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1. Element 115

Nuclei of transuranium element $_{115}$A have been created at the Joint Institute for Nuclear Research in Dubna, Russia, in collaboration with a team from the Lawrence Livermore National Laboratory in the US. The researchers used a gas-filled separator to detect the products of the nuclear reactions caused by the collision of a ^{48}Ca beam with an ^{243}Am target. Their first experiment, in which the energy of the nuclei in the beam was 248 MeV, revealed three reaction chains, each consisting of five alpha decays. Based on the decay characteristics, the reaction chains started with the decays of the isotopes of an element $_{115}$A with an atomic weight of 288. The second experiment, with a beam energy of 253 MeV, revealed one chain of four alpha decays, whose initial nucleus is likely to be among the isotope of an element $_{115}$A with an atomic weight of 287. According to a theoretical analysis, in both experiments the compound $^{291}_{115}$A nucleus formed prior to the alpha decays, from which three or four neutrons evaporated.

Source: *Phys. Rev. C* **69** 021601(R) (2004)

2. Resonance condensation of fermions

A team of researchers from the National Institute of Standards and Technology (NIST) and the University of Colorado (also in Boulder, USA) have observed for the first time the condensation of pairs of fermionic atoms under conditions covered by the Bardeen–Cooper–Schrieffer (BCS) theory in the vicinity of the Feshbach resonance. In earlier studies, the Bose–Einstein condensation of the bosonic $^{40}K_2$ and $^{6}Li_2$ molecules consisting of two fermionic atoms was already observed. Unlike this type of condensation, in the new experiments atoms were not bound into molecules but rather paired up due to collective effects. A similar process is realized when the Cooper pairs of electrons condense in superconductors governed by the BCS theory. To cool the gas of ^{40}K atoms, first evaporative and then magneto-optical techniques were applied. The experiment enabled the external magnetic field to be varied near the Feshbach resonance whose exact position was determined to a high accuracy from the molecular dissociation. Increasing (decreasing) the magnetic field with reference to its resonance value led to an attractive (repulsive) interaction between the atoms, thus allowing the smooth transition from the Bose–Einstein condensation of molecules to the BCS type condensation to be traced. In the latter case, the condensate of ^{40}K atoms is called a *fermionic condensate*. The fermionic condensate was found to live much longer before breaking the coherence than the condensate of bosonic molecules. On completing the experiment, the gas cloud was freed from the trap and the momentum distribution of the particles was measured. On evidence derived from these measurements it may be argued that the atoms were in the fermionic condensation state when trapped.

Source: *Phys. Rev. Lett.* **92** 040403 (2004)
http://prl.aps.org

3. Nanotube gels

A polymer-dissolved liquid polymer (gel) of carbon nanotubes has been created at the University of Pennsylvania. Nanotubes in a gel are about half a micron in size and are all aligned in the same direction. The new gel is suggestive in part of a liquid crystal, including such its properties as optical anisotropy and the character of the topological defects. The gel was obtained by mixing nanotubes with a solvent and then compressing the mixture.

Source: *Physics News Update*, Number 672 (2004)
http://www.aip.org/physnews/update/

4. A distant galaxy

An international team of astronomers using the Hubble Space Telescope and the ground-based Keck telescope in Hawaii has discovered the most distant galaxy ever seen. The galaxy is 13 billion light years away, its look-back time being just 5% of its present age. Just as with the former record holder, the new galaxy is seen due to its image being amplified by a gravitational lens (cluster of galaxies Abell 2218) lying on the line of sight. Based on the angular distance between the two images the researchers detected from the galaxy, the redshift of the galaxy is in the range 6.6–7.1. Despite its being 25-fold amplified by the gravitational lens, the galaxy's image is very faint, pushing the telescopes to their sensitivity limits. The galaxy has a size of about 2,000 light years and is undergoing an intense star formation period. Two unusual things about the galaxy's spectrum are that it does not exhibit a bright hydrogen emission line and that its ultraviolet radiation is much more powerful than that of similar galaxies observed at the present epoch. Studying distant galaxies is important for understanding their evolution and what mechanisms control the re-ionization of the universe.

Source: http://www.stsci.edu

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