COMING ATTRACTION: NSF REJECTS MIT, PICKS FLORIDA STATE FOR MAGNET LAB

The decision was shocking. Ignoring the findings of three of its own advisory groups, the National Science Foundation last 17 August selected Florida State University as the future site of a new national laboratory for high-magnetic-field technology. The foundation hypes the new lab, to be built just off the FSU campus in Tallahassee, as a one-of-a-kind center whose magnetic fields will be higher than any currently available, enabling researchers to achieve "exciting new discoveries" that should help the country regain its international competitiveness. High-field magnets are used in work on nuclear magnetic resonance imaging, high-temperature superconductivity, high-speed magnetically levitated trains, nuclear fusion, advanced materials and other applications in biology, physics, chemistry, materials science and engineering. France, Germany, Japan, the Netherlands and Belgium have been aggressively developing high-field magnets in recent years. In the US, work has gone on for the past 30 years in the Francis Bitter Magnet Laboratory at MIT.

By choosing Florida State for a $60 million grant over the next five years, NSF officials rejected the proposal of MIT to upgrade the Bitter Lab. The Bitter Lab is where the fractional quantum Hall effect was discovered in 1982. It holds world records for achieving a continuous dc field of 31.8 tesla, which is 700 000 times stronger than the Earth's magnetic field, and for attaining 68.4 T in a wire-wound, long-pulsed magnet for 5.6 milliseconds.

The newly approved lab at FSU, to be known formally as the National High Magnetic Field Laboratory, is intended to fulfill the requirements for a world-class facility as set forth in July 1988 by NSF's Seitz–Richardson committee (named for Frederick Seitz of Rockefeller University and Robert C. Richardson of Cornell). The committee's report warned that the Bitter Lab is falling behind magnet facilities in France and Japan and is inadequate for the scale of high-magnetic-field research that will be required for scientific and technological competitiveness in the decades ahead. The committee recommended that NSF establish a major national facility capable of developing a hybrid dc magnet generating a field strength of at least 45 T (13 T higher than the Bitter Lab record) and a 20-MW dc power supply. It also called for the lab to produce high-homogeneity superconducting magnets for nmr technology with fields greater than 25 T, as well as pulsed magnets with fields in excess of 75 T and a variety of water-cooled magnets with fields up to 25 T.

Seeking an open contest

In November 1989 NSF began soliciting proposals for the facility described in the Seitz–Richardson report. Because of the equipment and experience already in place at the Bitter Lab, most scientists at research universities and national laboratories were unwilling to write a proposal, believing that MIT had an inside track to the new facility. Some asked foundation officials if the competition would be open and fair. Despite NSF's assurances that the proposals would undergo the customary independent review, only a dozen universities expressed any interest. This prompted Erich Bloch, the agency's director at the time, to widen the net by shopping around for bidders.

