European Physicists Push Alternative to SSC

They claim that adding to CERN's facilities could do much of the physics of the proposed supercollider but at a fraction of the cost

Geneva. If American physicists could be persuaded to participate in the construction of a new particle accelerator in Europe, rather than insisting on building their own Superconducting Supercollider (SSC), they would be able to carry out virtually the same experiments at less than one-sixth of the cost.

This, at least, is the argument that is currently being developed by the European Laboratory for Particle Physics (CERN) in Geneva. And it is one that appears to be gathering momentum in European capitals, where government science officials, faced with growing pressures of the cost of new physics facilities on the rest of their research budgets, are beginning to discuss the long-term future of the laboratory.

The CERN proposal, although still in its early planning stages, is that a new ring of high-powered superconducting magnets be placed in the circular tunnel currently being built for CERN's newest machine, the Large Electron-Positron Collider (LEP), the final phase of which is currently scheduled for completion in the early 1990's. These new magnets would create a pair of intersecting proton rings that could, like the SSC, be used to study hadron-hadron collisions—but at a much lower cost, since it would make use of many of the facilities that will already be in place.

There are few illusions in Europe that proposals for an international project jointly funded with the United States to develop and construct this new ring are likely to generate an enthusiastic response from the American physics community, most of whose members remain committed to arguing the case for their own, admittedly larger, machine. Indeed, the U.S. response to the idea has so far been decidedly frosty. American physicists have argued that CERN's approach is technologically risky and that the SSC's higher-energy range may uncover more phenomena (*Science*, 3 August 1984, p. 490).

Nevertheless, by emphasizing cost-effectiveness rather than national pride, and exploiting the current controversy in Washington over whether or not the United States can afford the $6-billion price tag attached to the SSC, many of Europe's high energy physicists remain convinced that they may eventually generate sufficient international support for the construction at CERN of what has become known as the Large Hadron Collider (LHC).

In return, Europe—and perhaps other countries involved in the negotiations, such as Japan and Canada—might pledge their full support for the next "world" accelerator after that to be built in the United States. This could be an extended version of the SSC, or an accelerator based on entirely new technologies, such as those required for high-energy intersecting linacs.

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According to one official in West Germany's Federal Ministry of Research and Technology, the "first stone has been dropped in the water" by a letter sent in February by Alvin Trivelpiece, head of the Office of Energy Research in the U.S. Department of Energy, to various European governments inviting their physicists to participate in the initial R&D stage of the SSC.

Discussions on how to reply to this letter, in particular whether to do so individually or collectively, could well initiate consideration at the political level of whether to start lobbying in favor of the LHC.

In the short term there are more pressing problems facing CERN than what it will be doing in the next decade. At the top of the list is the need to maintain momentum behind LEP, a 51-GeV, 27-kilometer circumference ring on which construction started last year, and whose first phase is currently expected to be almost on schedule at the end of 1988.

A close second is concern about the reaction of the British government to the findings of a committee of inquiry set up last year to study Britain's possible withdrawal from CERN because of the burden its membership fee places on the rest of the science budget (*Science*, 20 April 1984, p. 266).

Initial fears that Britain would decide to opt out altogether seem to have subsided in Geneva. Although there are many British scientists in other fields who would shed few tears over such a move, it could provide a near-fatal blow to the organization, particularly if (as has been the case with the U.S. withdrawal from Unesco) smaller member countries used it as an excuse to withdraw at the same time.

Nor is any British action likely to be allowed to affect the immediate completion of LEP. With the Stanford Linear Collider already threatening to come on line up to 2 years earlier in 1986 and skim the cream off discoveries in the 50 × 50 GeV range of electron/positron collisions, Europe's physicists are united in feeling that they must not be too far behind with the more powerful facilities that LEP will be able to offer.

The most Britain can hope for at present appears to be agreement with the other 12 European countries who manage CERN to stretch out the planned upgrading of LEP into the 100 × 100 GeV energy range. This will take it into an area that cannot be reached by the Stanford machine under present plans, and is currently planned for completion by 1992. British officials are already discussing whether it might be extended over several more years, however.

