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Systematics calculations for the nEDM experiment at PSI

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The nEDM experiment at PSI is the flagship project at the new ultracold neutron (UCN) source at PSI which is in the commissioning phase. Estimations of systematic effects for the determination of the neutron EDM are an important part of this project. Experimental studies are accompanied by Monte Carlo simulations. Aim is to develop a realistic model of the nEDM apparatus, also implementing (inhomogeneous) magnetic fields and the Ramsey method of separated oscillatory fields. In this presentation, computations will be shown on the time evolution of the height difference of the centres of mass of the ultracold neutrons and mercury atoms, the latter serving as cohabiting magnetometer in the precession chamber. This centre of mass offset is caused by gravity and the large speed difference between UCN (˜5 m/s) and Hg atoms (˜150 m/s). This offset determines the ratio of precession frequencies measured for UCN and mercury atoms as function of a vertical field gradient [1]. By computing this centre of mass offset as function of storage times, consistency tests for magnetometer measurements of the vertical (most important) field gradient can be performed. This method also provides a possibility to determine the gyromagnetic ratio of the neutron. Furthermore, the transversal depolarization time constant (T2) can be estimated as function of field gradients and of simulated positional autocorrelation functions [2], also serving as crosscheck for measurements.

[1] C.A. Baker et al., Pys. Rev. Lett 97 (2006) 131801
[2] D.D. McGregor et al., Pys. Rev. A 41 (1990) 2631

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