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Tests of the Equivalence Principle with Atom Interferometers MICHAEL HOHENSEE, HOLGER MÜLLER, University of California, Berkeley — To a first approximation, gravity influences the motion of particles by changing the local flow of time. This "gravitational redshift" has been tested to an accuracy of 7×10^{-5} by clock comparisons, and to 7×10^{-9} by matter wave interferometers. The wavefunction of a particle moving through spacetime is equivalent to a clock ticking at the Compton frequency mc^2/h which traces out the same path. We will demonstrate this equivalence, proving that atoms are clocks. Moreover, we will show that they place stringent bounds on spin-independent, renormalizable violations of General Relativity. Matter wave interferometers may be among the few experiments sufficiently sensitive to detect higher order effects that arise through the nonlinearities of General Relativity. These effects are known to exist from solar system observations, but have never been confirmed in experiments under controlled laboratory conditions.

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