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Measuring the ^{40}K Feeding to the Ground State of ^{40}Ar

Experimental nuclear physicists are well acquainted with the ubiquitous 1461 keV background γ ray from the first-forbidden unique electron-capture decay of ^{40}K to ^{40}Ar. The third-forbidden unique beta decay to the ^{40}Ca ground state is also well known. Not so well known is the third-forbidden unique electron-capture decay channel directly to the ^{40}Ar ground state. This small decay branch has never been directly measured. Predicted intensities and experimental upper limits are highly variable (0-0.8%). This decay channel can be an important background for many rare-event searches, (such as DAMA, ANAIS-112, COSINE-100, SABRE, COSINUS, etc...). This exotic decay branch is also a limiting factor in ^{40}K based geochronological dating.
The KDK (Potassium (K) Decay (DK)) experimental group is an international collaboration dedicated to perform the first measurement of this undetected ^{40}K decay branch. The KDK group has created an enriched ^{40}K source that the low-energy x rays can escape, built a silicon drift detector to measure the x rays, and integrated both into a highly efficient γ-ray detector, Oak Ridge National Laboratory's Modular Total Absorption Spectrometer (MTAS).
The KDK setup has been calibrated, tested, and the enriched ^{40}K source was measured for 45 days.
We report on the experimental details and the current state of analyzing the unblinded KDK data.

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