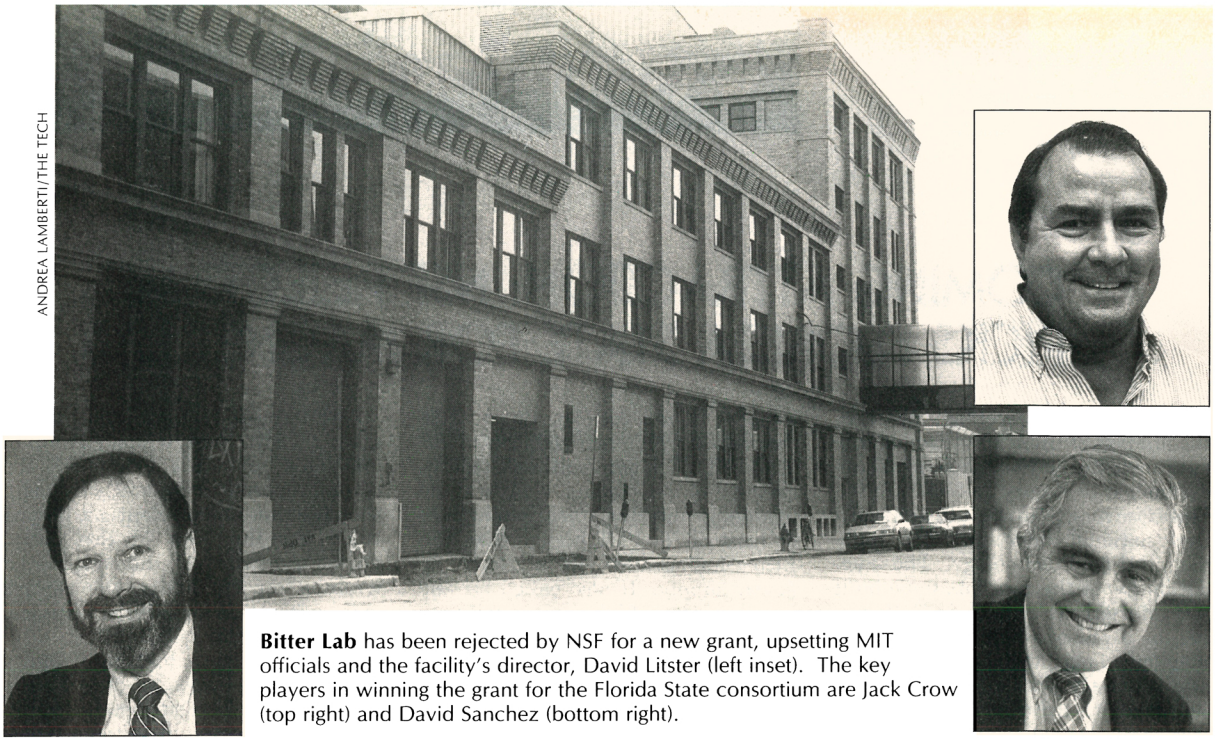
Bloch's reputation during his six years at NSF and his 32 years at IBM was as an abrasive, no-nonsense manager. A mover and shaker who changed NSF through the force of his principles and personality, Bloch sometimes upset the nation's scientific and educational establishment.

Bloch tried to interest such elite institutions as Stanford, the University of California at Berkeley and Lawrence Livermore Lab in forming a consortium and called on the University of Chicago, the University of Illinois and Argonne to enter the competition. But at the deadline on 1 May 1990, the only proposals were from MIT, from a partnership of Florida State, the University of Florida and the Los Alamos National Laboratory, and from New Mexico State University.

NSF immediately initiated a three-stage review: First, a small group of materials scientists evaluated the three proposals individually by mail; then the same eight scientists, having ruled out the New Mexico entry, visited the two rival universities and wrote a report; finally, the reports were considered by NSF's Materials Research Advisory Committee.

All three panels had no difficulty finding MIT's proposal "technically superlative." The site visit committee wrote, "There is little doubt that if funded at the proposed level [$81 million for five years], they [MIT] offer the best and surest chance for placing American high-field research back at the forefront within the next five years." The panel tried to present an even-handed evaluation: "On the one hand, MIT proposes to significantly upgrade an aging facility that has been at the forefront of many areas of high-magnetic-field science performed by the user community.... On the other hand, the Florida State consortium proposal represents a new facility that could, with more risk and in the longer term, significantly enhance the capability of the US.... It would also create a new scientific capability in the Southeast of the country." The committee then delivered an impression: "Our belief that this proposal could have an impact beyond that expressed in the Seitz–Richardson report results from our observation of the remarkable state and local support that is represented in the FSU proposal. In these days of fluctuating or declining support for science, this injection of state funds and faculty positions represents an unusual opportunity."

