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Searching for Hadronic CP Violation in Deformed Nuclei with Polar Molecules

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The fact that the universe is made entirely out of matter, and contains no free anti-matter, has no physical explanation. While we cannot currently say what process created the matter in the universe, we know that it must violate a number of fundamental symmetries, including those that forbid the existence of certain electromagnetic moments of fundamental particles. We can search for signatures of these electromagnetic moments via precision measurements in polar molecules, whose extremely large internal electromagnetic fields can significantly amplify these moments. These effects would arise from physics beyond the Standard Model, which enables tabletop searches for new, symmetry-violating particles and forces. With modern, quantum science techniques to control polar molecules, these searches can currently reach into the TeV scale, and offer a route to the PeV scale through advanced cooling and trapping techniques. I will discuss a new experiment being developed at Caltech to use polyatomic molecules bearing heavy, deformed nuclei to search for hadronic CP violation via nuclear magnetic quadrupole moments, which are sensitive to a wide variety of CP-violating sources beyond the Standard Model.

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