

Physics news on the Internet (based on electronic preprints)

1. Do quarks have substructure

In the experiments conducted at E. Fermi Laboratory the data were collected which could be interpreted as indication of existence of a new level of matter. Proton–antiproton collisions were investigated. The achieved energy scale was so high that distances of 10^{-17} cm could be probed. Individual quarks interacted with each other sending jets of hadrons. The number of jets was counted as function of 'transverse energy'. While the experiment and quantum chromodynamics predictions agree closely at energies lower than 200 GeV, the number of jets exceeds considerably the expected values at higher energies. The departure becomes noticeable at distances three order less than the proton size. A possible explanation for the departure that the detector is not correctly calibrated was rejected at a later time.

The observed excess in the number of events can be explained if one would assume that incoming quarks had scattered from something more compact inside other quarks. In some respect these experiments could be compared with those by Rutherford on the investigation of the atomic structure and with experiments at SLAC in which physicists discovered the quark structure of nuclons. If the results described are verified they would imply the departure from the standard model of particle physics. Quarks which up to present have been considered as most basic particles would themselves have a structure of the next level. Such a situation has already been studied in theoretical works where 'protoquarks' were introduced.

Source: http://www-cdf.fnal.gov

2. Heterostructures

Scientists from laboratory in Liverpool and E.L.Ginston research laboratory have created and investigated unique materials that are heterostructures composed of layers of high-temperature superconductors. Films of widely known copper-oxide superconductors $Bi_2Sr_2CaCu_2O_8$ have been combined with layers of closely-related compounds like $Bi_2Sr_2Ca_{n-1}Cu_nO_{2n+4}$. A recently developed technique was applied which includes precipitating atoms from a metallic vapour in the active ozone atmosphere at the temperature of about 700°C. The heterostructures exhibited unique superconducting properties and allowed for observations of tunnel effects. The process of formation of layers was observed with the help of instruments like electron microscopes. The morphology and microstructure of the heterostructures has been studied. The investigations confirm earlier formulated hypotheses on two-dimensional character of superconductivity in $Bi_2Sr_2CaCu_2O_8$.

Source: alison@wsrcc.com; cond-mat/9601090

3. New physical instruments

1. Researches at the National Renewable Energy Laboratory (NREL) designed a laser powered with concentrated sunlight instead of electricity. The sunlight supplied to laser crystal was collected and amplified 50000-fold by a series of mirrors and concentrators. Possible applications for the laser include space communication systems and space power systems.

Source: http://w3.pnl.gov:2080/er_news

2. At the University of Cambridge the researches work under technique which would enable merging of light from several telescopes into a single image. The technique is known as imaging interferometry. With the help of several relatively small telescopes one can obtain views as sharp as those from a telescope with a mirror of tens or even hundreds of meters. The first experiment was carried out with four telescopes at the University of Cambridge. The binary star Capella was observed at five times the resolution available from the Hubble Space Telescope.

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

4. Properties of water

As is known, when cold water is heated from zero temperature, it shrinks reaching a minimum volume and, therefore, a maximum density at temperature around 4 degrees of Celsius. Until recently no theoretical model has been able to explain this density anomaly. That, in its turn, restricted the accuracy of computations of organic or other systems containing water. Researches at Texas Tech University have suggested an explanation by looking not only at neighbouring molecules of water, but also at more distant ones. In all ten known forms of ice and in water the interaction of the closest molecules occurs in the same way. The situation is different for interaction of more distant molecules. In the liquid phase, in the temperature interval where the density anomaly is observed more stable is the state with higher density. The curve of dependence of density on temperature, calculated by researches is similar to that observed for water.

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5. Luminosity function of Galaxies

Researches at the Baltimore University and at the Arizona University Observatory have conducted first direct measurements of luminosity evolution of elliptic galaxies up to redshift $z = 1.2$. At such redshifts the Universe was nearly 1.5 times younger than it is now. Hubble Space Telescope data were used. The measurements demonstrated that the luminosity of elliptic galaxies decreases with time. At redshift $z = 1$ the luminosity was by 0.5 – 1 order greater than at present. No sign of significant evolution of the number of galaxies was revealed. The number of galaxies could change due to collisions and merging with formation of larger galaxies. Separate cases of merging are really observed; however as follows from the measurements described, no more than 10% of elliptic galaxies formed by merging at $z < 1$. This implies that the process of elliptic galaxies formation terminated before the moment which corresponds to redshift $z = 1$.

Source: kavan@pha.jhu.edu; astro-ph/9602041

Composed by *Yu N Eroshenko*

Uspekhi Fizicheskikh Nauk **166** (3) 335 – 336 (1996)
Translated by S D Danilov