

PACS number: **01.90. + g**

Physics news on the Internet (based on electronic preprints)

DOI: 10.1070/PU2004v047n06ABEH001853

1. Parity violation in electron – electron interactions

The violation of parity (reflection invariance) was discovered in the decays of cobalt nuclei in 1956 and has since been observed in many other processes. The E158 Collaboration at the Stanford Linear Accelerator Center (SLAC) has for the first time detected parity nonconservation in elastic electron – electron collisions at low energies (in Møller scattering). The violation of P invariance is caused by weak neutral currents, but Z^0-boson exchange, because of the large mass of the Z^0-boson, contributes very little to the scattering cross section compared to electromagnetic processes: the reason the effect has not been observed in previous experiments. The new experiment studied the scattering of a beam of (longitudinally polarized) electrons by a liquid hydrogen target. The quantity measured was the cross section difference between electrons with spins aligned along their motion and those with spins aligned opposite. The experimental technique allowed a very accurate determination of various types of corrections and errors involved. The measured cross section asymmetry $(\sigma_R - \sigma_L)/(\sigma_R + \sigma_L) = [-175 \pm 30(\text{stat.}) \pm 20(\text{syst.})] \times 10^{-9}$ is in excellent agreement with Weinberg angle measurements and with what the Standard Model of elementary particles predicts.

Source: *Phys. Rev. Lett.* **92** 181602 (2004)
http://prl.aps.org

2. Magnetic properties of a superconductor at room temperature

Thus far, no material has been discovered which possesses superconducting properties at room temperature. There are recent indications, however, that high-temperature superconductors (HTSCs) in the nonsuperconducting state retain certain properties previously thought only to be possible for the superconducting phase at low temperatures. One such possible property is the existence of Cooper pairs in an HTSC at room temperature. C Panagopoulos and his colleagues at the University of Cambridge (Great Britain) have discovered yet another new property. It is known that the magnetization of a superconductor is different in the following two cases: the superconducting transition takes place in the external magnetic field applied, and the field is only furnished after the transition. This difference, it was believed, exists only in the superconducting state and has to do with the properties of magnetic vortices. Panagopoulos and his colleagues have for the first time discovered that the dependence of the magnetization on whether the magnetic field or cooling is applied first is to a small extent retained in HTSCs (lanthanum and strontium cuprates) even at room temperature, when they are not superconducting. The phenomenon of interest is possibly due to the presence of magnetic vortices in an HTSC at temperatures above the critical temperature. Magnetic vortices were in fact observed in the nonsuperconducting phase of an HTSC, although much below room temperature. Explaining the new phenomenon could help in understanding the mechanism of high-temperature superconductivity.

Source: *Phys. Rev.* **B 69** 144508 (2004)
http://focus.aps.org/story/v13/st19

3. C_{50} molecules

Spherical carbon molecules known as fullerenes are sufficiently stable only when each pentagonal face of the molecule is surrounded by five hexagonal faces. This 'isolated pentagon rule' cannot be satisfied for molecules consisting of fewer than 60 carbon atoms and is the reason why small fullerenes do not form solid crystals and have previously only been observed in the gas phase. However, when combined with other substances, fullerenes may acquire additional stability. This has been demonstrated by L-S Zheng and colleagues at Xiamen University, and co-workers at the Chinese Academy of Sciences in Beijing and Wuhan who have for the first time obtained C_{50} molecules in the form of a solid compound with chlorine, $C_{50}Cl_{10}$. $C_{50}Cl_{10}$ molecules were synthesized from carbon tetrachloride in a helium atmosphere using a graphite arc-discharge technique. From the 90 g of the resulting sediment, about 2 mg of solid $C_{50}Cl_{10}$ was obtained following a purifying procedure. Interesting chemical and physical properties are expected to be found in C_{50} molecules.

Sources: *Science* **304** 699 (2004), www.sciencemag.org;
http://physicsweb.org/article/news/8/4/14

4. Magnetization reversal rate

The magnetization of a ferromagnet varies due to its magnetic domains changing the directions of their dipole moments. A team of researchers from the Stanford Synchrotron Radiation Laboratory, the L D Landau Institute for Theoretical Physics, and Seagate Technology has measured the rate of this process. The team used 10-T, 2-ps magnetic field pulses produced by ultrashort bunches of high-energy electrons from an SLAC accelerator. Various ferromagnetic materials were exposed to the magnetic pulses. It turned out that these short pulses do not have enough time to cause a noticeable reversion in the magnetization of a grain of the material. Thus, the magnetization reversal rate is at least 1,000 times less than previously thought. This result also imposes a severe limitation on the speed at which information can be recorded onto a magnetic medium.

Source: http://physicsweb.org/article/news/8/4/10

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