## Revisiting intermetallic superconductors

Since 1986, copper oxide compounds have dominated the superconductivity fast-track, with scientists making headlines last year by reporting transition temperatures near 250 kelvins — about −23°C (SN: 12/18 & 25/93, p.405).

But copper oxides are not the only superconductors worthy of study. In 1953, researchers first saw the zero-resistance phenomenon in a multimetal compound based on niobium, designated A15. In 1974, a group of chemists achieved superconductivity at a temperature of 23.2 kelvins in a niobium-based thin film — a breakthrough that has gone unchallenged for nearly 20 years.

Now, superconductivity researchers are refocusing attention on such "intermetallic" compounds. In the Jan. 13 and Jan. 20 NATURE, researchers at AT&T Bell laboratories in Murray Hill, N.J., led by physicist Robert J. Cava, describe several new families of intermetallic compounds, made from combinations of ordinary and rare earth metals, that achieve superconductivity at elevated temperatures. In the Jan. 10 PHYSICAL REVIEW LETTERS, R. Nagarajan, a physicist at the Tata Institute of Fundamental Research in Bombay, India, and his colleagues describe superconductivity in a nickel alloy.

Wondering why other such superconductors hadn't turned up before, Cava realized "people had just stopped looking."

These superconductors are distinguished by their use of three or four metals in combination. Cava's team describes one quaternary intermetallic compound — based on the elements yttrium, palladium, boron, and carbon — in which they achieved superconductivity at 23 kelvins. In another family of compounds, based on nickel, boron, carbon, and a fourth element from a group of rare earth metals, they saw no electrical resistance at 16.6 kelvins. Indeed, Nagarajan and his colleagues also confirmed superconducting transition temperatures at 12.5 and 13.5 kelvins in a related family of nickel-based alloys.

"We believe that the yttrium-palladium boride carbide superconductor will prove to be the first of a new family of high-temperature [superconducting] intermetallic compounds, and we suggest that boride carbides (and borides) represent one road to high-temperature [superconductors] that is worthy of exploration," the Cava group writes.

While recognizing that nickel raises the temperature at which superconductivity occurs, Cava and his co-workers aren't certain why. They note that the layered-crystal structure of the intermetallic compounds "is reminiscent of those of the copper oxide superconductors." Yet whether they operate by the same electrical mechanism, the physicists say, "remains to be seen."

Of interest, too, notes Nagarajan's group, is carbon's role in facilitating superconductivity. In one particular compound — containing yttrium, niobium, and boron — the researchers note that adding carbon "leads to a dramatic enhancement of superconducting properties," seemingly by modifying its "superstructure." But that mechanism, too, defies a complete explanation.

"The idea of putting four metal elements together to make a superconductor is new," says Cava. "People have tried two and three, but not four. Sometimes to improve results, you have to let nature stabilize competing factors, and the best way to do that is to put more elements into the pot and see what nature cooks up."

"The other obstacle to overcome is the prevailing idea that nature always wants to keep things simple. That's not always so. If anything, what copper oxide shows us is that the simplest compound is not necessarily the best." *— R. Lipkin*

## Radio ears: Probing the universe's fate

Will the universe continue expanding forever, or will it eventually stop expanding and begin to collapse? Powerful radio waves generated when pairs of high-energy jets of matter shoot out of the massive, compact centers of giant galaxies and crash into surrounding gas clouds may carry a remarkably direct answer to this question.

"This is a new tool for doing cosmology," says astrophysicist Ruth A. Daly of Princeton University, who has worked out a way to use the characteristics of these radio sources to detect changes in the universe's expansion rate.

Daly's method relies on the detection of a distinctive pattern of radio emissions from huge, distant galaxies with powerful, central energy sources thought to be black holes. In each case, the regions of radio emission appear as a pair of enormous, widely separated lobes that bracket and dwarf the galaxy itself.

The most energetic radio waves come from the outer edges of the lobes. There, the twin jets of particles traveling outward in opposite directions from the galactic center slam into the ambient gas and excite electrons, which whirl around in the gas cloud's magnetic field and emit intense radio waves.

Daly has found a way to estimate the distance between the two lobes of an extended radio source. Calculated on the basis of a link between the spectrum of radio frequencies emitted by a source and how long it took the lobes to form, this estimate doesn't depend on the distance of the radio source from Earth.

Daly can combine this information with observations from Earth of the source's angular width and its redshift — the characteristic shift to longer wavelengths of radiation emitted by a receding source — to determine how much the rate of expansion of the universe has changed. "If the intrinsic sizes of the sources remain roughly constant with redshift, that means the universe is open," Daly says. In other words, expansion would continue forever.

When Daly applied her method to 10 radio sources several billion light-years from Earth, the results strongly favored an open universe. Now, she and a co-worker are collecting and analyzing data on additional two-lobed radio sources to check these results. "I would like to know how representative those 10 sources are," she says.

Daly presented her findings at this week's American Astronomical Society meeting, held in Arlington, Va. A report describing the new technique and her preliminary results will appear in the May 1 ASTROPHYSICAL JOURNAL.

*— I. Peterson*

## Sunscreen can't give blanket protection

Sunlovers' security blanket against cancer-causing rays — sunscreen lotion — appears to have some holes in it, researchers now report.

Such lotions help prevent mild skin cancers and sunburn. But exposure to the sun's ultraviolet (UV) rays may have another, less visible effect that sunscreens fail to stop — impairing the ability of immune cells to fight melanoma, report Margaret L. Kripke and her colleagues of the University of Texas M.D. Anderson Cancer Center in Houston. New cases of melanoma, the deadliest of skin cancers, have doubled since 1980. About one in 105 Americans will develop it; 20 percent of them will die from it. U.S. melanoma deaths totaled about 6,800 in 1993.

"Protection against sunburn does not necessarily imply protection against other possible UV radiation effects, such as enhanced melanoma growth," Kripke and her co-workers report in the Jan. 19 JOURNAL OF THE NATIONAL CANCER INSTITUTE.

In fact, by preventing the pain and redness of sunburn, sunscreen may enable people to stay longer in skin-scorching sun, putting them at higher risk for developing melanoma, Kripke says.

In their study, the researchers applied either a sunscreen or an oil-water mixture to mice's ears and tails. After 20 minutes, the team exposed some mice for 20 to 27