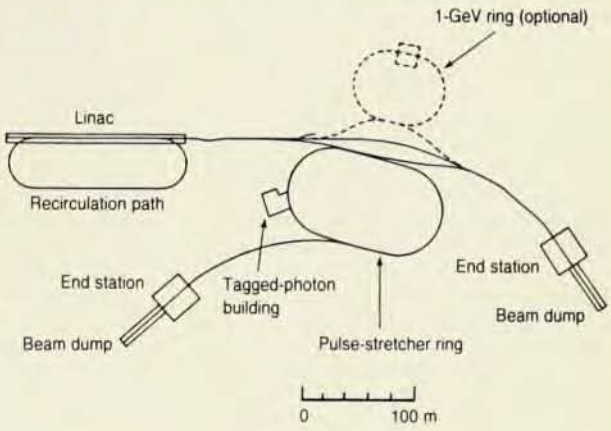
Battle for an electron accelerator: Argonne takes on SURA

On 23 April, the Nuclear Science Advisory Committee endorsed the recommendation of its Panel on Electron Accelerator Facilities, declaring the design by a group of Southeastern universities as the winning entry for a continuous-beam electron accelerator in an energy range of 0.5–4 GeV, with the possibility of reaching 6 GeV. NSAC's choice was surprising because it came from a neophyte on the big accelerator scene, a consortium of 23 schools, including the universities of Virginia, Maryland, North Carolina, South Carolina and Alabama, as well as Duke, Georgia Tech, George Washington, Georgetown, Catholic University and some smaller Virginia institutions such as George Mason and William and Mary. The runner-up, Argonne National Laboratory, with 34 years of experience in nuclear science and engineering, was stunned by the decision. Hearing rumors of the outcome, Argonne's director, Walter Massey, went before NSAC during its final review of the panel report on 22 April to urge reconsideration on nontechnical grounds of staff expertise, support facilities, and cost effectiveness. Massey described Argonne's long history of contributions to nuclear physics. In the end, however, NSAC decided to approve its panel's recommendation that DOE should put up some $147 million for the machine proposed by universities in eight Southeastern states. With that decision began an old-fashioned political brouhaha involving some prominent Congressmen, several state governors, dozens of universities, two Federal agencies, and the White House.

Thus, on 23 April, a Saturday, Senator Charles Percy (R-Ill.) called Energy Secretary Donald P. Hodel to argue for Argonne and received assurance that no further action would be taken until the laboratory made its case. While NSAC's recommendations have usually carried weight with its sponsors, the Department of Energy and National Science Foundation, this was more than a technical issue, Hodel observed; it was a policy matter. DOE's final judgment on the accelerator does not need to be made until next January—time enough, say some science watchers in Washington, for the machine to be battered in the battle.



SURA's proposal for a continuous 4-GeV electron accelerator consists of a 2-GeV pulsed linac through which a beam would be recirculated once and a pulse-stretcher ring that renders the output of the linac continuous. An internal target generates photons for tagged-photon experiments.

The importance of the machine was described in NSAC's *Long Range Plan for Nuclear Science*, which called for a cw (rather than pulsed) electron beam to explore the forces and structure within nuclei at collision energies up to 2 GeV (PHYSICS TODAY, May 1980, page 20). At this energy, nuclei seem to "melt" and exhibit new patterns of behavior in the largely unexplored transition region between nucleon–meson and quark–gluon interactions. While Stanford's linear accelerator produces 24 GeV, it does so only in short pulses, which are unsuited for coincidence experiments. Last summer, another NSAC group, the Subcommittee on Electromagnetic Interactions, led by Peter Barnes of Carnegie-Mellon University, went beyond the earlier idea and recommended an electron-beam facility capable of covering a variable range to 4 GeV, where quantum chromodynamics is expected to manifest itself even more strongly (PHYSICS TODAY, September 1982, page 18). Such an accelerator excites the imaginations of nuclear physicists because it may offer a needed bridge between particle physics and their own specialty.