MIT proposed to renovate Bitter's building, a former bakery that has deteriorated over the years through benign neglect, and to provide 17 magnets with fields greater than 21 T, including one that met the Seitz–Richardson specification of 45 T, in just four years. In addition, MIT stated it could produce magnets with long-pulsed fields greater than 70 T lasting up to 20 milliseconds, as well as magnets reaching 60 T for 0.1 second, magnets with 200–300-T fast



ANDREA LAMBERTI/THE TECH

Bitter Lab has been rejected by NSF for a new grant, upsetting MIT officials and the facility's director, David Litster (left inset). The key players in winning the grant for the Florida State consortium are Jack Crow (top right) and David Sanchez (bottom right).

pulsed fields of 2–10 microseconds, a 17.5-T nmr magnet that would be available in 1992 and a 20-T "baseline" magnet for nmr that would be completed by the end of 1994.

Starting from scratch

Florida State, for its part, offered to create eight to ten magnets by the time the lab was up and running. Of these, two or three, with maximum field strengths in excess of 30 T, would be ready in only two years, and the 45-T magnet would be completed in about five years. The peer reviewers agreed that Florida State, starting from scratch, was no match for the current capability and competence at the Bitter Lab. By one unofficial tally, the reviewers in all three groups combined voted 28 to 2 for the MIT proposal. The FSU proposal, said one panel, "entails considerably more risk than MIT and will undoubtedly require a minimum of five to eight years to catch up, even if it is successful."

The comments by the reviewers only seemed to make MIT more arrogant about its own abilities and more confident it would win the competition. Staff at the Bitter Lab simply shrugged off the statement by the site visitors that "the US would be equally well served by either proposal, but over different periods of time." NSF officials, however, presented this murky remark to the National Science Board as the precept for seeking approval on 16 August to award $60 million in a five-year grant to Florida State.

The case for Florida State, better known for its powerful football team than for scientific prowess, at least until now, was argued before the board by David A. Sanchez, NSF's assistant director for mathematical and physical sciences. While admitting that MIT possesses a virtually unparalleled reputation in science and engineering, the pivotal difference between the schools in this instance, said Sanchez, "and here I rely on my experience as a university provost [at Lehigh University], was that the level of commitment of the two institutions was strikingly dissimilar. Reviewers stated that the present facility at MIT existed in spite of the university's administration, who regarded the facility as peripheral [and made] very few faculty appointments of major users. It is a magnet manufacturer, not a national research center of excellence—at best a regional center. . . . In contrast, FSU, while not having on board at present scientists of the quality of those at MIT, was clearly committed to creating a national center of excellence."

FSU's "commitment factor," Sanchez suggested, will add more strength and stability to the lab than MIT can provide in the long run. Commitment in this instance has two components: a pledge of $58 million from Florida's state legislature to match NSF's $60 million grant, and a promise by the Florida universities to appoint 54 faculty members—22 of them tenured faculty, 20 visiting faculty and 12 research faculty. Florida's legislature has already appropriated $12.5 million for the lab, and university officials have said they may ask the legislature for $24 million or more in the next session to start on a new building and to begin designing the magnets at Grenoble with Hochfeld-Magnetlabor, the partnership of Germany's Max-Planck-Institut für Festkörperforschung and France's Centre National de la Recherche Scientifique. It is not certain who will build FSU's magnets. Besides the Grenoble lab, Oxford Instruments in Britain and Intermagnetics General, a US company, have each expressed interest.

The Bitter Lab, by contrast, builds its own magnets. It invented the hybrid magnets that make high fields possible. It receives financial support from Toshiba in Japan for research on nmr imaging for biomedical applications. IBM, which once provided funding for such work, is no longer in the business.

The original budget estimates in the proposals weren't very different. MIT sought $81 million for a five-year period, and FSU asked for slightly more. The Seitz–Richardson committee had figured that the array of magnets would cost $67 million over the first five years and the lab's internal program, equipment and staff would cost another $18 million per year. In discussions with NSF last July, both MIT and FSU were told to limit their requests to $60 million and to rely on cost-sharing from other sources for the rest.

