

PACS number: **01.90.+g**

Physics news on the Internet (based on electronic preprints)

1. News from Jefferson Laboratory

A new machine, called the Continuous Electron Beam Accelerator Facility, or CEBAF for short, has been built at Newport News, Virginia, USA. It is able to accelerate continuous streams of electrons to energies of 4 GeV, and it is planned to raise the energy to 8 GeV in the future. The accelerated electrons are then diverted to collide with targets containing nuclei. Electron collisions with nuclei have been found to eject protons from nuclei at a greater rate than predicted by the existing theories on the subject. The opinion is advanced that this effect can be properly explained if one takes into account the quark substructure. Some indications to its existence were supplied by recent experiments [see *Physics – Uspekhi* **39** 312 (1996)].

Source: *Physics News Update* No. 318
http://www.hep.net/documents/newsletters/newsletters.html

2. Collapse of Bose – Einstein condensate

At a meeting of the American Physical Society, R Hulet of Rice University reported the results of a study into Bose-Einstein condensate of lithium atoms. According to him, when the number of atoms in a magnetic trap reaches a threshold (which is about 1400 atoms), a miniature explosion takes place: the condensate is compressed at a very high rate, and the cloud of atoms spreads in all directions. This phenomenon corresponds to the theoretically predicted effect of macroscopic quantum tunneling. When close together, lithium atoms attract one another progressively stronger, instead of repelling one another as the atoms of most other elements do. When there are too many atoms in the trap, the condensate collapses from a low-density to a high-density quantum state immediately after it is formed. The collapse is accompanied by release of heat which causes the condensate to blow apart. This collapse and expansion looks qualitatively similar to what happens when a supernova is triggered, but there the attraction of particles is due to gravitation.

Source: *Science*
http://sciencenow.sciencemag.org/

3. Measuring small heat fluxes

M Roukes and his colleagues at Caltech have developed a technique whereby one can investigate heat fluxes at a level close to single phonons (quasi-particles which correspond to elementary vibrations of the crystal lattice). The key element of their setup is a plate $1-3$ μm on a side and 100 nm thick, fabricated from a monocrystalline GaAs. Heat is applied to the plate, and the subsequent flux of heat is then measured by a special thermometric arrangement. As measured by their setup at 10^{-5} K, the heat capacity of the sample was found to be 10^{-22} J K^{-1}. Currently, the researchers are improving their gear so as to reduce the transfer of heat to the sample from the instrumentation itself. With the new scheme, Roukes expects to be able to track the movement of single phonons with an energy of about 10^{-26} J.

Source: *Physics News Update* No. 320
http://www.hep.net/documents/newsletters/newsletters.html

4. Anisotropy of the Universe?

In the presence of a magnetic field, the cosmic plasma is a gyrotropic medium — the plane of polarization of radio waves propagating through it rotates (the Faraday effect). B Nodland of the University of Rochester and J P Ralston of the University of Kansas have discovered that the plane of polarization of radiation from distant radio galaxies experiences an additional rotation. The radiation is polarized in the galaxies by the synchrotron mechanism. Upon subtraction of the ordinary Faraday rotation, the remaining rotation turns out to be proportional to the distance to the galaxy as found from the redshift. Of the 160 galaxies studied to date, 71 have been found to have redshifts $z > 0.3$. This implies the cosmological origin of the phenomenon. The biggest surprise is the correlation between the additional rotation and the direction to the galaxy. The angular dependence has a dipole character when reckoned from some preferred direction. As the researchers believe, the new effect may suggest that the Universe is anisotropic on a large scale.

The preferred axis deviates from the direction of anisotropy of the cosmic background radiation due to the Sun's cosmological motion relative to the Universe by an amount comparable to the statistical error. Therefore, R N Bracewell and V R Eshleman at Stanford University hypothesis that the cause for the additional rotation of the plane of polarization likewise lies in the Sun's cosmological motion. However, the mechanisms that could be responsible for such additional rotation remain unclear.

Source: http://xxx.lanl.gov/astro-ph/9704196

5. Antimatter in the Galaxy

With assistance from the Compton Gamma Ray Observatory (CGRO), two large clouds of positrons, or antimatter electrons, have been discovered in our Galaxy. The annihilation of positrons and ordinary matter around them gives rise to gamma radiation, which was detected. The first cloud is located near the center and along the plane of the Galaxy. It is a fountain of antimatter expelled from the region that surrounds the Galaxy's center. The origin of the fountain is unclear. According to one hypothesis, it can be related to the massive star formation taking place near the large black hole at the center of the Galaxy. The other positron cloud is well off the galactic plane. It may be caused by the explosions of young massive stars.

Source: *NASA Press Releases*
http://www.hq.nasa.gov/office/pao/NewsRoom/releases.html

Composed by *Yu N Eroshenko*

Uspekhi Fizicheskikh Nauk **167** (6) 688 (1997)
Translated by B V Kuznetsov