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The KDK+ experiment: measuring the rare positron emission of 40K

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Potassium-40 (^{40}K) is a radioactive isotope of potassium that is found in rocks and the human body. It has two daughter isotopes, argon-40 (^{40}Ar), and calcium-40 (^{40}Ca). The most common decay of ^{40}K is to ^{40}Ca via β-decay, with a branching ratio of approximately 89.25%. The decay to ^{40}Ar can occur through three methods, electron capture to an excited state of ^{40}Ar, electron capture to the ground state of ^{40}Ar, and β+ decay. The electron capture decay to an excited state of ^{40}Ar is the most common of the three with a branching ratio of 10.55%. The decay via electron capture to the ground state of ^{40}Ar was first measured by the potassium decay˜(KDK) experiment, and found a branching ratio of approximately 0.1%. The final decay channel is through β+ decay. This is the rarest decay with a branching ratio of approximately 10^{-5}%. This decay was studied previously in the 1960s, however the experimental branching ratio does not agree with modern theoretical predictions. The KDK+ experiment is seeking to accurately measure this branching ratio by using a potassium salt dissolved in a liquid scintillator, and surrounded by 4 external γ detectors. β+ signals are detected using a triple coincidence between the liquid scintillator, for the β+ interactions, then two back-to-back 511 keV detections in opposing γ detectors. This talk presents an overview of the experiment, as well as the work that has been done to characterize the liquid scintillator.

Keyword-1

Potassium-40

Keyword-2

positron

Keyword-3

Liquid Scintillator

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