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# Physics news on the Internet (based on electronic preprints)

## 1. The Einstein equivalence principle

The principle of equivalence underlying the general theory of relativity implies the equality of the inertial and gravitational masses of a body. The former of these has a contribution from the gravitational interaction besides those from the strong, electromagnetic, and weak interactions, and in laboratory experiments, in which gravitation is negligible, the equivalence principle has been confirmed to an accuracy of $10^{-12}$. In massive astronomical objects the equality of the two masses should also be left intact by the gravitational contribution. That this is indeed the case has been shown by University of Washington scientists using data from three decades of lunar laser ranging (with light being reflected by mirrors placed on the Moon) and calculating the acceleration of the Earth and the Moon toward the Sun. Taking into account the different compositions of the Earth and the Moon, it is shown that the equivalence principle is obeyed to an accuracy within $10^{-3}$. Indicative of the high precision of the study, the contribution of the gravitational energy to Earth's inertial mass is as low as $4.6 \times 10^{-10}$.

Source: http://ojps.aip.org/prlo/top.html

## 2. A new ion acceleration technique

Three research teams (from the Lawrence Livermore National Laboratory, the University of Michigan, and the Rutherford Laboratory) have independently proposed exposing microscopic solid particles to ultrashort laser pulses as a means to produce high-power ion beams — possibly an alternative to bulky and expensive cyclotrons now in use. In the new technique electrons accelerated by the laser electric field leave the surface of the substance with the result that a powerful electrostatic field arises between the substance and the cloud of electrons. It is this condenser-type field which acts as an ion accelerator. The Livermore researchers using the world's most powerful accelerator were able to produce 50-MeV-protons. In the University of Michigan, while the protons produced are an order of magnitude less energetic, the facility used has the advantage of being compact and suitable for practical applications — in medicine, for example. In the Rutherford Laboratory, 420-MeV lead ions were produced along with 17-MeV protons.

Source: Physics News Update, Number 457
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

## 3. Hysteresis in superconductors

P Adams of Louisiana State University and his colleagues discovered what may be called a hysteretical superconducting transition. It is found in particular that under certain conditions the superconducting transition is produced by warming a sample rather than by cooling it. The effect was observed in the temperature-magnetic field coordinate system in a thin aluminium film with its plane parallel to the magnetic field — the configuration, the researchers believe, which is the reason for the effect. For example, at a temperature of 30 mK a magnetic field of 5.9 T destroyed the superconductivity and decreasing the field to 5.6 T reestablished it. In a fixed field of 5.65 T, warming a normal sample from 30 to 100 mK caused it to become superconducting and only raising the temperature above 500 mK destroyed the superconductivity.

Source: http://publish.aps.org/FOCUS/

## 4. A planet around a binary star

Of the 20 or so planets thus far detected outside the solar system, all have been found circling single stars. A University of Notre Dame team led by D Bennett and S H Rhie has now discovered a planet that orbits a binary star system. The team employed a technique called gravitational lensing, which uses the fact that the light from a distant star is focused gravitationally by the stars lying along the line of sight. Analysing changes in the observed brightness of the star then provides insight into the structure of such a gravitational lens. Using this technique, the team has discovered a planet about three times the mass of Jupiter orbiting a binary star system. Since more than half of all stars are members of binary or multiple star systems, planets orbiting such systems must be a widespread phenomenon according to the scientists.

Source: http://www.nasa.gov/

## 5. Jet formation in galaxy cores

One of the most intriguing details of the structure of galaxies is that they emit long and narrow jets which originate in the galaxy's core, stretch for hundreds and thousands of light years, and end up with gigantic gas clouds ('radio lobes'). The radio emission of both jets and their lobes is of synchrotron nature. According to theoretical models, jets form inside the accretion disk surrounding a supermassive black hole in the galaxy's core, and their narrow collimation is presumably due to magnetic fields operating there. While the jet formation region is too compact to be observed directly by existing telescopes, astronomers using the joint power of the VLA, VLAB, and other radio telescopes have for the first time succeeded in doing the job. Specifically, the region they saw is only a few tens of light years across and located in the galaxy M87, one of the closest jet-emitting galaxies to us. It is found that close to this formation region the jet has a conic shape with an opening angle of 60° and that it narrows to 6° a few light-years away. These observations are extremely useful for understanding the physical processes in the cores of galaxies.

Source: http://www.nrao.edu/

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