

## PROGRESS TOWARDS A SEARCH FOR CP-VIOLATING NUCLEAR Schiff MOMENTS USING RADIOACTIVE MOLECULES IN SOLIDS<sup>a</sup>

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Nuclear Schiff moments (NSMs) present a powerful probe into new physics through their connection to CP-symmetry violation. Such symmetry violations are needed to explain the observed baryon asymmetry of the Universe. We are investigating the application of molecular matrix methods<sup>b</sup> to the search for NSMs of pear-shaped nuclei in heavy polar radioactive molecules<sup>c</sup>. Pear-shaped nuclei (i.e. those with both octupole deformations), such as radium-225, are expected to have enhanced NSMs<sup>d</sup>. These methods involve trapping polar molecules in a noble gas matrix, which is predicted to lock their orientation relative to the matrix lattice vectors. This contribution focuses on the spectroscopy calculations leading to the draft NSM measurement scheme but also touches on the FRIB-EDM3 instrument, which consists of two main parts: the frontend, which will create and mass-separate molecular ions, such as RaF<sup>e</sup>, and the backend, which will neutralize the ions, co-deposit them in a noble gas matrix, and perform molecular hyperfine spectroscopy, which will ultimately enable an NSM search. Eventually we aim to carry out a sensitive search for the NSM of radium-225 using, for example, RaF molecules in solid argon. Information will be provided on the calculations relevant to developing an NSM measurement scheme, which have been carried out first on a simpler analog <sup>138</sup>BaF, replicating the results of <sup>a</sup>, then on <sup>225</sup>RaF.

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<sup>b</sup>A. C. Vutha, M. Horbatsch, and E. A. Hessels, Orientation-dependent hyperfine structure of polar molecules in a rare-gas matrix: A scheme for measuring the electron electric dipole moment, *Phys. Rev. A* 98, 032513 (2018)

<sup>c</sup>G. Arrowsmith-Kron et al, Opportunities for fundamental physics research with radioactive molecules, arXiv:2302.02165 [nucl-ex]

<sup>d</sup>N. Auerbach, V. V. Flambaum, and V. Spevak, Collective t- and p-odd electromagnetic moments in nuclei with octupole deformations, *Phys. Rev. Lett.* 76, 4316 (1996)

<sup>e</sup>J. Ballof et al, Progress towards the frib-edm3-frontend: A tool to provide radioactive molecules from isotope harvesting for fundamental symmetry studies, *Nuclear Instruments and Methods in Physics Research Section B Beam Interactions with Materials and Atoms* 541, 224 (2023)