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Probing the nature of the weak interaction with laser trapped 6He

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Radioactive beams coupled with atom and ion trapping techniques are a powerful combination for precision experiments to search for physics beyond the Standard Model (SM). 6He isotopes are particularly interesting to constrain tensor-like contributions to the weak interaction by studying their β decay. So far, such couplings have been experimentally ruled out at the 9% level but are excluded in the V-A description of the weak interaction by the SM. The beta-neutrino angular correlation parameter $a\beta\nu$, in the case of 6He, is exclusively sensitive to exotic tensor components and can be measured accurately by a β/recoil-ion coincidence measurement. Our goal is to measure $a\beta\nu$ at the 0.1% level by analyzing the momentum distribution of the recoiling daughter nuclei. This uncertainty would be an order of magnitude better than the precision of the current best measurement. Short-lived 6He atoms (T1/2 = 807 ms) are produced on-line via the 2H(7Li,3He)6He reaction @ 18 Mev using the Tandem Van de Graaff accelerator at the University of Washington in Seattle. Recent upgrades on our liquid Li target allow us to routinely produce 2x1010 6He/s with a high reliability. 6He atoms are then loaded into a double-magneto-optical trap apparatus where the β decays are studied by detecting the β particles with a multi-wires proportional chamber and a scintillator/PMT assembly in coincidence with the 6Li recoiling nuclei with a position sensitive microchannel plate detector. To achieve our goal, production rates, trapping efficiency and trap lifetime are optimized, and our detection setup has been carefully studied to reduce and control all systematic effects. The apparatus will be presented along with its performances and preliminary results. This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under contract numbers DE-AC02-06CH11357 and DE-FG02-97ER41020.

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