Preparing for contingencies

Florida State's plan for holding its

budget request to $60 million called for postponing several magnet projects in the early years, but it was determined not to alter its intention to hire new faculty. Moreover, Sanchez seemed simply flabbergasted by another promise, this one made by Charles B. Reed, chancellor of Florida's university system. Reed pledged that overhead fees (now 46%), usually allocated for administrative expenses, would go into a contingency account for the first five years to cover cost overruns or other emergencies.

The issue of state and university support for Federal science projects is contentious. Bloch, who completed his full six-year term at the helm of NSF last 30 August, was a feisty advocate of the idea. Programs like NSF's Engineering Research Centers and Science and Technology Centers were founded on the pragmatic concept of "leverage"—that is, the agency's grant would stimulate additional funds from states, localities, industrial firms and universities. Cost-sharing was required by the Department of Energy in its competition for the Superconducting Super Collider. DOE announced that states would need to ante up contributions in cash and in kind to enter the race for the gargantuan proton–proton collider. Even before Texas was declared the winner of the site contest, its legislature approved bond issues totaling $1 billion for the SSC, agreed to buy the land for the 54-mile tunnel and proposed to construct roads, utility lines and other infrastructure for the project.

Saving Federal dollars

Some academics argue that cost-sharing would undoubtedly save Federal dollars but would place greater financial burdens on the states. In such circumstances, private universities would be at a disadvantage because state legislatures are unlikely to fund "bricks and mortar" projects and research equipment at nonpublic institutions.

Florida lawmakers were turned on by the prospect that the magnet lab would bring jobs and other economic benefits to the region. In Florida, the appeal to lawmakers came mainly from Reed, who knows many of them personally from his years as legislative liaison for former Governor Bob Graham (now a US senator). "The country's scientific elite, including those who serve on peer review committees, think we pick oranges and play football down in Florida," says Reed.

The state has increased spending on higher education by 60% in the past five years. Science and technology programs supported by outside funds, mainly from Federal agencies, have increased from $135 million to about $400 million in those years. Of course, some of this was directed to Florida institutions by Congress, not by merit review procedures. One of the most controversial pork projects is a supercomputing center at Florida State University that DOE has helped finance since 1985. It was proposed by Representative Don Fuqua, then chairman of the House science committee, and adopted by George A. Keyworth II, President Reagan's science adviser, who needed Congress's support for a new Center for Advanced Materials at the Lawrence Berkeley Laboratory.

In the case of the new magnet lab, Reed and FSU scientists, led by Jack E. Crow, a solid-state physicist, refused to recruit members of Congress from Florida to put pressure on the science agency. The impulse to submit a proposal came mainly from Crow, who arrived at Florida State at the start of 1990 to head its Center for Material Research and Technology. He had been at Temple University for 17 years, two of those (1984–86) as a rotator in the Materials Research Division at NSF.

Through his NSF connection, Crow was familiar with the increasing tension between NSF and the Bitter Lab. The lab had been a fairly autonomous facility funded by the Air Force until the Mansfield Amendment to the 1970 Defense Appropriations Act forced the Pentagon to give up all programs not directly related to its military mission. Once it was turned over to NSF, the lab's budget began to dwindle in real terms—though the foundation likes to boast that funding increased by 20% in 1989 to $6 million, an amount that has remained almost constant ever since. Under NSF control the lab encountered a degree of micromanagement. The foundation gradually expanded its support of external users and shifted the emphasis at the lab to magnet development; funding for internal research ceased entirely four years ago.

