A $20-Million Test of Cooperation

Should U.S. high energy physicists, hard pressed to finance their own atom smashers, help fund the top project of European rivals?

European physicists have given the go-ahead for a sizable U.S. collaboration in a futuristic accelerator known as LEP, a behemoth to be built under the French-Swiss border that will speed subatomic particles around a circular tunnel 16 miles long (see p. 722). This single collaborative experiment, in which U.S. researchers would lead an international team of perhaps 250 physicists, would cost the United States $20 million. If approved, the U.S. contribution would be the largest ever to a foreign machine. The proposed experiment is thus an acid test for "international cooperation," a topic that has received much lip service amid the worldwide trend to increasingly large and expensive accelerators.

The proposed U.S. experiment is especially controversial because of tight finances at home. Old accelerators operate at a fraction of their potential while new U.S. projects languish for lack of funds. The Administration in fiscal year 1983 cut all construction funds for Isabelle, a half-built machine at Brookhaven National Laboratory on Long Island. Congress is currently considering a $10 million bailout.

The LEP experiment has already kicked up a certain amount of dust between two Nobel laureates in the United States. Lobbying vigorously for approval of the project is the group leader, Samuel C. Ting of the Massachusetts Institute of Technology. Another laureate in competition for scarce funds is Burton Richter, a physicist at the Stanford Linear Accelerator Center who recently gained tentative approval for a $186 million project on the West Coast (*Science*, 25 June, p. 1395). Ting and Richter in 1976 shared the stage in Stockholm for their independent discovery of the J/psi particle. At a May meeting of the High Energy Physics Advisory Panel (HEPAP), a group of physicists that advises the Department of Energy (DOE), Richter said U.S. physicists had better think very carefully before sinking money into Europe.

The issue is politically hot because the dollars would go not just for a large U.S. project but, in a roundabout way, for the construction of LEP itself. Traditionally, CERN (the European Laboratory for Particle Physics near Geneva) and many other accelerator centers around the world fund about 50 percent of the cost of particle experiments. But CERN, which has been hard pressed just to get LEP built, agreed not to increase dues from its 14 member countries. The upshot is that CERN will contribute only one-fifth to the capital cost of LEP experiments. In the case of Ting's project, the total cost might approach $50 million, with CERN putting in $10 million, the United States $20 million, and other countries in Ting's collaboration (including the Soviet Union) the rest.

Divisive at worst and controversial at best, the issues raised by the Ting proposal are getting careful attention from HEPAP, which devoted a session to them on 10 August. To help in its deliberations, HEPAP heard from a research director of CERN, Erwin Gabathuler—the first such European testimony about a specific project. HEPAP will ultimately advise the DOE on whether the project is worthy of funds. The director general of CERN wants a commitment in writing by October, when the final project selection takes place.

LEP is unique in the worldwide race to discover new subatomic particles because of its size. The nearest thing in the United States is the 4-mile-long circular tunnel just below the Illinois prairie at the Fermi National Laboratory. LEP's appetite for dollars has already caused something of a schedule slowdown. Although collisions among subatomic particles (electrons and positrons) can take place at eight points around the 16-mile-long ring, CERN decided it can afford only four experimental halls for phase one of the project (*Science*, 4 June, p. 1088). Ting's particle detector, sometimes known as The Great Wall of China because of its vast amount of iron, will inhabit one hall.

What is unusual about the proposed U.S. collaboration with the Europeans is its magnitude. There is a long history of minor cooperation. Moreover, the increased specialization of machines (in the 1970's countries often raced to build identical accelerators) means the trend to collaboration will continue. What irks some U.S. physicists is that the collaborations are more and more frequently taking place on European soil.

"There is a general swing back to Europe," says Alexander R. Dzierba, a physicist at the National Science Foundation (NSF). "In the long term, the next generation machines are being built in Europe."

To understand the promise and problems of the proposed LEP collaboration and similar projects that will undoubtedly emerge in the future, it is necessary to know something of how far the pendulum has swung to Europe in the past decade.

