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Measuring the Electric Dipole Moment of the electron using polar molecules in a parahydrogen matrix

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The electric dipole moment of the electron (eEDM) is a sensitive probe for new physics beyond the Standard Model that can also provide indirect evidence for the existence of dark matter. We propose an experiment to measure the eEDM using diatomic polar molecules (BaF) embedded in a cryogenic matrix of parahydrogen. By exploiting the large internal molecular field available in BaF molecules and the efficient cooling and large concentrations of molecules enabled by the parahydrogen matrix, the proposed experiment has the potential to improve the current eEDM limits by over an order of magnitude, down to around $10^{-31}\ e \cdot \mathrm{cm}$. Such an improvement could provide important information about the sources of CP violation and help understand the origin of the matter-antimatter asymmetry in the universe. Furthermore, our measurements could indirectly offer insights into the nature of dark matter since many extensions of the Standard Model that account for dark matter predict an eEDM large enough to be within the measurement range of planned experiments.

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