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Physics news on the Internet (based on electronic preprints)

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1. Anomalous magnetic moment of the muon

Virtual photons which are produced in reactions involving electrons and muons modify the Lorentzian structure of lepton currents, giving particles an anomalous magnetic moment in addition to the Dirac one. The anomalous moment, along with the dominant contribution from the electromagnetic interaction, also contains weak and strong interaction contributions. Until recently, the Standard Model of particle physics (see *Usp. Fiz. Nauk* **169** 1299 (1999) [*Phys. Usp.* **42** 1193 (1999)] for a discussion) was in excellent agreement with all the experimental data — the only exception being neutrino oscillation experiments. Now, however, the high- precision measurement of the anomalous magnetic moment of the muon carried out at the Brookhaven National Laboratory, US, has unexpectedly revealed a notable deviation from the Standard Model. The reason for choosing muons — rather than more abundant electrons — for the experiment is that effects related to the anomalous magnetic moment are proportional to the square of mass and are therefore stronger in the muon which is about two hundred times as massive as the electron. Based on millions of muon (more precisely, antimuon μ^+) decays studied using intense particle beams, new supersensitive detectors, and powerful superconducting magnets, it is claimed that with a probability of 99% the Standard Model underpredicts the anomalous magnetic moment. One explanation — along with possible experimental errors — could be some effects that are unaccountable within the Standard Model and are due to the supersymmetry of the muon or its having a substructure. The experiment is an international collaboration in which, among other institutions, the Novosibirsk Nuclear Physics Institute, Russia, is involved.

Source: http://xxx.lanl.gov/abs/hep-ex/0102017
http://www.bnl.gov/bnlweb/pubaf/pr/bnlpr020801.htm

2. Superconductivity in MgB_2

A Japanese team led by J Akimitsa found that the intermetallic compound MgB_2 (magnesium diboride) has a superconducting transition temperature of 39 K, nearly twice that of other known intermetallic compounds. On the other hand, experiments carried out at the Ames Laboratory in the US have shown that on replacing the boron isotope B^{11} by B^{10} the value of T_c rises by about 1 K, consistent with what the Bardeen – Cooper – Schrieffer theory predicts. Thus although the BCS theory is inadequate for high- temperature ceramic superconductors, it well describes the superconducting properties of intermetallics. While cuprate high- temperature superconductors have the advantage of T_c exceeding 90 K, magnesium diboride is far cheaper to manufacture and holds promise for many applications.

Source: *Physics News Update*, Number 526
http://www.aip.org/physnews/update/

Uspekhi Fizicheskikh Nauk **171** (3) 306 (2001)
Translated by E G Strel'chenko

3. Chiral varieties of nuclei

K Starosta of the State University of New York and his colleagues report their observation that some atomic nuclei can exist in two varieties, one the mirror reflection of the other. This phenomenon had been predicted theoretically. According to theory, chiral varieties may exist in three-dimensionally non-spherical nuclei with odd numbers of protons and neutrons, provided the spins of the single outer-shell proton, the single neutron, and the rest of the nucleus are oriented along the nucleus' minor axis, major axis, and the intermediate- length axis, respectively. Such nuclei, like a triple of vectors, may be either left- or right-handed. The SUNY experiment revealed doublet gamma-ray emission lines for the isotones (nuclei with the same neutron number N) $_{55}Cs$, $_{57}La$, $_{59}Pr$, and $_{61}Pm$ with $N = 75$. If the observed doublets can be interpreted as chiral vibrations, then this experiment provides the first evidence for the existence of stable ellipsoidal nuclei.

Source: *Phys. Rev. Lett.* **86** 971 (2001)
http://prl.aps.org

4. A supernova at the centre of the Galaxy

Chandra observations have provided the first clear images of the remnants of the supernova explosion Sgr A East against the background of other complex structures in the centre of our Galaxy. The new observations support the idea that layers of hot gas enriched with heavy elements were indeed ejected as a result of a supernova explosion. Interestingly, another object, the so-called Sgr A^* thought to be a black hole, is located within the gas layers left over from the explosion, implying that what we are dealing with is an example of a black hole-stellar explosion interaction at the centre of the Galaxy.

Source: http://chandra.harvard.edu

5. Cosmological parameters

Recent advances in microwave background anisotropy measurements and in particular the discovery of the Doppler (Sakharov) peaks have made possible the independent estimation of the basic cosmological parameters that describe the evolution of the Universe. However, a much higher accuracy is achieved if, in addition to the anisotropy information, data on the large-scale distribution of galaxies are employed in calculations. American astrophysicists M Tegmark, M Zaldarriaga, and A S Hamilton, applying a new effective calculation technique to the data on 14677 galaxies from the IRAS satellite have determined the most likely values for 11 cosmological parameters. It was found, in particular, that with probability 95% the cosmological constant Λ, dark matter (hidden mass), and baryon matter contribute 62%, about 33%, and only 5%, respectively, to the total cosmological density.

Source: *Phys. Rev. D* **63** 043007 (2001)
http://prd.aps.org

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