

HOPE –a magnetic UCN trap to measure the neutron lifetime

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The lifetime of the free neutron is a key quantity for primordial nucleosynthesis, calculation of experimentally inaccessible weak cross sections and for tests of the standard model of particle physics. During past decades, continuous efforts have been made to measure its value with increasing precision, predominantly using cold neutron beams or by trapping ultra cold neutrons (UCN) in material bottles. A new generation of neutron lifetime experiments will confine UCN in a magneto-gravitational potential. In contrast to material bottles neutron interactions with material walls are avoided, which represented a major source of systematic uncertainty.

HOPE employs a combination of a permanent magnet octupole system and several superconducting coils for confinement. It will be installed on the new UCN source SUN2 that is currently commissioned at the ILL in Grenoble. First systematic measurements are currently in preparation and will focus on the main sources of systematic uncertainties of magnetic UCN traps, neutron depolarization and marginally trapped neutrons. While first measurements will employ the classical “fill and empty” method, in a later stage a charged particle detector will enable us to perform also online measurements of the neutron decay products.

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