The Science Board's discussion, as revealed in transcripts obtained by PHYSICS TODAY, indicates that commitment was more relevant than competence in voting to endorse the NSF decision. Still, some members asked tough questions. "Are you saying the science from each of these facilities would be the same at some future date, but that MIT will always be ahead?" asked James Powell, president of Reed College. The answer was equivocal: "In the long term, the Florida State consortium has the potential for a far greater impact." Another member, Arden Bement Jr, vice president for science and technology at TRW Inc, wanted to know the effect on hundreds of users of the Bitter Lab in the interim before the FSU facility is operating. "In the transition from MIT to Florida State," replied Sanchez, "there would be a certain number of users who will need to get on magnets, [and] the only other facility available, other than the one at MIT, which would be phasing out, is at Grenoble." When Bement suggested that NSF was really "off-loading" the problem of the users, Sanchez said an agreement for Americans to use Grenoble is being negotiated. "We had to satisfy ourselves that the majority of the user community would be serviced during the period of transition."

Perry L. Adkisson, chancellor of Texas A&M University, which operates NSF's ocean drilling program (secured after a controversial shootout in the early 1980s with Scripps Institution of Oceanography), asked about Florida State's expertise. When Sanchez said he had been given "a list of some rather illustrious people" whom FSU is "going after," Adkisson wisecracked, with some truth, that this practice is not unknown at some universities.

The job of summing up the reviewer's reports for the board was left to Roland W. Schmitt, president of Rensselaer Polytechnic Institute and a former Science Board chairman. Schmitt asserted that "the real reasons for making this decision are very simple—namely, that you have an institution that is coming into the field new, with a lot of enthusiasm, a lot of dedication, a lot of energy on the part of people in the state and the institution. . . . And, secondly, it will in fact help to geographically disperse high scientific competence in the US. Both of those reasons . . . will appeal greatly to Congress, there's no question about that." He then added with prescience that the decision "will cause problems in the scientific world, I would guess."

The comment was immediately picked up by Frederick P. Brooks Jr, a computer science professor at the University of North Carolina. He noted that "every time we do something for reasons other than scientific merit we are creating trouble for ourselves." He later said that as an academic scientist in the Southeast, and as a former member of the Defense Science Board, he found it "heartbreaking to see what geographic politics has done to national

effectiveness."

Despite these tetchy points, the Science Board approved Florida State by a lopsided 9-to-1 vote. Not all 16 people who were members at the time attended the meeting, and 3 were disqualified from voting or even participating in the deliberations because of possible conflicts of interest. Frank H. T. Rhodes, Cornell University's president, was excluded because he is a director of General Electric, which was judged to have a financial stake in the outcome of the vote, as it holds a contract with Florida State. Also forbidden from participating were Daniel Drucker, an engineering professor at the University of Florida, and Bernard F. Burke, an astronomy professor at MIT. Rhodes was peeved to be excluded. He insists the decision would not affect either his or GE's pocketbook or prestige. Notwithstanding the decision on Rhodes, Schmitt, a former GE vice president, was given a waiver to take part in the deliberations. NSF's legal counsel ruled he had a remote and insubstantial stake in the decision.

When the winner was announced on 17 August, MIT's reaction was predictable. Paul E. Gray, in one of his last acts before leaving the office of MIT president, issued a disquieting denunciation, accusing foundation officials of manipulation of the peer review process and asking the board to reconsider. "If the staff summaries had presented a fair and adequate comparison of the two proposals," Gray wrote Science Board members on 4 September, MIT would not contest the decision. "Regrettably, this was not the case." He cited scientific and technical discrepancies in staff documents placed before the board relating to staffing, budgets and cost-sharing for FSU and MIT. Gray's letter was accompanied by a 45-page package, which included an explanation of MIT's position by J. David Litster, the Bitter Lab's director.

On 13 September, the board's chairperson, Mary L. Good, senior vice president of Allied Signal, wrote to Gray that the members had reaffirmed their decision. Indeed, she said, "the board was satisfied, and remains satisfied, that the recommendation of the director reflected careful review of all the considerations and would best maintain the long-term health and vitality of the affected fields."

