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Developing a Lithium Doped Glass Detector to Measure the Electric Dipole Moment of Ultra Cold Neutrons

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Matter domination over anti-matter in the universe is not explained by the Standard Model. Extensions to the standard model which could account for this lack of anti-matter introduce larger amounts of CP-violation. If neutrons have larger Electric Dipole Moments (EDMs) than predicted by the standard model, this would indicate one source of CP-violation. To measure the neutron EDM to high precision, Ultra Cold Neutrons (UCN) are cooled to temperatures of ˜3 mK. UCN have the interesting property that they can be contained in material bottles, and since they move so slowly (˜ 7 m/s), they follow ballistic trajectories in gravity.

A new high intensity UCN polarized source is being developed at TRIUMF, which is based on a spallation neutron source. UCN from this source will be used to measure the neutron EDM (nEDM) and place stringent limits on models of physics beyond the standard model. In order to detect the high rate of neutrons expected in this new nEDM experiment, a neutron detector capable of high rates ˜1.3MHz for a period of several seconds is required. A spin analyzing foil set before the detector means that neutrons of a single spin state are measured at a time. A lithium doped glass scintillator detector, based on the detector used at PSI is being designed. In this talk the principle for how this detector works, and how the high rates of data will be handled will be presented. In addition to handling the high rates, the background rejection, and stability of the efficiency will be considered.

One challenge in the nEDM experiment is determining the number of neutrons in the experimental cell, and thus accounting for any variations in UCN production due to moderator temperature changes or number of protons on target. Several possible scenarios for how to normalise the number of neutrons observed to the actual number in the cell are presented, such as using a rate monitor, sequential counting, and simultaneous detection.

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