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1. Quantized displacements

Vibrations of a microscopic silicon lever (nanomechanical oscillator) between discrete quantum-mechanical positions were observed in an experiment at Boston University. The experimental sample was lithographically prepared and placed in a magnetic field. Passing an alternating current through the lever caused it to vibrate at frequencies as high as 1 GHz — the maximum vibrational frequency ever experimentally achieved for a macroscopic object. Whereas at a high enough temperature the lever behaved as a classical object with a continuous set of spatial positions, at a temperature of about 1 mK only discrete displacements became possible for the lever.

Source: *Physics News Update*, Number 720
http://www.aip.org/pnu/2005/split/720-3.html

2. New exciplex molecules

The term exciplexes refers to molecules that can only be stable when electronically excited. Such molecules were first discovered in 1995 as a combination of two laser-excited cesium atoms and two helium atoms and have been observed in this form in liquid helium, on the surface of helium nanodroplets, and in cold helium gas. It was found that the exciplex molecule decomposes if an excited cesium atom makes a transition to its ground state. Now, P Moroshkin and his colleagues from the University of Fribourg in Switzerland have for the first time detected exciplexes in a sample of solid helium, with as many as seven helium atoms being coupled to a cesium atom in the molecule. The team doped a solid helium-4 matrix with cesium atoms at a temperature of 1.5 K and a pressure of 31.6 atm. Atoms in the sample were then excited by laser light and the fluorescence emission spectrum from the sample was recorded — to reveal two new signatures of bound molecular states in the far infrared region of the spectra: one from exciplexes previously observed in liquid helium, the other being due to new exciplex molecules shaped like a dumbbell containing seven helium atoms arranged on a ring around the cesium atom at the center.

Source: *Phys. Rev. Lett.* **94** 063001 (2005)
http://prl.aps.org

3. Ultrashort laser pulse

S Harris and his colleagues from Stanford University in the US have created a source of ultrashort laser pulses in the optical range (wavelength of 650 nm). The pulses last for just 1.6 fs, a record-short duration corresponding to as little as 0.8 of an optical cycle. The team decomposed Ti:Sapphire laser beam into harmonics by passing it through a cell containing deuterium gas, changed the harmonics' phases using a liquid crystal modulator, and then passed the beam through xenon gas. The nonlinear transformation undergone by the light resulted in a train of 1.6-fs pulses separated by intervals of 11 fs. By varying the phase shift, pulses with different time profiles were produced.

Source: *Phys. Rev. Lett.* **94** 033904 (2005)
http://prl.aps.org

4. Organic LEDs and fullerenes

Organic light-emitting diodes (LEDs) significantly improve their characteristics when doped with fullerene C_{60} molecules, researchers at Samsung's Corporate R&D Center in South Korea have shown. An organic LED contains a thin layer of organic material sandwiched between and receiving injected electrons and holes from two contacts and emits radiation due to the recombination of excitons (bound electron–hole pairs). Doping the organic layer increases the mobility of the holes in the hole-transport layer. J Y Lee and J H Kwon found that doping with 3% of fullerene molecules results in a five-fold increase in hole mobility, leading to a 30% increase in the luminance of the LED and doubling its service life.

Source: *Appl. Phys. Lett.* **86** 063514 (2005)
http://physicsweb.org/articles/news/9/2/11/1

5. Baryons in the Universe

It is currently believed that 95% of the mass of the Universe is in the form of dark matter and dark energy (or quintessence), entities whose nature is still unknown. The remaining 5% is ordinary matter, or baryons. Of the latter only half has been directly observed (in the form of stars and gas); the remaining half has thus far escaped detection. This puzzle may now have been solved by an NASA's Chandra X-ray Observatory study of the emission spectrum from the active galaxy Markarian 421. The scientists revealed the absorption lines of oxygen and nitrogen in the spectra of two intergalactic gas clouds 150 and 380 light years from Earth, thus suggesting that such clouds are the repository of the missing baryonic matter.

Source: *Nature* **433** 495 (2005);
www.nature.com

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