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1. Neutrino oscillations

Strong new evidence for the existence of neutrino oscillations has been found at the Sudbury Neutrino Observatory (SNO) in Canada with a confidence of 99.999%. Last year's report on the discovery of the oscillations (see *Usp. Fiz. Nauk* **171** (8) 912 (2001) [*Phys. Usp.* **44** (8) 812 (2001)]; *Usp. Fiz. Nauk* **172** (2) 213 (2002) [*Phys. Usp.* **45** (2) 205 (2002)]) was based on the analysis of SNO data jointly with those from the Super-Kamiokande collaboration in Japan. The new finding comes from SNO measurements alone, thus eliminating uncertainties due to the combination of data from two detectors. The accuracy was also improved in part by carefully accounting for the detector's own radioactivity and the associated background events. The SNO detector using heavy water D_2O is currently capable of detecting not only electron neutrinos (ν_e) but also muon (ν_μ) and tau (ν_τ) neutrinos. The Sun mostly emits ν_e, but the ν_e flux observed on Earth is less than calculated from the standard model of the Sun. However — and this is what makes the SNO's basic finding — the total flux of all the three neutrino types is found to be exactly the ν_e flux predicted. This means that many of the ν_e turn (oscillate) into other neutrino types on their way from the Sun to the Earth.

Source: http:// www.sno.phy.queensu.ca/sno/

2. Superconducting films on metal surfaces

Until recently it was believed that a superconducting material becomes less so when brought into contact with an ordinary metal. Now R Dynes at his colleagues at the University of California, San Diego, have discovered an inverse effect: the superconducting transition temperature T_c of a thin lead film increases from 1.6 K to 1.9 K when the film is brought into contact with a silver film. It had been suggested by the authors prior to the experiment that such a phenomenon should occur due to the flow of strongly coupled electron excitations from the ordinary metal to the superconductor. From the way the conductivity of the lead film depends on the thickness of the silver film at a fixed temperature $T = 1.65$ K it is found that the energy gap in the superconductor varies as the silver film thickness is varied.

Source: *Phys. Rev. Lett.* **88** 186403 (2002)
http:// prl.aps.org

3. 'Bright' solitons in a Bose-Einstein condensate

So-called 'dark solitons' in a Bose-Einstein condensate were first observed in 1999. Those solitons were atom-free cavities that did not change their shape as they traveled in a condensate. Now K E Strecker at Rice University and colleagues have for the first time created 'bright' solitons, consisting of real condensate atoms. To extract coherent blobs of lithium atoms from the condensate, a narrow laser beam was used. The interaction with a magnetic field led to attraction forces between the atoms, thus preventing the formation of a wave packet. The method produced up to 15 solitons traveling in succession along the laser beam.

Source: *Nature* **417** 150 (2002)
http:// www.nature.com

4. Galaxies in collision

Using the ACIS spectrometer onboard the space-based Chandra X-ray Observatory, astronomers have performed detailed observations of two spiral galaxies that are in the process of a head-on collision. The galaxies are 250 million light-years away, and at a stage about 10 million years after the collision started. At the core of the collision, vigorous star formation and giant shock waves due to powerful stellar winds are observed. For a distance of 75 thousand light-years, hot gas clouds are spewed out into intergalactic space. Whether these will fall back onto the galaxies or escape them remains unclear. At the centres of both galaxies point-like X-ray sources, presumably black holes, are seen. The sources' luminosity, however, is much lower than that of all the stars combined. In the future, the astronomers believe, the black holes will grow in luminosity due to gas falling into the core, and in time will merge to become a single supermassive black hole.

Source: http:// chandra.harvard.edu

5. Young radio pulsar

For 20 year astronomers have searched for the remnant of the supernova explosion that occurred in the constellation Cassiopeia in 1181 and was recorded in Japanese and Chinese chronicles. The remnant — a neutron star — was discovered in the X-ray range by Chandra in 2001. Very weak radio emission from this object was first detected by the Green Bank radio telescope early in 2002. This radio pulsar is thus the youngest known. Young radio pulsars are very rare. A combination of X-ray and radio observations will provide insights into the early evolutionary stages of radio pulsars.

Source: http:// www.aoc.nrao.edu/pr.html

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