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The limits on tensor-type weak currents and the beta-neutrino correlation of 6He

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Precision measurements in nuclear and neutron beta decays are a powerful tool in search for non V-A components in the weak interaction. Such a chirality-violating scalar or tensor interaction is predicted by several theories beyond Standard Model (e.g. [1][2]). We will present a new evaluation of the limits on time-reversal invariant tensor-type weak currents [3], taking into account most recent experimental data in nuclear and neutron beta decays (e.g. [4][5]), including the 5 sigma shift in the PDG2012 recommended value for the neutron lifetime. The effective field theory framework of ref [6] enables a comparison with the limits from pion decay. In addition, the sensitivity of a future 0.1% measurement of a correlation coefficient in beta decays is investigated.
Such precision is currently pursued at the University of Washington on the beta-neutrino correlation in the pure Gamow-Teller decay of 6He. The high-intensity 6He source at the local accelerator [7] makes it possible to simultaneously trap several thousand 6He atoms in a magneto-optical trap (MOT). These atoms are then transferred to a second, back-ground free, MOT. The beta-neutrino correlation is derived from the time-of-flight spectrum of the recoil 6Li ions. The beta particle which serves as a trigger is detected by a position sensitive hodoscope, the recoil ions are guided by an electrostatic field towards a multi-channel plate detector. All detector systems and both atom traps have been successfully commissioned. A first physics run is planned for this summer, aiming for a precision of 1% on the beta-neutrino correlation.

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Summary

Precision data in nuclear and neutron beta decays provide strong limits on tensor-type weak currents. To further increase the discovery potential of such experiments, a precision of 0.1% has to be reached. The ongoing experiment at the University of Washington to measure the beta-neutrino correlation in the decay 6He is pursuing such accuracy.

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