Physics news on the Internet (based on electronic preprints)

1. Non-exponential Quantum Decay

When they decay spontaneously, most quantum systems do so exponentially. For example, radioactive nuclei decay exponentially in the process of quantum tunneling. However, quantum mechanics does not exclude that the number of particles remaining in the original state could be some other function of time. For the first time, this was demonstrated by researchers at Texas University. In their experiments, they studied the escape of sodium atoms from a laser trap by quantum tunneling. The process was found to be of non-exponential character at least over intervals of the order of 10^{-6} s.

Source: http://www.nature.com/ Nature

2. Neutrino oscillations

Three independent teams of researchers have reported to have obtained new evidence for the existence of neutrino oscillations — the transformation of one kind of neutrino to another. The Super Kamiokande detector which recently began operation and is situated 300 km west of Tokyo can detect both solar and atmospheric neutrinos. The latter are formed under the action of cosmic rays in the upper atmosphere. In experiments, a smaller ratio of muon atmospheric neutrinos to electron neutrinos was observed than expected. This discrepancy can be explained if one assumes that muon neutrinos change into other kinds of neutrino. A similar result in respect of atmospheric neutrinos was also reported in the Soudan 2 experiment conducted in the state of Minnesota, USA. At Los Alamos, experiments using the LSDN detector were carried out using neutrinos generated by particle accelerators. These experiments, too, supplied evidence of neutrino oscillations. If it is true that neutrino oscillations do exist, it would help to solve the problem of solar neutrinos the experimentally observed neutrino flux from the Sun is one-third of what is calculated without allowance for oscillations.

Source: http://sciencenow.sciencemag.org/ Science

3. A new type of astronomical object

Working with the X-ray detector mounted on the ASCA satellite, Japanese scientists observed an unusual astronomical object. The detector was aimed in the direction of an invisible mass producing a multiple image of a quasar. Previous observations of this gravitational lens using optical

Uspekhi Fizicheskikh Nauk **167** (8) 886 (1997) Translated by B V Kuznetsov telescopes revealed only one visible galaxy. ASCA, however, found a very large amount of hot gas emitting in the X-ray range within the gravitational lens. Such gas corona surround giant accumulations of galaxies.

As an analysis of the X-ray spectrum shows, the gas cloud at 10¹⁰ light years from Earth is high in iron. This fact makes the discovery still more mysterious because iron and other heavy elements can by synthesized solely in stars predominantly combined into galaxies. However, optical telescopes resolve no association of galaxies within the gravitational lens. Hence, the Japanese researchers conclude that they may have discovered a new type of astronomical object. As other scientists think, the observed object may be an accumulation of extremely weak galaxies invisible to optical telescopes. Observations from the Hubble space telescope might clear up the situation.

Source: http://sciencenow.sciencemag.org/ Science

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