Testing a Conserved Vector Current hypothesis using radioactive ion beams

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Cross sections for neutrino-nucleon reactions were among the first predictions of the Standard Model of electroweak interactions [1]. Despite numerous efforts to test the structure of weak current operators it still requires better understanding. In this contribution we discuss the possibility of testing the weak currents and, in particular, the weak magnetism term through the measurement of $\overline{\nu}_e + p \rightarrow e^+ + n$ cross section using a beta-beam.

The concept of the beta-beam was introduced by Zucchelli [2], it comprises the production of pure ν_e or $\overline{\nu}_e$ beams by allowing radioactive ions circulating in a storage ring to decay. In particular it offers the possibility to establish a low energy beta-beam facility [3], producing neutrinos in the 100 MeV energy range.

Using low energy beta-beams and a close by installed water Čerenkov detector antineutrino proton scattering can be studied with the aim to determine weak current form factors. In such a detector both the number of emitted positrons as well as their angular distribution can be measured. The measurement results then can be used to study the weak current, and, in particular, its weak magnetism term by avoiding uncertainties coming from nuclear structure calculations.

We demonstrate that the weak magnetism term has an especially strong impact on the angular distribution of the emitted positrons. We show how weak magnetism form factor affects this distribution and eventually how it might be determined with an accuracy better than several percent [4]. This offers a new way of testing the Conserved Vector Current hypothesis, relating the weak magnetism term to the analogous term of electromagnetic current.

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