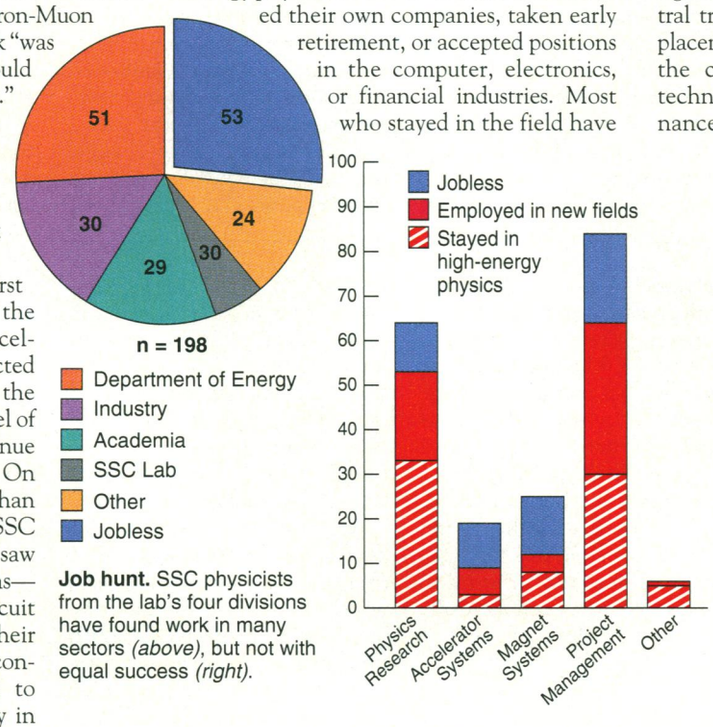
Colliding Forces: Life After the SSC

One year after Congress terminated the $11-billion project, SSC physicists are still reeling from the blow to their careers—and their dreams

When George Yost chaired meetings of the advisory council for the 1000-person scientific team building a $500-million detector for the Superconducting Super Collider (SSC), the physicist used to feel "we were at the center of the particle-physics universe." Now Yost's universe is the lab's 20,000-volume scientific library: He's responsible for mothballing it. Physicist Cas Milner, who coordinated tests for one feature of that same detector, called Gamma-Electron-Muon (GEM), thought that his work "was the most exciting thing I could imagine doing in science." Now he models stock-price fluctuations for TIAA-CREF, the New York–based nonprofit giant pension fund. "The sense of wonder is not there," he says.

This month marks the first anniversary of the demise of the $11-billion proton-proton accelerator that scientists expected would take them beyond the confines of the standard model of particle physics and continue U.S. leadership in the field. On 21 October 1993, more than 2000 employees of the SSC Laboratory outside Dallas saw Congress shatter their dreams—not to mention short-circuit their careers and jeopardize their mortgages. A House-Senate conference committee, bowing to the will of an angry majority in the House of Representatives, decided on that day to take the $640 million requested to continue work for another year on the giant accelerator and use it as a final payment rather than a scheduled installment toward the cost of the $11-billion machine. Now the lab's 1100-member scientific and technical staff has dropped below 100, and the Department of Energy (DOE), which has spent $2.2 billion on the project, has promised to close up shop by 1 January 1995, leaving behind only a skeletal caretaking staff.



Job hunt. SSC physicists from the lab's four divisions have found work in many sectors *(above)*, but not with equal success *(right)*.

SOURCE: SSC LAB

Exodus from physics

What has happened to the team of top-notch physicists that SSC Lab Director Roy Schwitters assembled in the rolling hills and prairie surrounding Waxahachie? Their fates not only provide an indication of the troubled state of the physics job market these days, but also show what happens on a personal level when the core facility in an entire field is abruptly abandoned.

Of the 198 physicists in the SSC's Physics Research Division, 72% have found new jobs, according to theoretical physicist Fred Gilman, who formerly headed the division. Only 55% of these 144 jobs are in high-energy physics, however. The rest have started their own companies, taken early retirement, or accepted positions in the computer, electronics, or financial industries. Most who stayed in the field have moved to universities or DOE national labs like Brookhaven, Fermilab, and Argonne, with some returning to their original institutions thanks to "rubber-band" contracts.

Some—especially those with strong computing skills—have jump-started their careers with relative ease. "People conversant with the most modern tools were in great demand" after the cancellation, says Schwitters. "They could clearly get a much greater salary and do quite well." The lab's top-level administrators, program planners, and support staff, with skills useful to a multitude of organizations inside and outside the government, have also fared well. Schwitters, for example, is now a professor of physics at the University of Texas, Austin, and his assistant, Kathy Anderson, has become an executive assistant to the president of Columbia University.

