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In brief: BEC to basics

Despite the enormous success of modern physical theory in describing the Universe, physicists still strive to prove physics wrong. At a fundamental level, this requires measuring physical constants such as the fine-structure constant, α (a measure of the coupling between charged particles and electromagnetic fields), as accurately and by as many different means as possible. New research suggests that recoil measurements of atoms in a Bose–Einstein condensate could soon allow such a duplicate determination of α and *h/m* (Planck's constant over atomic mass) with an accuracy of a few parts per billion.

Contrast interferometry using Bose–Einstein condensates to measure *h/m* and α
S. GUPTA, K. DIECKMANN, Z. HADZIBABIC & D. E. PRITCHARD
The kinetic energy of an atom recoiling due to absorption of a photon was measured as a frequency, using an interferometric technique called contrast interferometry. We used optical standing-wave pulses to create a symmetrical, three-path interferometer with a Bose–Einstein condensate. Its recoil phase, which is measurable with a single shot, varies quadratically with further recoils and is insensitive to errors from vibrations and ac Stark shifts. We have measured the photon recoil frequency of sodium with an accuracy of 7 parts per million, using a simple realization of this scheme. Plausible extensions should yield sufficient precision to determine *h/m* and the fine-structure constant, α, with parts-per-billion accuracy.
Physical Review Letters **89,** 140401 (10 September 2002)
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