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Physics news on the Internet (based on electronic preprints)

1. Quantum teleportation

'Quantum teleportation,' i.e., the instantaneous transfer of properties between widely distant particles (specifically, the transfer of photon polarization) has been experimentally demonstrated by physicists at the University of Innsbruck, Austria. The technique used was that proposed in 1993 by Charles Bennet very much in the spirit of the Einstein – Podolsky – Rosen 1935 Gedanken (mental) experiment for demonstrating the incompleteness of quantum mechanics. Two photons traveling through a cubically nonlinear crystal become oppositely polarised, so that measuring the polarisation of one of them makes that of the other automatically known. According to quantum mechanics, photon polarisations prior to measurement are superposed of two senses of polarisation and photon quantum states are therefore undetermined. Once the polarisation of one photon is measured, the other acquires a determined quantum state instantaneously without undergoing any measurement procedure and irrespective of how far from the first it is. The causality principle is not violated since it is not known a priori exactly which of the two possible polarisation states is realised.

Source: http://www.nature.com

2. Electrical properties of nanotubes

Nanotubes are hollow carbon cylinders a few nanometeres in diameter obtained by condensing gaseous carbon in a vacuum or an inert gas. Theory predicts that, when in contact, two different nanotubes form a diode, i.e., a device which is unidirectional to an electric current. The contact region between two nanotubes is a ring of five or seven carbon atoms. While one tube acts as a metal, the function of the other is as a semiconductor. This theory has been confirmed experimentally by Alex Zettl's research group at the Lawrence Berkeley National Laboratory, USA. While previous experimental studies of nanotube electrical properties had nanotube-electrode connection problems, the present study succeeded by using a scanning tunnel microscope tip as an electrode. The resulting diode performs at room temperature and is much smaller than its ordinary silicon counterparts. Microelectronics applications are hoped for.

Source: http://www.lbl.gov/Science-Articles/
Research-News.html

3. Superhigh precision frequency measurements

Superhigh precision frequency measurements in the visible and ultraviolet portions of the electromagnetic spectrum have been carried out at the Max Planck Institute in Munich, Germany, by measuring beats between two close frequencies. The interval between 1s and 2s hydrogen states was determined to within 3×10^{-13}. This accuracy exceeds previous work by a factor of 100 and allows subtle quantum mechanical effects to be investigated.

Source: *Physics News Update*, Number 351
http://www.hep.net/documents/newsletters/pnu/
pnu.html#RECENT

4. Star shell observations

A shell of gas expelled by a star in its conversion to a white dwarf has been observed using the Hubble Space Telescope, a preview of what is likely to happen to our Sun in about 5×10^9 years. Among many details revealed by the Hubble's pictures are unexplained dust disks which pinch the outflowing gas and are probably due to the presence of invisible companions. The hot interior of the shell, formed at the final stage of the explosion, is ejected with a velocity of more than 1500 km s^{-1}. The glowing 'red blobs' placed along the edge of the shell are probably shock-wave-compressed clouds of the gas that surrounded the star prior to the explosion. Also observed were jets of high-speed particles shot in opposite directions from the star. Further observations of both the star itself and the shell are planned. The observation has far-reaching implications for the theory of stellar evolution.

Source: http://www.stsci.edu/

Compiled by *Yu N Eroshenko*

Uspekhi Fizicheskikh Nauk **168** (1) 85 (1998)
Translated by E G Strel'chenko