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Neutron electric dipole moments in lattice QCD with background field method

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Neutron EDM (nEDM) is one of the most promising ways to probe CP-violating quark and gluon interactions and constrain potential extensions of the Standard Model. While nucleon models and low-energy theories provide some ballpark estimates for the nEDM sensitivity to these interactions, they may vary by an order of magnitude or more. Such theoretic uncertainties can only be eliminated by ab initio nonperturbative calculations in lattice QCD.
One of the most elusive sources of nEDM is the QCD theta-term, because its contribution is proportional to the lightest-quark mass. I will present our preliminary results for nEDM induced by theta-QCD calculated using background electric field method. At the moment, we obtain nEDM by chiral extrapolation from calculations with pion masses as light as 330 MeV. Combined with techniques based on low modes of the Dirac equation, it should be possible to perform our calculations directly at the physical point in the next few years. In addition, we plan to extend our work to other CP-violating interactions such as 4-quark operators, which are substantially simplified when using the background field method.

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