TRINAT result – Precision measurement of the polarization and beta-asymmetry from the β^+ decay of laser-cooled ^{37}K

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The TRINAT collaboration is utilizing magneto-optical trapping and optical pumping techniques to cool, confine and highly polarize ^{37}K atoms to provide an ideal source for precision β-decay experiments. Our goal is to measure parameters of the angular distribution to <0.1% which would search for (or help constrain) physics beyond the standard model in a way that is competitive with and complementary to direct searches at high-energy colliders. Recently, we published the results described in Ref [1], representing the best relative accuracy of any β-asymmetry measurement in the nucleus or the neutron [2]. This publication discussed the results which do not depend on the β energy. We are currently analyzing the energy-dependent observables, and in particular the Fierz interference parameter, which is sensitive to scalar and tensor components to the weak interaction. We also expect to place limits on second-class currents.

Our statistical uncertainty is 0.24%, including the 0.09% from the polarization measurement. The two largest sources of systematic uncertainty are a background and the effects of β scattering, which contribute 0.14% and 0.12% respectively to the error budget. Following this, the cloud parameters (trap position, movement and temperature) combine to contribute 0.12%, with all other systematics at or below 0.7%. We believe that with better control of the cloud of trapped atoms and increasing the electric field for collection of the charged daughter particles, we can reduce the backgrounds and uncertainties in the trap characteristics. This, with increased statistics, should reduce our uncertainty by a factor of 2. To reach our goal of 0.1%, we will have to reduce our scattering uncertainty by a factor of 3, which will be our more challenging task. We have a very unique geometry and are considering options on how to reduce this systematic by better calibrating our Monte Carlo simulation of scattering. We are currently developing some ideas on how to benchmark our simulations, using beamtime we have available if necessry.

[1] B. Fenker *et al*., *Progress in Research*, Cyclotron Institute, Texas A&M University (2016-2017) p. I-52.

[2] B. Fenker *et al*., Phys. Rev. Lett. **120**, 062502 (2018).