Clock Atom Interferometry and Floquet Atom Optics

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Clock atom interferometry (AI) describes the coherent manipulation of an atomic two-level system separated by an optical frequency difference. It makes use of narrow transitions to metastable states commonly used in optical atomic clocks. In contrast to conventional AI, such transitions can be driven resonantly using a single laser beam, which has promising implications for the suppression of laser frequency noise [1], a fundamental limitation for some of the most challenging applications like gravitational wave detection and dark matter searches [2]. Additionally, clock AI offers a clear path towards highly efficient atom optics [3], potentially enabling many thousands of sequential pulses. We have recently demonstrated large momentum transfer interferometers with state-of-the-art momentum separation using broadband clock AI [4]. These results were enabled by a novel approach to compensate for differential Doppler shifts over an extensive frequency range. In this talk, I will present these recent advances in clock AI and introduce Floquet atom optics, a compensation technique applicable to any two-level system at arbitrary coupling strength, with broad application in coherent quantum control.

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