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PENELOPE, ON THE WAY TOWARDS A NEW PRECISE NEUTRON LIFETIME MEASUREMENT

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A precise knowledge of neutron lifetime opens the way to determine the coupling constants of weak interaction precisely and hence the element Vud of the Cabibbo-Kobayashi-Maskawa matrix. Hence, measurements of the lifetime provide direct tests of the standard model of particle physics. Moreover, the neutron lifetime is important for astrophysical models, especially Big Bang nucleosynthesis. The most successful measurements have been made storing ultra-cold neutrons (UCN) that have energies of only a few hundred neV. However, a recent result from a UCN trapping experiment [1] disagrees with the PDG average of 885.7±0.8 s by roughly 6 standard deviations.

To resolve this discrepancy, we are developing an experiment with a superconducting magnetic trap for UCN at Technische Universität München, Physik Department E18. These UCN will be trapped in a multipole field of a flux density up to 2 T and will be bound by the gravitational potential to the top. This makes the extraction and detection of the decay protons (and electrons) possible and allows a direct measurement of the neutron decay rate.
Our envisaged precision of < 0.1 s demands almost lossless storage and good knowledge of systematic errors; these could result from e.g. neutron spin flip or high energetic UCN that leave the storage volume only slowly. Therefore, the neutron spectrum is cleaned by an absorber.
The big storage volume of 750 liters and the expected high neutron flux of the UCN source at the FRMII give more than 10e7 neutrons per filling of the trap. This shall allow us to concentrate on systematic effects, as the necessary statistics is reached within days; a crucial point for this kind of experiments.
The talk will motivate the measurement, desribe it in detail, present simulations and discuss systematic effects and investigations.
[1] A. Serebrov et al. Phys. Lett. B, 605:72–78, 2005.

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