physicists a new tool for understanding the "evaporation" of nuclei. They might also shed light on the reverse process, the condensation of nuclei from smaller parts. "It's relevant to what happens in the formation of neutron stars," says Viola. If so, the work is likely to be a hit—a palpable hit.

–CHARLES SEIFE

SUPERCONDUCTIVITY

Perplexing Compounds Rejoin the Club

If you want to start a fight in a roomful of physicists, ask them how high-temperature superconductors (HTSCs) work. The compounds, which are based on layers of copper oxides, lose their electrical resistance at temperatures as high as 138 kelvin—almost 100 degrees warmer than the best conventional superconductor. By rights, they should be prime candidates for a unified theory. Yet 15 years after the discovery of HTSCs, every theorist seems to have a different explanation for their strange properties.

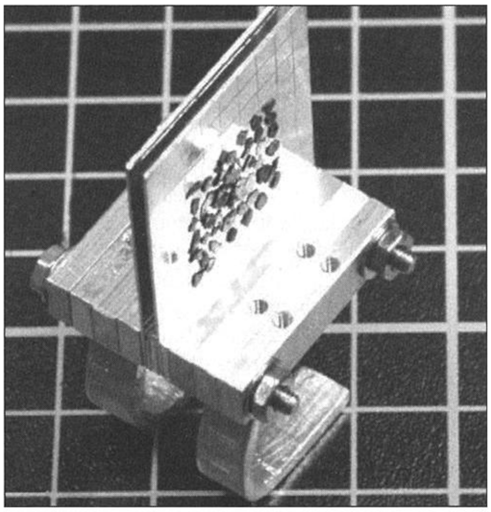
Now results of a laborious experiment, published online this week (www.sciencexpress.org), have solved a longstanding puzzle about the superconductors: why some, but not others, appeared to show a fundamental fingerprint of magnetic spin. Physicists have debated the reason vigorously since 1991, when researchers shooting beams of neutrons onto HTSC superconductors at the Institut Laue-Langevin in Grenoble, France, discovered an unusual pattern in their scattering data. Neutrons are like tiny bar magnets, carrying no electrical charge but a small amount of magnetic spin, a property they share with electrons. So the way these miniature magnets bounce off a superconductor can reveal what the material's electron spins are up to.

The French team discovered a faint peak that suggested the spins were conspiring in some collective resonant interaction, like a sea of compass needles all wiggling in unison. And because the resonant peak grew large and sharp when the material was superconducting, many thought that magnetic interactions might help solve the mystery of HTSC superconductivity.

The catch was that the resonance was seen only in HTSC materials the crystal structures of which had two or more layers of copper oxide; single-layer compounds such as lanthanum-strontium-copper-oxide, the first HTSC ever discovered, seemed exempt. Some physicists believed that meant spin resonances were a red herring that they could ignore.

Now the herring is back, and it's real. A collaboration between the Max Planck Institute for Solid State Research, two Atomic Energy Commission (CEA) labs in France, and the Institute of Solid State Physics in Chernogolovka, Russia, reports that the resonance occurs in a single-layer HTSC compound after all. Because the material they studied, a thallium-barium-copper oxide compound, hasn't been grown in crystals big enough for neutron scattering, the scientists had to devise a painstaking technical workaround. "We aligned several hundred small crystals so that they behave like one large crystal," says co-author Bernhard Keimer. With this composite specimen, they were able to carry out the neutron study. When they analyzed the data, the resonant peak was there. "This proves that the resonant mode is a generic property of these superconducting materials," Keimer says.

"This is a tour de force," says John Tranquada, an experimentalist at Brookhaven National Laboratory in New York. "Preparing and aligning 300 crystals was a tremendous task, and the measurements required considerable patience." Tranquada believes the data will stand up to scrutiny. Michael Norman, a theorist at Argonne National Laboratory in Illinois, agrees: "Now it's clear that this resonance is the rule rather than the exception."



Puzzle pieces. Precise alignment of hundreds of tiny superconductor crystals led to new spin observations.

Less clear is how theory will accommodate the new observations. "This is where the real debates start," Norman says, "and it's a mine field." Physicists are stepping lightly, because each theory has a different idea of what makes the HTSCs tick and no theorist is going to yield ground easily. All superconductors work because the electrons (or holes) become glued together in pairs; in conventional materials the pairing is due to one electron's distorting the crystal lattice and attracting another—like two bowling balls on a mattress. The pairs then waltz through the material without resistance. Most theorists believe some other kind of "glue" will be needed for the HTSC materials. Boosters of theories that invoke magnetic or spin effects to glue the charge carriers together will likely gain the most encouragement from the new data.

Keimer stresses that linking HTSCs through spin resonance is a first step, not a knockout punch. "Our experiment will not end the debate about a final theory of superconductivity," he says, "but it may help tilt it in a specific direction."

–DAVID VOSS

GENE THERAPY

Blood Test Flags Agent In Death of Penn Subject

Exactly what killed Jesse Gelsinger, the first volunteer to die in a human gene therapy trial, remains a mystery, but last week researchers in Germany fingered a feature of his immune system as a prime suspect. They also believe that a simple blood test might be able to prevent similar tragedies in future gene therapy trials.

In September 1999, 18-year-old Jesse Gelsinger took part in a trial designed to test the safety of using a form of adenovirus to transport new genes into patients. Adenovirus normally only causes mild colds. Nonetheless, within hours of the injection of the virus "vector," Gelsinger's immune system went into overdrive. Four days later he died of multiple organ failure. James Wilson, leader of the trial and head of the Institute for Human Gene Therapy at the University of Pennsylvania in Philadelphia, initially suggested that another viral infection or undetected genetic condition might have triggered the harsh immune response to the adenovirus that investigators concluded had killed Gelsinger (*Science*, 17 December 1999, p. 2244, and 12 May 2000, p. 951). After further studies in monkeys, he pointed to the proteins in the coat of the vector as a possible source of the immune response revolt. Wilson was unavailable for comment on the new findings.

Günter Cichon of the Max Delbrück Center for Molecular Medicine in Berlin and his colleagues sought to find out how adenovirus provokes the body's defenses. They mixed blood samples from 18 individuals with adenovirus that was "externally identical" to the one used in Wilson's trial. The virus set off a forceful response from the complement system, a natural and powerful defense against invading pathogens, but only in samples that already contained antibodies against adenovirus. Reporting in the current issue of *Gene Therapy*, the team concludes that a viral dose comparable to the one Gelsinger received raised the con-

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