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(G*) Designing a New Proton Beamline for a Low Energy Monoenergetic Neutron Source

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The Dept. of Physics, together with the NEWS-G collaboration at Queen's University are developing Spherical Proportional Counters (SPC) aimed for dark matter detection research. The response of SPCs to nuclear recoils with the interaction of the hypothetical dark matter particles can be best calibrated with a high intensity beam of low energy neutrons (˜10 keV –100 keV). Presently, the number of facilities having such neutron sources are quite low. This project aims to design and build a low energy neutron source at the proton accelerator facility of the Reactor Materials Testing Laboratory (RMTL).

This new neutron source consists of proton beam of 1.89 MeV –2 MeV energy which bombards a target of Lithium Fluoride. The target is made by evaporating LiF on a tantalum substrate. This target plate is then kept on an Aluminium Nitride backing plate which together is kept on a 304L stainless steel flange which seals the vacuum chamber.
According to the theoretical calculations, LiF produces a good yield of neutrons, best at an angle of 45°. However, the energy spectrum of these neutrons ranges from ˜31keV to higher. To achieve a monoenergetic source of neutrons at 24keV, we are also developing a collimator with an iron filter.

The collimator would consist of a combination of shielding materials, particularly Borated (B-PE) and Non-Borated Polyethylene (PE), and Lead (Pb). B-PE would thermalize the neutrons leaving at undesirable angles from the source and the Pb shielding would absorb the gamma radiation created by the B-PE as these would induce undesirable background in the SPC.

A thin layer of PE will also be used to decrease the energy of the neutrons originally in the energy range of > 31keV, down to a suitable energy range before they reach the iron filter to produce a 24keV neutron beam.

Keyword-1

Beamline

Keyword-2

Neutron-Source

Keyword-3

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