1994 EXPECTED TO BE YEAR OF DECISION FOR EUROPEAN SUPER COLLIDER

The CERN Council, the governing body of the European Laboratory for Particle Physics in Geneva, is to meet in special session on 15 April to take up the question of whether to build the Large Hadron Collider, Europe's counterpart to the defunct Superconducting Super Collider. A decision in favor of building the LHC was considered probable even before the demise of the SSC and now is considered even more likely. The actual decision may not be taken until the regularly scheduled meeting of the CERN Council in June, but that still will be well ahead of the German national elections, which otherwise might spell trouble.

Given that the LHC is planned as part of CERN's regular program and already has been designated by the council as the lab's next logical step, a two-thirds vote of the council might arguably be taken as sufficient for a go-ahead. But in practice, says Christopher Llewellyn Smith, the Oxford particle physicist who just succeeded Carlo Rubbia as CERN Director General, unanimity or near-unanimity will be required for such a crucial undertaking.

One reason a positive decision on the LHC is so likely is that CERN's leadership has quietly built a case over the years that the lab's survival as the world's premier particle physics institution depends on construction of the LHC. That argument has been of a piece with what James Cronin of the University of Chicago calls Europe's strategic policy of continuing to "concentrate material and intellectual resources" in particle physics. Cronin has worked at CERN and served on its science advisory committee.

Once taken, assuming it is taken, a positive decision on the LHC is not likely to be reversed, even if there is a political sea change in one of CERN's key member states. A major policy decision with respect to CERN is akin to a multinational treaty commitment and, based on past experience, has been considered very nearly binding on more than just the governments that happen to be in power when the agreement is made. This is what makes the politics of the LHC so fundamentally different from the SSC politics, where "Congress could make a new decision every year anew," as Karel Gaemers, the head of NIKHEF, observes. (NIKHEF, the National Institute for Nuclear Physics and High Energy Physics, in Amsterdam, is the main particle physics lab in The Netherlands.)

Christopher Llewellyn Smith (left), the Director General of CERN, confers with Hubert Curien, chairman of the CERN Council, at the 17 December meeting. Curien is a former research minister of France, which is considered to be solidly behind construction of the LHC.

Issue of US participation

Llewellyn Smith presented a 10-year plan for CERN and the proposal for the LHC at the CERN Council's last regular meeting, on 17 December, as scheduled. He estimated its hardware cost at 2.23 billion Swiss francs, or $1.4 billion, not counting the two detectors selected for the machine, which are to be funded partly from the budgets of institutes participating in the detector collaborations.

Each of the two proton–proton detectors might cost 350-420 million Swiss francs. Plus, 70 million are earmarked for heavy ion experiments, and 50 million for an unspecified experiment involving B meson decay and *CP* violation.

The original game plan for winning political approval for the LHC called for definitive proposals for the detectors and for the accelerator to be presented to the council at the same time, so that the political leadership would have a complete view of prospective costs and thus avoid the unpleasant surprises that dogged the SSC. (See the interview with

Llewellyn Smith, PHYSICS TODAY, November 1992, page 81). CERN's leadership decided at the last minute to defer finalization of the detector proposals, pending the outcome of discussions with veterans of the SSC detector collaborations. Llewellyn Smith says that the deferral could be up to a year.

Naturally, many orphan physicists from the SSC detector collaborations are eager to climb on board the LHC, and the CERN Council is eager to have them, provided the US government can be persuaded to make a financial contribution—or perhaps cash plus in-kind contributions—to construction of the ring, the detectors and to operating costs. As things stand now, CERN's leadership would very much like to get a commitment of, say, $500 million or $1 billion from nonmember states, so as to avoid having to curtail the experimental program or stretch out the LHC timetable.

Some members of the LHC detector collaborations, which already are gigantic, may not be too eager to open their arms to still more collaborators. But given the weighty financial and political reasons for getting the US in on the project, this will not be a significant factor. "All my colleagues see what happened with the SSC as a sad and sorry affair and would welcome Americans into their collaborations," comments Gaemers.

Detector discussions, ICFA

On 7 December CERN hosted an informal meeting with about a dozen SSC detector orphans, including a Canadian and a Japanese. Also in attendance were former spokesmen for the SSC collaborations, George Trilling (SDC) of Lawrence Berkeley Lab and William Willis (GEM) of Columbia University. From all reports it went well, and as Llewellyn Smith put it to PHYSICS TODAY, it "looked like things will marry well," technically and scientifically.

Of the four detectors proposed for the LHC, two merged more than a year ago to form Atlas, which will consist of large toroidal coils threaded by a small inner solenoid coaxial with the beams (PHYSICS TODAY, February 1993, page 17). Samuel Ting's L3P was rejected, mainly because it called for a very expensive bismuth germanium oxide crystal component, using materials from China. The L3P lost out to CMS, which relies on large, high-field solenoid magnets with tracking components placed right up against the beam pipe. But now that the question of design is somewhat open again, CERN Research Director Walter Hoogland indicates there is strong interest in resuscitating an element of L3P—use of a large crystal calorimeter—and people from Ting's group are joining CMS.

