

principles, conviction and ingenuity, and they commented on the parallel course of their physics careers in creating thermonuclear bombs. Both said they and their fellow scientists were convinced that work on the weapons was vital to their country's defense and necessary to maintain world peace—though Sakharov referred to the results as “a great tragedy.” Both also agreed on the importance of maintaining open discussions, as Sakharov put it, “particularly when we disagree. . . . At least we will understand our different points of view and avoid confrontation.” Teller was thankful that *glasnost* enabled Sakharov to see science and society outside the Soviet Union and “create a dialogue—one in which I would certainly like to participate.”

In his talk, Sakharov said he and Teller agreed on some subjects, such as ensuring the safety of nuclear reactors, but he added that there were other topics of disagreement and cited SDI as a “grave error.” He repeated what he has said to Teller in private, declaring that SDI would “destabilize the world situation” and that, “if deployed, even before the system were fully armed, there will be a tempta-

tion to destroy it [and] this in itself could trigger a nuclear war. The problem of SDI stands in the way of achieving a really profound arms control.”

Teller emphasized his agreement with the Soviet physicist “except on one point”—SDI. “We must know what can be known,” Teller asserted. Teller said he continues to work in nuclear energy, lasers and weapons defense, but Sakharov has been out of touch with those matters since his security clearance was revoked by the Kremlin 20 years ago. “He has not had the opportunity to work in the remarkable development of defensive systems in the Soviet Union [that] we have confidence in believing is years ahead of us.”

‘An atmosphere of trust’

Earlier in the week Sakharov had spoken on arms control on two occasions—on 15 November when he received the \$50 000 Albert Einstein Foundation Peace Prize, established in 1979 by members of the Pugwash Conference, and in a question-and-answer session the day before at the Kennan Institute, named for George Kennan who is credited with initiat-

ing the US policy of Soviet containment after World War II. In accepting the Einstein Prize he characterized science as providing “a unified conception of the world at the same time that all of the evolutionary processes develop and are turbulent around us. For a man of science, this sense of unity of the entire world provides the kind of grounding and orientation that religion gives for those who have faith.”

He detected that “an atmosphere of trust has begun to develop” between the US and Soviet Union after what he called “the beastly abuses of the Stalinist period.” Measures are now needed to strengthen that trust, said Sakharov. He suggested that “the best thing for us, the Soviets, to do would be a unilateral reduction of military forces. . . . The reduction of that army would in no way jeopardize the security of the Soviet Union.”

Less than a month later, Gorbachev seemed to adopt Sakharov's recommendation by proposing in a speech before the United Nations on 7 December that the Soviet Union would reduce its armed forces by 500 000 troops.

—IRWIN GOODWIN

DOE PICKS TEXAS FOR ‘GIPPERTRON’ AMID POLITICAL AND MANAGERIAL COLLISIONS

In the final 48 hours of the Reagan Administration the Superconducting Super Collider really accelerated. On the afternoon of 18 January Energy Secretary John Herrington signed the Record of Decision that made the site around Waxahachie, Texas, the official location of the SSC. Only minutes before, DOE had signed a contract with Universities Research Association to manage and operate the SSC for nine years and accepted URA's choice of Roy F. Schwitters, a Harvard physicist, to direct the project. The next morning, Schwitters received a vote of confidence from DOE's High Energy Physics Advisory Panel, meeting in Hilton Head, South Carolina, and the following day he was at work with one of the two URA subcontractors, EG&G.

The pace of events has been picking up since Herrington announced on 10 November that Texas is the “preferred site” of the supercollider. The final Environmental Impact Statement, which is required for such a project under the National Environmental Policy Act, was published in early December. In it, the conditions at all seven sites in the final runoff

are examined and evaluated. By comparison with the others, the Texas location emerges with the fewest problems. The biggest worry is fire ants, a peculiarly venomous species that migrated from Mexico after World War II. Federal and state agricultural agencies have not found any way of controlling the critters, which not only inflict painful bites but also damage buildings, motor vehicles and electrical equipment. The impact statement asserts that armies of ants regularly tunnel to watertable depths and chomp through underground cables along the way. Fire ants seem to be attracted to electrical equipment and cause short circuits by gnawing through insulation. The Energy Department claims the project will require special designs for electrical wiring and components as well as special protection for construction workers and for scientists and technicians.

