mally repulsive electrons together.

The conventional mechanism holds that electrons interact through crystal vibrations called phonons. Marvin L. Cohen at the University of California at Berkeley thinks the electron-phonon interaction may still be a viable mechanism for the recent high-temperature superconductive materials. (Cohen and his colleagues announced March 2 that they had reached a superconductivity onset temperature of 100°K with a compound of the same composition as Chu's.)

But Chu and theorist Philip W. Anderson at Princeton (N.J.) University believe that the electron-phonon interaction cannot explain superconductivity at temperatures higher than about 40°K. Chu and Wu are intrigued by the fact that the yttrium material contains two different phases — two compounds of different composition and structure. A green phase is not itself superconducting, according to Chu. So the researchers believe that either the other (black) phase is responsible, or the superconductivity mechanism is taking place at the interface between the two phases, an idea first developed about 10 years ago.

However, Anderson says he would be surprised if the existence of two phases has anything to do with superconductivity in these kinds of materials. Instead he proposes in the March 6 SCIENCE another mechanism, in which the electrons in the yttrium and lanthanum oxides — and in other materials that are not quite able to become completely ordered magnetically — are coupled through magnetic and electronic interactions.

In interviews this week, Carnegie researchers who were asked to analyze the material said it contains two novel crystal structures. "The new structure will really set theoreticians to thinking," says Robert M. Hazen, "because [one aspect] lends itself to some very unusual electronic properties." They plan to reveal the exact nature of the structures in a paper submitted to PHYSICAL REVIEW LETTERS. *— S. Weisburd*

Scientists, 'boxed in,' scramble after supernova, find neutrinos

Supernova 1987A is "an event unique in our lifetimes," said Stanford Woosley of the University of California at Santa Cruz. He was speaking March 6 at a hastily convened workshop on the supernova, which brought about 100 people to the NASA Goddard Space Flight Center in Greenbelt, Md. It is unique in more ways than Woosley knew at that moment: On March 10 came reports from neutrino detectors in the United States and Europe of simultaneous detection of neutrinos from the supernova, the first neutrinos recorded from beyond the solar system.

One thing that seemed clear at the March 6 meeting is that theorists are having a hard time assimilating the information from this, the nearest supernova since 1604. According to David Helfand of Columbia University in New York City, it is also 100 times nearer than the next nearest one to explode since the space age began. "There are not many chances to learn from space observations," he said. "We have to seize this one."

Robert P. Kirshner of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., quoted the distance to 1987A as 50 kiloparsecs or 1.5×10^{23} centimeters and calls it the brightest since 1885 (an explosion in galaxy M31). Its nearness may be not a blessing but a curse, Kirshner said, particularly as astronomers try to answer the question, "What star is that?" and to classify the explosion according to one of the subtypes of either type I or II supernovas. Or, in Woosley's words, "IIb or not IIb?"

Data from the International Ultraviolet Explorer (IUE) satellite show that the ultraviolet intensity of the supernova fell off very rapidly, after which it became evident that the star astronomers first thought had exploded, Sanduleak -69° 202, had not. If the Sanduleak star had been the precursor of the supernova, astronomers would have had for the first time a supernova whose predecessor was known and had been studied somewhat. But as J. Craig Wheeler of the University of Texas at Austin put it at the meeting, "The fact that the sucker is still there is irritating."

A second star, a close companion to Sanduleak -69°202, is also still there. Speculation now centers on a bulge that several observers saw on the southeast side of the image of the Sanduleak star before the explosion. This could be an even closer companion that the telescopes can't separate — "star No. 3." However, star No. 3 would have to be very dim. It would also have to be a type II supernova, which has hydrogen (type I does not). IUE has found hydrogen, and this creates theoretical problems, because, as Woosley says, it's hard to make something dim into a type II.

All this is making the researchers feel somewhat claustrophobic. "We seem to be getting into a box," said Woosley at the workshop. "It's not my fault," responded Kirshner. "I'm beginning to feel the same box you are," added Wheeler.

According to a theory due largely to Woosley and Thomas Weaver of Lawrence Livermore (Calif.) National Laboratory, stars start out burning hydrogen to helium. Later in life they process the helium to heavier and heavier elements. The heavy elements gravitate to the center; hydrogen and helium remain layered on the outside. When a star "supernovas," the heavy core collapses, triggering a shock wave that moves outward, blowing off the outer layers. This could be a star that had very little hydrogen left when it blew, Wheeler told workshop participants. Then the hydrogen should thin out soon, enabling scientists to see into the helium layer, and the spectrum should look like type IIb.

Yet a few minutes later Wheeler jumped up to say that, based on the redshifts he had just calculated from radio data, they may already be seeing through thinning hydrogen into the helium layer.

But Roger Chevalier of the University of Virginia at Charlottesville, relating the first radio observations, caused more theoretical consternation. The radio work, done at three Australian telescopes, at Fleurs, Molonglo and Parkes, shows 1987A developing much faster than other supernovas, making changes in days that took others months or years. But 1987A is throwing out matter at a rate only a few hundredths or thousandths as fast as the others.

"I just felt the box get tighter," responded Wheeler.

Several people at the meeting mentioned a reported detection of neutrinos from the supernova by an experiment located under Mt. Blanc in Europe, and wondered why it had not been confirmed by detectors elsewhere. The Mt. Blanc finding has not been confirmed, but on March 10 Randy Black of the University of California at Irvine (UCI) informed SCIENCE NEWS that the IMB detector operated by UCI, the University of Michigan and Brookhaven National Laboratory in a salt mine at Fairfax, Ohio, recorded 8 bursts of neutrinos in a 10-second period on Feb. 23, the day the supernova began. At the same time, the detector at Kamioka, Japan, recorded similar signals. However, that time is five hours different from that of the Mt. Blanc report. For the moment that discrepancy is an unsolved puzzle.

"It's the coincidence that has everybody in the field excited," says Frederick W. Reines of UCI, one of the original discoverers of the neutrino itself. It means the finding is almost certainly reliable. Before now neutrinos have been recorded from terrestrial sources and from the sun, but not from outside the solar system. "It's the real beginning of neutrino astronomy," says Black. That neutrinos could survive the journey also has implications for the theory of the neutrino, whether it has mass and whether it is subject to radioactive decay. Those implications are just beginning to be explored. For the supernova, it means information from the very beginning of the event, from the collapse of the star's core. As Reines puts it, "It means seeing deep into the event, rather than just looking at the surface." *— D. E. Thomsen*