The big question is: what then? In February, the CERN Council set up a special committee chaired by Carlo Rubbia (last year's Nobel Prize winner, along with fellow CERN physicist Simon van der Meer, for the discovery of the W and Z particles in 1983) to carry out a 2-year study of the laboratory's future options.

Several possibilities are already under consideration. But there is little doubt that the one that stimulates the most enthusiasm in Geneva is the idea of building a new ring of magnets within the tunnel now under construction for LEP. Indeed, space has already been left vacant within the LEP tunnel for precisely such a project, which could be carried out at the same time as LEP is operating.

Using current magnet technology, it is estimated that collisions could be caused

between beams of protons rotating in opposite directions with a center of mass energy of 10 TeV, sufficient to cause collisions between hadrons—the constituent parts of protons—at 1 TeV, the energy levels at which physicists expect new events to be created.

However, CERN physicists such as Giorgio Brianti, the head of a technical team currently drawing up more detailed proposals for LHC, are convinced that an adequately supported research program could eventually lead to superconducting magnets producing a field of 10 tesla, which would allow the LHC to achieve proton collisions with a considerably higher center of mass collision energy of up to 18 TeV. Producing such magnets would, however, be a major technical challenge.

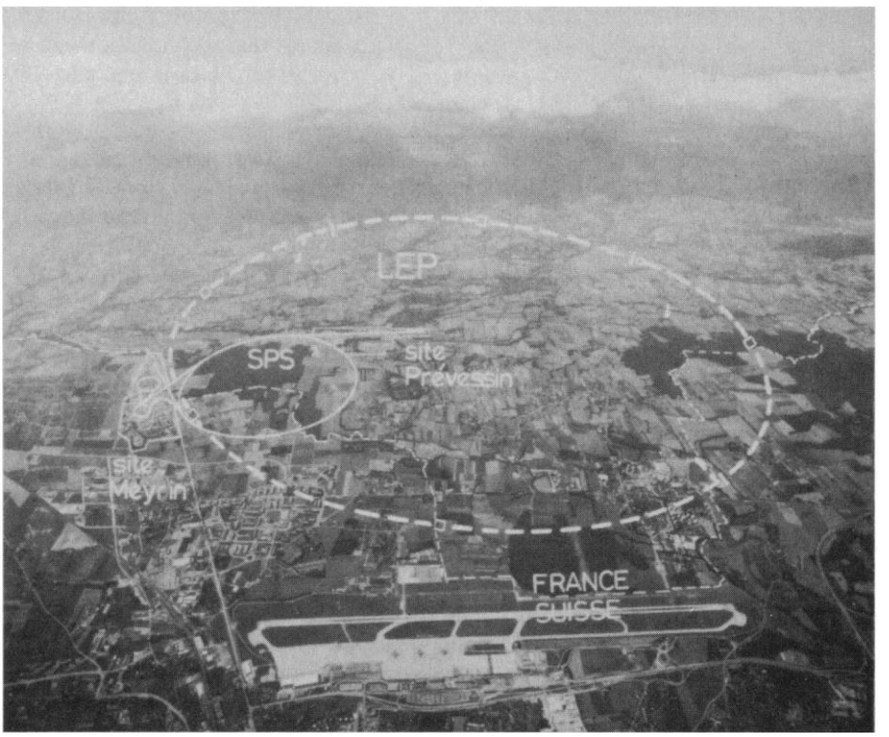
In both cases, the energy levels would be sufficiently high to explore the dynamics of hadron/hadron collisions (although in the latter case much more productively). This is the same basic goal as the SSC, plans for which are currently being developed in the United States. Building both machines virtually simultaneously would obviously make no sense, so some form of choice between the two will inevitably have to be made.

Even CERN's director, Herwig Schopper, admits that the SSC, designed to operate at the higher collision energy of 40 TeV, would be "better than anything we could do in the LEP tunnel." But with a price tag of $6 billion, compared to informal estimates for the LHC of less than $1 billion, many physicists in Europe feel that the extra performance of the SSC could turn out to be an expensive luxury for the world's scientific community.

