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Free Fall Experiment with UCN

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We performed a gravity quantum experiment for the test of weak equivalence principle for free neutron. The gain in kinetic energy of free falling neutrons was is compensated by a quantum of energy \hbar \Omega, due to the phase modulation of the neutron wave. As phase modulator a grating was used moving perpendicular with respect to the direction of the neutron wave propagation. The neutron interference filters, neutron analogs of the Fabry-Perot interferometers were used both as for the primary monochromatization and for the neutron energy analyzing after the falling. By the comparison of the quantities mgh and \hbar \Omega the weak equivalence principle was tested with accuracy 0.2%.
At nearest future we plan to perform the next experiment with a modified procedure using a new spectrometer, which is under construction now. As before, neutron interference filters will be used as a spectrometric device and the controlled variation of the neutron energy will be realized by diffraction by a moving grating. But the energy of the neutron will be measured by a peculiar time-of-flight method. For this purpose the neutron flux will be modulated by a chopper and the detector will measure the corresponding oscillation of the count rate. The count rate oscillation phase \Phi=2*Pi*F*t, where F is the frequency of the chopper, is proportional to the time of flight t. Due to the high neutron monochromatization relatively large modulation frequencies can be used.
An analysis shows that using the same UCN source it is possible to increase the accuracy of the experiment approximately by one order of magnitude. First test of new spectrometer is scheduled for the end of 2010.

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