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1. Molecules in a Bose – Einstein condensate

The presence of Rb molecules in a Bose - Einstein condensate of Rb atoms, first created at the University of Colorado in 1995, has been experimentally demonstrated at the University of Texas. The two-atomic molecules (dimers) are produced when two nearby atoms absorb a photon and then emit another one — a photo-dissociation process which leads to an effective cooling of Pb_2 molecules to about 100 nK. With low thermal velocities making the molecules amenable to a high-resolution spectroscopic study, they were found to have a lifetime of 1 ms and to account for about 1% of Rb atoms.

Source: http://www.sciencemag.org/

2. Ultraviolet laser

A 10-nm free-electron UV laser has been constructed at the DESY lab in Hamburg by the TESLA research group. Free-electron lasers normally depend for their operation on the so-called 'undulator,' a device capable of producing radiation in the frequency range unattainable by other means. The light emitted by electrons in this device (due to small-amplitude oscillations perpendicular to a very nearly straight travel line) is stored in a mirrored cavity and stimulates coherent radiation. At wavelengths below 150 nm, however, the cavity walls do not reflect effectively enough to ensure that light accumulates. The TESLA experiment involves instead a single passage of light through a very long undulation section. Coherent synchrotron radiation results from the light-electron interaction. Besides an analogous 5-nm-wavelength laser planned for 2003, the development of a 500-GeV linear electron accelerator with an integrated X-ray laser will possibly benefit from the new technique.

Source: *Physics News Update*, Number 473
http://www.hep.net/documents/newsletters/
pnu/pnu.html#RECENT

3. Dark matter particles detected?

Contrary to the view that the Universe is mainly made of stars, gas, and dust, it is now well established that it is actually dominated by 'dark matter' (or 'hidden mass') of unknown nature, which is only felt through its interaction with normal matter and which, in particular, forms the extended massive halo around our galaxy. Possible candidates for dark matter particles are the so-called "weakly interacting massive particles" (WIMPs). Although attempts to detect dark matter particles directly — by, say, observing recoil nuclei in the scintillation material — are being made in many laboratories around the world, thus far none of them has been successful due to the extremely weak interaction involved and because of the large number of low-energy background recoil nuclei. However, the DAMA experiment at the Gran Sasso National Lab in Italy now reports seasonal variations in the number of such recoil nuclei. This may be due to the fact that the orbital motion of the Earth superposes on the solar system's motion through the Milky Way halo thus causing both the WIMP velocity in the detector and the intensity of WIMP-nucleus interactions to vary in time over the calendar year. The mass of the observed WIMPs is estimated to be about 50 times that of the proton. The study is still at the preliminary stage and alternative interpretations of the observed seasonal variations are also possible. Further independent experiments will hopefully clarify the matter.

Source: http://www.lngs.infn.it

4. Observations of the M31 core

New high-resolution images from the Chandra X-ray Observatory have revealed five point X-ray sources in the central $1'$ region of the core of the galaxy M31 in the Andromeda Nebula, one of which, $1''$ off the centre, is thought to be a super-massive black hole. While the black hole in M31's core is about 3×10^7 times more massive than the sun according to previous observations, this source has an unusually soft X-ray spectrum, suggesting that the X-ray radiation is generated when an accretion disk forms around the black hole. A theoretical explanation of the observed spectral feature has yet to be found. Another X-ray source, $26''$ off the centre, may be identified with a stellar mass black hole that emits radiation as the material of a neighbouring star is accreting onto it.

Source:: http://xxx.lanl.gov/abs/astro-ph/0003262

5. New type of quasar

According to R Antonucci's 1985 unified scheme, the precise type of activity of a galactic nucleus depends on how the line of sight is oriented relative to the rotation axis of the central black hole. This idea has now been confirmed by the Chandra observations of a galaxy whose nucleus is a powerful X-ray source but which shows little or no quasar activity in the optical and radio range. The Chandra team (led by A Fabian) called the new type of galaxy a Type 2 quasar.

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

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