^{65}Zn: A Measurement of Electron-Capture Decays Using Data from the KDK Experiment

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On behalf of the KDK collaboration

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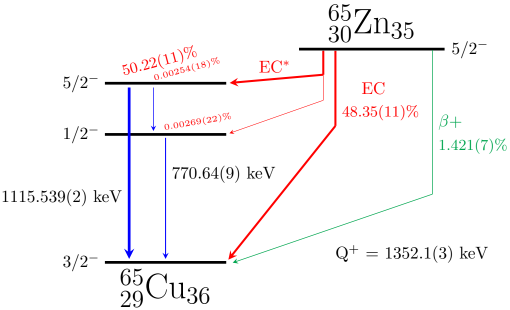
^{65}Zn

Uses

- Common gamma calibration source
- Tracer (medicine, biology)

Experiment

- Data from KDK experiment
- Setup allows for measurement of electron capture branches
- KDK Instrumentation Paper submitted to NIM (pre-print: arXiv:2012.15232 [1])

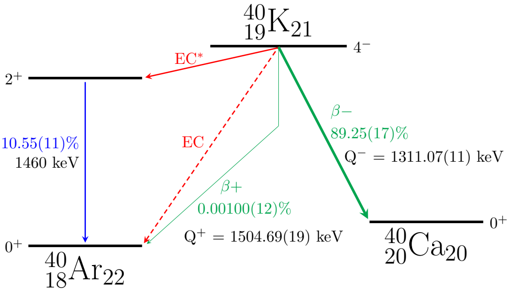


Novel measurement of $\rho \equiv I_{\mathrm{EC}}/I_{\mathrm{EC}^*}$

KDK is measuring ρ for ^{40}K

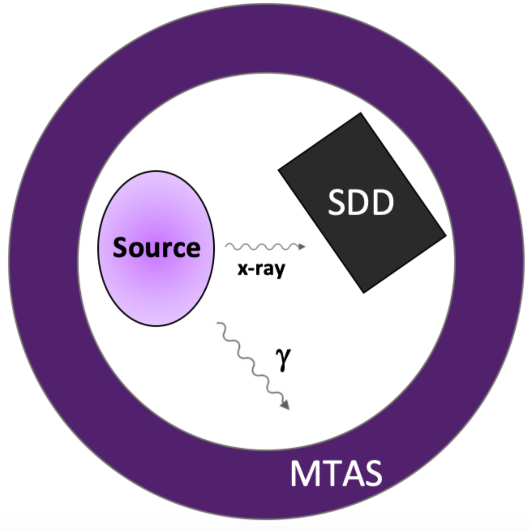
^{40}K

- ^{40}K is a background in many rare-event searches, is of interest in nuclear theory and geochronology [2, 3]
- More on ^{40}K & KDK in M. Stukel's talk this Thursday (indico link)



Open ^{65}Zn dataset is being used to test methods for main ^{40}K analysis.

KDK Setup I



- EC event: x-ray
- EC* event: x-ray & gamma

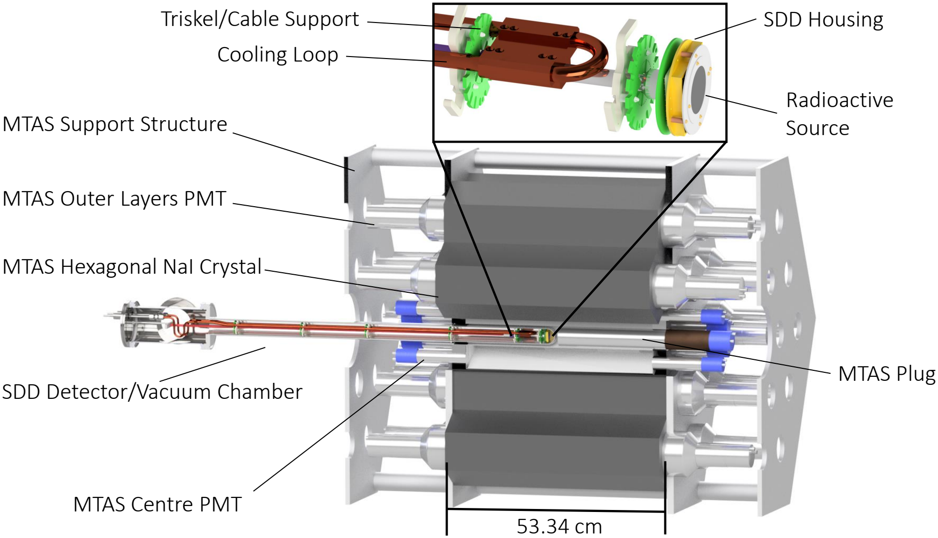
Inner **Silicon Drift Detector (SDD)** *(MPP/HLL Munich)* detects x-rays

Outer **Modular Total Absorption Spectrometer (MTAS)** *(Oak Ridge National Laboratory)* detects gammas

