

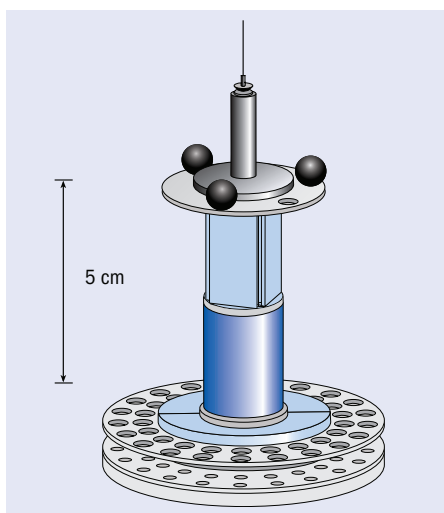
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Newton's law stays good below the dark-energy scale

Modern physics has invented all sorts of speculative ideas to help reconcile observations about gravity. Physicists have invoked dark energy to help explain accelerated cosmic expansion and they have postulated extra dimensions to explain the weakness of gravity compared with the other fundamental forces.

The required density of dark energy, which would have a repulsive gravitational effect, seems to be at the level of about 3.8 keV/cm^3 . This corresponds in natural units to about $85 \mu\text{m}$, so it could be that something interesting might happen to Newton's law of gravitation around that scale. The idea with extra spatial dimensions is that the extra dimensions are "curled up" or compactified, and so are not normally observed. In these theories, the gravitational force could become strong at distances smaller than the size of the largest compactified dimension.

To investigate these ideas, DJ Kapner and colleagues at the University of Washington in Seattle performed three experiments using a very precise torsion balance, testing the inverse-square law over a range of separations from 9.35 mm down to $55 \mu\text{m}$. Their results



A drawing of the torsion-balance instrument.

improve constraints on the inverse square law by up to 100, and show that the law holds down to $56 \mu\text{m}$, below the dark-energy scale. This also implies that a single extra dimension has to be smaller than $44 \mu\text{m}$.

Further reading

D J Kapner 2007 *Phys. Rev. Lett.* **98** 021101.

Composite is stiffer than diamond

Combining two materials can yield a composite with a Young's modulus (stiffness) far higher than either material alone. Now TJaglinski of Washington State University in Pullman and colleagues at Ruhr-University Bochum and the University of Wisconsin-Madison have made an extreme composite of barium titanate and tin.

The material has a Young's modulus that, depending on temperature, can be several times higher than that of diamond. Such extreme stiffness may also occur in nature and be involved in deep-focus earthquakes.

Further reading

TJaglinski et al. 2007 *Science* **315** 620.

Delayed-choice experiment confirms quantum mechanics

We are used to the quantum weirdness of the two-slit experiment, but things get much weirder than that. In the 1980s John Wheeler proposed a "delayed choice" gedanken experiment. This would make a two-way interference experiment (allowing either two paths or just one) a little more interesting by delaying the choice of whether or not to allow two paths until after a photon would have had to commit classically to one thing or the other.

Now, for the first time, Vincent Jacques and colleagues from the École Normale Supérieure de Cachan, East China Normal University and the Laboratoire Charles Fabry de l'Institut d'Optique have made an almost ideal practical realization of Wheeler's gedanken experiment. Their experiment uses a quantum random number generator to decide whether to allow one path or two, and makes a space-like separation between the photon entering the interferometer and the decision being taken. The results show that quantum mechanics triumphs over common sense yet again.

Further reading

Vincent Jacques et al. 2007 *Science* **315** 966.

Ocean waves drive the Earth's hum

You can't hear it, but the Earth is humming to itself at a seismic eigenfrequency of about 10 mHz and with an excitation energy equivalent to a magnitude 5.75 earthquake. There has been controversy in recent years as to whether atmospheric turbulence or ocean waves were driving the hum.

Now Spahr C Webb of Colombia University in New York has calculated the coupling between ocean waves and seismic modes and found that it reproduces the seismic spectrum of the hum. Interestingly, the mechanism depends on the weak nonlinearity of ocean waves and the interaction of waves with the shallow continental shelves.



The Earth – quietly humming to itself with ocean waves. (Courtesy NASA/Apollo 17.)

Further reading

Spahr C Webb 2007 *Nature* **445** 754.