

PACS number: **01.90.+g**

Physics news on the Internet (based on electronic preprints)

DOI: 10.1070/PU2005v048n04ABEH002321

1. Bose – Einstein condensate of chromium atoms

T Pfau and his colleagues from the University of Stuttgart, Germany have for the first time created a Bose – Einstein condensate from a gas of chromium atoms. Unlike all the other Bose-condensed atoms, chromium atoms possess a very high magnetic moment of 6 Bohr magnetons in their ground state $^7S_3$, making them interact 36 times more strongly compared to alkali atoms. Using evaporative cooling of ^{52}Cr atoms within a crossed optical dipole trap, the researchers observed Bose – Einstein condensation of more than 50,000 chromium atoms at a temperature of 625 nK. A chromium BEC can find practical applications in nanolithography and can also be used to study long-range magnetic dipole – dipole interactions between condensed atoms. In particular, the researchers believe that theoretically predicted phase transitions might be observed using the chromium BE condensate.

Source: http://arXiv.org/abs/cond-mat/0503044

2. Interfering electrons

Researchers from Austria, Germany, and Bosnia and Hercegovina have carried out at the Technical University of Vienna a new version of the classical double-slit quantum-interference experiment, in which single electrons interfere in time – energy rather than in position – momentum domain. In their experiment, a train of ultrashort (a 5 fs long, a few-cycle) linearly polarized pulses from a Ti : sapphire laser, all practically identical and having the same phase, intersected an argon gas jet inside a vacuum apparatus, and the electrons from the ionized argon atoms were detected by two opposing time-of-flight detectors lying in the polarization plane. If a laser pulse contained two maxima and one minimum of oscillations of the electric field, then an interference pattern was observed at one of the detectors (namely, at that toward which the two maxima are directed). Changing the phase of the pulses by $\pi/2$ caused the pattern to be seen at the other detector. The explanation of the interference effect is that any of the two field oscillation maxima could produce ionization and that the two ionization paths interfered quantum mechanically with each other. The interference pattern was observed in the electron energy spectrum.

Source: http://physicsweb.org/articles/news/9/3/1/1

3. Quantum correlation of three macroscopic objects

Recently, quintuplets of photons have been observed in the so-called quantum entangled states (see *Usp. Fiz. Nauk* **174** 919 (2004) [*Phys. Usp.* **47** 854 (2004)]). For macroscopic objects, however, quantum correlations are much harder to obtain. Until recently, only two macroscopic objects representing a quantum information qubit have been obtained entangled. Now, a University of Maryland team has for the first time observed a quantum-correlated state of three macroscopic objects: a niobium inductor – capacitor (LC) circuit and a pair of Josephson junctions, each a sandwich consisting of two superconductors with an insulating layer between. At low temperature, quantized oscillations of electric current were seen to be transferred along the circuit, with all three devices being in correlated quantum states as determined indirectly from the way the Josephson junctions scatter microwave radio pulses. Studies like this are important in creating future quantum computers.

Source: *Physics News Update*, Number 722
http://www.aip.org/pnu/2005/split/722-2.html

Uspekhi Fizicheskikh Nauk **175** (4) 436 (2005)
Translated by E G Strel'chenko

4. Plasma in collapsing bubbles

Neither experiment nor theory has yet provided the definitive explanation for sonoluminescence — a phenomenon in which gas bubbles in liquid emit light when subjected to ultrasound. The phenomenon is powered by the spherical shock wave generated by the collapse. While some data suggest that the light is generated by hot plasma in the bubbles (*Usp. Fiz. Nauk* **171** 796 (2001) [*Phys. Usp.* **44** 759 (2001)]), others indicate chemical reactions as the reason (*Usp. Fiz. Nauk* **172** 930 (2002) [*Phys. Usp.* **45** 910 (2001)]). Thus far, no evidence has been found to confirm reports of nuclear 'sonofusion' in deuterated liquid acetone (*Usp. Fiz. Nauk* **172** 473 (2002) [*Phys. Usp.* **45** 433 (2002)]). Now, the first reliable evidence for the presence of plasma in bubbles has come from a new experiment by K Suslick and D Flannigan of the University of Illinois, who studied the way bubbles filled with argon and xenon collapse in sulphuric acid. The analysis of the emission spectrum from single bubbles revealed the presence of plasma with temperatures up to 20,000 K in the bubbles. Because Suslick and Flannigan's experiment differs considerably from previous experiments in the composition of the medium, its results cannot be extended to other cases. Besides, the presence of plasma is a prerequisite but not a sufficient condition for fusion reactions: much higher temperatures are also required.

Source: *Nature* **434** 52 (2005); www.nature.com

5. High-power radio bursts

Observations with the NSF Very Large Array (VLA) radio telescope in New Mexico gathered in 2002 revealed a series of five high-power bursts of 0.33 GHz radio emission in the direction of the center of the Milky Way galaxy. The bursts were 77 minutes apart and each was 10 minutes in duration, the signal in-between not exceeding the background level. The new source of the radio bursts, which was given the name GCRT J1745-3009, had never been seen before nor has it been seen since the detection of the five bursts. Nor has an associated X-ray or optical radiation been detected from it. The distance to this transient source is unknown, so its location can be anywhere from close to the Sun to the Galactic center (in the latter case its energy density should be very high). Because similar signals have never been detected from the cosmos, GCRT J1745-3009 may either belong to a new class of radio sources or be yet another mode of activity of already known objects. The radio pulses might have been generated by a brown dwarf, but their characteristics are strongly different from those of the radio emission from brown dwarfs; besides, the periodicity of the pulses is hard to explain in this scenario. Another hypothesis is that the radio bursts had their origin in a magnetar, a neutron star with a strong magnetic field, and that the 77-min time interval is the orbital period of a black hole binary star system.

Source: http://arXiv.org/abs/astro-ph/0503052

Compiled by *Yu N Eroshenko*

Notification to the Readers

The paper "Gravity and absolute space. The works of Niels Bjern (1865 – 1909)" by D E Burlankov was published in the August, 2004 issue of *Physics – Uspekhi* (Vol. 174, No. 8, p. 899; English translation: Vol. 47, No. 8, p. 833).

The decision to publish the paper had been taken because it contained an interesting historical narration of a meeting between Niels Bjern and the outstanding Norwegian mathematician Sophus Lie and of a discussion of scientific matters between them. After publication, the Editorial Board passed the paper to the Norwegian Embassy in Russia, asking for biographical details pertaining to Bjern and his great-granddaughter Anna Florence, who was also mentioned in the paper. The reply from the Embassy and the University of Oslo was that neither Bjern nor Florence could be found in any official records. Later, in a letter to the editors, Burlankov offered his apologies and admitted that Niels Bjern was a fictional person, and the discussion between him and Sophus Lie (a thought experiment, as Burlankov called it) was only used for clearer demonstration of the author's standpoint regarding general relativity.

The artistic method of describing meetings and conversations of fictional or real persons who had lived in various times is broadly used in literature. However, *Physics – Uspekhi* is a scientific journal, and this absolutely requires that both scientific and historical facts given there must be precise. In any case, the fictional form of delivering authors' ideas requires special discussion and must be unambiguously indicated in the text.

The editors offer their apologies to the readers for the publication of Burlankov's paper.

Physics – Uspekhi Editorial Board