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69 - Quasi-Monoenergetic Neutron Beams for Characterizing Dark Matter Detectors

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Many designs of dark matter detectors rely on ionization from a nuclear recoil. An essential characteristic of these detectors is the quenching factor: the ratio of energy deposited via ionization in the detector by a particle of a given energy via nuclear recoil to that via electronic recoil. The electronic response is straightforward to measure using radioactive sources. The obvious way to characterize the nuclear response is bombardment with low-energy neutrons, but most easily available sources are broad-spectrum in nature and have relatively low rates for safety and regulatory purposes. We aim to establish at the Queen's University Reactor Materials Testing Laboratory (RMTL)^[1] a quasi-monoenergetic neutron beam in order to characterize the detectors used by the NEWS-G collaboration. Eventually this could become a user facility for use by operators of other dark matter detectors.

<p> RMTL has a 4 MV tandem accelerator which can deliver proton currents up to 45mu;A with a maximum energy of 8 MeV. Using nuclear targets such as Lithium Fluoride or Vanadium, one can produce neutrons of various energies. By accepting only a narrow slice of the neutron emission angle, the width of the energy distribution can be made arbitrarily small. The neutron fluence is strongly dependent on the beam energy and target material, but the relatively high beam current can yield rates of 1.5x10⁵even near threshold. RMTL has a Nested Neutron Spectrometer^[2] which can be used to characterize the produced neutron beam, and a backing detector will be installed for coincidence measurements. <p> We hope to demonstrate a beam of 100plusmn;20 keV neutrons over the summer of 2019, with an end goal of 30plusmn;10 keV. This low-energy quasi-monoenergetic neutron beam will allow us to measure quenching factors at sub-keV nuclear recoil energies. <p> This poster will introduce the NEWS-G detectors and concepts, the RMTL facility itself, the technique to produce neutrons, and the latest progress towards our goals. <p> [1] Queen's University https://rmtl.engineering.queensu.ca/
 [2] Maglieri, R. <i>et al.</i> (2015), Measuring neutron spectra in radiotherapy using the nested neutron spectrometer. Med. Phys., 42: 6162-6169. doi:10.1118/1.4931963

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