

NSF Cancels Brookhaven's Last Remaining Particle-Physics Experiment

The planned RSVP search for extremely rare particle metamorphoses has been felled by escalating cost estimates.

With the future of experimental particle physics in the US already looking bleak (see *PHYSICS TODAY*, May 2005, page 26), yet another major experimental project has been canceled. In August, NSF announced the cancellation of the RSVP (Rare Symmetry-Violating Processes) experiment just before its construction was slated to begin at Brookhaven National Laboratory.

RSVP was actually a pair of proposed experiments—called KOPIO and MECO—that were jointly to avail themselves of an intense proton beam from Brookhaven's venerable Alternating Gradient Synchrotron (AGS) to make K^0 mesons and muons in unprecedented profusion for the investigation of extremely rare processes. Such processes are particularly sensitive tests of the standard model of particle theory; they might well point the way to a more unified theory of the fundamental forces.

Three years ago, the Department of Energy canceled two major experiments then in progress at Brookhaven: a charged-kaon precursor of KOPIO and a precision measurement of the muon's anomalous magnetic moment (see *PHYSICS TODAY*, April 2002, page 25). Those cancellations marked the end of DOE funding for accelerator-based particle physics at Brookhaven. DOE did continue to support the laboratory's Relativistic Heavy Ion Collider (RHIC) through its nuclear-physics budget. RSVP survived as Brookhaven's last remaining particle-physics project because it was an NSF undertaking.

When RSVP was initially approved by NSF in 2000, its presumed construction cost was \$145 million. At the time, the collaboration was led by Frank Sciulli of New York University. Last year, William Willis of Columbia University took over RSVP's management. After years of frustrating delay, the fiscal-year 2005 budget, approved by Congress last fall, finally appropriated the first \$15 million for construction. The facility's prospective completion date had slipped to 2011, after

which the experiments were expected to run for about five years.

Termination

The National Science Board, NSF's policy-making body, voted in August to terminate RSVP "before the start of construction, as a result of significantly increased construction and operating costs identified during the final stages of planning." The board acted on the recommendation of Michael Turner, head of NSF's directorate for mathematical and physical sciences. "The estimated construction cost had almost doubled," says Turner, "and the experiment's projected operating cost had ¹/₂ tripled. For all its scientific merit, which was very strong, the cost of RSVP, as we now see it, would have done unacceptable harm to NSF's broad program of support for physics, most dramatically in elementary-particle physics."

A member of the National Science Board said privately that "one reason we voted so quickly to accept Turner's recommendation was the high-energy physics community's lukewarm support for RSVP."

At NSF's request, a baseline-review committee headed by Stanley Wojcicki of Stanford University had vetted RSVP's cost and feasibility in April. The committee affirmed RSVP management's updated estimate of \$282 million for construction. That's about a 1.7-fold increase over the initial estimate, adjusted for inflation. A significant ingredient of that increase was the growing cost of upgrading the AGS for RSVP. At present, with no ongoing particle-physics experiments to sustain, the synchrotron's only role is to keep RHIC filled with circulating heavy-ion beams. RSVP would use much more intense AGS beams than RHIC, with resulting increased radiation impact on equipment and the environment. That would have required considerable upgrading and re-

placement of AGS components and much additional radiation shielding.

Uncertainties

The RSVP–RHIC nexus also plays an important role in the trebling of RSVP's projected operating cost. Given the tightness of DOE's nuclear-physics budget, there has been some fear that RHIC might eventually run only one-third of the year. Indeed, with RSVP scheduled to run from 2011 to 2016, it was possible that, by then, RHIC might be defunct. The less RHIC runs, the more the cost of operating the AGS falls on RSVP.

It wasn't just the per-year cost that contributed to the trebled estimate of RSVP's operating cost integrated over the life of the experiment. The Wojcicki panel concluded that the planned five or even six years of running might well be an unrealistically short time for achieving the extraordinary sensitivity goals KOPIO and MECO had set for themselves.

The decay of the K^0 to a π^0 and two neutrinos has never been seen. The standard model predicts that this symmetry-violating mode should occur once in 60 billion K^0 decays. The KOPIO group set out to measure that tiny branching fraction with an uncertainty of about 10%.

MECO's undertaking was just as daunting. The standard model strictly forbids the metamorphosis of a negative muon into an electron without the compensatory creation of a pair of neutrinos to conserve "lepton flavor." But enticing speculations beyond the standard model predict such direct conversion in muon capture by atoms at rates as small as one in 10^{17} .

Both experiments were setting out to find new phenomena with sensitivities exceeding those of previous searches by four or five orders of magnitude. The longer the experiments take to achieve their scientific goals, the greater is the risk that RHIC will no longer be there to share the cost of running the AGS.

In June, a HEPAP (High Energy Physics Advisory Panel) subpanel



Turner

headed by Robert Cahn of Lawrence Berkeley National Laboratory reported to NSF and DOE on RSVP's scientific merits. The report concluded that "KOPIO and MECO are well-motivated searches for physics beyond the standard model—'long shots' with potentially high payoffs." It added, however, that RSVP should not proceed if it required "NSF to carry the full cost of operating the AGS over a period of years."

