"The neutron lifetime challenge: particle physics with neutrons in bottles and beams"

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Measurements of neutron decay provide us with our most precise characterization of components of the charged weak current of the nucleon and are playing an important role in the broad band constraints from beta decay at the 11 TeV level on new physics. In the standard model, two coupling constants (for vector and axial-vector couplings) are required to specify the neutron lifetime and the angular correlations of the decay products. Although there has been striking progress over the past two years in the status of the axial coupling constant on both experimental and theoretical fronts, the experimental status of the lifetime is not so clear, with a roughly 4 sigma discrepancy evident between experiments made with stored ultracold neutrons and those made with neutron beams. In this presentation, the status of storage experiments made with ultracold neutrons and experiments made with cold neutron beams is reviewed, highlighting recent experimental results, the origin of key sources of systematic uncertainty and how the community has moved to address these issues. We in the UCNtau collaboration have developed an experiment to store ultracold neutrons in an asymmetric magnetic trap at the Los Alamos Neutron Science Center, reducing losses to the point where, if neutrons didn’t decay, their storage time would be over a month (limited by scattering from ambient gas in our vacuum system). Our most recent results, which reinforce the discrepancy between storage and beam experiments, are presented, as well as our attempts to experimentally constrain explanations of the lifetime discrepancy through decays to “dark” particles.

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