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Physics news on the Internet (based on electronic preprints)

1. Measurement of Plank's constant

The most accurate measurement of Plank's constant so far has been conducted by researchers at NIST, also providing more accuracy for other fundamental constants, such as the electron mass, proton mass, Avogadro's number, etc. The experiment designed by B Kibble of the National Physical Laboratory in England relies on using a solenoidal pendulum, a kilogram mass attached to a metal solenoid in a magnetic field. The magnetic field of the solenoid balances the force of gravity acting on the mass. Decreasing the current through the solenoid wiring causes the mass to move downward, at which moment two quantities dependent on Planck's constant, namely, the velocity of the mass and the induced voltage, are measured. It proved possible to cancel out geometry sensitive factors in conducting the experiment. Planck's constant is found to be $h = 6.62606891 \times 10^{-34}$ J s, with an uncertainty of 89×10^{-9}, two times better than in the best measurements so far. Based on this experiment, the mass unit, the kilogram, can now be defined in quantum language rather than relying on the mass standard kept in France.

Source: http://ojps.aip.org/prlo/top.html
Physical Review Letters, 21 September 1998

2. Kaons and supernova blasts

Collisions of 1 Gev/nucleon gold nuclei were investigated at the GCI Lab in Darmstadt, Germany. For a period of 5×10^{-23} s, the reaction zone is 3 times denser than normal nuclear matter. The micro-explosion that occurs during the collision causes gold nuclei to break up giving rise to strange mesons, mostly charged K mesons (kaons), which fly out predominantly perpendicular to the collision plane. As their paths suggest, the kaon effective mass alters at high energies, which is consistent with other experimental data and may be due to the fact that, along with kaons, antikaons are involved in the reaction. As exotic short-lived particles, kaons are of interest not only for high-energy physics but also for astrophysics, where their properties within dense nuclear matter place certain constraints on the dynamics of supernova explosions and the stability of neutron stars. Based on the results obtained, it is found that a star with a $1.5-2$ solar mass iron core cannot remain a neutron star after explosion but collapses into a black hole instead.

Source: http://xxx.lanl.gov/abs/nucl-ex/9807003

3. Nanolithography

A Stanford research team led by H Dai has developed a technique that uses carbon nanotubes for nanoscale image writing. Earlier, the only use of nanotubes was as AFM (atomic force microscope) tips in nanostructure studies. The new technique allows an image writing rate of 10 mm s^{-1}. An electric field applied to the nanotube removes hydrogen atoms from the hydrogen layer deposited on the silicon substrate, after which oxidation of the surface leads to the formation of a silicon substrate with SiO_2 tracks deposited on it. With this technique, data storage on a nanometer scale becomes possible.

Source: *Physics News Update*, Number 390
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

4. A red dwarf planet

Red dwarfs, stars belonging to the spectral classes K and M, constitute about 70% of all the stars in the Galaxy. The first discovery of an invisible companion — a planet — orbiting an M-class dwarf was made by astronomers at the University of San Francisco and independently by their colleagues at the Geneva Observatory. The planet, which has 2 to 4 times the mass of Jupiter, is only 0.21 astronomical units from the star and orbits it in 61 days. The star, although only 15 light years from the Sun, is invisible to the naked eye. It is a hundred times less luminous than the Sun and three times less massive.

To date only a few stars, none of them red dwarfs, have been found to have massive planets. All the planets were discovered only indirectly, either from perturbations in a star's path or spectroscopically, from periodic fluctuations in a star's spectrum. It is hoped, however, that the new planet may be seen directly by the most powerful optical telescopes. As is the case with other massive extrasolar planets, the new planet is very close to its primary, a fact for which no interpretation is yet available.

Source: http://www.nature.com/
Nature Science Update

5. Acceleration anomaly

Galileo and Ulysses spacecraft navigation data have provided new evidence for the existence of the thus far unexplained acceleration of 8×10^{-8} cm s^{-2} toward the Sun, which remains after contributions from all known or possible sources, such as the Sun, solar wind, planets, the Milky Way as a whole, and the dark matter of the solar system, are subtracted. The first evidence of this anomaly was provided by Pioneer 11 and 12 back in the 80s. While systematic data processing errors are still suspected, it is not ruled out that unknown gravitational effects may be behind the phenomenon. More careful analysis of the motion of planets, comets and the proposed Pluto Express craft is likely to clarify the matter.

Source: *Physics News Update*, Number 391
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

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