Contenders. By last January, five groups had submitted proposals for the new machine. Even before the NSAC panel first met, recalls its chairman, D. Allan Bromley of Yale, "I realized this was going to be a highly visible, highly political competition. Our work had to be open, above the table, and even-handed." Bromley began receiving letters from governors, senators, and scientists advocating their favorite proposal. He withheld these from the panel members because, he explains, "they were irrelevant to our scientific and technical considerations, though I was certain the letters would not influence us. Our purpose was to choose the best proposal." Bromley circulated copies of the proposals to the various groups in February so they could defend their own concepts and question their opponents during an unusual round-robin of written statements and oral presentations. That month, panelists visited each of the proposed sites for the machine except one, the Bates Laboratory at MIT, which could not be reached on the scheduled date because of a blizzard.

By early March the panel eliminated the three low-energy designs submitted respectively by the University of Illinois, Bates Laboratory, and National Bureau of Standards. The report, carefully crafted by Bromley, its principal author, lays out the panel's views in language worthy of a diplomatic communique. "We have no doubt that the Illinois group, given their performance

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in recent years, could, if given the opportunity, move expeditiously to produce the facility that they have proposed," the report states. The Bates Laboratory was hailed for its "unique combination of dedicated, skilled experimentalists who, perhaps more than any others, have demonstrated the potential of truly high resolution measurements with electrons and equally dedicated, skilled nuclear theorists . . . who interact with a much broader national and international community, retain their active interest in, and input to, electromagnetic physics." NBS, the panel found, "has a record of accomplishment in electromagnetic physics, over several decades, of which it can be justly proud," including "the education of a large number of leading scientists in the field."

That left two contenders—Argonne and Southeastern Universities Research Association. To its delight, the Bromley panel found the "two quite different proposals of this scope, magnitude and quality" to be "a measure of strength of the electromagnetic physics community in this country." It concluded that "either could very well form the basis for an extremely powerful national facility." Even so, the panel observed, both "fall short of the originally proposed specifications—that from Argonne in terms of maximum achievable energy and that from SURA in terms of maximum achievable current." In the opinion of Ednor Rowe of the University of Wisconsin, a panel member who has built both types of electron accelerator, "In both cases, the designs push the limits of science and technology. Each machine is as difficult as the other."

Hexatron GEM. Argonne's hexatron design is a variation of the conventional race-track microtron with beam energies extended to a maximum of 4 GeV, once considered impossible to achieve in such a machine. According to the Bromley panel, Argonne's design suffers from two inherent problems that could be hard to overcome. The most critical is the development of six sector magnets, each weighing 673 tons and requiring precise alignment to within 0.1 millimeter for months at a time. The magnets would hold the beam in place as it recirculates 37 times through a microtron ring. Because such high standards have never been met, the panel's subgroup of accelerator experts worried that even if the magnets were built correctly, they might not remain stable as temperatures change and foundations settle. Their other concern was that fluctuations in the synchrotron radiation might increase the size of the beam, especially at energies above 3.5 GeV, so that it would no longer fit the given aperture. "Thus, although it is an innovative design, the hexatron represents a challenging and difficult engineering problem," the panel wrote in its report. "Unfortunately, if the necessary tolerances cannot be achieved or if the errors cannot be sufficiently corrected, the performance will suffer substantially." So, without major advances in the state of the art of beam confinement for Argonne's proposed hexatron GeV Electron Microtron (GEM), the panel feared, the machine might never reach its higher energies.

MASSEY

Linac stretcher. By contrast, SURA's design is considered "quite straightforward," though the panel was divided on whether it is more conservative once its problems are weighed against its advantages. Based on Stanford's linear accelerator, where some of SURA's designers had once worked, it would incorporate a conventional pulsed linac with a "stretcher ring" that would extract the pulse into a stable, sustained beam. Although the stretching technology has been shown to work on a prototype at Sendai, Japan, the Bromley panel noted that "no electron storage ring has achieved the very high injection efficiency or the very large circulating beam" specified by SURA. A more serious uncertainty is that the klystron tubes would have to be over three times more powerful than SLAC's klystrons to meet SURA's requirements for energy, current, and cw operation. Until such klystrons are developed, the panel's accelerator specialists say SURA cannot meet its full beam intensity in the planned construction period of 4½ years. SURA proposes to begin operating with klystrons equal in power (46 kW average) to those used at SLAC, then gradually replace these with klystrons of much higher power (40-MW peaks) as those are developed.

A factor that weighed heavily in favor of SURA was the panel's conclusion that the linac-stretcher design could be extended with the addition of another ring to reach 6 GeV, while Argonne's GEM could never attain such energy.

