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Measurement of the Fierz interference term with PERKEO III

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Measurements of the free neutron decay enable a variety of tests of the Standard Model of particle physics. Observables of the decay are, among others, the beta asymmetry A , the proton asymmetry C , and the Fierz interference term b . From precision measurements of A the CKM matrix element V_{ud} may be determined, whereas measurements of C provide limits on right handed currents. A non-zero Fierz term b would signal the existence of scalar and tensor interactions beyond the Standard Model.

Determinations of these neutron decay parameters were pursued by the PERKEO III experiment by measurements of the electron and/or proton energy spectrum, during multiple runs at the ILL PF1b facility. For these measurements we used a pulsed beam of cold neutrons to control major systematic effects. This beam is guided into the decay volume of the experiment, in which some of the neutrons decay. The charged particles from the decay are then guided by a magnetic field towards one of two detectors, depending on towards which hemisphere they were directed to. The detectors are identical scintillation detectors with a PMT readout. With this measurement technique PERKEO III delivers the currently most precise values for A and b with a polarized neutron beam.

We present experimental details of the 2019/2020 campaign to measure the electron spectrum of unpolarized neutrons to extract an improved limit for the Fierz interference term b and the ongoing analysis.

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