THE SEARCH FOR TIME-REVERSAL VIOLATION IN RADIUM NUCLEI

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Electric dipole moments (EDMs) are signatures of time-reversal, parity, and charge-parity (CP) violation, which makes them a sensitive probe of expected new physics beyond the Standard Model, such as supersymmetry. No experiment has yet observed a non-zero EDM to challenge the Standard Model. Due to its large nuclear octupole deformation and high atomic mass, the radioactive Ra-225 isotope is a favorable EDM case; it is particularly sensitive to CP-violating interactions in the nuclear medium. We have developed a cold-atom approach of measuring the atomic EDM of Ra-225 atoms held stationary in an optical dipole trap. We previously demonstrated this technique with an initial experimental upper limit of $|d(^{225}Ra)| < 5e\text{-}22$ e-cm (95% C.L.), and have since improved this limit 36-fold to 1.4e-23 e-cm. This is not only the first time laser-cooled atoms have been used to measure an EDM, but also the first time the EDM of any octupole deformed species has been measured. Upcoming improvements are expected to dramatically improve our sensitivity, and significantly improve on the search for new physics in several sectors. This work is supported by U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-AC02-06CH11357.