Though the LHC's detectors will be harder to build and use than the SSC's because they need to handle about ten times the SSC's luminosity, some aspects of detector development may be more advanced in the US. Fermilab Director John Peoples, who has been detailed to preside over the SSC closedown in Waxahachie, Texas, mentions calorimetry and detector magnet technology as US strengths; another American strength is high-resolution tracking with silicon detectors capable of withstanding very intense radiation. The only working silicon vertex detector, suitable for a hadron collider is, after all, at Fermilab, Peoples observes, referring to the detector designed to measure tracks very near the interaction point—the kind essential in B physics.

Peoples currently is serving as chair of the International Committee on Future Accelerators, the high-level group that meets regularly to discuss international coordination of big accelerator projects. With everybody concluding from the SSC debacle that the era of purely national mega-accelerator projects is drawing to a close, ICFA's perceived importance naturally has been growing, and its discussions and conclusions will surely be an important ingredient in whatever agreement emerges from the European–US discussions.

ICFA rules traditionally prohibit particle physics labs from charging outsiders user fees. But with 500 US physicists already at CERN and many more to come if an LHC agreement is reached, it is likely the ICFA rules will be waived.

ICFA held a special meeting at CERN in early December and continued discussions of the new situation at a meeting hosted by TRIUMF on 16–17 January, in Vancouver, Canada.

Time line for US decision

Another very important ingredient in the US decision will be the report from a special subcommittee of the Department of Energy's High Energy Physics Advisory Panel that has been convened to make strategic recommendations to the Secretary of Energy in light of the SSC's demise. That subpanel, chaired by Sidney Drell, the deputy director of the Stanford Linear Accelerator Center, is to make a preliminary report in March and a final report in May. Energy Secretary Hazel O'Leary is to report to Congress by 1 July on matters related to the termination of the SSC project, including the possibilities of international collaborations.

Yet another ingredient in the ongoing discussions is a report on particle physics being prepared within the framework of the Organization for Economic Cooperation and Development. The OECD report is being done on an accelerated schedule and may be ready by late spring or early summer.

Trilling and Willis agree there is no chance, given US budget cycles, of the Clinton Administration promising a financial contribution to the LHC in time for this to be a factor in the deliberations the CERN Council conducts in April and June. But there is at least some chance the Department of Energy might make a more or less emphatic statement on what the US role in the LHC might be. Such a statement could be very useful to CERN's leadership. At the same time, Willis observes, CERN's leadership has been careful to dissociate its decision-making process from the US schedule, so as not to make the LHC in any way hostage to US moves.

Willis says he has been a little surprised at the "generosity of CERN's position with respect to nonmember-state participation, given the sensitivity of member states to special treatment of any one state. . . . They haven't started with greedy demands, and they've sounded flexible."

Risk factors

How sure a thing is the LHC from technical and financial points of view? Will CERN's leadership be able to avoid the design revisions and repeated cost overruns that, along with a perception of managerial ineptness, contributed so mightily to the SSC's final defeat?

From the start it has been plain that CERN's plan to achieve economies by squeezing the LHC into the existing LEP tunnel would require the lab to push both magnet and detector technologies to the outer limits of the art's current state.

Detector development is at too early a stage for outsiders to have a reading on prospects for success. Hoogland said three years of detector R&D have given CERN physicists confidence they will be able to do the physics they want to do. But he also conceded that handling the luminosity—being able, for example, to disentangle 30 overlapping events—poses serious technical problems. One will be to make the electronics adequately resistant to radiation:

Here, Hoogland said, the defense industries in France, the UK and the US had a contribution to make.

It is clear that CERN's leaders are genuinely eager for US help—technical and scientific as well as financial. Llewellyn Smith said that as a theorist he was not the right person to comment on the technicalities of detector collaboration. But he and his colleagues have been enormously impressed in discussions so far by the experience and intellectual power that US physicists would bring to the project.

The LHC's magnet development program plainly has been having troubles. For more than two years now the lab has been saying it was about to do the first string test—a job the SSC completed a year and a half ago—and yet the first test still has yet to take place. Though Rubbia told PHYSICS TODAY a year ago that CERN had set itself the task of doing a string test successfully before seeking political approval for the LHC, Llewellyn Smith now says that is not CERN policy and never has been.

