

PACS number: **01.90.+g**

Physics news on the Internet (based on electronic preprints)

1. Atom identification

Although the scanning tunneling microscope is sufficiently precise to see individual surface atoms, the identity of the atom (especially if it is an impurity) often remains unknown. In an identification technique developed by American physicists John Spence and Uwe Weierstall, electrical field is applied to remove a surface atom and then to transfer it to a distant detector. The identity of the atom is determined from its mass-to-charge ratio as found from the ion's path in the magnetic field. Among other things, catalysis and the study of crystal growth processes are potential applications.

Source: *Physics News Update*, Number 339
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

2. Crystal size in an alloy

Microscopic crystalline lead inclusions in an aluminum matrix have been studied by physicists at the Berkeley Laboratory using the electron microscope. It is found that nanoscale crystal particles assume a few different shapes and came in a range of discrete sizes, other sizes and shapes being avoided. After an aluminium film 100 nm thick was prepared by means of vapor deposition, an ion beam was employed to implant lead crystals. The resulting sample was transparent to the electron beam and well suited for electron microscopy studies. Details of lead-aluminium atomic interaction are believed to be responsible for the effect in that only certain numbers of lead atoms arranged in some special ways are capable of minimizing the energy of the embedded crystal.

Source: http://www.lbl.gov/Science-Articles/Research-News.html

3. Single neutron star

A lone neuron star not entering any multiple stellar system has been observed for the first time in visible light using the Hubble Space Telescope. In 1992, the ROSAT (Roentgen Satellite) detected an x-ray object which was invisible at optical wavelengths. Today, Hubble's high sensitivity has also allowed the object's optical radiation to detected. The upper estimate for star's distance, 400 light years, was found by noting that it lies in front of a cloud this distance away. Spectral measurements show the source to be extremely hot, and combined temperature, distance and luminosity data put its radius within 14 km. In the current view, only a neutron star may be this hot and compact. All neutron stars known so far are either components of multiple systems or emit radio energy as pulsars. The new object does not pulse. This is the first ever lone neutron star identified optically. The absence of pulses is probably due to the star being very old.

Neutron stars result from supernova explosions, the density of matter in their center being sometimes as high 10^{15} g cm^{-3}. Because equations of state at such densities are understood very poorly, several models of the internal structure of neutron stars currently exist. Since the upper radius estimate obtained from observations, 14 km, is close to the lower theoretical bound, about 10 km, some restrictions can now be put on both such models and the equations of state of neutron star matter. The fact that the neuron star is isolated makes its study easier in that its near-surface physics is not complicated by the overflowing of matter from companions.

Source: http://www.stsci.edu/

4. Giant star

Infrared observations of the most luminous of all known stars have been carried our using the Hubble Space Telescope. The star, located near the center of the galaxy, is completely invisible because of the dust cloud lying between it and the Earth. The star releases as much energy in 6 second as the sun does in one year. The radius of the star exceeds that of the Earth's orbit. A gas nebula about 4 light years in size seen near the star is the star's shell cast off 4 to 6 thousands years ago. When the giant star formed $(1 \div 3) \times 10^6$ years ago, its mass was perhaps 200 times that of the Sun. The study of such a bright and massive star has great implications for the theory of stellar evolution.

Source: http://www.stsci.edu/

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Uspekhi Fizicheskikh Nauk **167** (11) 1242 (1997)
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