Congress acts

Several months before the Wojcicki review, Turner had warned congressional staffers to expect significant increases in the RSVP cost estimates. In June, both the House and Senate appropriations committees voted not only to withdraw the \$42 million designated for RSVP construction in the president's FY 2006 budget, but also to require the return of the unspent

bulk of the \$15 million appropriated for FY 2005. As PHYSICS TODAY goes to press, those harsh edicts have yet to survive a vote of the full Senate and a House-Senate conference. But, given the NSF termination vote, the fate of RSVP would seem to be sealed.

"After the cancellation of Fermilab's BTeV experiment earlier this year and with BaBar winding down at SLAC," says Brookhaven's Laurence Littenberg, a spokesman of KOPIO, "we were to be this country's last gasp of quark-flavor physics—a field that produced many important results. When you pull the plug like that, it's destructive to the careers and motivation of younger physicists. And what about our foreign collaborators? After the history of abuse, can we really expect them to come back when we ask them to contribute to a US-based International Linear Collider?"

"Encouraged by NSF, many of us

spent six or seven years of our lives developing MECO," says spokesman William Molzon from the University of California, Irvine. "Given our dependence on the AGS and RHIC, it's deeply disappointing that NSF, DOE, and Brookhaven never had a joint plan to make it possible for RSVP to succeed."

Plans are afoot for experiments in Japan and Switzerland with goals similar to those of KOPIO and MECO. "But," says the Cahn report, "these proposals are not [yet] as well developed [as] RSVP."

Turner insists that NSF's termination of RSVP "was not a walking away from particle physics, but a painful strategic decision about how best to contribute to its support. This is a field on the verge of great breakthroughs, and NSF will continue to invest in it."

Bertram Schwarzschild

Proposed Export Restrictions Alarm US Researchers

Despite hundreds of complaints, the US Department of Commerce is considering export rule changes that many say could hinder research.

In March 2004, a report by the US Department of Commerce (DOC) office of the inspector general recommended changes to the department's "deemed exports" policy, rules that are intended to keep researchers from restricted countries from taking knowledge about controlled technology from the US back to those countries. At first glance, the proposed changes seemed less than momentous.

One recommendation was to change an "and" to an "or" in a regulation governing the use of research equipment by foreign nationals. Another called for classifying foreign nationals based not on their current citizenship or permanent residence, but on their country of birth.

A year later, when DOC issued a request for comments on the inspector general's recommendations, officials in scientific societies, academic organizations, industrial groups, and even some Department of Energy laboratories realized the implications would be anything but trivial. E-mails were sent, meetings were held, and within several weeks of posting the notice, DOC received more than 300 letters critical of the recommendations. When the official comment period closed in late June, the compilation of those comments was more than a thousand pages long.

What is at stake, according to many in the research community, is the ability of foreign researchers and students from countries such as China, Russia,

Pakistan, and India to use equipment and software that are on federal lists of "controlled" technology. The regulations controlling the export of sensitive technology date back to the Reagan administration and are designed to prevent the transfer of technology that could help a nation on the restricted list develop its military.

The "deemed export" section of the rules, established in 1994, is intended to prevent a researcher from a restricted country from using controlled technology to learn how to re-create that technology in his or her home country. Foreign researchers and students who need to use such equipment are required to get a deemed export license. The regulations currently have an exemption for foreign researchers engaged in fundamental research, so the licensing provision hasn't been a serious issue in the science community.

Redefining use

Another provision defining what constitutes "use" of restricted technology is written so that foreign researchers may operate most laboratory equipment without obtaining a license. But a proposed change in the rule would redefine "use" by changing the "and" to "or" in the current definition, which reads, "operation, installation, maintenance, repair, overhaul and refurbishing" of equipment. Universities currently view the "use" definition as meaning a foreign researcher would

have to do all those things before a license is required, said Toby Smith, senior federal relations officer with the Association of American Universities.

But Smith said the new definition would make even basic operation of controlled lab equipment subject to deemed export licensing. Smith and others said that complying with the change would require hundreds of hours of staff time and cost millions of dollars. And the proposal to classify foreign researchers based on their country of birth would mean, for example, that a person born in China but who is a citizen of Canada would be subject to the regulations controlling exports to China.

According to officials from several universities who have sent comments to DOC, the change would mean all foreign researchers and students in the US would have to be reclassified based on their country of birth and then checked against the list of restricted countries. All the equipment used in research labs would have to be checked against federal restricted technology lists, and then the different lists would have to be cross-checked to see who needed a deemed export license.

"We believe that [the recommendations] would have a long-lasting negative impact on this nation's scientific research enterprise," wrote C. Peter Magrath, president of the National Association of State Universities and Land-Grant Colleges. Douglas Ray, chief research officer for Pacific Northwest National Laboratory in Richland, Washington, wrote that hundreds of