Meanwhile, the lab has decided it will have to cut the maximum field strength to 8.65 T from 9.5 T—an objective critics always had dismissed as unrealistically high. Llewellyn Smith says that CERN will be able to compensate for the lower field strength to some extent by making the magnets slightly longer, so that the targeted center-of-mass energy will still be 14 TeV (as opposed to 15–16 TeV, as originally foreseen). He says he thinks, having looked at the issue very carefully, that 14 TeV still provides a margin of safety in terms of identifying the most probable Higgs mechanism and discovering new physics.

In defense of the magnet program, Llewellyn Smith says that it's been "operating on a shoestring," and he notes that it recently got a favorable verdict from the LHC external review committee headed by the French physicist Robert Aymar, director of materials sciences at the French Atomic Energy Commission. That committee said there was no doubt that 8.65 T could be achieved, and it deemed cost estimates for magnet and cryogenic systems as accurate and conservative enough so that there would be no need of a contigency fund.

That said, the current price tag for the LHC already is nearly twice the figure circulated and generally accepted at a meeting of ICFA held at Brookhaven in 1987. Llewellyn Smith says the price of the ring is only 10% higher than first documented estimates. However, he says, detector estimates are nearly twice as high because four rather than three experiments are planned and because the detectors are now expected to handle very high luminosities at the outset.

German factor

Until recently CERN's leadership was hoping to get the LHC built and operating by the end of the century. But now that the schedule is no longer driven by the competition with the SSC, caution and prudence prevailed upon the lab to delay commissioning until 2002 and first physics until 2003.

The original schedule would have required the LHC to begin operating before detectors had reached design goals and to operate initially in tandem with LEP 200, the upgrade of the current LEP 100. But Llewellyn Smith says that would not have been optimal anyway. With the LEP upgrade delayed mainly because of unforeseen difficulties with the rf cavities, LEP 200 now is expected to be doing physics from approximately 1996 to 1999.

Llewellyn Smith says that while Germany was not the driving force in the decision to delay the LHC, certainly it is happy with the decision. Its position has been that the first results from DESY's HERA should be digested before work begins on another major accelerator project. (See the interview with DESY Director Bjorn Wiik, PHYSICS TODAY, March 1993, page 79.) The LHC could be operated in combination with LEP as a proton–electron collider like HERA.

The conventional wisdom is that Germany, because of its economic primacy in Europe and its increasingly volatile domestic politics, is the big unknown in the international politics of the LHC. And there's nothing wrong with the conventional wisdom, provided it's also appreciated that the uncertainties associated with Germany can be overstated.

Germany's national election will be in October, well after the CERN Council is expected to authorize the LHC. To the extent there's a mainstream expectation about the election, it's that both major national parties, the conservatives and the socialists, will suffer severe setbacks and that Chancellor Helmut Kohl's government will not survive. The current government's position is that it would like—and expects—to see the LHC approved in June even if some technical and financial issues have to be resolved later.

Other member states

Early last fall the Dutch government seized the occasion of opening an exhibition at CERN to announce it was appropriating funds to support NIKHEF's contributions to LHC detector development. While this may have been mainly a publicity exercise, it made The Netherlands the first CERN member state to commit itself solidly to the LHC. Italy followed suit in November.

Britain, another country with very strong ties to CERN, nonetheless has been deeply ambivalent about its role. Nearly a decade ago a commission headed by John Kendrew issued a report that called for cuts in British funding for particle physics and cuts in its contributions to CERN. At that time, as it happens, a younger Llewellyn Smith was the British particle physics community's designated critic of Kendrew. (See PHYSICS TODAY, September 1985, page 87.)

Since then, Great Britain has in fact cut funding for particle physics by about 25%, but it also has reorganized the research councils in such a way as to protect particle physics from further erosion. It also has taken steps in the direction of segregating its contributions to international undertakings to protect the British science budget from the vagaries of exchange rates (PHYSICS TODAY, August 1993, page 47). Meanwhile, Britain's close equivalent to a science minister, William Waldegrave, issued a challenge to the British particle physics community, offering a bottle of champagne to the person who could best explain in writing why the Higgs boson was worth finding. The contest produced five winners and when the dust had settled, Waldegrave declared that he now would be sorry if it proved unfeasible to pursue the Higgs by means of the LHC.

Imponderables

The British have never put much stock in turning a large fraction of their population into scientists or in making the public highly science literate. But the top British universities still do emphasize training academic intellectuals, even economists and physicists, to speak and write well. Given the outcome of Waldegrave's competition and its impact, that may turn out to be a significant and even crucial factor in the political success or failure of the LHC.

But there are lots of other factors. The Europeans could have decided, for example, to site a larger super collider in Germany to guarantee the support of their biggest and most politically formidable state. But that

also would have made the project subject to the vagaries of anti-German sentiment, and so, as Cronin emphasizes, they wisely continued a policy of concentrating material and intellectual resources at CERN.

