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Physics news on the Internet (based on electronic preprints)

1. Proton radioactivity of highly deformed nuclei

The proton radioactivity, i. e., the emission of a single proton from a nucleus, has been for the first time measured at Argonne National Laboratory using highly deformed nuclei of proton-rich elements beyond tin. The decay rate and energy of emitted protons were measured for ATLAS accelerator produced holmium-141 and europium-131 nuclei implanted in a silicon detector. The nuclei, with an eccentricity ratio of 1:1.5, are classified as highly deformed rather than super-deformed (which would require 1:2). Decay characteristics measured differ considerably from proton radioactivity predictions for spherical nuclei but compare well with a recent non-spherical theory. Data on the energy levels of highly deformed nuclei are obtained.

Source: *Physics News Update*, Number 360
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

2. A new limit on the photon mass

Although the existence of a nonzero photon rest mass cannot be ruled out at the present time (as is also the case with the neutrino), its upper limit is being increasingly lowered owing to the continuing advances in experimentation. The previous limit, $m < 6 \times 10^{-16}$ eV, was established in 1975 based on measuring Jupiter's magnetic field. The newest — laboratory — limit, $m < 7 \times 10^{-17}$ eV, was obtained by R Lakes of the University of Wisconsin by measuring the anomalous torques in the motion of the Cavendish balance in a magnetic field. A nonzero photon mass would have major implications, such as longitudinal electromagnetic waves in vacuum and the frequency-dependent velocity of light. For Lakes' experiment, a cosmic vector potential predicted by some theories should be detected. It was not.

Source: *Phys. Rev. Lett.*, 2 March
http://asp.org/Journals/PRL-online/

3. Fine structure constant changes

The study of quasar absorption lines led J K Webb and his team to conclude that the fine structure constant α varies on a cosmological time scale. The basic idea behind this conclusion is that the line separation scales with α^2. Keck I data on a number of chemical elements were compared with the same elements' terrestrial spectral data. A sample of thirty quasars in the redshift range $0.5 < z < 1.6$ were investigated. While α does not show any variation for $z < 1$, for $z > 1$ it is found that $\Delta\alpha/\alpha = (-1.5 \pm 0.3) \times 10^{-5}$. Error analysis has failed to suggest an alternative explanation thus far. The varying α is predicted by models that unify fundamental interactions based on the compactification of extra spatial dimensions. The same effect might be caused by a mild intergalactic boson field coupled with the electromagnetic field. The best bound on the variation of α, $\Delta\alpha/\alpha = (-0.9-1.2) \times 10^{-7}$ for 2×10^9 years ($z \approx 0.1$), was found in terrestrial conditions on the natural 'nuclear reactor' Oklo. Because of the fundamental theoretical significance of the problem, further studies will be required to verify the reported result.

Source: http://xxx.lanl.gov/astro-ph/9803165

4. Lunar ice

Significant deposits of water ice have been discovered at the Moon's north and south poles by the Lunar Prospector spacecraft. Using a neutron spectrometer to detect neutrons flung out by cosmic rays from the lunar surface it was found that about 1% of ice is contained in the soil at the lunar poles. It is estimated that from 11 million to 330 million tons of ice, presumably brought by comets and meteorites, is dispersed over the area of 15,000 to 70,000 square kilometres. Earlier, radar studies have indicated the presence of ice on the lunar surface. The ice may be of great importance as a supporting resource for future lunar exploration missions.

Source: http://lunar.arc.nasa.gov

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