SURA also presents nontechnical drawbacks. It lacks the management, experience and infrastructure to build and run a large, complicated accelerator. Moreover, it proposes to construct the machine at a low-lying site outside Newport News, Virginia, near the Virginia Associated Research Center and NASA's abandoned Space Radiation Effects Laboratory, which is still faintly radioactive though not considered hazardous to humans. The buildings have been offered by the state of Virginia, which values them and the land at $10.5 million. The Bromley panel objects to this location, criticizing its remoteness from one or more major universities and from an international airport. SURA organizers have agreed to consider some new sites, especially Charlottesville, near the University of Virginia, and Blacksburg, near Virginia Polytechnic Institute.

Virginia is SURA's strongest base of operation. Senator John Warner (R-Va.) has been a true believer in SURA for years. He has lobbied vigorously on Capitol Hill and at the White House. James MaCarthy of the University of Virginia conceived the SURA linac-stretcher and became its chief designer. Virginia's legislature and its governor, Charles Robb, have already committed $160 000 to the SURA scheme and, better yet, have authorized five new Commonwealth chairs to support a director and senior accelerator scientists. SURA's member universities have pledged to appoint another 30 professors of physics. "The offer of 35 professorships is impressive," says Ed Rowe. "When you wave that before a bunch of academics like those of us on the panel, it's dazzling." Bromley believes the large number of physicists who would be lured to SURA will include some first-rate accelerator designers who have little to do elsewhere.

SURA originally proposed calling its facility the National Electron Accelerator Laboratory. Once the name was known, critics of SURA at Argonne and elsewhere called attention to a report last September by another DOE advisory body, the Energy Research Advisory Board, which had strongly opposed establishing any new multiprogram national laboratories and just as strongly endorsed strengthening existing national labs (PHYSICS TODAY, January, page 59). To head off such attacks, SURA changed the name of its facility in early June to Nuclear Science Electron Accelerator Laboratory, which, with a little editing, maintains the acronym NEAL. Bromley insists that his panel was not restricted

from recommending NEAL by the ERAB decision; the NSAC panel was asked by DOE to judge the merits of the technical aspects of five proposals. Any argument about new versus old labs was "completely outside the purview of my panel," he says.

For his part, Argonne's Massey remains perplexed by the Bromley panel's recommendation once it found that either group could build equally excellent machines. Says Massey: "If the panel had said in its report, 'Argonne's proposal just wasn't good enough' or 'We don't believe Argonne can do a good job,' I would understand. But that's not what it wrote. The report does not lead logically to the conclusion. We have a great lab here, and as its director and as a taxpayer, I can ask DOE and Congress, why build another national lab when this one can do as good or better a lot cheaper?" Massey takes considerable pride in pointing to a passage in the report that reads: "The hexatron is an imaginative new development in accelerator technology and [Argonne's] proposed use of its surplus ZGS facilities to enable it to make a cost-effective proposal is exemplary. Argonne has a very dedicated, able group of scientists and engineers already in place and these, together with the presence of established management and support structures, were factors that strongly favored Argonne."

New "evidence." Seizing on this, Argonne quickly put together two rejoinders. One cited "additional evidence" accumulated since its proposal was written to bolster its claim that the techniques of beam containment in the GEM design are well understood, having been tested at the Indiana University cyclotron, the Swiss Institute of Nuclear Research and its own ZGS. What's more, recent developments at the University of Mainz in West Germany and at Los Alamos, asserts Argonne, support the hexatron GEM design as feasible and within the state of the art. Argonne's other argument relies on an economic balance sheet in which the lab argues that if NSAC realy wants the SURA design, then it can be built at Argonne—cheaper, too. By Argonne's reckoning, the SURA machine could be built and operated at Argonne over its lifetime of 15 years for $376 million, a saving of $42 million over the proposed site at Newport News, where it would cost $418 million—and with greater savings if it were built elsewhere by SURA.

