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Precision determination of the axial-vector coupling constant from neutron beta decay

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Within the standard model of particle physics only two free parameters determine the decay of the free neutron, where we profit from the precise determination of the Fermi coupling constant in muon decay. These free parameters are the ratio of axial-vector and vector coupling constants $\lambda = g_A/g_V$ and the CKM mixing matrix element V_{ud}. With about a dozen experimental observables the problem of the determination of these parameters is largely over-constrained and hence enables the search for new physics via non $V-A$ couplings in this process.

We present the result of the neutron decay spectrometer Perkeo III on the ratio of coupling constants which was derived from a measurement of the parity violating beta asymmetry in polarized neutron beta decay with a precision of $\Delta\lambda = 5.5\times10^{-4}$. This result is more precise than the current PDG world average by a factor of four and clarifies a long standing tension between previous measurements. The instrument was installed and operated at the Institut Laue-Langevin. A pulsed cold neutron beam was used to control or eliminate major sources of systematic error. We will discuss the measurement and first implications of the result on the search for new physics.

The presentation will conclude with a status report on the follow-up instrument PERC, which is currently under construction at the beamline MEPHISTO of the MLZ. The aim of PERC is an improved measurement of several decay correlations in neutron beta decay by an order of magnitude.

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