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Physics news on the Internet (based on electronic preprints)

1. Radio frequency photonic crystals

Photonic crystals, earlier designed for optical and infrared frequencies, are two-dimensional structures with a space-periodic dielectric constant, in which the so-called band gap allows precise control of the frequencies and directions of electromagnetic waves propagating in the crystal. While such materials are expected to have telecommunication and laser applications, their three-dimensional versions are not yet available for optical and infrared uses. For radio frequencies, a three-dimensional crystal is reported to have been developed by E Yablonovitch and D Sievenpiper of the University of California, Los Angeles, in the form of a high-capacitance high-inductance layered conducting circuit. The device, a system of mutually perpendicular metal strips, has a band gap spanning 15 to 30 GHz and can operate at wavelengths of about 2 cm, which is 5 times its size.

Source: http://ojps.aip.org/prlo/top.html
Phys. Rev. Lett. March 30, 1998

2. Quantum dots

Unusual behaviour of electrons near the quantum dot has been found by R Ashoori and his colleagues at MIT using a potential well formed by three semiconductor layers and a metal electrode. Applying a voltage to the latter enables electrons to be confined in the well and the number of arriving electrons to be determined to the accuracy of a single electron. For quantum dots 0.6 to 18 microns across it is found that as the electric potential is increased, surprisingly, a significant part of the electrons come to the well by pairs rather than one by one. The reason for this pairing phenomenon is not clear.

Source: *Physics News Update*, Number 364
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

3. Two phases of liquid water

The presence of two phases in supercooled water was discovered by an international team of American and Japanese researchers. Water can remain liquid at negative temperatures if it is very pure or under high pressure. For temperatures below 220 K it is found that ice IV, one of the 14 known ice varieties, has two widely distant melting pressure points, implying the existence of two phases in liquid water. It is believed that one of these has its molecules much more clustered than the other. The existence of two phases is likely to affect water properties at room temperatures and pressures.

Source: *Physics News Update*, Number 365
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

4. The Lense – Thirring effect

According to the theory of general relativity, the Earth drags all objects in its vicinity around itself as it rotates. This extremely small effect, predicted by J Lense and H Thirring in 1918, has been observed by an international team of scientists from NASA and a number of European and American universities. Specifically, high precision orbit measurements have been made over the period of 3 years for the LAGEOS I and LAGEOS II satellites using the retardation of reflected laser signals for their location. Using a very accurate model of the gravitational field of the Earth, a 2-meter-per-year orbit shift towards the Earth's rotation direction was observed, which is within 20% of the prediction.

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

5. White dwarf in the Large Magellanic Cloud

A young white dwarf a mere 40 million years old has been discovered using the Hubble Space Telescope in the star cluster NGC 1818 located 164000 light years away in the Large Magellanic Cloud. White dwarfs form when a massive star ejects the outer layers surrounding its dense core. Prior to such an ejection, the progenitor star of the young dwarf is estimated to have been 7.6 times as heavy as the Sun. Until now it has been believed that stars with masses greater than 6 solar masses break down completely without giving rise to white dwarfs. A new lower bound on the progenitor star mass will provide further insight into the evolution of galactic star clusters.

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

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