

Physics news on the Internet (based on electronic preprints)

1. Discovery of the leptoquark?

For three years now experiments have been under way at HERA, a particle accelerator in Hamburg, Germany, concerned with deep inelastic collisions of 820-GeV protons and positrons or electrons with energies of 27.5 GeV, respectively. In such collisions, positrons interact with individual quarks inside a proton. The resultant streams of particles are registered by two independent detectors, Zeus and H1. During the experiments, hundreds of thousands of such collisions have been investigated. According to the data gathered by the two groups, the number of observed events is several times the figure predicted theoretically on the basis of the Standard model of elementary interactions. The probability of statistical fluctuations able to cause this discrepancy is not greater than 1%. This result may signify the presence of unknown fundamental interactions between quarks and leptons or the existence of new elementary particles, such as the 'leptoquark' with a mass of 200 GeV. The HERA experiments are being conducted by a team of scientists from 12 countries including Russia. The research goes on, and the statistical material thus accumulated may throw more light on the phenomenon.

Source: http:/info.desy.de/

2. Is a quantum computer feasible?

Many scientists think the quantum computer will become a reality only decades from now. At present, only elementary logical cells have been developed. The importance of this project is that, being a unified quantum entity, the quantum computer would be able to make computations many thousand times faster than the best of existing computers. However, there is also a sceptical body of thought which holds that the quantum uncertainties arising in the course of computations would lead to an accumulation of errors to a point where it would be impossible to use the quantum computer efficiently. To resolve the problem, theoreticians at the Los Alamos National Laboratory (California, USA) have compiled a new algorithm of computations for the quantum computers of the future. The algorithm is based on the multiple repetition of individual strings of computations. Thanks to the huge speed of the quantum computer, such repetitions would not tell markedly on its performance, but would reduce the overall error in computations to an acceptable level. The fundamental possibility has thus been demonstrated for the quantum computer to operate properly.

Source: http:www.lanl.gov/Internal/New/pressreleases

3. Detection of individual molecules

One way to gather information about the vibrational–rotational states of molecules is Raman spectroscopy. The fairly weak Raman effect can be amplified (by 14 orders of magnitude), if a particle of the substance under study is attached to a metallic particle a few nanometers across. The cause of such a high amplification remains unknown. Using this technique, researchers at the Massachusetts Institute of Technology and their colleagues in Berlin have devised a procedure whereby individual molecules can be detected. They have been able to observe individual organic molecules on the surface of silver particles in a colloidal solution. The advantages of the new technique are a short observation time and the fact that the experiment leaves the molecules intact. The detection of individual molecules is of particular interest for chemistry and biology.

Source: *Physics News Update*, No. 308
http://www.hep.net/documents/newsletters/newsletters.html

4. The optical counterpart of a gamma-ray burst

Until now, attempts to reliably identify cosmic gamma-ray bursts with any known classes of astronomical objects have invariably failed. It was not even clear if gamma-ray bursts originated in our Galaxy or had a metagalactic source (for more detail, see *UFN* **166** 743 (1996) [*Physics-Uspekhi* **39** (7) 695 (1996)]). In March 1997, researchers at Amsterdam University reported that they had possibly found the source of a gamma-ray burst. This gamma-ray burst was observed on February 28 by BeepoSAX, a Dutch–Italian space probe. The gamma-ray burst came from the constellation Orion, and its position was located to within 1 minute of arc. Soon after that, two optical telescopes set up in Canary Islands were trained on the same area of the sky, and on March 8 the scientists noted a growing bright spot in one of the galaxies. It is highly probable that the gamma-ray burst and the spot have a common origin. Thus, evidence has been obtained that gamma-ray bursts are formed in distant galaxies. However, further observations will be necessary in order that the question of the nature of gamma-ray bursts can be answered with certainty.

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http://science-mag.aaas.org/science

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