Furthermore, points out Brianti, building the LHC in the LEP tunnel could have several advantages over the SSC, such as the possibility of using LEP to study high-energy electron/proton collisions.

At CERN itself, the main debate is now focused on whether to propose construction of the relatively "quick and cheap" machine designed to operate at an energy level of 10 TeV—a strategy favored by Rubbia and some other enthusiasts—or whether to take longer to develop the new superconducting magnets that would be needed to reach the higher energy range.

As for the proposal that, whatever form it takes, the LHC should be supported as a rival international candidate to the SSC, three topics tend to dominate discussion of the relative merits of the European project. The first is whether a performance sufficiently competitive to that of the SSC can, in fact, be achieved at a reasonable cost, and this depends heavily on the successful development of superconducting magnets using niobium/tin windings.



CERN's new ring

Space has been left in the LEP tunnel for superconducting magnets.

Although research is being carried out into these in various European laboratories, CERN currently has little money to spare from LEP. However, laboratory officials claim they have received a substantial amount of industry interest in carrying out research on superconducting magnets in connection with LEP and are confident that—given enough time—the magnets can be satisfactorily produced.

The second topic is the relative scientific merit of working at the two energy levels. Here theorists such as CERN's John Ellis point out that, according to the present state of knowledge, there is no reason why an LHC operating at 18 TeV should not be sufficient to explore the full physics of hadron/hadron collisions.

Ellis calculates that increasing the collision energy to 40 TeV will only raise the equivalent center of mass energy for hadron collisions by 50 percent. CERN's physicists admit that, if the United States is lucky, this could be sufficient to produce evidence of unpredicted phenomena out of range of the LHC. But there is a strong feeling in Geneva that American physicists have chosen 40 TeV as their target energy level partly because they knew this could not be reached in the LEP tunnel.

The third question is the political one. There is general agreement on both sides of the Atlantic that particle accelerators have become so expensive that no one country can afford to duplicate the work of another, and that some form of joint strategy is needed. "What is important is that coherent, complementary programs are developed on both sides of the Atlantic," says Schopper.

This conclusion has been endorsed by the high energy physics panel of the Versailles Working Group on Technology, Growth and Employment, chaired by Trivelpiece of the U.S. Department of Energy, which reported to the economic summit held earlier this month in Bonn that although "the required facilities can be built and operated within broadly constant budgets . . . provided that there is no duplication of research efforts," nevertheless achieving this implied "planning on an interregional basis to ensure complementarity and cost-effective decision-making."

Achieving such complementarity—let alone cost-effectiveness—will be easier said than done. European physicists, still flush from CERN's recent successes with the W and Z, are well aware of the high symbolic significance placed on the SSC both by the U.S. high energy physics community and by the Reagan Administration as a way of evening the score.

Deal Struck on NIH Grants

A compromise struck between Senator Lowell P. Weicker, Jr. (R–Conn.), and David Stockman, director of the Office of Management and Budget (OMB) will enable the National Institutes of Health (NIH) to fund 6000 new and competing grants a year for 4 years, including fiscal year 1985. Weicker, chairman of the appropriations subcommittee that oversees NIH, has been battling the Administration since January in an effort to undo an OMB directive that would have reduced NIH grant levels in fiscal year 1985 from a congressionally approved number of 6500 to only 5000 (*Science,* 1 February, p. 498).

The compromise made it through the Senate in the early hours of 10 May as part of the Budget Resolution. Approval by the House is still required, but what will happen is uncertain. On the one hand, some representatives who are strong NIH supporters say they will accept nothing less than a restoration to the full 6500; on the other, the House has voted a freeze on other science agencies, including the National Science Foundation and the space agency.

