SCIENCE NEWS of the week

# Superconductivity Glimpsed Near 300 K

Room-temperature superconductivity is a dream of condensed-matter physicists that seems on the verge of coming true. New experimental results point tantalizingly to its existence, including a short appearance of superconductivity at a temperature of 292 kelvins, or 66°F. The experiment was conducted by Alex Zettl, Angelica Stacy and Marvin Cohen of the Lawrence Berkeley Laboratory and the University of California at Berkeley.

The problem with the many reports and rumors of superconductivity at or near room temperature is that other experimenters, or even the same experimenters, have not been able to confirm or repeat the reported results. Nevertheless, one of the physicists involved in the search for high-temperature superconductivity, Paul Grant of the IBM Almaden Research Center in San Jose, Calif., speaks of what he calls the "church" of high-temperature superconductivity. "We have to believe there's something out there," he says.

Room-temperature superconductivity would mean resistanceless flow of electricity at temperatures requiring no special refrigeration, and that means no generation of waste heat and no power loss. This would be a great advantage to closely confined circuitry, such as computers, and it might even bring worthwhile savings in long-distance transmission.

Zettl and his collaborators reported in Berkeley at last week's Workshop on Novel Mechanisms of Superconductivity that they took an yttrium-barium-copper-oxide and cooled it down from 300 K. Between 292 and 280 K it lost resistance. The resistanceless quality seemed stable, Zettl says, lasting two or three hours. The next day they tried to repeat the experiment, heating the same sample above 300 K and cooling it back down, but in the second cooling the high-temperature resistance loss did not occur.

The precise chemical composition can vary within these samples. Zettl thinks that inside the sample there was a filament or "link" of a specific composition that went superconducting at 292 K, but that the thermal stress of reheating and recooling broke it. Therefore he was not able to apply the second standard test for superconductivity, the Meissner effect, in which a superconductor resists penetration by a magnetic field imposed from outside.

Paul C. W. Chu of the University of Houston and his colleagues from the University of Houston and the University of Alabama at Huntsville were able to test for the Meissner effect in a sample that lost all resistance at 225 K (−54°F), but only 1 percent of the sample showed the Meissner effect. Therefore Chu is not making any out-and-out claims. In his view, repeatable superconductivity has not been confirmed above 100 K.

By replacing some of the oxygen in these compounds with fluorine, a group at Energy Conversion Devices, Inc., in Troy, Mich., led by Stanford R. Ovshinsky, produced a compound in which they found bulk superconductivity at 155 K (−180°F) and a filamentary Meissner effect at 260 K (8.6°F). At the Berkeley meeting, Alex Braginski of Westinghouse Research Laboratories in Pittsburgh reported a "resistance anomaly" but not total resistance loss after substitution of two fluorines for oxygen. He calls the anomaly "a partial agreement with Ovshinsky." *– D. E. Thomsen*

## Further findings on flare phenomena

To the earth-bound, the sun lends an appearance of being a docile, warm, friendly sort of star that keeps flowers in bloom and summer days languid. But to the solar astronomer, that same sun is a massive ball of hot swirling gases prone to complex atomic reactions and violent explosions that rise thousands of miles above the surface. And though the sun's proximity allows researchers a blazing laboratory in their own backyard, much about the 5-billion-year-old star remains shrouded in mystery.

One such enigma is the solar flare, which surges out from the sun in a fiery blast that may last a few minutes to an hour, but is capable of spewing forth the equivalent amount of solar energy the earth gets in a year. Large flares can cause temporary radio blackouts, auroral displays and loss of satellite communications. No one quite knows why these flares occur, but current theories tie them in with the interaction and distortion of magnetic fields surrounding sunspots (SN: 6/28/80, p.404).

As much of a mystery is the timing of these flares, shown to occur every 152 to 154 days. Some astronomers think this timing occurs because of interactions between various phenomena, such as the coinciding of hotspots or other rotating features of the sun. Now, Taeil Bai and Peter A. Sturrock of Stanford University report in the June 18 NATURE that the periodicity of solar flares is a product of a global, rather than local, phenomenon.

The researchers studied the 152-day periodicity of 442 major flares recorded from February 1980 to December 1983 by the Hard X-Ray Burst Spectrometer, one of several devices on board the Solar Maximum Mission that began studying the sun in 1980 (SN: 9/6/80, p.152). The spectrometer monitored X-ray emission by the amount of energy across different spectral ranges.

Earlier studies have shown that flares occurring each 152 days might result from the coinciding of the sun's hotspots, or active zones, with each other. To check this, Bai measured the rotation period of the sun's hotspots in the Northern Hemisphere and found it to be 26.75 days. But observations showed that the alignment of these hotspots, as well as alignment of other active zones rotating at different periods, failed to produce most of the flares seen at the 152-day period.

Bai also tested a theory that previously showed that flares occurred during the coupling of "active bands" inside the sun produced by gravity-mode oscillations, a type of distorting force in the sun. It is believed that when these bands overlap they generate excess energy and induce convection in the sun, followed by the creation of sunspots and the production of flares. But Bai's analysis of the rotation period of two bands thought to do this showed that that the occurrence of flares every 152 days didn't match up to the times the bands overlapped.

Although Bai's study showed that almost half of all flares studied occurred in the prominent active zones of each hemisphere, he also found that flare activity outside active zones corresponded with the 152-day cycle, indicating that the periodicity occurs because of some mechanism involving the entire sun. In addition, the flares in the Northern and Southern Hemispheres that showed the 152-day periodicity independently also peaked at the same time. Although Bai attributes the timing of the flares to something that involves the whole sun, he won't hazard a guess as to what that might be.

Bai is equally mystified by findings in a recent study of 443 flares occurring during the sun's 19th solar cycle, from 1954 to 1964. "We found a periodicity of 51 days [within that cycle], which is one-third of what we found in cycle 20 and 21," he says. "I'm puzzled why the period was reduced by a factor of three." That problem, Bai says, is one he'll leave the theorists to solve. *– K. Hartley*