In 1971 a unique machine at CERN known as the Intersecting Storage Rings started attracting many U.S. physicists. By 1978, 25 percent of its users were North Americans. In 1977 another machine at CERN, the Super Proton Synchrotron, started luring back Europeans who had been working in the heart of the United States at Fermilab. By 1980, according to a HEPAP study, for every European team in the United States there were more than two U.S. teams in Europe. A further inducement to U.S. physicists was the completion in 1981 of an innovative machine at CERN known as a proton-antiproton collider, which may yet win the race to find the elusive and long-sought intermediate vector boson. The next attraction will be LEP.

In addition to U.S. physicists, sizable pieces of American equipment have traveled to Europe. The most recent migration has been the Crystal Ball detector, a large $3-million device that was constructed and utilized for 6 years at the Stanford Linear Accelerator Center in California. This spring, as part of a cooperative agreement, it was moved to the Deutsches Elektronen-Synchrotron laboratory in Hamburg.

The full dollar drain on U.S. high energy physics is difficult to assess, although the trend is clear. For 1981, the DOE estimates 8 percent of its university-research money ended up in Europe ($3.6 million), and the NSF sent 6 percent ($1 million) of its university budget. With individual universities, funded from a variety of sources, the percent is sometimes higher. "The intensity of our effort overseas has increased markedly

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in the past 4 or 5 years," says Don D. Reeder, chairman of physics at the University of Wisconsin. "It is now about 20 percent of our total funding."

A result of all this brotherly interaction has been a predictable rise in international coauthorship. According to the NSF, in 1973 about 22 percent of all coauthored papers in physics had an international group of authors. By 1980, that figure climbed to more than 30 percent.

Collaborations of the past decade have been rather small compared to what is outlined in Ting's proposal, which worries some U.S. physicists. "We're in an especially tough position," says Leon M. Lederman, director of Fermilab. "Ting's project will probably come out of equipment money, and that's in scarce supply. Equipment money funds computers, and at Fermilab and other places the old-generation facilities are saturated. It also funds experiments, which is a problem at Fermilab because instead of just moving a few magnets you have to dig earth."

Lederman also says the Ting proposal may prove completely acceptable. "Under the right circumstances, I really wouldn't have too many problems. It's a lot of money, but spread over 3 years or so it would not be too burdensome. If there is a chance to do very substantial, unique, interesting physics, I think it's a good idea."

At Stanford, Richter too says the project may be perfectly workable, but looks to dollar availability in addition to scientific merit. "The principle of cooperation is something I very strongly support. But any specific proposal or project that comes also has got to be considered in light of available resources."

Although some U.S. physicists champion what might be described as a chauvinistic policy, that attitude is far from universal. A nuclear physicist who stresses cooperation is presidential science adviser George A. Keyworth, who has consistently railed against the "pork-barrel" mentality of high energy physicists. Keyworth most recently drove his point home in a speech before the AAAS (*Science*, 13 August, p. 606). "We have to make sure that we concentrate on the areas where breakthrough is most probable. We just can't afford the shotgun approach we've used in the past," Keyworth said in an interview on the future of U.S. physics. "There is nothing wrong with the Europeans putting emphasis in a particular area and then having us partake. The time for cooperative research has come."

Ting's proposal would put that sentiment to the test in a number of ways, not the least being a trial of bureaucratic and political skill. Ting's team is international, with groups from China, the Soviet Union, Sweden, Germany, Switzerland, the Netherlands, France, Italy, Spain, and other as yet unnamed countries. A delicate task for the DOE, which has become wary of cost estimates in the wake of Isabelle's near doubling in price,

A Turnabout on EPA Lead Rules

In a dramatic change of policy, the Environmental Protection Agency (EPA) put out the news on 30 July that it will withdraw a proposal to relax controls on lead in gasoline. Instead, the EPA will tighten federal limits on lead additives, with the goal of reducing the amount of lead in the air by 31 percent over the next 8 years.

