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Physics news on the Internet (based on electronic preprints)

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1. Negative index of refraction

In 2000, physicists at the University of California at San Diego created a material with negative values of electric permittivity and magnetic permeability in the microwave frequency range (see *Usp. Fiz. Nauk* **170** 552 (2000) [*Phys. Usp*. **43** 520 (2000)]) for more details]. This property, however, only occurred for an electromagnetic wave propagating in one dimension. Now, the same group have developed a material with anomalous properties in a plane, enabling experiments on the refraction of light and bringing out the subject of a negative index of refraction, $n < 0$. The new material is an array of copper wires and rings embedded in a fiberglass matrix and arranged in a configuration specifically designed to yield $n < 0$. The distinguishing features of $n < 0$ materials are (1) that the refraction of electromagnetic waves at their boundary occurs opposite to what is required by Snell's law, and (2) that the phase velocity of a wave is opposite to its group velocity. A theoretical study of the properties of $n < 0$ materials was performed in the 1960s by V G Veselago (current e-mail address: infomag@glasnet.ru) of the P N Lebedev Physics Institute (see *Usp. Fiz. Nauk* **92** 517 (1967) [*Sov. Phys. Usp*. **10** 509 (1968)]).

Source: http://www.unisci.com

2. Metallic oxygen

Metallic oxygen in the liquid molecular state has been created at high temperature for the first time by a team at the Lawrence Livermore National Laboratory in the USA. Previously, metallic properties were only seen in solid oxygen and at low temperatures. In the new experiment, a strong shock wave generated in a reservoir of liquid oxygen produced a pressure of 1.2 Mbar and a temperature of 4,500 K for a period of 100 – 200 ns as it passed through the liquid many times bouncing back and forth between the walls. The presence of a metallic phase was detected by measuring the electrical resistance of the oxygen. The technique used was similar to that by which metallic hydrogen was obtained at the same laboratory in 1966 (*Usp. Fiz. Nauk* **166** 583 (1996) [*Phys. Usp*. **39** 545 (1996)]).

Source: *Phys. Rev. Lett*. **86** 3108 (2001)
http://prl.aps.org

3. A photon transistor

J Tominaga and his colleagues in Japan have created a laser analogue of the usual semiconductor transistor, in which a red laser beam modulated by a certain signal controls the intensity of another, blue beam. Both beams were aimed at a thin film, made up of alternating plastic and silver-oxide layers, on whose surface collective charge excitations — known as plasmons — were produced under the action of the light. Besides, the red light created silver particles which interacted with the plasmons, and as a result of the exchange of energy between the plasmons and the red radiation, a copy of the input blue signal having 60 times its intensity, emerged.

Source: *Physics News Update*, Number 534
http://www.aip.org/physnews/update/

4. A double quasar

Astronomers using the Hubble Space telescope discovered a pair of quasars with an angular separation of 0.3 arcseconds. With a redshift of 0.848, this corresponds to a spatial separation of only 2.3 kpc — as compared to 15 kpc or more in the quasar pairs observed previously. From the large difference in the spectra of the pair components it was concluded that the quasar is truly double — unlike multiple images of one and the same object produced by gravitational lensing. The probability of accidental projection along the line of sight is only $1/10^6$. The quasar is believed to have been created by the merger of two galaxies followed by the mutual approach of supermassive black holes located at their cores.

Source: http://xxx.lanl.gov/abs/astro-ph/0104236

5. Neutrino flux variations

The existence of periodic variations in the solar neutrino flux has been the subject of discussion over the years. Evidence for 11-year variations — which cannot be considered conclusive, though — has been observed in a chlorine experiment by Davis (see *Usp. Fiz. Nauk* **166** 1030 (1996) [*Phys. Usp*. **39** 1083 (1996)]). Now Stanford and NASA researchers using a new data processing technique have detected solar neutrino flux variations with a period of 27 – 28 days in their (gallium-based) GALLEX/GNO experiments. This is exactly the time it takes the Sun to turn once on its axis. Flux variations with periods of 11 years, half a year, and 27 days are predicted for a neutrino with a magnetic moment. This moment might interact with the Sun's magnetic field, which varies with the same periods relative to the Earth. This might give rise to spin precession and convert normal neutrinos into right-hand ones, which do not participate in the weak interaction and so are not recorded in existing detectors. The shortfall of neutrinos from the Sun could also be explained by this mechanism.

Source: http://www-leland.stanford.edu/dept/
news/newsfs.html

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