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Ab-Initio Calculations of Electric Dipole Moments in Light Nuclei

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In any finite system, the presence of a non-zero permanent electric dipole moment (EDM) would require both parity (P) and time-reversal (T) violation. The standard model predicts a very small CP violation and consequently any observation of the EDM would imply physics beyond the standard model. Thus, EDMs have long been proposed as a way to test these fundamental symmetries. Experimental studies have placed upper bounds on neutron, nuclear and atomic EDMs, while theoretical studies have calculated their magnitudes using a variety of methods. In particular, it has been found that nuclear structure in certain nuclei can enhance the EDM. Here, we use an ab-initio no-core shell model (NCSM) framework to theoretically investigate the magnitude of the nuclear EDM. We calculate the EDMs of several light nuclei using chiral two- and three-body interactions and a PT-violating Hamiltonian based on a one-meson-exchange model. We will present a successful benchmark calculation for 3He, as well as results for the more complex nuclei ^{6}Li, ^{7}Li, ^{9}Be, ^{10}B, ^{11}B, ^{13}C, ^{14}N, ^{15}N, and ^{19}F. Our results suggest that different nuclei can be used to probe different terms of the parity violating interaction. These calculations will allow us to better understand which nuclei may have enhanced EDMs, and thus allow us to suggest which ones may be good candidates in the search for a measurable permanent dipole moment.

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Theory

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