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Backgrounds and sensitivity of the KDK experiment measuring a rare decay of potassium

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40K is one of very few isotopes allowing comparison of a third-forbidden unique decay with first-forbidden unique decay. It is also a source of uncertainty in certain dark matter searches, and in K-based geochronology dating techniques. In particular, one decay branch of 40K has never been experimentally measured: the electron capture directly to the ground state of 40Ar, expected to be of the order of fifty times smaller than the well-known decay to the excited state of 40Ar. In the KDK (potassium decay) experiment (https://arxiv.org/abs/2012.15232), this small decay branch has been investigated by integrating a low-threshold X-ray detector into the high-efficiency Modular Total Absorption Spectrometer (MTAS) at Oak Ridge National Laboratory. We present details of the technique used to measure this small decay branch, with focus on backgrounds, the expected sensitivity, and progress towards unblinding the analysis.

Primary author: DI STEFANO, Philippe (Queen's University)

Presenter: DI STEFANO, Philippe (Queen's University)

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