Resonance EDM method: A sensitive hadronic EDM experiment in storage rings

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for the Storage Ring EDM Collaboration

The experimental study of electric dipole moments (EDM) of fundamental particles had the most impact in restraining models that extend the standard model (SM). This study has had several advantages:

1) The standard model contribution is far below the sensitivity of any planned experiment. That means the SM does not contribute any background.
2) Most SM extensions predict additional CP-violation, leading to EDMs in the range of the planned experiments.
3) The baryon asymmetry in the universe (BAU) requires CP-violation beyond that available in the SM. EDM experiments are among the best to unveil such new CP-violation sources.

EDM experiments in storage rings have so far been performed parasitically to another main effort. Our collaboration made the first extensive study of a dedicated EDM experiment in storage rings. The latest version, the resonance EDM method (Y. Orlov et al., PRL **96**, 214802 (2006)), was presented at the LOI level at the BNL program advisory committee (PAC) in September 2006. The PAC enthusiastically endorsed the effort and recommended that BNL management provide the required support to the collaboration to carry out the systematic error studies for a period of one to two years.

An EDM search on the deuteron (the simplest nucleus in nature) at the 3×10^{-29} e·cm/year level would have the best sensitivity over current or currently planned experiments for theta-QCD, and quark and quark-color EDMs. The sensitivity for new physics at this level is at the impressive 10^3 TeV energy scale, assuming that the CP violating phase is of order 1. If new physics does exist at the LHC energy scale, the sensitivity to the CP-violating phase is at the 10^{-5} rad level, which is far beyond the LHC design sensitivity.

Our approach to hadronic EDMs, using the bare nucleus of deuteron (the simplest nucleus in nature), is complementary to both the neutron and the other EDM experiments since they are all sensitive to different CP-violating sources. It is also complementary to experiments at the energy frontier, i.e. colliders under construction (LHC), and under consideration (ILC). It can provide important information at the science frontier at a very moderate cost.