Argonne's offer to adopt the SURA design and Argonne's economic analysis were presented by Senator Percy to DOE Secretary Hodel when they met on 25 May in a closed-door session in the ornate old Senate Foreign Relations Committee room in the Capitol. Percy pointed to several passages in Argonne's booklet. Examples: Argonne is a 30-minute drive from two major airports, O'Hare and Midway, and within commuting distance of the University of Chicago (which operates the lab), Northwestern, and the University of Illinois. In fiscal 1982, the Federal government spent $4027 in Virginia per capita, only $1950 in Illinois for each resident. Among the 50 states, only Alaska received more Federal funds per capita than Virginia. Only four states, among them Indiana, Wisconsin, and Iowa, each bordering Illinois, received less per capita than Illinois. Virginia is an area of relatively rapid growth, with a large number of defense contractors, particularly in Newport News shipyards, and an unemployment rate of 7.1%, while Illinois has been hit hard by closings of many old smokestack industries and suffers a 12.4% unemployment level. Percy referred to the "injustice" of starting a Federally subsidized lab "from the ground up" when a "center of excellence" such as Argonne already exists.

This argument was also used in a letter to Hodel signed by six Midwest governors, from Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin. Argonne should be "fostered and developed to the fullest extent possible," they wrote, as part of "our ongoing efforts towards the development of high-technology resources and the economic revitalization in the Great Lakes region." Meanwhile, Hanna Gray, president of the University of Chicago, asked the Big Ten universities and her board of trustees to lobby Congress and the White House for the new accelerator. In addition, several major Midwest corporations have enlisted in Argonne's fight—notably Sears, Ford and FMC Corp.

"I had been told last January and February that our competitors for the electron accelerator and their political representatives in Washington had been to the White House and Jay Keyworth's office," Massey told us, "but I didn't consider such activities appropriate. We deliberately decided to refrain from politicizing science. We were convinced we would win on our merits. We still think we have the best proposal. Look, if this were only an academic matter, we wouldn't be fighting. The issue is too important for the future of nuclear science and also for Argonne. This will be the last accelerator of this kind for some time. But if DOE decides Argonne has lost, I will put all my effort toward the new machine wherever it's built."

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Founded in 1949 with many of the scientists and engineers who worked at the University of Chicago's wartime Metallurgical Lab, where the first nuclear pile was built, Argonne developed water-cooled nuclear reactors for power stations and submarines. In the last two years its budget has been slashed by $8 million to $252 million this year and its staff cut by 840 to 4230—somewhat larger reductions than any of the other seven multiprogram national laboratories.

Old controversy. The fight for this electron accelerator recalls the political controversy over a 10-GeV fixed-field alternating gradient synchrotron that a group of 15 schools in the Midwest Universities Research Association sought to build in the 1960s. The largest machines were operating at the time on the East and West coasts, at Brookhaven and Berkeley, provoking scientists and politicians in the Midwest to stake their claim to the next government-backed accelerator. In 1963, a panel named by the Atomic Energy Commission and the President's Science Advisory Committee recommended a giant leap forward to a 200-GeV proton accelerator, to be built at Berkeley's Lawrence Radiation Laboratory. The panel, headed by Norman F. Ramsey of Harvard, also urged the funding of MURA's accelerator near Madison, Wisconsin, "provided this does not delay the authorization of the steps . . . recommended for attaining higher energy." The panel's proviso soon was recognized as "the kiss of death," and, sure enough, later that year President Lyndon Johnson opposed MURA, he declared, to keep the Federal budget below $100 billion. Subsequently, Johnson approved construction of the 200-GeV machine, and more than 100 localities in 44 states vied for it. The site eventually chosen in 1966 was Weston, Illinois—a political plum some said Johnson gave for Senator Everett Dirksen's support on a critical foreign-policy issue. The site is now the Fermi National Accelerator Laboratory, 25 miles from Argonne.

"What worries me is that the politi-

cal controversy that has resulted now jeopardizes what is certainly a worthy project," observes Bromley. "It would be a great pity if the machine were not built." Says Harry Holmgren, who heads SURA from his office at the University of Maryland: "The contest for the accelerator was extremely fair. If nobody got it because of the political squabbling, it would be a disaster." —IG

Knapp confirmed as NSF director

Edward A. Knapp, President Reagan's choice to direct the National Science Foundation, was confirmed by the Senate on 15 April after assuring members of the Senate Committee on Labor and Human Resources two days earlier that he would resist any attempt to apply "political litmus tests" for appointees to NSF or its advisory committees. He stated his position after Senator Edward Kennedy (D-Mass.) asked Knapp to respond to "allegations and charges of politicization of the NSF under your leadership—a move that is unprecedented in the history of this nonpolitical agency."

