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Physics news on the Internet (based on electronic preprints)

1. D-pairing in high-temperature superconductors

High-temperature superconductors were discovered in early 1987. Since then, the key role in the mechanism of high-temperature superconductivity has been assigned to the s-pairing of electrons, while d-pairing has been thought to be responsible solely for minor effects. This is true of ordinary low-temperature superconductors. Recent experiments on tallium superconductors seem to have proved the converse: high-temperature superconductivity owes its existence largely to d-pairing. This has been ascertained from a study into thin superconducting films at Buffalo University. Using a scanning magnetometer, a film was investigated at IBM's research laboratory. The film was also subjected to X-ray diffractometry at the University of Paris. The technique used for the purpose eliminates the influence of Josephson current and offers a way to give a definitive answer about the nature of pairing. It is, thus, possible to explain superconductivity in a tallium specimen solely in terms of the theory of d-pairing. This fact is of fundamental significance for further advances in the theory of high-temperature superconductivity.

Source: *Nature*
http://www.nature.com/

2. Interaction of water molecules

According to T Zwier (France), when water vapor is cooled to 1 K, molecular clusters are formed. The clusters each consist of 8 water molecules arranged at the corners of a cube. The cooling was carried out by allowing a compressed vapor to expand rapidly. The cubic structure and composition of the clusters were ascertained from analysis of the vibrational spectra the clusters emit when excited by an IR laser. The clusters were found to have any one of two modifications according to two possible orientations of the molecular bonds. Which modification exists depends on the conditions in which the clusters were formed. The ability of water molecules to form cubic clusters was previously predicted theoretically.

Source: http://unisci.com/

3. New observations with the Hubble space telescope

Collisions of Supernovae. Two interacting supernovae have been detected in the galaxy NGC 6946 which is 17×10^6 light years away from Earth. These objects were first spotted with the telescopes at the Keat Peak Observatory (Arizona, USA) and the X-ray telescope on board ROSAT. However, their angular resolution was not enough to separate the stars. Indeed, only one bright supernova was supposed to have been observed, but the character of its radiation contradicted what ought to have been expected. Observations made by the Hubble Space Telescope revealed that there must be at least two supernovae. Moreover, the shells shed upon explosion apparently collide, thus giving rise to an unusual emission spectrum. According to astronomers, the stars are spaced about 40 light years apart.

A Dust Disk. A dust disk 300 light years across has been observed in the center of the galaxy Agr 220. The disk is surrounded by a double galactic core consisting of two bright compact stellar associations. Presumably, the double core and disk resulted from the collision of two separate galaxies.

Induced Star Formation. Stars are being born in the stellar association NGC 2264 under the influence of radiation from other stars. A young massive star, known as the Allen Source, generates streams of fast particles (stellar wind), which increase the density of the surrounding cosmic medium. Within about 1 light year, conditions have thus been created favoring the birth of new stars. They are close to the Sun in their 'vital statistics'.

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

4. The internal structure of Callisto and Europa

The space probe Galileo has been helpful in measuring the gravitational fields and internal structures of Callisto and Europa, satellites of the planet Jupiter. Callisto was found to be an almost homogeneous body that has no well-defined core and consists of a mixture of water ice and rocks containing iron and iron sulfide. By contrast, Europa has an elaborate internal structure not unlike that of Earth. This is consistent with the hypothesized presence of liquid water under Europa's ice shield. According to a hypothesis, the two satellites differ in structure because they are located at different distances from Jupiter (Callisto is markedly farther away) and, accordingly, different tidal forces act upon them. The magnetometer on board Galileo detected that Europa has a magnetic field; no signs of a magnetic field or magnetosphere were noted in the case of Callisto.

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

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