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# An Intermediate-Energy Neutron Beam for Calibrating Dark Matter Detectors

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Searching for low-mass WIMPs typically relies on ionization from a nuclear recoil in a detector. Calibration of the detector response at different energies can easily be done with charged particles with radioactive sources, but in this case the charged particles give energy directly to the detector material's electrons, not via a nuclear recoil. The ratio of detector response to nuclear and electronic recoils at a given kinetic energy is called the quenching factor.

Neutrons do induce nuclear recoils, but easy-to-get neutron sources produce high-energy (˜MeV) neutrons from nuclear reactions. Intermediate and low-energy neutrons can be obtained from reactors or accelerators.

At the Reactor Materials Testing Laboratory (RMTL)[1] at Queen's University, there is a 4 MV tandem accelerator which can deliver proton currents up to 45µA with a maximum energy of 8 MeV. Using nuclear targets such as Lithium Fluoride or Vanadium, one can produce neutrons of various energies. Producing lower-energy neutrons is rather inefficient, but due to its role as a nuclear irradiation facility, RMTL has high enough beam current to overcome this problem.

In 2019 we performed several neutron production tests at RMTL and were able to roughly characterize the proton beam. A significant challenge is the energy width of the proton beam, moderation of the neutrons from excess material in the target chambers, and reflections from the walls.

This poster will introduce the WIMP detector we wish to calibrate, the RMTL facility itself, the technique to produce neutrons, results from the tests in 2019 and the latest progress towards our goals.

[1] Queen's University https://rmtl.engineering.queensu.ca/

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