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KDK: measuring a rare decay of potassium relevant to geochronology

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Potassium-40 (40K) is a naturally-occurring radioactive isotope. In geochronology, the O(Gy) lifetime of 40K is used in dating techniques. This radionuclide decays mainly by beta emission to calcium, and by electron-capture to an excited state of argon. The electron-capture decay of 40K directly to the ground state of argon has never been measured, and predicted intensities are highly variable (0–0.22%). This poorly understood intensity affects the precision of K-Ar dating [1]. The KDK (potassium decay) experiment is carrying out the first measurement of this electron-capture branch, using a novel setup at Oak Ridge National Labs [2]. KDK deploys a very sensitive detector to trigger on the low-energy radiation emitted by both forms of electron capture, and a very efficient veto to distinguish between the decays to ground state and those to the excited state. We report on our latest experimental results and implications for K-Ar dating.

[1] Carter et al, Geochronology, 2, 355–365, 2020, https://doi.org/10.5194/gchron-2-355-2020

[2] Stukel et al, Nuclear Inst. and Methods in Physics Research, A 1012 (2021) 165593, https://doi.org/10.1016/j.nima.2021.165593