

First-ever measurement of the β -asymmetry parameter from Laser-Cooled atoms: Status of the ^{37}K experiment at TRIUMF

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Recently the TRINAT collaboration made up of members from the Texas A&M University Cyclotron Institute and TRIUMF in Vancouver BC undertook an experiment to measure for the first time the β -asymmetry of ^{37}K . The analysis of the data is nearing a conclusion and the publication of the physics result is forthcoming.

There have been a number of major analysis tasks that have been completed in the last year. First a major bug was found in the readout of the detector data stream. The effect of this was that the silicon detector signals and the signals from the scintillator detectors were read out into different events. This led to unexpected results when imposing coincidences between detectors. The bug has subsequently been patched and coincidence conditions using the strip detectors are now reliable.

The correction of the previously mentioned software bug enabled the completion of the calibration of all of the scintillators and all of the 160 channels from the silicon detectors. Using this calibration has allowed us to develop our analysis of the asymmetry as a function of β energy in addition to what we originally looked at which was the asymmetry as a function of the optical pumping time. Additionally the asymmetry as a function of $\cos(\theta)$ was investigated, but with small detectors and low statistics it is difficult to make meaningful bins in $\cos(\theta)$.

In this experiment we had very few ^{37}K atoms in the trap for a number of reasons that were enumerated in our report from 2013. One of the consequences of this is that the previously used technique of measuring the polarization by counting photo-ions was not available. We have subsequently decided to use an offline measurement of the polarization made with ^{41}K . It can be shown that the uncertainty that would arise from the change in isotopes is small because the hyperfine structures are extremely similar and the isotope shift is well measured. Reproducing the experimental conditions of the run turns out to be the largest source of uncertainty in using such a measurement. Examples of the types of systematic effects that we considered were the temperature of the liquid crystal variable retarders, the power in the laser sidebands, and long timescale drifts of the power supplies. Our final number for the polarization of the ^{37}K in the December 2012 run and the largest systematic error in the experiment is $99 \pm 1\%$.

The analysis of the data is ongoing and we expect to publish the results shortly. We are continuing to quantify some systematic errors such as the effect of cloud movement and uncertainties in the energy calibrations of the detectors. These effects are small in comparison to the statistical uncertainty which is $\sim 1\%$ and the uncertainty in the polarization. Currently at TRIUMF setup is underway for a follow up experiment that will collect ~ 20 more data and will have better tools to determine the polarization such as a position sensitive electron MCP that will provide complementary information to what is currently provided by the ion MCP. Additionally each of these detectors has been optimized to increase the signal to noise ratio for better background suppression.