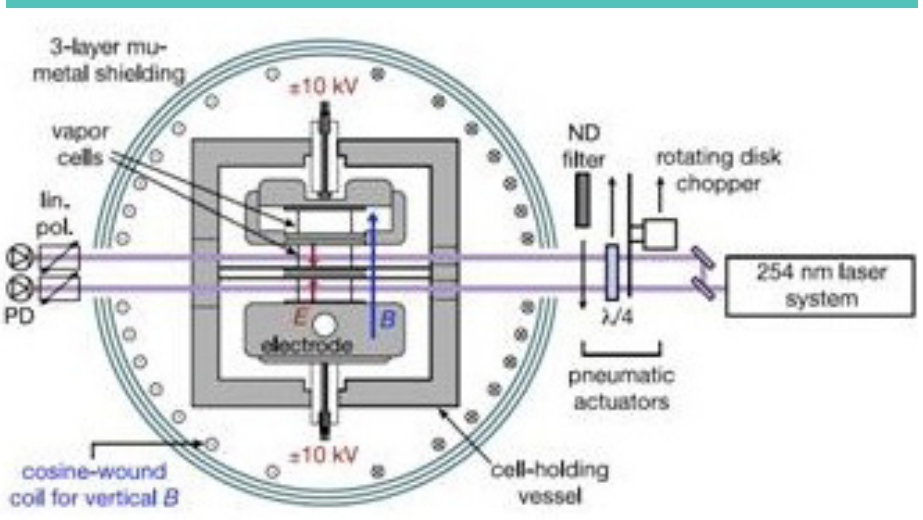
Boston University Physics Colloquium



Searching for Physics Beyond the Standard Model Through Dipole Interactions

I will review physics of the electric and magnetic dipole operators, first focusing onthe history, which is intimately tied to the development of the standard model, and then on the searches for physics beyond the Standard Model using the dipole interaction. The measurement of magnetic dipoles of elementary particles began with the experiments of Stern and Gerlach, which eventually told us that the g-factor for spin was 2. Refined investigations showed that $g_s > 2$, which resulted in the first "quantum loop" calculation by Schwinger. The magnetic anomalies, a=(g-2)/2 of the electron and muon are now known to a relative precisions of ±0.23 parts per billion and ±0.54 parts per million respectively, and there appears to be a several sigma difference between the measured muon anomaly and the Standard-Model value. The related electric dipole moment (EDM), which is forbidden by parity and timereversal symmetries (and by implication charge conjugation-parity), has been searched for down to sensitivities of $\sim 10^{-26}$ e-cm and $\sim 10^{-19}$ e-cm, with no hint of a signal. Since the Standard-Model EDM is $< 10^{-36}$ e-cm, the experimental observation of an EDM would signify the presence of new physics, and a new, non-Standard-Model source of CP violation, which is needed to explain the predominance of matter over anti-matter in the universe. Observation of the related Standard-Model forbidden process $\mu+ \rightarrow e+ \gamma$, or the spontaneous conversion of a muon to an electron in the field of an atomic nucleus, which could also go through a dipole operator, would unambiguously signify the presence of New Physics: Charged lepton flavor violation.

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March 2, 2010 (Tuesday) at 3:30pm (Refreshments at 3:15pm)

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