Monte Carlo Simulation of Spin Relaxation due to $\vec{v} \times \vec{E}$ effect in nEDM experiment

RICCARDO SCHMID, BRAD PLASTER, BRADLEY FILIPPONE, Caltech, NEDM COLLABORATION — We have simulated the precession of spin-polarized Ultra Cold Neutrons and $^3$He atoms in uniform and static $B$ and $E$ fields and calculated the spin relaxation. The spin relaxation times $T_1$ (longitudinal) and $T_2$ (transverse) of spin-polarized UCN and $^3$He atoms are important considerations in the new measurements of neutron Electric Dipole Moment in the SNS nEDM experiment. The uniform $E$ field creates a motional magnetic field due to the $\vec{v} \times \vec{E}$ effect which combines with collisions with the walls of the holding cell to produce constant variation of the total $B$ field and result in the spin relaxation of the neutron and $^3$He samples. Scattering of $^3$He atoms in $^4$He also results in spin relaxation and is highly temperature dependent. In the SNS nEDM experiment the $B$ field has magnitude of 10 mGauss. The applied $E$ field is parallel to the $B$ field and has a magnitude of 50 kV/cm. We have found the relaxation times for the neutron due to the $\vec{v} \times \vec{E}$ effect to be long compared to holding times and neutron lifetime. On the other hand, the $\vec{v} \times \vec{E}$ effect could be important for $^3$He relaxation times.

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