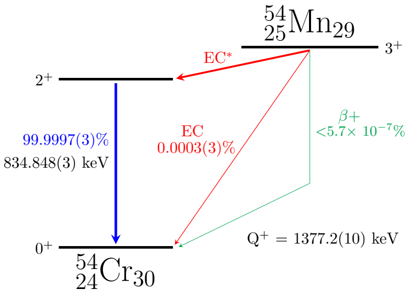
(Electronic support: TRIUMF)

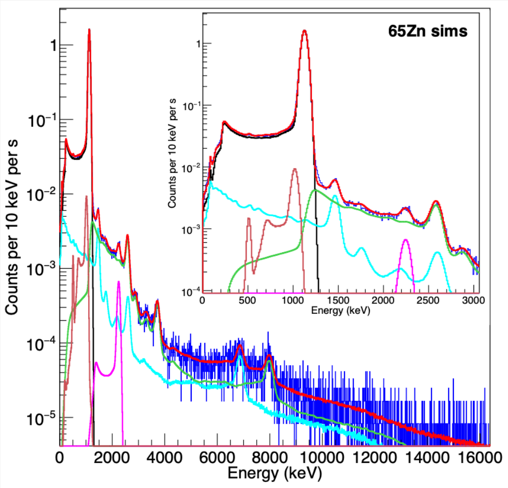
KDK measures $\rho = I_{\mathbf{EC}} / \ I_{\mathbf{EC*}}$

KDK Setup II (arXiv:2012.15232)



Measured 835 keV (^{54}Mn) efficiencies are extrapolated 1115 keV (^{65}Zn) using simulated efficiency ratio. Comparison of data + simulation for ^{65}Zn is shown.



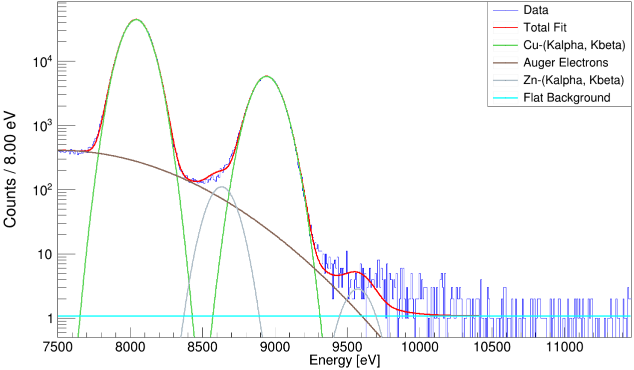


1115 keV **efficiency 97.93(6)% at the** 4 µs **Coincidence Window (CW).**

1. Sort SDD data by checking for MTAS coincidence
2. Fit coincident & uncoincident spectra simultaneously
3. Divide signal counts in uncoincident & coincident spectra

SDD resolution: 198 eV FWHM at 8 keV

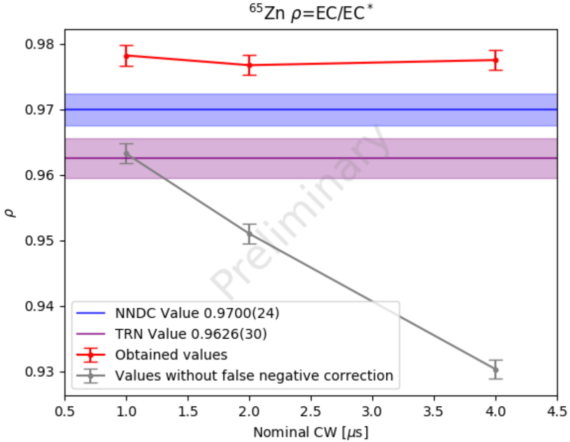
^{65}Zn Uncoincident Spectrum, 1μs CW



Fit accounts for false positives and negatives
Notably: $<100\%$ MTAS efficiency, EC coincidence with MTAS background

Various background models are currently being studied.

Preliminary ^{65}Zn ρ Results



Coincidence window dependency

- ρ should be independent of coincidence window
- False negative corrections resolve unphysical CW-dependency

Currently finalizing false positives and & negatives

Summary

^{65}Zn

- ^{65}Zn dataset used to test analysis methods, and to obtain physics results
- ρ never been measured
- The apparatus, featuring a high-efficiency gamma detector and high-resolution x-ray detector, provides a novel measurement method for ^{65}Zn decays
- False positive and false negative corrections are ongoing, final results to be published in the near future

KDK

- KDK is measuring several rare decays, with results applicable to many fields
- KDK Instrumentation Paper submitted to NIM (pre-print: arXiv:2012.15232)

Thank you to the KDK Collaboration

N. Brewer[1], H. Davis[2,3], P.C.F. Di Stefano[4], E. Lukosi[2,3], B.C. Rasco[1], K.P. Rykaczewski[1], M. Stukel[4], and the KDK Collaboration

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