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The Atomic and Nuclear Physics of Atomic EDMs

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Atomic Electric-Dipole-Moment (EDM) measurements employ low-energy atomic and precision-measurement techniques to measure the effects of elementary particle forces that affect the distribution of charge and mass in the nucleus, which is probed by the atomic electrons. Experiments and their interpretation strongly overlap atomic and nuclear physics in the experimental and theoretical problems presented. On the experimental side, the atomic EDM couples to electric fields while the magnetic dipole moment couples to magnetic fields requiring exquisite control and characerization of the magnetic fields. Measuring the tiny frequency shifts requires clock-comparisons and a large signal-to-noise ratio for frequency resolution much smaller than the linewidths, which are lmitied by observation times. To address the experimental challenges, I will discuss systematic effects related to magnetic fields and techniques of magnetometry and co-magntometery as well as optical pumping and related techniques that enhance signal-to-noise. I will also address the interpretation of atomic EDMs in terms of a set of low-energy parameters that relate to effective-field-theory coefficients, and I will empshaize the need for improved calculations from both atomic-theory and nuclear theory.