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Electron EDM Experiment using Francium at TRIUMF

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Dark Matter, neutrino masses, and the excess of matter over antimatter in the universe, are examples of gaps in our understanding of physics. An electric dipole moment (EDM) of the electron, either large or unobservably small, will be a feature of successful theories of these phenomena, and of other extensions of the Standard Model.

Our Electron EDM Collaboration is developing an experiment to search for an electron EDM using francium atoms produced at TRIUMF. Francium is an alkali atom, with its atomic structure well understood, and with its high sensitivity to an electron EDM established accurately from field theory.

Our experiment will use a francium atomic fountain. A fountain allows the measurement to be done in free space and in free fall, with no collisions with gasses or walls, with no confining lasers or A.C. Stark shifts, and with no applied static or time-varying magnetic fields. There will only be a static electric field between optical state preparation and state analysis, and the optical state preparation and state analysis occur in a region free of both applied magnetic and applied electric fields.

In this experiment we can measure our sensitivity to an EDM and even adjust it to zero. We will be able to measure our sensitivity to systematic effects and can make the systematics large to show that we have them under control. We can also test that any observed effect is linear in the electric field and that it reverses with electric field, both of which are definitive signatures of a permanent EDM.

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