But many at the SSC have found that their unique training and experience make them less, not more, attractive to prospective employers. "It's tragic to take someone who is highly skilled and has a very high competence and help them dumb down their resume so that they don't appear overqualified for any job they might apply for," says physicist Kate Morgan, part of a group designing and testing the GEM detector's central tracking device, who helped teach outplacement courses. Morgan recently joined the computer architecture and emerging technologies group at Citicorp's Global Finance Division in a suburb of Dallas–Fort Worth. "For many of us who chose to change fields," she says, "not only do our skills not apply; they are an active detriment."

Older, more experienced physicists like Yost, who spent 18 years at the University of California, Berkeley, before coming to the SSC and who hopes to return to academia, have found that few university physics departments can afford to hire senior-level researchers. "I'm willing to go anywhere in the country," says Yost. "But many universities added high-energy physicists with the expectation that they would work on the SSC (see box on p. 533), and now they don't know what they're going to do with them. It's certainly a buyers' market." Moreover, because the cancellation came after colleges had already recruited for the 1993–94 academic year, "very few were able to compete or apply successfully for academic jobs," says Vera Luth, an experimental physicist who's now back at the Stanford Linear Accelerator Center (SLAC), from which she had taken a 2-year leave.

This reshuffling of the lives of so many talented scientists has gone practically unnoticed by the public. That's in sharp contrast to the glare of publicity that accompanied nearly every step of the decade-long march of the SSC from conception through selection of the site to the annual debates in Congress over money and management. But that doesn't mean it hasn't been wrenching to those involved. "There was very little public attention outside Dallas itself to the human dimension of canceling a project of this size

New Campus Programs Also Feel the Pinch

When Congress pulled the plug on the Superconducting Super Collider (SSC) last year, it sent a chill through leading high-energy physics departments around the country that were collaborating on the project. But they weren't the only academic centers to experience a sudden freeze: More than a hundred universities, many getting into high-energy physics for the first time, abruptly lost their chance for support from a $100-million state program designed to bolster academic high-energy physics.

The fund, created by the state of Texas as a way to broaden participation in the SSC, was intended to provide universities with money to hire physicists who would work on the two main detectors for the collider. When the SSC died, however, so did this program. Its cancellation, after only $36 million had been spent, dashed the plans of many emerging universities and left others with newly hired faculty members they could no longer support.

Bill Reay was one of the lucky ones. After 36 years at Ohio State University, Reay last year moved himself and a 9-member team to Kansas State University, where he planned to use the school's $1-million tender—including $250,000 from Texas—to work on experiments at the SSC measuring whether neutrinos mix and have mass. Kansas State was part of the 10-member Rocky Mountain Consortium that hoped to hire 27 faculty members with funding from Texas, and school officials have promised continued support for Reay's group as it shifts its work to the Fermi National Accelerator Laboratory's Tevatron. Four other transplanted physicists in a similar coalition of 18 southern universities weren't so lucky—their schools have been forced to let them go after the Texas money dried up. In the end, only nine of the 27 slots promised the Rocky Mountain consortium and 11 of the 29 positions slated for the southern coalition were filled, leaving several schools with unfulfilled scientific dreams. Only one school—Colorado State—hired enough scientists, three in all, to avoid what physicist Uriel Nauenberg of the University of Colorado calls "a very dangerous situation" of having a department that is too small to do good science.

The SSC's termination also put a crimp in another program funded by Texas that linked established high-energy physics programs with smaller departments at minority colleges. "Our aim was to increase the number of minority students going on to higher degrees in physics," says physicist B. E. Bonner of Houston's Rice University, which was working with Prairie View A & M, a historically African-American university in Texas, to build detector equipment for the SSC. Although he said one Prairie View student is now a researcher at Fermilab, "we had hoped to do a lot more of it."

–W.R.

and scope," says Raphael Kasper, former associate director of the SSC Lab and now a program officer at the Alfred P. Sloan Foundation in New York. "A lot of people had a tremendous emotional investment in this, and I suspect that even people who think or claim that they have come to terms with the cancellation have not."

