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KDK+: The Enhanced LSC Stability Experiment

Friday, 14 February 2025 11:00 (15 minutes)

KDK and KDK+ research is focused on the Potassium-40 decays (40K). The most frequent decay mode is a β- decay to calcium-40. 40K also has an electron capture decay to the excited state of argon-40, as well as two much rarer decays, in the form of an electron capture and a β+ decay to the ground state of argon-40. The electron capture decay of 40K to the ground state of 40Ar was only recently experimentally observed by the KDK experiment, where a branching ratio of 0.098% ±stat 0.023% ±sys 0.010% was measured. The KDK+ experiment is now aiming to experimentally measure the β+ decay to the ground state of 40Ar. Liquid scintillators are known to have extremely high counting efficiencies for β decays, so the plan for KDK+ is to use a liquid scintillator to measure this extremely rare β+ decay. Measuring this decay requires a stable liquid scintillator cocktail (LSC) loaded with a 40K source. The stability of loaded liquid scintillators will vary depending on the sample chemistry, necessitating an experiment to test the long-term stability of the mixture. Previous work determined an ideal solution concentration of 85% liquid scintillator and 15% 1-molar potassium chloride, and an initial stability test was conducted. This initial test showed a 6% loss in signal over a two-month period, although no primary cause was identified. This necessitates a second stability test, which will use a plastic scintillator as a comparison to determine if this decrease in signal is occurring internally in the LSC or is due to some external factors. Since this branching ratio is extremely low, a high counting efficiency is necessary, as well precise understanding of how it will change over a long-term experiment.

Your Email

23vqp@queensu.ca

Affiliation

Queen's University

Supervisor

Philippe Di Stefano

Supervisor Email

philippe.distefano@gmail.com

Your current academic level

Undergraduate student

Primary author: INGO, Cameron (Queen's)

Presenter: INGO, Cameron (Queen's)

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