IBM, AT&T AND MIT ESTABLISH SUPERCONDUCTOR CONSORTIUM

AT&T, IBM, the Massachusetts Institute of Technology and MIT's Lincoln Laboratory announced in late May that they are forming a consortium to develop applications in electronics for high-T_c superconductors. The organization, which is called the Consortium for Superconducting Electronics, will be administered at MIT by a director who has not been named at this writing. It is expected that other research organizations will join the consortium as members.

Current plans call for about 25 researchers from AT&T, IBM and MIT to work jointly on four topics: signal distribution and conditioning networks; junctions, SQUIDS and exploratory devices; advanced devices and integrated circuits; and high-temperature materials and technology. Researchers from all member organizations will participate on each topic.

The consortium has submitted a proposal to the Pentagon's Defense Advanced Research Projects Agency for between $4 million and $6 million in funding.

John Deutch, the provost of MIT, has described the consortium as a model for cooperation among universities, government labs and industry in areas crucial to US economic competitiveness. Deutch credits Ralph E. Gomory, who has just retired as IBM senior vice president for science and technology, for "implementing the recommendations of his own report." Gomory headed a committee that recommended, at the beginning of this year, the creation of between four and six consortia to coordinate efforts of universities, laboratories and industry in high-temperature superconductivity (see PHYSICS TODAY, April, page 41).

Relying on information that was current last fall, the Gomory report estimated that US government spending on superconductivity was about $96 million in 1988, and Japan's about $70 million. Nearly half of US funding came from the Department of Defense, and nearly half went to government laboratories—mainly to ten large ones. In Japan, funding comes roughly equally from the Science and Technology Agency, the Ministry of International Trade and Industry, and the Ministry of Education. The bulk of the money from the Science and Technology Agency has gone to national laboratories such as the National Research Institute of Metals and the National Research Institute for Inorganic Materials, while about half the MITI money has gone to a consortium of private companies called IPG and about half to the International Superconductivity Technology Center, "exclusive of buildings and salaries." ISTEC was established in January 1988 specifically to do research on superconductivity.

A military bias?

Asked by PHYSICS TODAY whether the heavy dependence of US superconductivity research on military funding would not inevitably bias work away from commercial applications, Gomory said he understood the import of the question but was not overly worried, at least in the particular case of the IBM–AT&T–MIT consortium. He said that the consortium's proposal to DARPA was not specifically geared to military applications and that it would stand or fall on its own merits.

It bears noting, however, that the Gomory committee's report identifies space devices as the most promising applications in the near term. ". . . [H]igher temperature operation," the report maintains, "does not by itself add any additional function to [a] device and in some applications such as sensitive instruments it is even a disadvantage because of the increase in thermal noise. Therefore, for many applications, higher temperature operation does not appear to change the picture substantially as long as some degree of refrigeration is still required.

"The complete elimination of the need to refrigerate below ambient temperature would have a large effect on the economic viability of many previously proposed applications. In fact, temperatures of about 100 K can be obtained just from radiative cooling in a space environment. Hence, if the thallium-type materials with $T_c = 125$ K can be futher improved (perhaps to about 140 K), many applications in a space environment should become possible without any additional refrigeration. Thus, the aerospace industry may become an early proving ground for the applications of high temperature superconducting materials."

Looking further ahead, the report says that the discovery of the high-temperature superconductors "will most likely follow the path of other notable scientific events, such as the semiconductor laser, whose practical impact took from one to two decades to develop." The report argues that the fruits of the discovery will go to those who are able to stay the course, and this is the basis of the report's main recommendation. If much of US research continues to be done by small isolated groups, the report argues, much of it will wither away as the going gets tougher.

Deutch and Gomory hope to see the Consortium for Superconducting Electronics become a model for other consortia. Gomory thinks it does not greatly matter how such consortia are organized internally and could imagine formal or informal consortia coalescing around nuclei such as Paul Chu's group at the University of Houston, Allen Hermann's group in Boulder, and Conductus Inc in Sunnyvale, California.

Already, Chu's Texas Center for Superconductivity, with support from DuPont, has joined with MCC to form a consortium. Conductus, established in 1987 to develop superconducting electronics, has an advisory board with members from Stanford and the University of California, Berkeley. The president of Conductus is Peter

Cannon, former research director for Rockwell International, and its head of research is John Rowell, the former assistant vice president of solid-state science and technology research at Bellcore (see PHYSICS TODAY, November, page 38).

