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Physics news on the Internet (based on electronic preprints)

1. Superconducting magnet

A 13.5-T superconducting magnet has been built at the Berkeley National Laboratory thus surpassing the previous high of 11.03 T set by Dutch researchers in 1995. Today's accelerator magnets usually employ a niobium-titanium alloy; an example is the magnet planned for the Large Hadron Collider currently under construction at CERN. Niobium-titanium alloys cannot produce a field above 10 T, however. The new magnet built by Scanlan's team of Berkeley Lab has its coils wound of niobium-tin wire. The magnet is about 1 meter in both length and diameter and is cooled to 1.8 K. In building the magnet, the group overcame many technical problems associated with superconductor destruction due to cooling processes and high magnetic fields. The machine, viewed as a model for superpower magnets for next generation accelerators, makes it possible to examine the effects the magnetic field has on superconducting materials, of interest for even stronger future magnets.

Source: http://www.pnl.gov/er_news/toc.html

2. Polymer chain spring constant

The spring constant of a polystyrene chain about 50 nm long has been measured at the Niels Bohr Institute in Denmark. The constant is found to be 2.5×10^{-4} N/m, which is more than theoretically predicted. The objects studied were micron-size beads spontaneously tethered to a glass plate by means of the polymer chain. The spring constant was determined by measuring the distance between the bead and the plate in water solutions. Previous measurements were limited to polymer chains such as DNA molecules, which are much stiffer and tens or hundreds of times longer.

Source: *Physics News Update*, Number 352
http://www.hep.net/documents/newsletters/pnu/

3. Quantum teleportation†

Analogous to, but somewhat differently from, A Zeilinger's team at the University of Innsbruck (see the preceding issue), F De Martini and his coworkers in Rome have performed quantum teleportation experiments. Two state-correlated particles, specifically phonons, are initially produced in each case, of which one stays with the sender while the other is sent to the receiver. Apart from these two, a third particle, whose state is the information to be transmitted, is involved in the experiment. In the Austrian experiment the second and third particles are two different phonons, in Rome they are one and the same photon, of which two different characteristics, the polarization and the direction of motion, are used in the experiment. While the measurement of the common characteristic of the second and third particles by the sender uncontrollable changes the state of these two particles, exactly the same change is also undergone by the first particle, which could be arbitrarily far away from the first two at the moment of measurement. By measuring the state of the first particle the receiver obtains the quantum part of the information, and the sender must send the receiver the results of his, the sender's, measurements (i.e., the classical part of information) by normal communication channels in order for the receiver to read the message. It is with the aid of this classical part that the receiver transforms his measurement into the initial message.

Source: http://www.nature.com
Nature **390** 575 (1997)

† The reader is referred to a monograph by B B Kadomtsev *Dynamics and Information* (http://ufn.ioc.ac.ru/books/kadom.html), for more on 'quantum teleportation' theory and the interaction of EPR-correlated particles in Yu L Sokolov's experiments.

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4. Infrared background radiation

The first ever definitive data on the metagalactical component of the infrared background radiation have been obtained from NASA's Cosmic Background Explorer (COBE). The difficulty with such measurements is in separating out the strong infrared radiation coming from Solar System and Galactic objects. The background radiation was found to be uniform. It is argued that it was emitted from distant galaxies and has since been repeatedly scattered and re-radiated by interstellar dust. From the background radiation intensity, the stellar energy per unit volume emitted over the history of the Universe can be estimated, leading to the conclusion that interstellar dust clouds keep many young stars of the Universe hidden from the terrestrial observer.

Source: http://wwwssl.msfc.nasa.gov/newhome/headlines/

5. Supernovae at cosmological distances

Investigation of deep-space Ia supernova explosions continues at Berkeley Lab. Supernovae of this type are special in that they have very close parameters (thus providing a 'standard candle power') and are well studied (by now, 40 of 65 so far discovered have been analyzed). The most distant supernovae exploded seven billion years ago. The body of data suggests that the Universe is open and will expand forever and that Einstein's cosmological Λ term probably has to be invoked in astrophysics.

Source: http://www.lbl.gov/Science-Articles/

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