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Physics news on the Internet (based on electronic preprints)

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1. Ultracold helium ions

S Schiller and his colleagues at Heinrich-Heine University in Dusseldorf, Germany have developed a new method for cooling helium ions to very low temperatures. Ultracold ions are necessary for experimentally verifying the predictions of quantum electrodynamics and are also needed in the search for new effects in quantum electrodynamics. Schiller's team first cooled a gas of beryllium-9 ions to the 'Coulomb crystal' state in a linear rf trap using an ultraviolet laser and then introduced helium ions into the trap. As a result of the interaction between the ions, a core of ultracold helium ions formed at the center of the cloud of beryllium ions. In this way, as many as 150 helium ions were cooled to a temperature of about 20 mK.

Source: http://arXiv.org/abs/physics/0412053

2. The effect of gas on nanotube properties

H E Romero and his colleagues from the US and Sweden have experimentally shown that single-wall carbon nanotubes change their electrical resistance when blown by a gas flow, the amount of the change depending on the mass of the gas molecules. The US – Sweden experiment was conducted at atmospheric pressure and involved nanotubes 1 – 1.6 nm in diameter and a few microns in length, and the blowing gases used were all monatomic inert gases, as well as (molecular) methane and nitrogen. The mass dependence of resistance change was found to increase approximately as $m^{1/3}$, and the effect itself is due to the very small deformations which nanotube walls experience when colliding with atoms or molecules. This property, the authors believe, may lead to new high-sensitivity gas analyzers in the future.

Source: *Science* **307** 89 (2005);
www.science.com

3. A silicon laser

A compact all-silicon laser has been made at Intel labs in Santa Clara, CA, USA and Jerusalem, Israel. A prototype of such a laser was earlier tested at the University of California at Los Angeles. The operation of the new laser is based on the Raman effect. The laser generates light pulses at a wavelength of 1669.5 nm for about 100 ns, and then ceases to lase due to two-photon absorption. Solving this problem may open up a wide range of applications for silicon lasers.

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

4. Black hole radiation correlations

J M Miller and J Homan from correspondingly the Harvard-Smithsonian Center for Astrophysics and MIT Center for Space Research in the USA have observed a dependence of the iron K_α line intensity on the phase of X-ray quasi-periodic oscillations in the radiation from the X-ray source GRS 1915+105, presumably an accreting black hole with a mass of 14.4 ± 4.4 solar masses. The source is about 40,000 light years away from Earth in the constellation Aquila. The astronomers used data from the NASA's Rossi X-ray Timing Explorer (orbital telescope) in their work. The origin of the observed quasi-periodic oscillations with frequencies of 1 and 2 Hz have not yet been reliably established. If the oscillations have to do with a circular Keplerian motion around the black hole, then the radiation should be emitted at a distance of no more then 100 Schwarzshild radii. An alternative answer may be the general relativistic Lense – Thirring precession, in which case the generation should occur much closer to the black hole, in the region of strong spacetime curvature. Although the observed broadening of the Fe K_α lines is associated with reflection from the inner accretion disk, the assumption was often made that the lines are generated in jet regions far from the disk. The observed dependence of the intensity of the K_α lines on the phase of quasi-periodic oscillations provides evidence in favor of another hypothesis, according to which the Fe K_α lines are also generated in the inner accretion disk.

Source: http://arXiv.org/abs/astro-ph/0501371

5. Giant cavities in a gas halo

Two giant cavities (namely, low-gas-density regions), 200 kpc in diameter each, were investigated in the halo of the galaxy cluster MS0735.6+7421 using the NASA's Chandra X-Ray Observatory. At the center of the cluster is a giant elliptic cD galaxy with a black hole of about 3×10^8 solar masses at its core. The plasmas in the cavities are powerful radio sources, and cavity boundaries are set by elliptic-shaped shock waves. The cavities were formed at the ends of relativistic jets that emerged from the black hole but are no longer active. According to estimates, the total energy expended on cavity formation amounts to 6×10^{61} erg, which is a record high for other known systems of this kind. If this energy was released into the jets during the accretion process, then the black hole must have taken as little as 100 million years to build up most of its mass. The study of the giant cavities is also important for understanding the structure of 'cooling gas flows' onto the center of the cluster.

Source: http://arXiv.org/abs/astro-ph/0411553

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