Quantum sensing for precision measurements: warm atoms and ultracold neutrons

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I will discuss two different approaches for performing precision measurements with spin-polarized quantum systems. Both are motivated by the quest to measure finite permanent electric dipole moments (EDMs), a signature of new CP-violating physics that is needed to explain the presence of matter in our universe.

Ultracold neutrons have effective temperatures in the milli-Kelvin range, and only one accessible internal degree of freedom. While perhaps more challenging to store and detect than ultracold atoms, they offer a pristine experimental platform for precision studies of CP-violation in the strong sector. I will discuss storage and Ramsey interferometry of ultracold neutrons, and introduce a new concept for spin- and energy-selective detection.

Warm vapors of closed-shell atomic species provide another avenue to measure EDMs and control systematic errors, this time with many internal degrees of freedom. Recent advances in ultraviolet laser technology have made it possible to envision novel measurement schemes, based on multiphoton excitation of noble gases from the ground state. I will discuss proof-of-principle measurements, and outline new possibilities for precision magnetometry using ultraviolet frequency combs.