THE FRIB-EDM^3 INSTRUMENT: A TOOL FOR CREATING AND SPECTROSCOPICALLY STUDYING RADIOACTIVE MOLECULES FOR TESTS OF FUNDAMENTAL SYMMETRIES[a]

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Electric dipole moments (EDMs) are a signature of time-reversal, parity, and charge-parity (CP) violation. New sources of CP violation beyond the Standard Model (BSM) are required to explain the baryon asymmetry of the universe, and a non-zero EDM could indicate new CP-violating interactions[bc]. Radioactive nuclei with large octupole deformations offer an enhanced EDM that can be used to probe for BSM physics with increased sensitivity by forming polar radioactive molecules. The EDM3 method aims to implant such molecules in a noble gas matrix, offering high statistics and control of systematics for an EDM measurement[d].

We aim to adapt this technique for a nuclear EDM measurement using the FRIB-EDM3 instrument[e]. The instrument will form polar radioactive molecules in cryogenic noble gas solids for molecular spectroscopy. The frontend will form molecular ions and perform mass separation of the ion species. Mass filtered ions will be transmitted to the backend where they will be neutralized and implanted in a noble gas film to perform spectroscopy. We report on the design and construction of the frontend, and initial conclusions on the effectiveness of our mass separation and ion transport techniques from testing the existing instrument. We also report on the designs of our charge exchange cell and film growth chambers that constitute the backend.

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