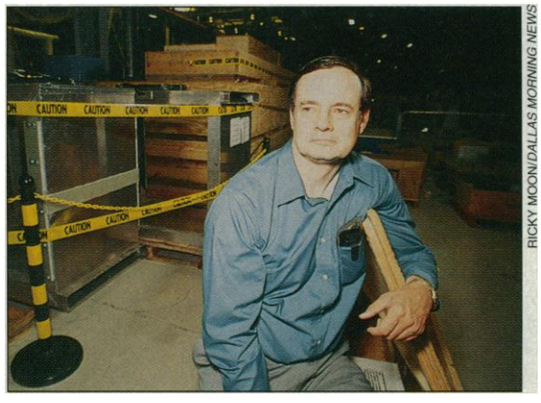
Lowered expectations

"The physicists are the group that has had the hardest time" finding jobs outside the laboratory, says Debra Aiken, a human resources representative in the SSC Lab's Central Facility and president of the lab's alumni association. "They are geniuses, but the difficulty comes with having to go out and market themselves and communicate to the ordinary person their strengths and what they can offer." Adds Marie Snidow, who on the day after the cancellation changed from being a recruiter at the SSC Lab to being an outplacement counselor: "We have had to focus a lot of our time on helping [the scientists] let go of the idea that they can stay in high-energy physics and getting them to focus on transferable skills. ... It's really a shock to the system."

Milner is a prime example. "At first I was panicked," he recalls. "We had gathered a very large number of physicists in one spot, and they were all dumped into the job market at the same time." He was turned off by the thought of another job in physics: "It was hard to imagine going back to some other lab where things were comparatively dull." Personal contacts led him to TIAA-CREF, which manages $135 billion in pension funds from employees of colleges, universities, and other educational and research institutions.

But the thrill is gone. "The ideas of science are a lot more thought-provoking and evoke a sense of mystery," he says. "The problems in finance are certainly quite interesting, but they are not as hard to understand."

Irwin Sheer, another physics immigrant to the financial world, first sent out resumes in June 1993, after the House voted 280–150 to delete funds for the collider. [In 1992 the House voted down the SSC by a smaller margin but reversed itself a few months later after strong lobbying by Senate proponents of the collider.] "I had been working on the cutting edge of high-energy physics, and suddenly my options weren't nearly as exciting," he says.



RICKY MOON/DALLAS MORNING NEWS

Packing it in. George Yost is helping to box up what's left of the SSC's scientific library.

Sheer received a 2-year offer from a university physics department but decided instead to seek a new career. "My crystal ball said things are going to be tough in physics for quite a while unless you have a tenured position to weather the storm," Sheer recalls. In January Sheer took a job at Timber Hill, a Westchester County (New York) brokerage house, where he can apply the mathematical and software-engineering skills he developed for the GEM collaboration.

Morgan, who made the switch from particle physics to Citicorp, says she's glad to be employed. But, like her colleagues who have had to abandon careers at the cutting edge of science, she remains bitter over the SSC's fate. "The loss of a job is a traumatic experience for anybody," she says. "The loss of a career is devastating. I spent 15 years doing physics, but if I wanted to keep that career I would have had to leave my home [her husband, SSC physicist Jheroen Dorenbosch, has elected to stay in the area to find commercial users for the lab's high- performance computer center] and give up my life. I opted not to do that. That means my investment in my future went out the window."

Even scientists who have found ways to continue working in high-energy physics "are doing it in enterprises of smaller scope and probably lesser complexity," says Sloan's Kasper. Sam Baker, a health radiation physicist who left Fermilab to direct the SSC Lab's environmental safety team, relished the challenge of creating a safe workplace in a "green

field" environment in Texas. Instead, he is monitoring radiation safety at the 48-year-old Argonne (Illinois) National Laboratory. "My job at the SSC was mainly to be sure that the same problems we were running into at Fermilab wouldn't occur in Texas," Baker says. "We really did get things off on the right foot. We're not going to leave [the SSC's neighbors] with a bunch of long-term environmental problems. But I'm disappointed that we couldn't continue with the work."

All technical activities at the lab must be halted by 1 January, including work on the linear accelerator, the first of three boosters for the main accelerator, and documentation of everything done before the cancellation. Some parts of the SSC will take care of themselves: The 23 kilometers of tunnel already dug, for example, will be allowed to fill up with ground water from the surrounding soil. But for many former SSC scientists, there's a hole in their professional lives that nothing can fill. Indeed, soldiering on is challenge enough.

For Argonne's Sam Baker, whose wife still works in the SSC's administrative offices and whose teenage son is an hour away at the Texas Academy of Mathematics and Science, reuniting his family is a first step. "Slowly," he says, "we're getting our lives back together."

–Wade Roush

Wade Roush is a free-lance science writer in Boston.

SPACE SCIENCE

Small Satellites Offer Global Appeal

JERUSALEM—In the aftermath of the collapse of the Soviet Union, east European scientists like Karoly Szego seemed to have little hope of taking part in space research missions. Their governments had little money to support such ventures, and they lacked the access to space that comes with membership in the exclusive Western space clubs. But prospects for Szego—and for scientists from other countries that don't have the resources to support much space science—are looking up. The reason: The worldwide trend toward smaller, cheaper satellites is lowering the cost of participating in space programs.