Even before the threat of fire ants, DOE's selection of the Texas site was under attack. As news reporters awaited Herrington's announcement of the preferred site last November in DOE's auditorium, they were handed

a four-page black-bordered statement by Senator Alan J. Dixon, an Illinois Democrat, protesting that the decision was “based on politics rather than on merit.” It didn't escape the notice of Dixon and members of Congress from the six other states in the final runoff for the SSC that Herrington's decision came two days after the election of George Bush, an adopted Texan, as President. Their anger with the outcome of the selection process, said House minority leader Robert H. Michel of Illinois, “may lead some of us to reconsider our support for the project.”

That support is vital because even the SSC's staunchest advocates admit that the project's most vulnerable point is its enormous cost in a period when Washington is worried about budget deficits and fiscal debits. Although Bush endorsed the giant machine during his campaign, many politicians of both parties are wondering whether the country can really afford to spend at least \$6 billion for it over the next seven years. “How in the world are we going to fit a project like that into a budget with no real growth?” asks Senator J. Bennett

Johnston, the Louisiana Democrat who, as chairman of both the Energy and Natural Resources Committee and the Appropriations Subcommittee on Energy and Water Development, will play a leading part in deciding the supercollider's fate. "It's simply budget arithmetic."

The power of Texas

Still, when push comes to shove in Congress, the SSC is almost sure to get the backing it needs. After all, Texas has not come to Washington empty handed. Although the state is in dire financial straits as a consequence of lower oil prices and overextended bank loans, it has pledged to put up \$1 billion toward SSC construction costs. The membership list of the Texas SSC Authority, a private group promoting the supercollider, reads like a roster of the state's rich and famous. Several members have close ties with President Bush, including Texas oilman Robert A. Mosbacher, the new Commerce Secretary. What's more, four members of Bush's Cabinet hail from the Lone Star State, as do such influential Democrats in Congress as House Speaker Jim Wright Jr and Senate Finance Committee Chairman Lloyd Bentsen.

At Herrington's November news conference designating the Texas site, Wright and Bentsen were accompanied by Phil Gramm, a Republican who has led the Senate chorus of hosannas for the SSC since the concept was first plugged on Capitol Hill. The supercollider plainly excites superlatives. "This is the most important scientific project that will be built anywhere in the world in the

last quarter of the 20th century," declared Gramm. Bentsen nodded in agreement but was otherwise silent—the result of laryngitis brought on during his unsuccessful campaign for vice president. In a statement later, he praised the site choice and pledged to do "everything in my power to guarantee [that] funds for construction are appropriated on time.... I am happy to have had a hand in bringing it about." Bentsen's remark and the appearance of Texas legislators seemed to bolster the argument that the SSC runs on political power.

This notion gained currency on 18 January when Herrington, after conferring the Fermi Prize on Victor F. Weisskopf of MIT and Richard B. Setlow of Brookhaven, formally confirmed Texas as home for the supercollider. There to accept the prize for Texas were Governor William Clements, Senator Gramm and Representatives Joe Barton, who represents the district of the SSC, and Martin Frost of nearby Dallas.

The origins of the behemoth supercollider go back to a 1983 report by the High Energy Physics Advisory Panel calling for "immediate initiation of a multi-TeV high luminosity proton-proton collider." The following year a reference design study was completed and by 1986 the Central Design Group, selected by URA, issued its basic design for the accelerator. In February 1987 the Energy Department published its invitation for proposals. The department received 43 proposals by the deadline of 2 September that year. By Christmas Eve, a committee of the National Academies of Sciences and Engineer-

ing, consisting of physicists, geologists, economists and industrialists, had culled the number of sites to eight. When the state of New York withdrew its site near Rochester from the "best qualified" list because of stormy local objections, that left seven in the race for the 53-mile ring.

