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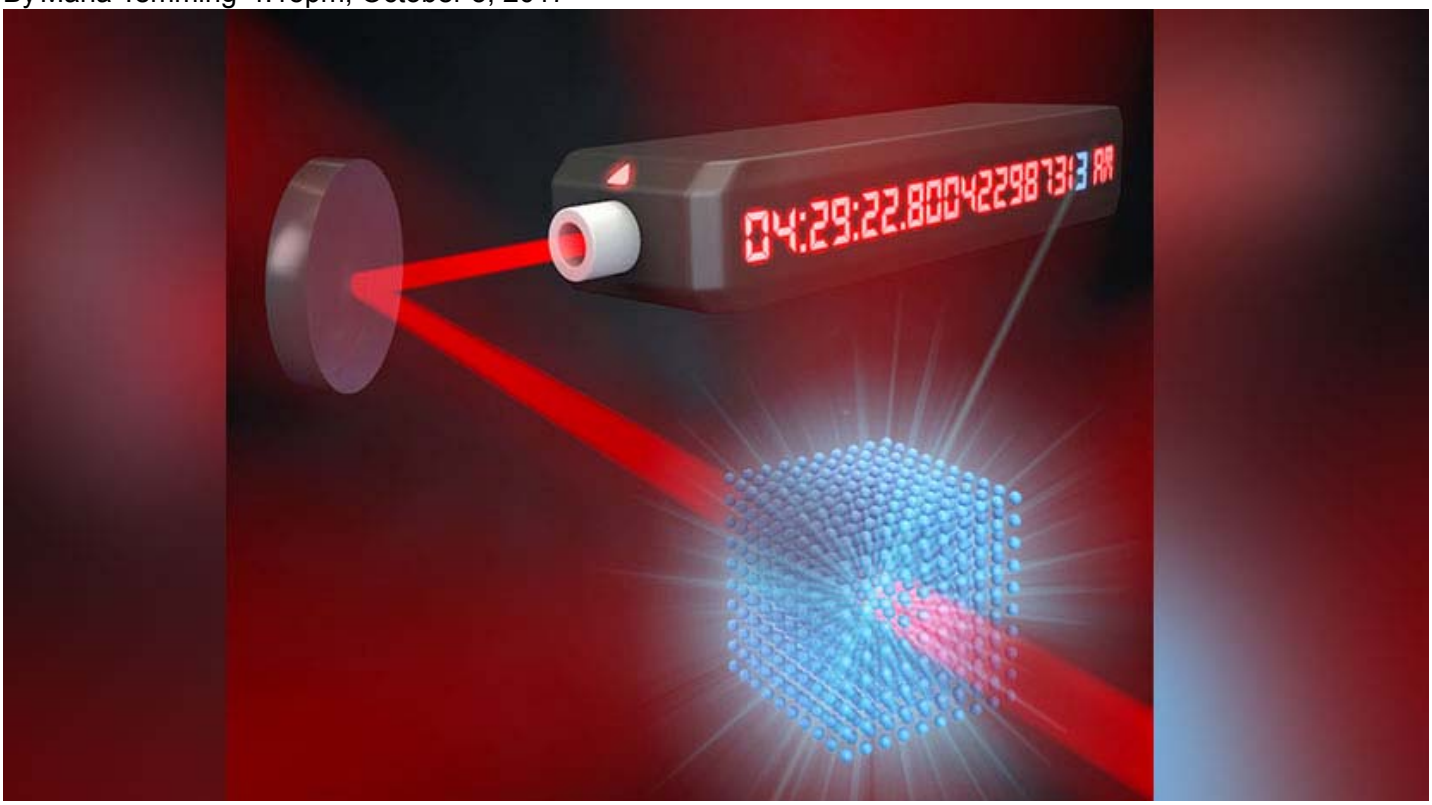
New atomic clock is most precise yet

Next test is whether the timepiece can translate precision into long-term accuracy

By Maria Temming 4:15pm, October 5, 2017



GRID'S GOT RHYTHM The world's most precise timepiece consists of strontium atoms in a grid, ticking off oscillations of laser light trillions of times per second.

The Ye group and Steve Burrows/JILA

A new model of atomic clock is now the world's steadiest metronome, with a tick rate about six times more precise than the previous record-holder.

This souped-up clock is an optical lattice — it measures time by counting the oscillations of light in a laser beam, which happen about 430 trillion times per second. Strontium atoms in the clock tick off each oscillation by absorbing and re-emitting this light.

Previous optical lattices held strontium atoms in a queue of pancake-shaped gas clouds, where atoms were liable to bump into each other, which could make them lose their rhythm (*SN: 10/22/11, p. 22*). That limited the precision of the clock's measurements.

In the new clock, described in the Oct. 6 *Science*, researchers meticulously assembled atoms in a gridlike structure — like eggs in egg cartons stacked on top of each other, explains study coauthor Benjamin Bloom, a

Citations

S.L. Campbell et al. A Fermi-degenerate three-dimensional optical lattice clock. *Science*. Vol. 358, October 6, 2017, p. 90. doi: 10.1126/science.aam5538.

Further Reading

A. Grant. An even more precise atomic clock. *Science News*. Vol. 187, May 16, 2015, p. 16.

A. Grant. How to build a quantum-entangled superclock. Science News Online, June 15, 2014.

A. Grant. Quantum timekeeping. *Science News*. Vol. 185, March 8, 2014, p. 22.

A. Yeager. Atomic clock sets world records for precision, stability. Science News Online, January 23, 2014.

C. Petit. The ultimate clock. *Science News*. Vol. 180, October 22, 2011, p. 22.

quantum engineer at Rigetti Computing in Berkeley, Calif. Thanks to weird laws of quantum mechanics, atoms locked in this rigid configuration can't jostle each other.

The arrangement helped to match the duration of each of the clock's ticks. After running the clock for an hour, each tick lasted the exact same amount of time as the rest, give or take a couple quadrillionths of a second. The clock's predecessor could guarantee its ticks were identical only down to about 10 quadrillionths of a second (*SN: 5/16/15, p. 16*).

But just because the newfangled clock boasts extremely consistent ticks doesn't necessarily mean it doesn't tick too fast or too slow, says coauthor Jun Ye, a physicist at JILA, an institute jointly operated by the National Institute for Standards and Technology and the University of Colorado, Boulder. To make sure this next-gen atomic clock keeps accurate time in the long run, Ye and colleagues must now compare it with other atomic clocks.

Extremely precise, accurate timekeeping can help scientists improve their definitions for standard units of measure. It can also help physicists spot incredibly small differences in how fast time elapses in various places, says Paul-Eric Pottie, a physicist at the Paris Observatory who was not involved in the study. This could help scientists catch gravitational waves rippling through space, since any variation could indicate that gravity is warping time differently in different spots.
