

PHYSICS UPDATE

▶ ELEMENT 111 HAS REPORTEDLY BEEN SEEN at the Gesellschaft für Schwerionenforschung (GSI for short) in Darmstadt, Germany, the same lab where the discovery of element 110 was recently announced (see PHYSICS TODAY, January, page 19). The group at GSI created element 111 by shooting a beam of ^{64}Ni at ^{209}Bi targets. In their 20 December announcement they report detecting three $^{272}111$ nuclei, which decayed with a half-life of $1.5^{+2.0}_{-0.5}$ milliseconds. In all three cases, the daughter and granddaughter nuclei, $^{268}109$ and $^{264}107$, were themselves isotopes not previously observed. (S. Hofmann *et al.*, GSI preprint.)

▶ A COPPERLESS PEROVSKITE SUPERCONDUCTOR has been found by a collaboration of physicists at IBM Zurich and Hiroshima University. Perovskites, which are prominent in the Earth's mantle, are a class of ceramic crystals (such as MgSiO_3) that exist in a layered cubic structure. The subject of the recent measurements, Sr_2RuO_4 , goes superconducting only below a very cold 0.93 K, but it has piqued some interest because its crystal structure is analogous to that of the various copper oxide materials that, since 1987, have been found to be superconducting at temperatures above 30 K. The copper oxide planes, suspected to play a special role in the high-temperature superconductors, are replaced in Sr_2RuO_4 by ruthenium oxide planes. The question now is whether the mechanism of superconductivity in the new material is the same as in the copper oxides, despite the great difference in their critical temperatures. If so, studying the copperless perovskite might shed further light on the mechanism of superconductivity in its isostructural cousins. (Y. Maeno *et al.*, *Nature* **372**, 532, 1994. See also the article by Daniel Cox and Brian Maple in this issue, page 32.)

▶ DARK MATTER IS NOT DOMINATED BY RED DWARF STARS. Nonluminous matter has been invoked to explain the rotation of spiral galaxies and the internal motions of clusters of galaxies. What is the nature of this dark matter? One possibility is that a large component of it is ordinary "baryonic" matter (made of protons and neutrons) in the form of faint stars such as red dwarfs. Indeed, many such dim stars are seen in the vicinity of our own Sun. But further afield in the Milky Way the density of red dwarfs, now surveyed by the Hubble Space Telescope, turns out to be far too low to explain the rotation of our Galaxy, according to two independent teams of astronomers. One team, led by John Bahcall (Institute for Advanced Study) and Andrew Gould (Ohio State), concluded that red dwarfs can ac-

count for no more than 6% of the mass of the Galactic halo and 15% of the Galactic disk. The other group, led by Francesco Paresce (Space Telescope Science Institute and European Space Agency), found that the core of at least one globular cluster contains fewer dim red dwarfs than expected. It seems that dark matter will therefore have to consist of even lighter objects, such as brown dwarfs, or exotic, hypothetical particles not yet detected. (J. Bahcall *et al.*, *Astrophys. J.* **435**, L51, 1994; F. Paresce *et al.*, *Astrophys. J.*, to be published 15 February 1995. See also PHYSICS TODAY, July 1994, page 17.)

▶ SOME EXACT RESULTS IN FOUR-DIMENSIONAL SUPERSYMMETRIC YANG-MILLS THEORY have been obtained by Nathan Seiberg of Rutgers and Edward Witten of the Institute for Advanced Study in Princeton, New Jersey. Although Seiberg and Witten's achievement addresses quark confinement and symmetry breaking, the new results have also generated excitement among mathematicians who work with multidimensional geometry. In particular, Witten has shown how to apply the results to Donaldson theory of four-manifolds, greatly simplifying work in that field. (For a fuller account, look for a Search & Discovery story in an upcoming issue.)

▶ AN ELECTRONIC MICROREFRIGERATOR, a device that removes hot electrons from cold metal electrodes, has been built by scientists at the National Institute of Standards and Technology in Boulder, Colorado. The refrigerator is a "tunnel junction" consisting of superconducting aluminum separated from a copper electrode by a thin barrier. Only electrons above a certain energy can cross the barrier. The remaining electrons circulate through an electrical circuit and return to the electrode through a superconducting Pb contact, which allows electrical current to flow without the transmission of heat from the circuit. In the first demonstrations of this method, John Martinis and colleagues lowered the temperature associated with the electrons from 100 mK to 85 mK. This technique, analogous to cooling a cup of coffee by blowing the steam molecules away from it, has the potential to further cool low-temperature electronic devices, allowing more sensitive, less noise-laden measurements. Such devices could include balloon-borne instruments that measure the cosmic background radiation. (M. Nahum *et al.*, *Appl. Phys. Lett.* **65**, 3123, 1994.)

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