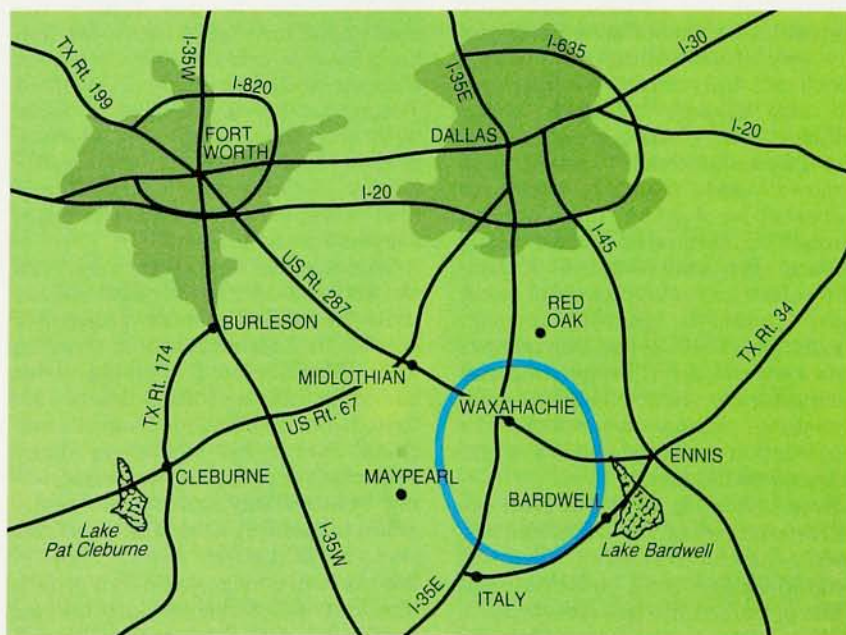
The odds for Texas

Right from the outset Texas was considered the odds-on favorite, largely because of its political influence. Accustomed to wheeling and dealing, state politicians organized the Texas National Research Laboratory Commission, an agency whose principal purpose is to promote the supercollider. Law firms in Dallas, Austin and Washington vied to provide *pro bono* lobbying services for the commission; the commission in turn hired other lawyers to stalk the corridors of power in Washington.

In her 1952 novel *Giant*, Edna Ferber anointed Texas with an aura of indomitability. James Michener, 33 years later, in his book, *Texas*, describes the state's inhabitants as irrepressible risk takers and power brokers. The fiction is steeped in reality. In 1983 Austin outgunned 56 other cities and ponied up \$23 million to win the Microelectronic and Computer Technology Corp, a research consortium of 20 major US companies. In 1987, after a fierce battle among 14 states, including California, Massachusetts and New York, Sematech, a semiconductor research center supported in part by the Department of Defense and 13 chip makers, settled in Austin.

With state backing, the Houston Area Research Council was created for physicists and engineers at the University of Texas, Rice, Texas A&M and the University of Houston to prepare for the coming of the supercollider. "The SSC is another Spindletop oil gusher," said Gramm. "With oil running out, Texas is going to leapfrog into another economic revolution by exploring the frontiers of knowledge and producing high technology. We call it 'High Tex.'"

The site of the supercollider is in fertile Blackland Prairie corn and cotton fields, some 25 miles south of Dallas and 35 miles southeast of Fort Worth. At the center of the proposed ring is Waxahachie (population 18 000), a town with turn-of-the-century charm that is captured in its stately well-preserved Victorian homes and ornate red-granite county courthouse. The town appears frozen in time between 1900 and 1940. As a period piece, it has been the setting of more than a dozen feature films.



ELLIOT PLOTKIN

including "Bonnie and Clyde," "Tender Mercies" and "Places in the Heart." Still, its high school offers two physics courses taught by Ronnie Hastings, who holds a PhD from Texas A&M in nuclear physics.

Hastings says some local citizens worry that the town's charm might be lost to the SSC. Some are bitter about the prospect of being forced to move. But for most the supercollider signifies prosperity and prestige as Waxahachie plunges into scientific sophistication. "It's likely that our town will become the mecca of high-energy physics," says Hastings.

DOE officials, Texas politicians and particle physicists resent the stigma of political influence in winning the SSC. To be sure, the SSC Site Evaluation Report, prepared by a ten-man DOE task force headed by Wilmot N. Hess, the department's associate director for high-energy and nuclear physics, clearly gave Texas its highest marks—outstanding ratings for geology, regional resources, setting and environment, and good ratings for regional conditions, electricity and water. Geologically, its uniform layers of chalk and marl, the task force found, reduced the chances of running into unforeseen problems in tunneling at an average depth of 150 feet, well above the water table.

The trouble with Illinois

The task force gave Illinois, the other top contender, only two outstanding—for geologic suitability and regional resources. It allowed a cost advantage of \$240 million to \$312 million to the Illinois site because the Tevatron injector would serve the SSC, and it cited other savings of \$233 million to as much as \$699 million for such items as personnel, power lines and supplies already in place at Fermilab. But by making use of the injector, the task force argued, "the designers' ability to make minor shifts of the collider ring during final design is severely limited." And, while the Illinois site consists of a strong, stable bedrock of dolomite and limestone, the tunnel would be at an average depth of 430 feet, and the need to acquire some 3400 parcels of land from as many as 3000 owners could result in endless negotiation and litigation. The task force was not convinced that the state would be able to deliver the land to the Federal government on schedule to begin construction, especially since there was organized opposition to the SSC. According to DOE, the state was ineffective in dealing with it.

