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1. A superconducting ferromagnet UCoGe

Researchers at the University of Amsterdam and the University of Karlsruhe were able to show that the intermetallic compound UCoGe, a weak ferromagnet below Curie temperature 3 K, becomes superconducting upon further cooling with $T_s = 0.8$ K and at normal atmospheric pressure. Superconducting properties were also detected earlier at high pressure or very low temperatures in metal ferromagnets UGe_2 and URhGe, and some evidence was reported that UIr and $ZrZn_2$ were also superconducting. It was assumed that the possible mechanism of superconductivity in ferromagnets operates on magnetic transitions between two polarized phases. The superconductivity in UCoGe is most likely very different, involving magnetic fluctuations that result in spin-triplet pairing of electrons. This conclusion is based on measuring specific heat capacity and critical magnetic field as functions of temperature.

Sources: *Phys. Rev. Lett.* **99** 067006 (2007); prl.aps.org
http://arXiv.org/abs/0708.1388

2. Hydrogen-7

A heaviest isotope yet of hydrogen, ^7H, consisting of a lone proton and six neutrons, was produced and investigated in an experiment at GANIL (France) by the team of physicists from six European countries, who made use of the SPIRAL facility based on ISOL technique of beam production. The isotope ^7H exists, like other hydrogen isotopes heavier than tritium (^4H, ^5H, and ^6H), as a short-lived resonance state that decays into tritium and neutrons. ^7H nuclei were produced in the $^{12}C(^8He,^7He \to {}^3H + 4n)^{13}N$ transfer reaction as a result of removing one proton from an ^8He nucleus when a beam of ^8He nuclei was sent into a carbon-containing gas target. A special active-target MAYA detector recorded both the energy spectrum and the trajectories of ^{13}N nuclei produced in the reaction. These data allowed complete reconstruction of the nuclear reaction kinematics and identification of a 0.09-MeV-wide peak close to the energy of 0.57 MeV corresponding to the resonance state ^7H. All in all the experiment observed seven events of the creation of ^7H. Some inconclusive evidence of the existence of ^7H was obtained by A A Korsheninnikov and co-workers in a 2003 experiment that detected a steep rise in the nuclear reaction cross section in the vicinity of the $^3H + 4n$ disintegration threshold, which is in qualitative agreement with the results of the new GANIL experiment. So far, the available theoretical models do not provide an accurate prediction of the ^7H resonance energy but point to energies in the range from 1 to 3 MeV. Further experiments with ^7H may clarify another interesting aspect, namely, the possibility of producing a bound or unbound state of four neutrons.

Sources: *Phys. Rev. Lett.* **99** 062502 (2007); prl.aps.org
http://arXiv.org/abs/nucl-ex/0702021

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Translated by V I Kisin

3. Femtosecond X-ray holography

H Chapman (University of California, Lawrence Livermore National Laboratory) and his colleagues in the USA, Sweden, and Germany implemented a new method of generating holographic X-ray patterns of objects at femtosecond temporal resolution. X-ray pulses of a free-electron laser were sent through a small hole in a 'detector' mirror and heated a thin, translucent membrane that has been covered with a sample material to be investigated — in this case polystyrene balls of about 140 nm in diameter. The pulse knocked electrons off the ball surfaces after which the balls expanded explosively as a result of mutual repulsion of the remaining positive charges. The other part of the beam (the reference beam of the hologram) passed through the membrane and was reflected by a second, 'backing' mirror. X-rays bounced off the polystyrene balls and the second mirror were then reflected from the front mirror and interfered in a digital camera, creating in it a holographic pattern of the exploding balls. This technique made it possible to study the structure of specimens (balls) and their evolution with record temporal resolution — about one femtosecond, and with the spatial resolution currently standing at 50 nm.

Sources: *Nature* **448** 676 (2007); www.nature.com

4. Fluorescent microscopy

A team led by Stefan Hell and Mariano Bossi at the Max Planck Institute for Biophysical Chemistry in Göttingen (Germany) developed a novel technique for fluorescent optical microscopy with the spatial resolution in the nanometer range. Special fluorescent dyes (rhodamine amides) were added to living cells. Light emission from dye molecules could be switched on or off using illumination by external radiation. The average distance between dye particles was greater than the wavelength of the optical radiation and the emitted light was recorded with a digital camera. Then fluorescence of the neighboring particles was switched on and registered. The process was repeated many times. This resulted in obtaining numerous images; combined, they gave an image with a spatial resolution (not limited by the wavelength of light) of 10 to 30 nm and a high signal-to-noise ratio.

Sources: http://www.physorg.com/news105966261.html

5. Unique event of microlensing

A unique event of gravitational microlensing was recorded in the Cassiopeia constellation by a team of Japanese astronomers. Lensing occurred to the light of a star located in a sparse stellar field. Also, this star happens to be the brightest and closest (about 1 kpc from the Earth) among all other stellar sources that have been observed so far in microlensing events. The probability of such cases of microlensing is very low but in view of this new event their frequency may be 50 times greater than was previously assumed. The considerable brightening (by ~ 4.5 magnitude during a ~ 15 day period) of the star GSC 3656-1328 was discovered by amateur astronomer A Tago in Japan on October 31, 2006, after which this star was observed using several other telescopes. An analysis of its spectrum showed that brightness varies not because the star is inherently variable but as a result of gravitational lensing on an unknown object.

Sources: http://arxiv.org/abs/0708.1066

Compiled by *Yu N Eroshenko*