The fight over the NIH grants has been intense, pitting budget cutters against researchers who successfully persuaded Congress last year that the time is ripe for a substantial increase in the nation's commitment to funding biomedical science. Congress appropriated a record-breaking $5.15 billion for NIH, which included more than $200 million to pay for 1500 new grants. But OMB, arguing in part that budget cuts are needed to reduce the federal deficit, balked at the size of the increase and came up with what was thought to be an ingenious plan for subverting the will of Congress. The budget office ordered NIH to "forward fund" more than 600 of the additional 1500 grants it would make in fiscal year 1985. By this maneuver, NIH would have made a legally binding commitment to pay those grants in years 1986 and 1987. In effect, a portion of NIH's fiscal 1985 resources would be spent now for 1986–1987.

The forward-funding provision was meant as a way to get around laws that prohibit the Administration from executing budget rescissions without the express approval of Congress. It was regarded by Capitol Hill aides and NIH officials alike as an unorthodox but legal way to reduce research funds. But Weicker was not so sure and asked for a ruling from the Comptroller General.

To everyone's surprise—including OMB's—he challenged the legality of the OMB directive. Citing a little known 1789 statute (the Bona Fide Need Rule), the Comptroller General said that multiyear or forward-funding by NIH would be unlawful (*Science*, 5 April, p. 35). OMB officials who had been adamant about 5000 grants for 1985 began to reconsider.

During the first week in May, Stockman met privately with Weicker and other members of the Senate; it was then that the 6000 agreement was made. In addition to the grants deal, a compromise was struck on a couple of other elements in the budget, the most important being funding for research centers. OMB had wanted to hold the line at 500, while Congress preferred 533. The Budget Resolution splits the difference.

Assuming that the appropriations process now moves quickly through both houses of Congress, the confusion and consternation that have been the hallmark of biomedical researchers recently should be resolved. The question of what the OMB directive meant in terms of peer review and priority scores for grants has been particularly worrisome because researchers (and NIH administrators themselves) thought that in the first grant cycle, approval was given to some applications that would only have been funded if the total grants pool was 6500. Thus, they worried, the competition in the second and third cycles would be unduly stiff, leaving many first-rate proposals out in the cold. This, according to an NIH official, turns out not to be the case. Fewer grants were awarded in the first round than supposed; in fact, the figure is said to be about 30 percent. So, if the 6000 figure finally goes through and NIH is able to award substantially more grants than it did last year, it ought to be business as usual, or even better.

—BARBARA J. CULLITON

Equally, CERN's enthusiasm for the project is based partly on the realization that it is the best prospect for a major new accelerator to be built in Europe in the 1990's.

"If the Americans build [the SSC], then we in Europe are in trouble," Simon van der Meer told a meeting in Stockholm last December shortly after receiving his Nobel Prize. "If the U.S. community doesn't get the money to build the new machine, we in Europe will be in a good position. That's our current dilemma."

But there is an equal realization that the LHC could not be constructed within the laboratory's current level of funding (several major projects have been delayed to enable LEP to be completed within a constant operating budget) and that it would therefore require substantial outside support.

A solution that would bring in other countries not currently members of CERN offers particular attractions to the British government, perhaps the most vocal supporter of the need for cost-effectiveness in international projects and thus for spreading costs as widely as possible. Indeed it is expected to be one of the main recommendations from the report of the committee currently reviewing Britain's membership in CERN.

Two other countries that might be persuaded to join forces on funding the LHC are Japan and Canada. Both have already indicated, through discussions in the Versailles Working Group, that they would consider participating in either the SSC or the LHC, and there are already said to be signs from many Japanese physicists that they would be prepared to back a package deal which included U.S. support for the LHC and European support for a large-scale R&D program into long-term accelerator techniques in the United States.

There is even talk in some European capitals of including in this package agreement to support the construction in the United States of some other large-scale research facility, such as the next major fusion energy device, although no-one has yet suggested a framework—apart from the Versailles Group—in which negotiations toward such a goal could be adequately handled.

At present, most thinking along these lines is purely speculative, and European and American physicists seem content to move along parallel paths. The point at which these paths will cross, however, is steadily moving closer, and some hard bargaining is likely to lie ahead—on both sides of the Atlantic.

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