Gray protested in another letter the following day: "While you may not have been persuaded by our request for review of what we believe was a seriously flawed process and unfair judgment, I am appalled that you could take so hasty an action without taking time to consider and evaluate the views of the larger scientific community and the users of high-magnetic-field facilities. The consequence of your refusal to reconsider is to cast further doubt on the NSF and NSB process for reaching decisions on major scientific projects."

Enclosed with Gray's second protest was a letter from the Magnet Lab Users' Committee, representing about 300 researchers and students in some 100 research groups. Its chairman, C. D. Graham Jr of the University of Pennsylvania, argued that the choice of Florida State "will have a severe negative impact ('catastrophic' might be the proper word) on users for many years—perhaps indefinitely.... The Florida projection seems highly optimistic to us, given that Florida is starting from zero staff, experience and equipment. Even if Florida performs fully up to promises, only a fraction of the facilities of the current magnet lab would be available to users even after 1995." It seemed to many users that what is now a flap could become a fiasco.

Causing a Catch-22

Members of peer review groups also expressed their anger. Myriam Sarachik of the City University of New York, a member of the Seitz–Richardson panel, wrote as one of the eight site visitors who recommended unanimously that the lab be located at MIT. "It will take FSU many years to get where MIT is right now," she argued. "The momentum lost in the process may never be regained, and there will... be many difficult interim years during which the US will almost surely lag far behind [the competition from abroad]." Similar views came from Horst Stormer and Aron Pinczuk of AT&T Bell Labs, who wrote that the decision "will have severe detrimental consequences for our research and the research of our colleagues." Requiring Bitter's users to travel abroad to France or Japan as MIT winds down its operation and FSU revs up "is utterly impractical," they said. Another reviewer, Paul Chaikin of Princeton, informed the Science Board that the way his panel wrote its report "may have had the effect of making the contest look much closer than it actually was.... I would like to dispel the idea that the proposals were judged equal."

On 12 October the Science Board, beseiged by letters, e-mail and faxes, revisited its decision. Sanchez admitted that the users had expressed valid criticism. He reminded the members that NSF was giving the Bitter Lab $6 million for 1991, the final year of its three-year contract, and that Litster's proposal for two more years of funding was under consideration. He also said FSU's magnets were likely to be available to users in January 1993, "so I think that reflects the commitment." Brooks was still uneasy. He offered a resolution reaffirming the board's decision. "It's important that the board not only do right but that it appear to have done right." Schmitt opposed the resolution "because it puts us in a Catch-22 position... because it will get us in the news as either waffling or having doubts about our prior procedure." In the end, Brooks's resolution was withdrawn, but not before two members who weren't present in August declared they would have voted for MIT.

NSF considers the case closed. But two Massachusetts members of Congress aren't satisfied. Representative Joseph P. Kennedy II and Senator John F. Kerry criticized the decision as "not in the best interest of our nation" and urged the National Academy of Sciences to examine how NSF awards research grants and contracts. In a letter to Frank Press, the NAS president, they complained that the action "sets a dangerous precedent for the decision-making process at NSF and suggests that the criteria used by the NSF for selecting major grant and contract recipients... threatens to shake the foundations of research that have been so vital to US scientific leadership." Their concerns led to the insertion of a paragraph in the House–Senate conference report for NSF's 1991 appropriations, directing the foundation to engage the academy to examine the NSF's procedures for selecting major research facilities and for weighing the advice of its independent review groups.

Once the user community gets over its initial shock, it may accept the promise of a well-provided, well-equipped lab in Florida. As the acting designated director of the new lab, Crow has already made some cost estimates: A new building should run to about $32 million. The cooling system could cost $6 million and general instrumentation another $11 million. He expects the lab to be running by January 1993. To meet that date he has signed up a deputy director, Hans-Jorg Schneider-Muntau, Grenoble's chief engineer, who has 18 years of experience in the design and operation of high-field magnets.

"Everyone will be surprised at how well FSU will do," says Sanchez.

—Irwin Goodwin ■