Szego, a Hungarian physicist, is part of a team of scientists and engineers from seven nations building 10 instruments for the 1998 launch of the 300-kilogram Central European Satellite Advanced Research (CESAR). The mission, to study Earth's magnetosphere, ionosphere, and thermosphere, is scheduled to be launched on an Italian rocket at a cost of around $50 million. CESAR is the biggest of a slew of upcoming small satellites that are allowing more players into a game that has been, until now, the province of large countries (see table). The trend, which is also giving traditional space powers a chance to do more science for less money, was the talk of the the International Astronautical Federation Congress, held here earlier this month.

This enthusiasm for small, inexpensive satellites is an abrupt change from the bigger-is-better philosophy that prevailed for much of the 37-year history of space exploration. Within a year of the first space probe—the 80-kg Sputnik 1—the Soviet Union had orbited a 1-ton satellite. The U.S. space program was no different, featuring such scientific behemoths as the 3-ton Galileo mission to Jupiter and the 12-ton Hubble Space Telescope. But with the collapse of the Soviet Union and a shrinking National Aeronautics and Space Administration (NASA) budget, science programs around the world are suddenly thinking small.

In Russia, where budget cuts and inflation have made the old style of space research unaffordable, small satellites are the only option available to many space researchers. "Microsats may help us solve our financial problems," says Michael Ovchinnikov from the Keldysh Institute of Applied Mathematics in Russia. "And instead of 5 to 10 years to develop a spacecraft, it should be not more than 1 or 2 years."

And even in the West, space agencies are promoting a smaller, faster, and cheaper approach. NASA, for example, is sifting through a raft of proposals for its Discovery program—satellites costing in the range of $100 million to $150 million—for planetary exploration, with two missions already in the works (*Science*, 27 May, p. 1244). France's space agency CNES is also contemplating a small-satellite future, eyeing a series of $50-million spacecraft that would focus on oceanography, astronomy, and geomagnetism.

Even relatively inexpensive missions are out of reach for some countries, however. For them, pooling resources to work on a single small spacecraft makes sense, says Szego. CESAR, for example, provides eastern European scientists an alternative to the crippled successor to the Soviet space program, as well as an opportunity to showcase their technical skills and bolster their bid for membership in the European Space Agency (ESA). And participation in the project has important industrial spin-offs as well. "Developing the industrial works is really an important driver in this," says Szego.

Some Latin American countries are also taking this collaborative approach. Argentina and Brazil, for example, are working with NASA on SAC-B, which will provide a variety of upper-atmospheric data. Argentina is supplying the spacecraft and instruments, and Brazil will help prepare them for launch. The satellite will be taken aloft on a Pegasus rocket supplied by NASA. Brazil also plans to launch a small remote sensing satellite to monitor the country's vast forests and fields, and Chile is building a 50-kg spacecraft called FASat-Alfa that will carry a simple suite of scientific instruments. Mexico also intends to launch two 50-kg satellites with cameras to observe the Earth. The launch vehicles for these missions have not yet been chosen.

For all the hoopla over small satellites, scientists and government officials acknowledge that large spacecraft are still essential for many missions. "First-class science can be done with small satellites, but not everything," says Arnoldo Valenzuela, a physicist at the Max Planck Institute for Extraterrestrial Physics in Munich who spoke at the Jerusalem conference. Some Earth observation missions require simultaneous readings by several sensors aboard a single satellite, while mirrors needed for many astronomy missions demand large platforms. "Big missions are still necessary," he says, "and we don't want politicians using small satellites as an excuse to reduce [overall space] budgets." But for Szego and his colleagues, small is the only way to go.

–Andrew Lawler

PLANNED SMALL SATELLITE MISSIONS

Mission	Country	Mass (kg)	Launch	Purpose
FASat-A	Chile	50	1995	Engineering tests
Interball	Czech Rep.*	59	1995	Aurora research
SAC-B	Argentina*	175	1995	Upper atmospheric research
Badr-B	Pakistan	60	1995	Earth observation
USSP	Russia	60	1996	Scientific and communications
Satex-1	Mexico	50	1996	Engineering tests
Techsat	Israel	50	1996	Earth observation
Hutsat	Finland	50	1998	Engineering tests
CESAR	Italy* and East Europe	300	1998	Upper atmospheric research

* Includes substantial international participation SOURCES: NATIONAL SPACE AGENCIES, IAFC