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**Francis M. Pipkin Award Talk - Precision Measurement with Atom Interferometry**

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Atom interferometers are relatives of Young's double-slit experiment that use matter waves. They leverage light-atom interactions to masure fundamental constants, test fundamental symmetries, sense weak fields such as gravity and the gravity gradient, search for elusive "fifth forces," and potentially test properties of antimatter and detect gravitational waves. We will discuss large (multiphoton-) momentum transfer that can enhance sensitivity and accuracy of atom interferometers several thousand fold. We will discuss measuring the fine structure constant to sub-part per billion precision and how it tests the standard model of particle physics. Finally, there has been interest in light bosons as candidates for dark matter and dark energy; atom interferometers have favorable sensitivity in searching for those fields. As a first step, we present our experiment ruling out chameleon fields and a broad class of other theories that would reproduce the observed dark energy density.