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Physics news on the Internet (based on electronic preprints)

1. Improving high-temperature superconductivity

Along with new high-T_c materials, advanced fabrication techniques for improving the efficiency of those already available are being actively sought, with a particular view to increasing the critical current density beyond which superconductivity is destroyed. D Larbalestier and his team at the Applied Superconductivity Centre of the University of Wisconsin, Madison, succeeded in identifying the critical-current-limiting factors. By using a novel magneto-optical visualization technique to monitor the current flow and the barriers it encounters in its way, microscopic defects and cracks and, to a somewhat lesser extent, grain boundaries were found to be the culprits. The development of materials free of these flaws holds promise of considerably widening the scope of superconductivity applications.

Source: http://unisci.com/

2. Metallic hydrogen

The problem of making solid hydrogen metallic still remains open. The 1997 Berkeley experiment, the first to produce metallic hydrogen, started from gaseous hydrogen and did not pass through the solid phase. While theoretical analyses yield 340 GPa as a metallization pressure for solid hydrogen, a Cornell research team reports that it remains an insulator even at 342 GPa, thus challenging previous theories. Such a pressure was achieved using the so-called 'diamond anvil cell' and could not be increased further because of the incipient cracking of the diamond. Research into metallic hydrogen, believed to be abundant in the interiors of larger planets, is of special relevance to astrophysics.

Source: *Nature*, May 7
http://www.nature.com/

3. An optical twin of a gamma burst

Another gamma burst/optical source identification is reported, which differs in several important respects from the two previous, February 1997 and May 1997, identifications. The gamma burst was detected using the Compton Gamma Ray Observatory's BATSE device, and the accompanying X-ray burst, by the Italian – Dutch BeppoSAX satellite. X-ray observations allowed the burst to be localised with great precision on the celestial sphere. A few hours after the burst, a faint optical source was detected by ground-based optical telescopes at the location, whose brightness decreased more rapidly than in the previous identification cases. As the brightness became much lower, it turned out that the source is projected onto a very distant galaxy, whose redshift was found to be $z \approx 3.4$ using the Keck II telescope. It is this galaxy where both the gamma bursts and the optical source are most likely to have their origin. Apart from the source's being extremely distant, a surprising feature is that the gamma energy it released was about a hundred times more than expected for a gamma burst. No sources with such high energy release have yet known. The findings favour a cosmological origin for gamma bursts over the local (galaxy halo) model.

Source: http://wwwssl.msfc.nasa.gov/default.htm

4. Gravitational fields near neutron stars

Neutron stars, first discovered in 1967, appear when an ordinary star is compressed and then explodes in a violent event known as supernova. About as massive as the Sun and as small as about 10 miles in diameter, a neutron star has its matter compressed to the point where the space – time around is strongly (up to 30%) curved according to the theory of general relativity. Unlike Newton's theory of gravity, Einstein's also predicts the existence of an innermost circular orbit such that at distances closer to the star surface particles cannot orbit around the star and must spiral down. This effect was confirmed by the Rossi Explorer observation of X-ray radiation from a binary star system located 20,000 light years from the Earth and having a neutron star as a component. The matter of the second, ordinary, star flows over to the neutron companion, emitting X-rays in doing so. Interestingly, the radiation shows periodic pulses which may be regarded as evidence of the innermost circular orbit. The finding appears to be the first ever test of the strong-field prediction of the general theory of relativity.

Source: *Physics News Update*, Number 368
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

5. Radio-frequency burst

An extremely powerful burst of radio-frequency radiation coming from CI Cam, a variable star earlier known only as an X-ray source, was detected by the New-Mexico VLA radio telescope on March 31, 1998, along with an X-ray burst detected by the Rossi satellite. One explanation is that the burst was caused by a star that collapsed after having exhausted its nuclear fuel. Alternatively, the fall of a clump of matter onto an invisible companion of the star — a black hole or a neutron star — might be a possibility.

Source: *ABQjournal Science Technology*
http://www.abqjournal.com/scitech/

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