The decision won immediate but qualified praise from environmental and public health activists, who have been trying to persuade the agency that a lead decontrol proposal made in February would endanger the health of American children (*Science*, 12 March, p. 1375).

EPA officials took the unusual step, as one direct observer said, of making a "controlled leak" of the new regulatory documents to the press before they were released in the *Federal Register*. The new regulations have not received final approval from EPA Administrator Anne Gorsuch at this writing. However, Gorsuch is expected to follow the recommendation of Kathleen Bennett, assistant administrator for air, noise and radiation, who urged the EPA to adopt the revisions in a memo dated 29 July.

According to Bennett's memo, the EPA jumped into this controversy at the behest of the Vice President, who wanted to know whether there was any need for controls on lead in gasoline. (Lead additives provide a cheap boost to octane but they have been controlled as an air pollutant since 1973.) After soliciting public comment, the EPA found that most health officials opposed any relaxation of lead controls. "Based on our evaluation of the information submitted to the docket," Bennett wrote, "relaxation of the regulations is not warranted. In fact, new studies support the concept that lead emissions should be minimized."

The new regulatory scheme, according to Bennett, would bring about a reduction in lead usage in 1983 from 58 billion grams (the amount that might have been allowed under the original EPA proposal) to 42 billion grams. If the EPA made no change at all in the regulations, the rules now on the books would bring the level of usage down to 47 billion grams in 1983. The cost of complying with the new rules will probably be no more than one-tenth of a cent per gallon.

A draft version of the new proposal reveals that the EPA has chosen a complex, three-staged regulatory tactic in dealing with lead. The first document withdraws the February proposal. The second offers a substitute, setting two standards, one for big and one for small refiners. The third creates interim rules to govern a sector of the small refiner market that will be losing an exemption it now enjoys.

Just as important as the change of rules is the EPA's decision to publish a summary of the lead problem that describes the health effects in strong terms. Ellen Silbergeld, a specialist in toxicology at the Environmental Defense Fund who fought against any relaxation of the lead standards, called the EPA's review "excellent." For the most part, the paper endorses the 1978 criteria document the EPA used in setting ambient air standards. The paper also adopts the findings of a 1980 National Academy of Sciences study, *Lead in the Human Environment*. The latter recommended that "the reduction of lead emissions from gasoline combustion should be a major lead control strategy." Finally, the EPA looked over recent studies of lead's effect on children's behavior, that indicate lead interferes with performance at school. Although some of these studies have been challenged, the EPA found that they suggest the hazards of low-level lead intoxication may be greater than previously thought. If confirmed, these studies may mean that the EPA will have to lower its estimate of the maximum safe blood lead level.—ELIOT MARSHALL

would be negotiating detailed cost schedules and contracts with the participating countries. The Soviets alone are said to be considering a contribution of $15 million to Ting's project. Further, as Lederman puts it, "if the other groups found they couldn't pay their part, DOE would be faced with a crisis, having put up $20 million when the detector might need another $10 [million]." Lederman chuckles and calls these possibilities "delectable."

Some proponents of collaboration stress that work overseas is beneficial for U.S. programs, and not just in terms of scientific discovery. "It can take U.S. physicists out of the country and therefore lessen the pressure to build new machines," says Stanley G. Wojcicki, a physicist at Stanford who worked on a proposal for a LEP detector that was tentatively rejected by CERN. "Thus there will be more money left over to do experiments, to exploit American facilities that are already operating." It is also a truism that Nobel Prizes and other awards are won by individuals, rather than countries that take on the task of building huge machines.

So too, the risks and benefits of collaboration will eventually be shared as the pendulum starts to swing back to the United States. In the not too distant future, Fermilab will complete its next-generation machine, the Tevatron, and thereafter Stanford will build Richter's linear collider. Brookhaven also may eventually complete Isabelle or another machine based on a similar design. At Fermilab, Lederman says he already has proposals from about 200 Europeans for work on the Tevatron, which might start as early as 1985. In the past, he says, Europeans sometimes put in 20 percent of the work at Fermilab but for the Tevatron it will be closer to 25 percent. "It's becoming impossible for countries to build and run duplicate machines," says Lederman. "The ultimate solution might be a world laboratory."