Of the other sites, none had any serious disadvantages, but neither did

they have the overall strengths of the Texas proposal. The only site that came close to Texas in the ratings was in Tennessee, with three outstanding. Nonetheless, such karst features as sinkholes and caves in the geological structure were considered likely to contain water, which would complicate tunneling and increase costs. In addition, the site had a potential for "impacting sensitive habitats, cultural resources and aggravating existing air quality problems."

Members of the DOE task force insist that neither local nor Washington politics entered into their evaluations. Still, any government project carrying such a large financial burden and so much scientific prestige is bound to be entangled in politics. Back in 1966 the choice of Illinois for Fermilab brought forth accusations that President Johnson was behind it—though records and reminiscences indicate that the Atomic Energy Commission selected the best site from among the locations proposed by 45 states (see the article by Catherine L. Westfall, *PHYSICS TODAY*, January, page 44). So, when Senator Donald Riegle, a Democrat of Michigan, one of the seven finalist states in the competition for the SSC, said the DOE decision "has a strong smell of White House politics," Herrington was rankled. "We picked the best from the best," he declared.

A whiff of politics could be detected, however, when Herrington named the SSC laboratory the Ronald Reagan Center for High Energy Physics. That's not so odd, he observed, since NASA's space center in Houston is named for Lyndon B. Johnson and its Florida launch facility for John F. Kennedy.

The use of nicknames

Early on, the concept of a supercollider had been dubbed "Desertron" for two reasons: An accelerator 53 miles in circumference would surely be built in some deserted location, not in a populated area, and nobody could be certain what would be found, if anything, in proton-proton collisions of 40 TeV at the center of mass. Because Texas was considered a likely place for the machine, the nickname "Texatron" was sometimes used to characterize it. Now, however, as the Reagan Center, the SSC has acquired another moniker—the "Gipperton." It comes from the pet name Ronald Reagan uses for himself at times—a reference to his role as George Gipp, a football hero at Notre Dame University, in the movie "Knut Rockne—All American." A Senate staffer has already thought up an irreverent

FERMILAB VISUAL MEDIA SERVICES



Roy Schwitters: Deep in the heart of Texas

punchline for SSC researchers: "Let's find the Higgs boson for the Gipper!"

Since it first appeared in the Reagan Administration's budget in 1984, the supercollider's leading prophet, Alvin W. Trivelpiece, then director of DOE's energy research office, sought to satisfy friends and foes in Congress and the scientific community that the SSC would be "beyond reproach" in every way. Trivelpiece spent more time defending the SSC on Capitol Hill than all his other projects combined. In the end it was Trivelpiece who convinced President Reagan to approve construction of the machine (*PHYSICS TODAY*, March 1987, page 47). Soon afterward, Trivelpiece left DOE to become executive officer of the American Association for the Advancement of Science, abandoning the project to others in the department who have not been as effective. After he exited the SSC scene, Trivelpiece was likened to Moses, who never himself crossed into the "promised land" to which he led his people. On 1 January, Trivelpiece became a vice president of Martin Marietta Energy Systems Division and director of Oak Ridge National Laboratory, which his company operates under contract for the Energy Department.

Prospects for the machine brightened considerably with the appointment of URA, a consortium of 66 research universities, to manage and operate the Reagan Center. URA was created in 1965 by the National Academy of Sciences to oversee the construction of Fermilab. It still runs Fermilab for DOE. Since the origin of the supercollider R&D program in

1984, URA has been a kind of board of directors for the SSC design group, which set up shop at the Lawrence Berkeley Laboratory.

Though there had been rumors that some commercial companies would want to manage and operate the SSC project, URA was the only organization to respond to the Energy Department's request for proposals last August. In early December, DOE began negotiating a contract with URA. The contract contained "boilerplate" no different from the wording the department used with such other high-energy physics labs as Brookhaven, SLAC and Fermilab. But in this case, apparently because of the high cost and high visibility of the SSC, DOE officials seemed to want more control. The physicists feared the bureaucrats would introduce fine print that would enable DOE to call most of the shots on R&D and subcontractors. Negotiations almost broke off just before Christmas when URA's president, Edward A. Knapp, a Los Alamos nuclear physicist and former director of the National Science Foundation, and Schwitters objected to DOE attempts to micromanage.

After weeks of argument, the two sides agreed on adding special provisions. The contract, a copy of which has been obtained by PHYSICS TODAY, now requires DOE to specify any basic management decisions, including the choice of subcontractors, it wants to impose on URA. Schwitters argued that no commercial organization would allow a government agency to hold a major contractor on such a short leash.

