Jenke[1], Gunther Cronenberg[1], Hanno Filter[1], Peter Geltenbort[2], Andrei N. Ivanov[1], Thorsten Lauer[3], Tobias Lins[1], Heiko Saul[1], Ulrich Schmidt[4], and Hartmut Abele[1] — [1]Atominstitut, TU Wien, Wien, Austria — [2]Institut Laue-Langevin, Grenoble, France — [3]FRM II, TU München, Garching — [4]Physikalisches Institut, Universität Heidelberg, Heidelberg

Modern astronomical observations clearly point to the existence of dark energy and dark matter. Their true nature and content remain a mystery however. The two most obvious candidates for dark energy are either Einstein's cosmological constant or quintessence theories. In particular the idea that chameleon scenarios, a realization of quintessence with a coupling to matter, may exist, is attracting high interest of a growing community.

Here, we present results from the qBounce measurements using ultracold neutrons. Our observation technique is based on Rabi-spectroscopy of bound quantum states in the gravity potential of the earth, devoid of electromagnetic perturbations. As yet undiscovered particles of dark matter or dark energy would introduce a measurable energy shift, the result delivers severe restrictions on any gravity-like interaction. The present accuracy indicates that gravity is understood at the level of $\Delta E = 10^{-14}$ eV. Hence, we can present experimental limits for dark-energy chameleons fields and the pseudo-scalar interaction of an axion, a prominent dark matter particle.

GR 21.2 Thu 15:05 SPA SR220

Preparing a Measurement of the Charge of the free Neutron within qBounce — Gunther Cronenberg[1], •Hanno Filter[1], Peter Geltenbort[2], Martin Thalhammer[1], Tobias Jenke[1], and Hartmut Abele[1] — [1]Atominstitut, Technische Universität Wien, Stadionallee 2, 1020 Wien, Austria — [2]Institut Laue-Langevin, 6 rue Jules Horowitz, 38042 Grenoble Cedex 9, France

With a new Gravity Resonance Spectroscopy technique we plan to probe the electric neutrality of the neutron. This is possible by expanding our existing qBounce setup. Through adding two regions to our current three regions setup, we would basically implement Ramsey*s Method of separated oscillating fields with a beam of ultracold neutrons [1]. The approach has the potential to improve the 25 years old existing limit on the electric neutrality of the neutron [2] [3]. Our project is related to the question of the quantisation of the electric charge, which is a well established experimental observation. Charge quantisation in the Standard Model of Particle Physics can be introduced by many fundamentally different extensions. Hence a measurement of the charge is a promising way to refine the theoretical framework with far reaching consequences for various topics i.e. neutron-antineutron oscillations, magnetic monopoles, or the search for a Grand Unified Theory [2].

GR 21.3 Thu 15:25 SPA SR220

qBounce: Frequency's view on Newton's Law — •Gunther Cronenberg[1], Thomas Bittner[1], Hanno Filter[1], Peter Geltenbort[2], Tobias Jenke[1], Martin Thalhammer[1], and Hartmut Abele[1] — [1]Atominstitut, Technische Universität Wien, Stadionallee 2, 1020 Wien, Austria — [2]Institut Laue-Langevin, BP 156, 6 rue Jules Horowitz, 38042 Grenoble Cedex 9, France

In the frame of the qBounce experiment, resonant transitions between several of the lowest quantum states of gravitationally bound neutrons are observed for the first time. The coupling between the states is provided by well-defined mechanical oscillations of the confining neutron mirrors boundary conditions. The Rabi- like setup in the latest generation is improved by renouncing the upper confining mirror. The presented spectroscopy method enables a frequency's view on Newton's Inverse Square Law of Gravity, which has been put under scrutiny by theoretical extensions of the Standard Model. The method allows testing the weak equivalence principle (WEP) for a quantum system in the sub-millimetre regime of space-time. The weak equivalence principle is a corner stone of our understanding of gravitation, which is being challenged by emerging theories.