The task before HEPAP and the Department of Energy is to decide whether the Ting proposal is scientifically sound and, if so, to debate the advisability of making a $20-million investment in Europe. Congress too might choose to enter the process. The record of successful minor collaborations over the past decade bodes well for a large-scale project. In the case of Ting's proposal, the migration of money and know-how would be sizable. Yet the scientific allure is considerable, and the project might mark a new era of cooperation at a time when such unquantifiable notions are seldom given a chance.—WILLIAM J. BROAD

Breeder Wins Exemption from Licensing Procedures

Persistence pays, the Administration has learned in its campaign to get an exemption from regular licensing procedures for work on the sodium-cooled fast breeder reactor to be built on the Clinch River in Tennessee. The plant is intended to be a low power (350 MWe) facility demonstrating the feasibility of a system that uses and produces the extremely long-lived radioactive fuel, plutonium. The Nuclear Regulatory Commission (NRC) had twice turned down the Department of Energy (DOE) when it asked for an exemption in March and June 1982. On the third try, on 5 August, the DOE got its way, winning permission to start construction before the plant has been licensed for safety.

The reversal came about because the newest Reagan appointee to the NRC, James Asselstine, changed his vote from nay to aye, allowing for a vote of 3 to 1 in favor of the Administration's request. Others voting in favor were Chairman Nunzio Palladino and Thomas Roberts, both Reagan appointees. Commissioner John Ahearne voted against the DOE request. Commissioner Victor Gilinsky, who has voted against it in the past, was absent because he missed a plane connection.

The victory for DOE and the backers of the breeder, important though it may be, is more symbolic than substantial. The Administration values it as a token of its new clout within the NRC and as an indication that the NRC may not balk at licensing the reactor when the technical hearings on its safety have been completed. Congress will vote later this year on appropriations for this project, whose cost is estimated to be over $3.5 billion, up from an original estimate in the early 1970's of around $700 million. Had the NRC denied the exemption for construction work, it would have given wavering congressmen a convenient reason for cutting the breeder from the budget. The skeptics might have argued that the Administration's own licensing authority, the NRC, could not be persuaded to endorse work on the breeder, so why should Congress go along? Now it will be impossible to find shelter in that procedural thicket, and congressmen will have to confront the issue more directly.

The exemption itself is narrow, allowing for preliminary work such as clearing the site and laying roadways and pipes. At the insistence of Asselstine, joined by Roberts, the NRC ruled out any early work on safety equipment, such as piping for emergency cooling water. The NRC decided that these would have to await consideration in licensing hearings.

The NRC staff and commissioners recognized the extraordinary nature of the exemption, and several commissioners said the technical justifications for granting it were slim. The decision was particularly awkward for the NRC in view of its desire to create an exemplary record in licensing the first breeder. Nevertheless, those who voted for it were swayed by the government's broad argument that the national interest was at stake. Palladino, in particular, suggested that it was not fitting for the NRC to stand in the way if the President has declared this a matter of national urgency and Congress has authorized funding.

Eldon Greenberg, attorney for the Natural Resources Defense Council and the Sierra Club, who tried to block the exemption, held a press conference after the vote to say the decision was "wrong on the law and wrong on the facts." He expects to file for an injunction to stop construction within a week.—***Eliot Marshall***

Stanford Patent Delayed

The United States Patent and Trademark Office has tentatively rejected claims for a genetic engineering patent sought by Stanford University. If the patent application is ultimately turned down, the worth of an earlier gene-splicing patent granted to Stanford and the University of California could be weakened. That patent has already yielded $1.4 million in licensing fees.

The first patent, issued in 1980, covers the method to replicate or express foreign genes in microorganisms. The second would place a claim on virtually all recombinant DNA plasmids which contain foreign genes.

On 2 August, the patent office gave notice that it challenged some of the claims made in the Stanford applica-

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