—WILLIAM SWEET

DISCONTENT WITH PhD PROGRAMS VOICED AT AAPT–APS CONFERENCE

All is not well with physics doctoral programs in the US, Robert Resnick of Rensselaer Polytechnic Institute found after speaking with physicists at some 50 of the nation's 170 PhD-granting universities over the past two years. The litany of woes worried him so much that he convinced the American Association of Physics Teachers and The American Physical Society to hold their first conference on the subject at the fourth in a series of meetings of physics department chairs. Discussions at the meeting, held 22–23 May in Arlington, Virginia, did little to allay his anxieties, or those of about 75 department heads and representatives from many of the nation's leading universities, about maintaining a continuing flow of highly trained graduate students and PhDs. They concluded that unless several things are done, the situation will surely worsen.

One of the first actions they agreed upon was to send a letter to President Bush's designated science adviser, D. Allan Bromley of Yale University, who had been chosen for the job a month before. Signed by nearly all the participants at the conference, the letter called attention to the "serious difficulties" faced by graduate physics departments "in ensuring an adequate supply of doctoral physicists to satisfy national needs." It went on to express "our deep concern over the ability of Federal agencies to address adequately this important national problem." The nature of the problems is an oft-told story: the impending retirement of an aging physics faculty that itself was educated in the 1940s and 1950s; the increasingly dim prospect of replacing this group with equally talented and motivated professors; the decline in funding (when inflation is taken into account) over the past decade for individual researchers upon whom graduate students often rely for support and equipment, with the bleak outcome that "young physicists are choosing not to embark upon university careers."

Bromley, of all people, hardly needs reminding of the present plight of academic physics. He rang the tocsin in 1986 when he wrote "A Renewed Partnership," the report by the White House Science Council on the faltering health of the nation's research universities (PHYSICS TODAY, March 1986, page 65). Participants at the AAPT–APS meeting were painfully aware of the problems. "The issues in graduate physics education are interrelated with academic research programs," said Homer Neal of the University of Michigan, chairman of the conference.

Elaborating on Neal's assertion, Resnick listed more than a dozen key issues he had gathered from his talks with academic physicists. Some involved research directly: the need to learn to use supercomputers in research projects, the problem of completing a PhD thesis while engaged in an experiment involving a large group, and the seemingly ever-increasing specialization by teachers and researchers, with its inevitable casualty—less likelihood of achieving the longed-for unity in physics.

Other issues raised questions about traditional appurtenances in graduate education: Does the Graduate Record Examination properly reflect undergraduate physics major programs, and does it properly represent the preparation required for graduate work? Is a better impedance match possible between undergraduate and graduate physics education? Should department qualifying exams be used for deciding course levels or degree qualifications for students? What training do teaching assistants need so that they can head up classroom studies and introductory sections of physics labs? Should physics departments seek to improve the English of foreign-born TAs, who often lack the ability to communicate well with Americans? Have we given enough thought to the virtues and defects of using graduate TAs and to the alternatives to this type of teaching? How can we attract and retain more US-born physics students in graduate degree programs? What ways can we devise to bring more women and underrepresented minority students into graduate physics? Do the exciting new developments in physics call for revisions in graduate school curriculums? Can the length of time be shortened for attaining a physics PhD? What should be the role of graduate programs in preparing physics teachers for high schools, community colleges and even universities?

Resnick considers the problems so perverse and pervasive that he doubted if any single conference could come to grips with them. Nobody was surprised that the answers were not all forthcoming. "The overwhelming problem is the physics pipeline," declared Kent Wilson, acting assistant director of the National Science Foundation's Directorate for Mathematical and Physical Sciences. "We have always solved this problem by immigration to this country, and the only difference between the past and present is that now I find many of the names harder to pronounce.... Women and minorities in physics present a more difficult problem. I must admit I don't have a clue as to how to solve the problem. Whatever we've been doing at NSF obviously has not been working."

NSF's tight budgets in the past decade have led the agency's program officers to impose high cutoffs for research proposals and fellowship applications, with obvious dire consequences for graduate education. "Our cutoffs are now set so high, we are making choices from among high-quality proposals—often turning down 50% of those we get," said Wilson.

At a panel discussion of NSF's responsibilities in improving graduate education, Thomas W. Appelquist of Yale said the agency's physics advisory committee, which he belongs to, had recently completed a survey, under the leadership of Joseph Cerny of the University of California, Berkeley, revealing, among other things, that the grad students and postdocs who suffer most from inadequate funding are those in atomic and molecular physics and in nuclear physics theory. James A. Krumhansl of Cornell, the president of APS, argued that NSF may be altering graduate education in significant ways by promoting such initiatives as science and technology centers and the Presidential Young Investigators program. According to Krumhansl, the PYI program has caused an unanticipated squeeze on NSF's research grants, which have not grown to accommodate the increased cost, let alone the higher cost of doing research.

A similar dilemma for NSF has been caused by today's scientific revolutions in, say, condensed matter physics, observed Judy R. Franz of West Virginia University. APS mem-