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WISArD : Weak Interaction Studies with 32Ar

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Nuclear beta decay offers a very powerful tool to test the Standard Model (SM) in the electroweak sector. The wide variety of nuclei and beta transitions allows us to choose the perfect candidate for specific tests of the SM which are complementary to high energy physics studies [1]. In particular, the possible existence of scalar (resp. tensor) currents in the well-established vector – axial-vector (V – A) description of the electroweak interaction can directly be probed using the beta-neutrino angular correlation coefficient αβν for pure Fermi (resp. Gamow-Teller) beta decays. As the neutrino is not easily accessible, the αβν coefficient is determined from the recoil of the daughter nucleus. This recoil can either be measured in dedicated trap measurements or from the kinematic shift it induces on the energy distribution of emitted particles in the case of unstable daughter nuclei.

One of the best precision to date on aβν for a pure Fermi transition was obtained using 32Ar, from the broadening of the beta-delayed proton group emitted by the isobaric analogue state of the daughter nucleus 32Cl [2]. In the new WISArD experiment, we propose to reach the 10-3 uncertainty on aβν with 32Ar, both for the pure Fermi and pure Gamow-Teller transitions. Instead of focusing on the proton spectrum broadening, energy shifts between beta-delayed protons emitted in the same or the opposite direction to the beta will be measured [3].

A proof-of-principle experiment performed at the ISOLDE-CERN facility in Nov. 2018 yields a value of αβν in agreement with the SM. The uncertainty is at the 5×10−2 level for the Fermi transition and is dominated by statistics. These preliminary results as well as systematics studies that will play a crucial role for the final experiment will be presented.

References

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