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Physics news on the Internet (based on electronic preprints)

1. A way to measure minute forces

Scientists from IBM's Almden Research Center and Stanford University have developed a technique whereby forces of the order of 7×10^{-18} N can be measured, using a mechanical sensor. The ability to measure so tiny forces is basic to the operation of a new instrument, called the magnetic resonance force microscope (MRFM), still under development. As scientists believe, the new instrument will be able to produce three-dimensional maps of structures at the molecular level. Also, it will be probably able to measure the spins of individual electrons. The MRFM combines the ability of a scanning tunneling microscope to image individual atoms and the capacity of magnetic resonance imaging to tell one kind of atom from another. However, the fundamentally new element of the MRFM is the mechanical sensor which is a silicon cantilever 230 μm long and 60 nm thick (one-thousandth the thickness of a human hair) with a magnetized tip. It took several years of strenuous effort to develop this new sensor which is able to respond to magnetic signals coming from specific atoms as they resonate in an electromagnetic field. The 7×10^{-18} N force acting upon the cantilever causes it to vibrate, these vibrations shift a laser interference pattern, and this is viewed in an optical fiber interferometer. The MRFM will provide detailed insight into the structure of complex organic molecules.

Source: http:/www-leland.stanford.edu/dept/news/release/970317attonewton.html

2. Protons to store data

Karel van Heusden and his colleagues at a research laboratory in the state of New Mexico, USA, have invented a novel type of short-term memory for computers. Instead of electrons, it uses protons to store data. The new device is fabricated from silicon dioxide crystals which often have lattice imperfections that spawn rogue protons. A way has been found to align protons on the silicon dioxide wafer by putting it in an electric field so that they will store a 1 or a 0, and to have them stay put after the field is turned off. The new device should be easy to manufacture and can finally serve as an inexpensive substitute for magnetic and other storage media.

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

3. Optical counterpart of a gamma-ray burst

As was reported in the previous issue [*Physics – Uspekhi* **40** (4) 443 (1997)], ground-based telescopes intercepted optical radiation from the gamma-ray burst (GRB) source numbered GRB 970228 in the BATSE catalogue. The follow-up observations are bringing in ever new interesting results. The optical GRB counterpart was gradually but steadily dimming, and the sensitivity of ground-based telescopes was no longer sufficient to resolve it. However, the Hubble space telescope has allowed astronomers to re-acquire the optical counterpart and the nebula of unknown origin around it. It is not unlikely that the nebula is a distant galaxy. It is hypothesized that the optical transient is a supernova that turned up in the way of the gamma-ray burst quite by chance. However, the probability of such an event is extremely low. The roll-off of the source's X-ray spectrum on the low-energy side corresponds to the absorption of X-radiation across the entire thickness of the Galaxy (of the order of 50 kpc) and supports the view that the source is positioned at the edge of the Galaxy or even far beyond its confines. On the other hand, according to the research team in charge of analyzing Hubble data, the observations show proper motion of the faint object associated with the optical transient. The angular rate of proper motion is so high that, if the physical velocity is 1000 km/s, the object must be within a mere 300 pc of the Earth. If it is true that the source is moving, then at least some of the gamma-ray bursts must be of local origin. However, other research teams have not confirmed the fact of the object's proper motion. The final conclusion will possibly be drawn after the next series of Hubble observations is completed.

Source: http://wwwssl.msfc.nasa.gov/newhome/headlines/ast31mar97_1.htm

4. A powerful flare of gamma rays from a distant Galaxy

As part of their study of high-energy gamma rays of cosmic origin at an observatory in the mountains of Arizona, USA, astronomers detected an extended pulse of gamma radiation. They did so when their telescopes picked up a glow excited in the upper atmosphere. From an analysis of the data gathered a year ago, the astronomers report that this was the most powerful stream of gamma rays ever seen from a celestial source. It lasted for several hours, and its source was Markarian 421, an elliptical galaxy about 400 million light-years from Earth. The gamma rays were probably generated as matter plunged into a black hole at the galaxy's center. The most surprising thing is, however, not the immense power of the radiation, but the fact that it safely reached Earth without having been absorbed in intergalactic space. Gamma photons of superhigh energies tend to destroy themselves when they collide with infrared photons emitted by hot gas and dust and filling intergalactic space. That the high-energy gamma rays suffered no absorption could mean that the concentration of infrared photons is significantly lower than expected. Because this concentration is pivotal to many cosmological processes, the observations in question may have astronomers revise their ideas about these processes.

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

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