A crucial consideration will be whether CERN's management is able to retain the confidence of Europe's political leaders in the coming year. Everybody knows how badly the SSC was hurt by perceptions of managerial incompetence and arrogance. So sensitive are member-state relations that Llewellyn Smith has asked CERN's Maurice Jacob to help look after them as a kind of informal secretary of state. Jacob is a senior French physicist at the lab and past president of the French Physical Society and of the European Physical Society.

—WILLIAM SWEET

FRANZ TO BECOME EXECUTIVE OFFICER OF APS

Judy R. Franz, a professor of physics at the University of Alabama in Huntsville, has been named executive officer of the American Physical Society. She replaces N. Richard Werthamer, who resigned in July 1993 (PHYSICS TODAY, August, page 48).

As described by past APS President Ernest Henley, the chair of the search committee, Franz was the committee's unanimous choice because of her "outstanding background, sensibility, energy, initiative, character, ability and connections." The APS council approved her selection in November, and Burton Richter, the current president of APS, announced Franz's acceptance of the position in January. He said she would join the editor in chief and the treasurer at the helm of the society on or about 1 April.

Franz received a BA in physics from Cornell University in 1959 and a PhD from the University of Illinois at Urbana–Champaign in 1965. A postdoc at the IBM Research Laboratory in Zurich from 1965 to 1967 provided experience in an industrial setting. She rose through the ranks of the physics department at Indiana University, becoming professor of physics in 1979, and then was a physics professor at West Virginia University from 1986 to 1991. During that period she also held visiting professorships at the Technical University of Munich and at Cornell.

Franz's research has concentrated on the theory of electronic behavior of disordered materials. She has been particularly interested in the transport properties of liquid and amorphous systems that exhibit local chemical order and charge transfer. Much of her work has involved the application of quantum percolation theory to the investigation of the metal–nonmetal transition in systems such as liquid and amorphous alloys, liquid semiconductors, metal–molten salt solutions and expanded metals. Franz is currently the chair of the APS division of condensed matter physics.

Judy R. Franz

Franz is a fellow of the American Physical Society and of the American Association for the Advancement of Science. She has been a president of the American Association of Physics Teachers and has received several awards for outstanding teaching. She has also served on the council of the Association of Women in Science, headed the APS committee on the status of women and headed the APS education committee. Franz is the principal investigator on an NSF grant aimed at improving the climate for women physicists in research universities.

"We must work to help preserve funding for high-quality research as emphases in Federal funding undergo possible shifts," Franz said after being informed of her appointment. "Luckily physics itself has never been healthier, with exciting new results appearing in many areas of physics. I expect APS to continue to play the dominant role in the 'advancement and the diffusion of the knowledge of physics,' as specified in our constitution. I hope that APS will also be able to play the important role of uniting the physics community in planning effectively for the future." She also noted that "the onset of electronic publishing of research results is not far off and must be dealt with effectively."

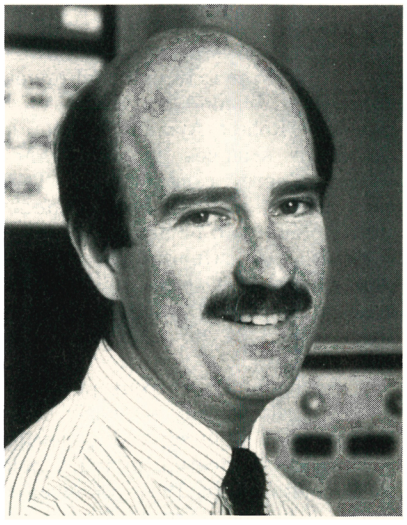
ARMSTRONG IS PRESIDENT OF RHEOLOGY SOCIETY

The Society of Rheology has elected two new leaders: Robert C. Armstrong of MIT, who succeeded Joe D. Goddard of the University of California, San Diego, as president, and Kurt F. Wissbrun, who succeeded Armstrong as vice president. Armstrong and Wissbrun began their two-year terms during the organization's 65th annual meeting, which took place in Boston in October.

Armstrong earned a bachelor's degree from Georgia Institute of Technology in 1970 and a PhD from the University of Wisconsin in 1973. He then joined the chemical engineering faculty at MIT, where he is currently a professor and executive officer. Armstrong's research interests include polymer fluid mechanics, numerical simulation of viscoelastic flows and experimental measurement of complex viscoelastic flows.

Wissbrun, the Society of Rheology's new vice president, was a senior research associate with Celanese Research Company until retiring in 1990; he now works as a consultant. He holds a PhD in physical chemistry from Yale University.

The other Society of Rheology officers were all re-elected. Andrew M. Kraynik of Sandia National Laboratories continues as secretary, Edward A. Collins of Avon Lake, Ohio, is still treasurer, and Arthur B. Metzner of the University of Delaware remains the Society of Rheology editor. ■



Robert C. Armstrong