

PACS number: **01.90. + g**

Physics news on the Internet (based on electronic preprints)

DOI: 10.1070/PU2002v045n07ABEH001182

1. Neutron phase shift

H Rauch and his colleagues at the Atomic Institute of the Austrian Universities (Vienna, Austria) and the Institut Laue – Langevin (Grenoble, France) performed an experiment which demonstrated for the first time a phase shift of neutrons passing through a narrow slit. The effect was predicted theoretically by J M Levy-Leblond and D Greenberger in the late 1980s. The motion of neutrons that have passed through a narrow horizontal slit is quantized in the vertical direction, thus leading to a phase shift in the direction of motion. The experiment used an array of 186 slits 22.1-μm in width and a neutron beam from a nuclear reactor. The beam was split into two components, one of which was sent through the slit system. The phase shift was measured from the interference of the beams in a neutron interferometer and found to be in good agreement with theoretical evaluations. Earlier in 2002, discrete quantum states of neutrons in a gravitational field were observed by another team of researchers at the Institut Laue – Langevin [*Usp. Fiz. Nauk* **172** 220 (2002) *Phys. Usp.* **45** 233 (2002)].

Source: *Nature* **417** 630 (2002); www.nature.com

2. Measuring the orbital angular momentum of a photon

Along with the spin angular momentum, photons are characterized by an orbital angular momentum. M Padgett and his colleagues at the University of Glasgow (Scotland) have developed a technique for measuring the orbital momenta of individual photons. Using a sequence of interferometers they split a beam of light into two, with odd and even orbital angular momenta of photons, respectively. Repeating this procedure for both of these beams enabled researchers to distinguish photons by four states of their orbital momentum. Measurements were even possible with such low initial beam intensities that only one photon reached the detector. The experiment may be useful in developing new quantum communication systems.

Source: *Phys. Rev. Lett.* **88** 257901 (2002)
http://prl.aps.org

3. Crystalline Möbius strip

Researchers at Hokkaido University (Japan) have succeeded in fabricating one-surface Möbius-strip-like crystalline structures. These structures are single crystals having neither seams nor any other defects. Thin crystalline niobium selenide ribbons had been synthesized by heating selenium and niobium powders in a vacuum-tight quartz tube. The Japanese team improved the common technique of synthesizing crystals by introducing a temperature gradient, with the consequence that selenium could be in the gaseous and liquid phases at one and the same time in the tube. The surface tension of the liquid led to the formation of various closed ring configurations, Möbius strips among them. The unusual crystals may find application in the study of topological effects in quantum mechanics.

Source: *Nature* **417** 397 (2002); www.nature.com

Uspekhi Fizicheskikh Nauk **172** (7) 812 (2002)
Translated by E G Strel'chenko

4. Verification of special relativity

According to the special theory of relativity, the speed of light is independent of the direction and magnitude of the observer's velocity **v**. The independence of the speed of light from the magnitude of **v** has been demonstrated recently with a record accuracy in the experiments at the Universities of Konstanz and Düsseldorf in Germany [*Usp. Fiz. Nauk* **172** 220 (2002)*Phys. Usp.* **45** 233 (2002)]. The same team has performed a new experiment to verify the direction independence of the speed of light (a modern version of the Michelson – Morley experiment), whose accuracy, 1.7×10^{-15}, is the best achieved to date and three times better than earlier. The researchers studied a standing electromagnetic wave in a liquid-helium-cooled cavity made of sapphire crystal. Two such resonant cavities were oriented at right angles to each other. The whole setup could be rotated, thus enabling the researchers to establish the directional independence of the speed of light.

Source: *Physics News Update*, Number 590
http://www.aip.org/physnews/update/

5. Dark galaxies

The theory of galaxy formation has long been plagued by a problem concerning small galaxies, i.e. the satellites of large ones: according to numerical simulations, their number should be much larger than astronomical observations reveal. It was assumed that the lacking satellites exist in the form of concentrated dark matter (hidden mass) which is unseen because the stars in it are very few or simply absent. This hypothesis has now been confirmed by gravitational lensing observations carried out by N Dalal of the University of California at San Diego and C Kochanek of Cambridge, Massachusetts. N Dalal and C Kochanek have observed 7 galaxies that act as gravitational lenses for still farther galaxies. Based on the configurations of additional images due to lensing, the researchers came to the conclusion that 6 of the 7 lensing galaxies have numerous (satellite-like) dwarf galaxies around them and that for each of these six the dwarf galaxies have about 2% of the central galaxy's mass. Our Galaxy also may be expected to have many invisible satellites. The star formation process in them may have proved inefficient due to the low temperature (low virial velocity) of the galactic gas.

Source: http://arXiv.org/abs/astro-ph/0111456

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