 

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

## 1. Bose–Einstein condensate

Wolfgang Ketterle and his colleagues at the Massachusetts Institute of Technology (MIT) have produced a Bose–Einstein condensate of $5 \times 10^6$ atoms of sodium, 10 times bigger than in previous experiments (see *Uspekhi Fizicheskikh Nauk* **165** 1380 (1995) (*Physics Uspekhi* **38** 1331 (1995))). To create the condensate a magnetic trap of special configuration was employed. The dimensions of the sample, $8 \times 150 \mu m$, were large enough for the condensate to be explored directly with a laser beam. The researches have found that the condensate behaves like a lens and scatters light anisotropically.

Source: *Physics News Update*, No 272
http://www.hep.net/documents/newsletters/newsletters.html

## 2. X-ray source

American researches from Advanced Photon Source (APS) laboratory have created a unique X-ray source. The X-ray beam brightness exceeds by a factor of 10,000 any previously available results. The new source is based on a storage ring with circulating charged particles. One of technical difficulties the researches were to resolve was determining beam position with the precision of less than one micron. To achieve such an accuracy they developed a special monitor with the layer of vapor deposed synthetic diamonds. Other technical difficulty was producing a deep vacuum in the storage ring.

It is expected that the high brightness of the beam will make it possible to reveal many details in molecular and atomic structures. There will be a possibility of faster image-taking and observing chemical reactions at intermediate stages. The new X-ray source can find use in many technological applications: in creating new semiconductor and polymer materials, in microelectronics, in biological, medical or other researches.

Source: *Energy Research News*
http://w3.pnl.gov:2080/er_news/toc.html

## 3. A black hole in the centre of quasar?

Observations of quasar E1821 + 643 at milli-arcsecond resolution were carried out at the American National Radio-astronomical Observatory. This quasar has redshift $z \approx 0.3$ and refers to radio-quiet quasars characterised by brightness at frequency of 5 GHz being less than or comparable with the optical one. The experiments involved long-base radiointerferometry with working frequencies of 4.9 and 8.4 GHz. The observations were aimed at choosing between the models of the radio source: the model with a black hole at the centre, that with supernovae bursts in the central star conglomeration, or that in which the radiation is emitted by synchrotron mechanism near neutron stars. In the latter case it is expected that the emitting area would be resolved into many small sources with brightness temperature less than $10^5$ K. The observations indicated that in the milli-arcsecond range (corresponding physical resolution is about 1.7 pc) the radiation source is compact with its brightness temperature exceeding $2.2 \times 10^8$K. This rejects the model with neutron stars. Although supernovae bursts could provide an explanation for the high temperature, the central star conglomeration should be extremely dense to account for total energy release. The density of such a conglomeration, confined within a volume of several cubic parsecs, should reach a value of $10^7$ times greater than that in M82 Galaxy. The black-hole model is also supported by the discovery of structures having scales of 100–1000 pc and resembling precessing jets. The researches consider the model with a black hole in E1821 + 643 being more probable than the model with the extremely dense star conglomeration. Until very recently only nearest Seyfert Galaxies were the objects of radio observations at angular resolution of that kind, and there was an ambiguity in interpreting the results obtained.

Source: http://xxx.lanl.gov/astro-ph/9606102

## 4. Observations of the Crab Nebula

Images of the Crab Nebula were collected by NASA's Hubble Space Telescope for a period of several months, excluding a several-week interval. When comparing the images a number of interesting phenomena were discovered concerning the pulsar at the centre of the Nebula. It turned out that jets of particles stream away from the polar region of the pulsar at half of the speed of light. Besides, streams of matter from the equatorial pulsar region were also observed. An explanation for these outbreaks could be furnished by magnetohydrodynamical processes occurring near a rapidly spinning neutron star. Perhaps similar processes are at work at centres of active galaxies and quasars, but on a larger scale. The images also show rapid changes in internal regions of the Crab Nebula where jets of particles impinge on a surrounding material to form shock waves. The shape and position of shock wave fronts vary rapidly on a typical scale of several days.

Source: *NASA Press Releases*
www.hq.nasa.gov/office/pao/NewsRoom/releases.html

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