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A Quasi-Monoenergetic Neutron Beam for Calibrating Dark Matter Detectors

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At the 8 MeV proton accelerator of the Queen's University Reactor Materials Testing Laboratory, we are establishing a quasi-monoenergetic beam of neutrons. These neutrons will be used to induce nuclear recoils of known energy in the dark matter detectors of the NEWS-G experiment. This is needed to to measure the quenching factors of the various gases used, in particular in proton-rich gases such as methane and at lower recoil energies where no data exist. The quenching factor is ratio of detector response from a nuclear recoil compared to an electronic recoil of the same energy (see Marie Vidal's contribution for more details). Beyond NEWS-G, access to the neutron beam will be opened up to other dark matter experiments or other users.

The requirement is a controllable beam of neutrons with ~30 keV kinetic energy with ~10% width. Working in this "intermediate" range of neutron energies is quite challenging, as most detectors are optimized for thermal or high-energy neutrons.

I will describe our progress since 2019 in producing neutrons from bombarding lithium fluoride with protons, attempts to characterize the beam, shielding, and detectors.

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