

Physics news on the Internet (based on electronic preprints)

1. Quantum decoherence

S Haroche and his colleague from Paris have conducted experiments aimed at quantitative study of collapse of a superposition of quantum states under the action of external perturbations. In the experiments, Rydberg atoms were used. They were sent through a set of electromagnetic resonators with properly chosen resonance frequencies. The transition between atom states with quantum numbers 50 and 51 was studied; this transition corresponds to a frequency of 50 GHz. With one of resonators driven slightly out of phase, the coherence of atoms leaving the resonators turned out to be substantially impaired. The scientists studied the quantitative characteristics of this effect in detail. The experiments were implemented very nicely and demonstrate the possibilities of modern experimental methods. The researchers believe that similar techniques will make it possible to carry out quantum non-perturbing measurements. In particular, this may allow investigations of super-high-frequency photons without attenuation. Quantum non-perturbing measurements are especially interesting in that the decoherence may occur under the influence of the Universe's microwave background radiation and, possibly, still unknown fundamental interactions.

Source: http://publish.aps.org/indexjrnls.html
Brune M et al., *Phys. Rev. Lett.* **77** 9 December (1996)

2. Ice on Moon

Researchers from NASA have reported that they obtained the evidence of water ice presence at the Moon's south pole. This conclusion was drawn on the basis of results of radiolocation investigations of lunar surface in 1994. The intensity and polarisation of signal reflected by the south pole do not correspond to those of signal reflected by lunar bare rock, and by all probability suggest the presence of water ice in the polar region. The effect is not observed for the Moon's north pole. In theory, the possibility for the ice existence on Moon was considered 35 years ago. The corresponding hypothesis had exploited the fact that the Moon's south pole, because of its orientation, is poorly exposed to the Sun. When a comet impacts the lunar surface, the ice contained in the comet vaporises; it then migrates to the south pole and is trapped there in deep craters.

Source: http://www.skypub.com./news/news.html
Sky & Telescope's Weekly News Bulletin, December 6, 1966

3. Surface of ice

It is known that ice possesses a uniquely low coefficient of friction. For long this was explained by melting of the ice surface layer under the action of pressure. However subsequent investigations showed that the role of pressure in ice melting is not very important. The surface layer of ice remains liquid down to a temperature of $-43\,^{\circ}C$ independently of the pressure applied. Yet the processes taking place in the ice surface layer were unclear. A research team from the Berkeley National Laboratory headed by V Hove and G Somorjai has conducted new investigations which revealed a detailed picture of behaviour of molecules in the ice surface layer under low temperatures. A sample of ice of very high purity was investigated. It was obtained by vaporising water molecules on a platinum subtract under a deep vacuum. The scientists observed the diffraction of low-energy electrons on the sample molecules. It was found that the ice surface layer remains quasi-liquid down to a temperature of $-183\,^{\circ}C$. Surface molecules form a crystalline structure, but they continue to vibrate with very high amplitudes as compared to those of molecules in deeper layers. According to one of hypotheses, a liquid film on the surface of the Antarctic ice is capable of catalysing a long series of chemical reactions which ultimately lead to the formation of ozone holes over the Antarctic continent.

Source: http://www.lbl.gov/Publication/Currents/
Berkeley Lab Currents, December 6, 1996

4. Repeated gamma-bursts

Despite the discovery of gamma-bursts dates back as far as nearly 30 years, the nature of gamma-burst sources remains unknown. Gamma bursts are manifested as bursts of gamma-radiation with duration of several seconds and energy of 0.1 – 1 MeV, distributed isotropically over the sky. Modern space instruments detect one burst per day on average. There exist three main classes of gamma-burst models: (1) Gamma-bursts arrive from the periphery of the Solar system; (2) Gamma-bursts are generated in our Galaxy and are caused by physical processes taking place in magnetospheres or nuclei of neutron stars; (3) Gamma-bursts are of cosmologic origin. For more details, see *Uspekhi Fizicheskikh Nauk* **166** 743 (1996) [*Physics – Uspekhi* **39** (7) 695 (1996)].

In November 1996, four space-based detectors recorded a pair of extraordinary gamma-bursts. Their distinctive feature is that they came from the same point of the sky (within the instrumental accuracy) with an interval of only 2 days. The probability of mere coincidence is extremely low and with high reliability one may argue that both gamma-bursts were generated by the same source. If this conclusion is true, then it excludes a substantial part of models of gamma-burst origin, since many of them are principally incapable of explaining the recurrent gamma-bursts on scales of a few days. In particular, it throws doubts on one of the most popular cosmological models which explains gamma-bursts by collision of neutron stars in close binary systems in halos of distant galaxies. Nevertheless, each of the three classes mentioned above contains models that are compatible with the new observational evidence. Among other features of the detected bursts, the very long duration of the second burst (about 23 minutes) deserves special mentioning.

Source: http://www.ssl.msfc.nasa.gov/

Composed by *Yu N Eroshenko*

Uspekhi Fizicheskikh Nauk **167** (1) 56 (1997)
Translated by S D Danilov