In addition, a letter of understanding, signed by Knapp and by Hilary Rauch, manager of DOE's Chicago operations office, calls for both sides to meet and discuss in "good faith" the merits of any directed subcontracting. If the parties are unwilling or unable to reach agreement, URA would have 30 days to state its position before carrying out the DOE decisions. "In this way the issue is made clear—a paper trail is created," explained an authoritative executive branch source, "that sorts out the differences and sets forth responsibility for the decisions. This could be important if Congress decides to keep close watch on the project." In its part of the contract, DOE maintains control on allowable costs, such as overhead and profits for subcontractors, considered standard practice in government procurements, but relinquishes the appearance of micromanagement.

Both parties admit in retrospect that many differences were caused by the inexperience of academic scien-

tists with a procurement contract. "To us the contract looked similar to the way Defense Department contractors work," says Knapp. "Nobody in high-energy physics has ever written such a detailed proposal as ours. We would prefer to depend on the ability of the community to make decisions, as it was with accelerators in the past. But clearly the SSC is not like any other machine ever built." Under the contract, URA will be paid a management allowance of about \$1 million per year in lieu of a fee. Two subcontractors are named in the contract—EG&G, a diversified engineering company based in Wellesley, Massachusetts, and Sverdrup Corp, an engineering and architectural management firm headquartered in St. Louis. EG&G, which operates the Idaho Nuclear Test Station for DOE, will hire engineers, technicians and secretaries as well as provide administrative functions for the lab. Sverdrup, builders of the Chesapeake Bay tunnel, will manage the construction project. By doing this, Sverdrup gives up the opportunity to bid later on any engineering and construction contracts for the project.

As director, Schwitters will be point man for both the technical and political aspects of the project. Urbane and articulate, he is expected to be deft and decisive with Congress and contractors. After earning his PhD at MIT in 1971, Schwitters joined SLAC, where he was a member of the team that discovered the J/ψ particle. In 1979 he joined the Harvard physics faculty and the following year he won the coveted Alan T. Waterman Award, given by the National Science Foundation to outstanding researchers under the age of 35. While at Harvard, Schwitters was co-director of the International Collider Detector Facility at Fermilab. Other members of the supercollider's top management team are, as deputy director, Maury Tigner of Cornell, who headed the Central Design Group the past four years; Helen Edwards of Fermilab, who will be associate director in charge of accelerator systems; Bruce Chrisman of Fermilab, associate head of laboratory facilities; and Bob Robbins of Sverdrup, head of conventional construction.

Particle physicists hope to have the SSC operating by 1996 if Congress approves construction this year. During the last three years, Congress only appropriated enough to keep the Central Design Group together to do R&D. In the current fiscal year, the SSC was given about \$100 million, but no funds were allocated for construction. Though DOE had wanted \$363

million for fiscal 1990, which would have allowed for tunneling to start, the White House Office of Management and Budget reduced the request to \$250 million, the figure in the Reagan budget proposed on 9 January. That would allow \$90 million to continue R&D and \$160 million for construction—mainly for work on the superconducting magnets, which Central Design Group members admit is "the biggest problem before us" (PHYSICS TODAY, April 1988, page 17).

The contest to come

The construction schedule also is uncertain. A more realistic timetable, with tunneling started in 1991, would have the machine running by 1999 or 2000. Under the longer scenario, the budget would be stretched out so that it never exceeds \$700 million in any single year, rather than peaking at about \$1 billion in 1995 under the current plan. Cost-sharing by state and foreign governments could begin in 1991 and total as much as \$2 billion, which would amount to about one-third of the SSC's full price.

Because the world high-energy physics community will use the machine, Congress insists on foreign participation to help pay for as much as one-third of it. Energy Department officials have visited Japan, Canada and Western Europe in active pursuit of collaborators, but so far have returned with a written expression of intent from Italy and spoken interest from other countries. Congress also wants industry to participate in building the new technologies for the supercollider. On 23 December DOE announced its selection of 16 industrial firms that are likely to compete in building the 8000 superconducting dipole magnets, each 17 meters long, and 1600 quadrupoles that will keep the two beams of protons in their narrow racetrack-shaped paths. The companies are a formidable global group, including: General Atomics (teamed with Kawasaki Heavy Industries of Tokyo), General Dynamics, General Electric, General Motors, Grumman (allied with Italy's Ansaldo), Asea Brown Boveri, Babcock & Wilcox, Hitachi (along with Mitsubishi Electric), Germany's Interatom (as a team with Siemens), Fuji Electric and Westinghouse.

On 8 February an international industrial conference on the SSC is being held in New Orleans. More than 50 companies, among them the world's leading construction, electronic and heavy magnet manufacturing firms, will be attending.

—IRWIN GOODWIN ■