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Investigation of Large Area Avalanche Photodiodes for the Experimental measurement of the Electron Capture decay of 40K: KDK Project

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The 40K isotope is the only known example of a unique-third forbidden transition. Its branching ratio directly to the ground state of 40Ar through electron capture has never been experimentally measured. This branching ratio will help with understanding the background in the DAMA/LIBRA experiment and other dark matter searches. "KDK"is the name of an international collaboration that is dedicated to this measurement.

The experiment will be performed by having a small, inner detector that will trigger on the x-rays and Auger electrons from 40K. This detector is currently a cooled Large Area Avalanche Photodiode (LAAPD) with an attached signal amplifier module. LAAPD's are silicon based solid state detectors that convert photons into a charge current and have been shown to be capable of measuring low energy x-rays and electrons. The LAAPD will be surrounded (4π solid angle coverage) by an outer detector to tag the 1460 keV gammas released from the excited state of 40Ar. The outer detector is the Modular Total Absorption Spectrometer (MTAS) at Oak Ridge National Lab (ORNL), Tennessee. MTAS can provide a ˜98-99% efficiency on tagging the 1460 keV gammas. By running the two detectors in coincidence we can separate the events caused by the decay of the excited state of 40Ar* through electron capture from the direct decay to ground state. Through this separation, we can perform a dedicated measurement of the EC channel.

We report on the performance of a Large Area Avalanche Photo Diode (LAAPD) for the direct measurement of the low energy x-rays and electrons. By observing multiple sources (65Zn, 54Mn, 55Fe and 40K) the LAAPD can be studied and characterised for the 40K energy range. Their viability for the use in a dedicated measurement of the EC branching ratio will then be determined.

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