Towards a new measurement of the neutron EDM
The nEDM project at PSI

Abstract

Electric dipole moments (EDM) of particles are direct signatures for CP and T violation. Whereas the Standard Model predicts very small EDM values due to a unique CP violation phase, most of its extensions (e.g. SUSY) incorporate new mechanisms and tend to predict large EDMs, already severely constrained by experiments. Improving the accuracy over the present limits provides therefore a unique opportunity to observe new physics.

We propose here to perform a new high precision experiment of the neutron electric dipole moment (nEDM) with an accuracy of 5×10^{-28} e.cm or better, an improvement of nearly two orders of magnitude over the present best measurement ($d_n \leq 2.9 \times 10^{-26}$ e.cm), obtained by the RAL/Sussex collaboration at the Institute Laue Langevin in Grenoble. The central elements of our approach are the use of the new spallation UCN source at the Paul Scherrer Institute, and the optimization of the in vacuum Ramsey resonance technique, with storage chambers at room temperature. The basic features of our experiment will include (i) an increased sensitivity due to much larger UCN densities at the PSI source, larger storage volume, better polarization product and possibly larger electric field strength, (ii) a better control of systematics thanks to a double-chamber system, (iii) an improved monitoring and stabilization of the magnetic field with an array of laser pumped Cs magnetometers, (iv) an improved co-magnetometer system.

The final goal will be reached in steps: (i) operating and improving the existing room temperature apparatus of the former RAL/Sussex/ILL collaboration until 2008 at ILL, while designing in parallel of a new spectrometer, (ii) gaining a factor 5 in sensitivity with this upgraded apparatus at PSI in 2009-2010, (iii) running with the new apparatus at PSI in 2011-2015 in order to reach an other order of magnitude improvement.