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1. Three body problem

Along with pair interactions, those between trios of charged particles are operative in many physical phenomena, the electron ionization of a hydrogen atom being a simple but very important example. Owing to huge mathematical difficulties, no complete solutions have thus far been obtained for this or similar problems, whether analytically or numerically in spite of the half century of computer technology, and only a limited number of special models with infinite spherical or plane wave functions have been successfully treated. Now, scientists at the Berkeley National Laboratory have for the first time solved the problem using a supercomputer and subjecting the Schrödinger equation to a special transformation which allows electron wave functions vanishing at infinity to be treated as wave packets. In this way, the cross section and other characteristics of the process have been exactly determined.

Source: http://www.lbl.gov/

2. Superconducting balls

R Tao of the Southern Illinois University and his colleagues observed an intriguing phenomenon when viewing a suspension of micron-sized copper oxide superconducting particles in liquid nitrogen. When an electric current was passed between two electrodes immersed in liquid nitrogen, it was found that, rather than arranging themselves along the current lines as expected, the suspended particles formed themselves into balls about 0.25 mm across, each containing over a million particles. The balls formed very quickly and were even stable against collisions with electrodes. It is believed that the particles ball up because it is energetically favorable for them to do so from the surface energy viewpoint. Unfortunately, the liquid nitrogen employed for creating the suspension prevented careful study of the ball structure. Presumably, gravity-free space flight experiments will provide more information.

Source: *Physics News Update*, Number 464
http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT

3. Hot gas Milky Way halo

Only recently in orbit, and at least 100 times more powerful than its predecessors, NASA's ultraviolet space observatory (FUSE) is now yielding its first results, particularly data on the composition, velocity, and spatial distribution of interstellar gas obtained by the spectral analysis of the light of remote stars coming through the gas. The first target of the observatory is the Milky Way halo, a football-shaped, half-million-degree gaseous object extending 5,000 to 10,000 light years. Although the halo has been known for a long time, its origin has been the subject of much debate in the astronomical community. Some scientists thought it was due to stellar wind and UV radiation from hot stars; according to others, shock waves from supernova explosions produced the halo. Having revealed the presence of hydrogen ions in the halo — which could only appear in the second scenario — FUSE data have in fact proved that the halo was largely produced by supernova explosions, numbered in thousands and involving ejections of matter and powerful shock waves. An important task now facing FUSE is to determine the abundance of deuterium in space — a quantity which contains valuable information on the first minutes of the universe's evolution.

Source: http://www.nasa.gov/, http://fuse.pha.jhu.edu/

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4. Microlensing

The MACHO project. One of the major goals of the MACHO project in recent years has been the observation of microlensing of stars of the Large Magellanic Cloud, our galaxy's companion. The microlensing effect, i.e., the gravitational focusing of the light of a star by a massive object located along the line of sight of the star, is observed as star brightness changes lasting from a few days to over a year, the time interval the moving gravitational lens takes to cross the line of sight. 13 to 17 microlensing events have been recorded reliably — several times more than expected from lensing by well-known astrophysical objects like brown dwarfs, Jupiter-type planets, or neutron stars. Thus, gravitational lenses cannot be identified with any known type of cosmic object and are possibly components of the so-called hidden mass — e.g., fossil black holes in some models. Most of the individual objects are from 0.15 to 0.9 solar masses and together they may account for as much as 20% of the galaxy's total mass according to the latest observations.

Isolated black holes. Two microlensing events of very long duration, lasting 800 and 500 days, have been recorded using a number of ground-based telescopes and NASA's Hubble Space Telescope. The latter, providing accurate characteristics of the lensed stars, allowed the masses of the gravitational lenses to be determined, which turned out to be about 6 solar masses in each event. Since neither neutron stars nor brown dwarfs can be that heavy, isolated black holes are the most likely cause of the microlensing. Previously, objects with black hole type properties have been seen only in pairs with ordinary stars using the x-ray radiation from the accretion disks. The new data suggest that black holes are rather numerous and that they may emerge isolated in the explosions of lone massive stars.

Source: http://xxx.lanl.gov/abs/astro-ph/0001272,
http://www.nasa.gov/

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