The exchange was prompted by Knapp's announcement on 9 December that he had asked for the resignations of NSF's deputy director and one of four assistant directors who are Presidential appointees (PHYSICS TODAY, February, page 51.) A second assistant director announced that he was leaving the agency before Knapp's nomination. When Knapp was nominated to head NSF, his job as assistant director of the agency's mathematical and physical sciences directorate became vacant. (Knapp came to NSF last September from Los Alamos, where he was director of the accelerator technology division.) Kennedy, joined by Claiborne Pell (D-R.I.), wanted to know if the White House Office of Presidential Personnel was behind Knapp's directive. "It was my decision to ask for the resignations," Knapp replied. "I wanted . . . my own team in managing the foundation." He reminded the committee that President Truman had vetoed the first bill to establish the agency because it lacked any requirement for Presidential appointments.

As for filling the vacancies at the top of NSF, Knapp said "an excellent set of nominees" had been assembled after a wide search and sent to the White House for final selection.

Asked by Kennedy whether the agency planned to support research on supercomputers and to advance science and mathematics teaching in secondary schools, Knapp replied that both were already in NSF programs. Actually, Knapp declared, computers present two problems—access by university scientists to the latest generation of computers and joint university–industry cooperation. "I believe some form of computer networking is the proper way to solve the access problem," he

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observed, but "a large government-funded program to stay ahead of Japan [which has initiated a "fifth generation" project to develop superintelligent computers] might be counterproductive . . . The secret weapon of the American economy is the entrepreneurial spirit. Usually large organized programs don't give much impetus to that spirit." NSF, said Knapp, intends to revive university–industry relations in computers that he claims have "deteriorated in the past few years."

On science education, he noted, NSF's new programs recently transmitted to the Congress call for developing materials for teacher training, sponsoring workshops for improving teacher skills, and providing Presidential awards for teaching excellence. "We expect to concentrate on the junior high schools where studies have shown that student alienation from science takes place, as well as the senior high schools," said Knapp. "It is at that time in their schooling when students should become enthusiastic about science." —IG

NASA seeks input from university-based scientists

In response to the concern of the academic community about restrictive budgets for astronomy and space physics, the Association of American Universities formed a Space Science Working Group, now coordinated by Gerry Shannon in the AAU office in Washington, D.C. According to Shannon, the purpose of the group is to bring university-based scientists together to outline common problems and articulate them to Congress. Now functioning on a nonprofit basis, they have formal representation from the space-science departments of 22 universities. University governmental relations officers also participate. A steering committee, headed by John A. Simpson (University of Chicago), and including Edward C. Stone Jr (Caltech), Paul Hayes (University of Michigan) and George Field (Harvard) among its members, outlines priorities for the group. Shannon said that the group wants as broad a base of contacts with the academic community as is possible, in an attempt to represent the interests of the physics, astronomy, upper atmosphere and planetary exploration research communities.

NASA has also recently set up a joint university–NASA panel to make recommendations to James Beggs, administrator of NASA, about both the present state of NASA–university relations and how these relations can be strengthened in the future. Thomas Donahue (University of Michigan and head of the Space Science Board) told us that NASA initiated the idea. The panel was formed in March, and includes on the university side: Donahue, Ronald Prinn (MIT), Richard Zdanis (Johns Hopkins University), Simpson, Verner Suomi (University of Wisconsin), and Stone. For NASA the members are: Frank McDonald (chief scientist), John Naugle (former chief scientist), Albert Opp, Robert Watson, George Pieper and Jeff Rosendahl. —JC

OTA finds export controls only slow Soviet access

Before the Export Administration Act of 1979 expires on 30 September, Congress needs to decide if it needs to tighten current rules on how the Soviet Union and Warsaw Pact nations obtain militarily sensitive US technology—bought, borrowed or burgled. To help in that decision, the Congressional Office of Technology Assessment in May issued a 106-page report, *Technology and East–West Trade*, which underscores the ambivalence of export control policy: Commerce seeks to expand trade to strengthen the domestic economy, and Defense wants to prevent exports that might strengthen the Soviet military. OTA claims "it is rare to find examples of technologies obtained from the West which the USSR could not have produced itself, albeit with delays." □