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Referencing an Oscillator to the Rest Mass of an Atom MICHAEL HOHENSEE, SHAU-YU LAN, BRIAN ESTEY, PEI-CHEN KUAN, DAMON ENGLISH, PAULI KEHAYIAS, HOLGER MÜLLER, Physics Department, University of California, Berkeley — Modern atomic frequency standards are referenced to transitions between two different internal electronic states of an atom, or trapped ion. The superior fractional stability demonstrated by trapped ion clocks over previous frequency standards stems from the fact that ion clocks are referenced to an optical ($\sim 10^{14}$ Hz), rather than a microwave ($\sim 10^{10}$ Hz) transition, while the underlying systematic shifts of the ion's energy levels are controlled at comparable levels in both systems. Still higher oscillation frequencies ($\sim 10^{25}$ Hz) are exhibited by the Compton-frequency ($\nu_C \equiv mc^2/h$) phase oscillations of a massive particle's wave function, but such frequencies are too fast to access directly. In this talk, we will describe the physics of how matter-wave interferometers can indirectly access these Compton-frequency oscillations, and be used to lock a real world RF oscillator to a specific subharmonic of ν_C.

Michael Hohensee
Physics Department, University of California, Berkeley

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