LHC APPROVAL

Meeting an Unprecedented Challenge

Lorenzo Foà, CERN's Director of Research, points out that the approval last December to build the Large Hadron Collider not only heralds some major changes in the laboratory's activities but also represents an unprecedented challenge for the entire high-energy physics community.

A mock-up of LHC in the LEP tunnel.

The recent decision of the CERN Council to approve the Large Hadron Collider (LHC) project will have an enormous impact in the life of the laboratory. The most important aspect will be to provide CERN with a rational and fascinating long-term programme. Today, the precise measurements performed at the Large Electron Positron (LEP) collider have shown that the Standard Model, and in particular the electroweak theory, is the correct foundation for a detailed understanding of the building blocks of matter. Two fundamental aspects have yet to be faced: the Higgs mechanism, which should explain the origin of the concept of mass, and the possible interchange between matter and forces suggested by the the theory of supersymmetry. Starting from next year, the recently upgraded LEP2 will double the explorable range of mass. It has a fair chance of discovering one Higgs boson, particularly if the basic structure of the world is supersymmetric, and maybe one of the supersymmetric particles directly.

With LHC we now have the right machine to continue this exploration from where LEP2 stops and to cover the full mass range up to 1 TeV, a range in which these two fundamental aspects of the complete theory must be clearly visible if they have something to do with reality. The perspective of a long-term, coherent and unique programme exploring the basis of the theory describing the constituents of matter is an impressive source of motivation for the technical and scientific personnel of CERN, and for the thousands of users who commute between CERN and their home institutes to exploit the laboratory's facilities.

Constraints to be Addressed

A second aspect relates to the severe financial constraints set by Council as conditions for approval. The freeze of the budget for the three coming years (followed by only partial indexation in the subsequent years), the savings needed to cover the cost of the project, and the expected reduction in the number of staff from 3000 to 2300 within 10 years will force the laboratory to re-examine its overall structure and to evaluate activities and services in the perspective of what will really be needed a decade from now.

A Major Impact from Collaborations

A third, and surely not a minor modification in the life of CERN, stems from the fact that large collaborations which will prepare the LHC experiments are taking shape. For on the day the LHC was approved, the collaborations for the large, general-purpose ATLAS and CMS detectors presented the technical proposals for these two proton-proton experiments. Furthermore, one year from now the ALICE collaboration will present the design of the apparatus to study lead-lead interactions, and a letter-of-intent for a spectrometer devoted to b-quark physics is due in few months.

These collaborations represent the entire particle-physics community, from Europe and America to Asia. The important commitment by CERN non-Member States justifies the view that the larger of these states will take a partnership role, not only in the construction of the experiments but also in the construction of the accelerator and in the everyday life of the laboratory. If this transpires, the completion of the negotiations which are starting now would mean that CERN could become the real centre of the world high-energy physics community. It would also mean that LHC's full design energy could possibly be achieved in a single phase by the year 2004, instead of by 2008 *via* a "missing magnet" first phase (each half-cell — there are 23 cells per octant — would have two instead of three 14.2 m dipole magnets).

The presentation of the technical proposals by the two largest collaborations and the beginning, in a short while, of the extended construction phase, has another significant impact on activities at CERN. Over the past five or six years, the process to form the experimental collaborations and the birth of two complementary designs has been based on a major research and development programme which explored a large variety of technical options for facing the tremendously unfriendly environment of proton-proton interaction at a luminosity of 10^{34} $cm^{-2}s^{-1}$. Now that most of the choices have been made, this R&D activity will shift from the study of possible new detectors to optimizing prototypes of the final detector designs. Moreover, it will take place mostly inside the collaborations. The same focusing of strengths and funds is expected to occur in the laboratories and institutes around the world which are responsible for the various pieces of the apparatus.

Everyone at CERN, in the Member States, in the United States, and in Japan is aware that the construction of these experiments is an unprecedented challenge to the high-energy physics community and will require the utmost professionalism, effective concentration of technical strengths and funds, and strong support from funding agencies even though social difficulties will not allow an expansion of basic science.

The LHC Decision

– *Design energy* (centre-of-mass collisions): 10 TeV in 2004/14 TeV in 2008 based on a constant budget with no non-MS (Member State) contributions; 14 TeV in 2004 if a review of progress and non-MS contributions in 1997 is favourable.
– *LHC host-state contributions* (France and Switzerland) to LHC: indexed after 1998; amount to approx. 200 MSFR.
– *CERN annual budget:* no indexation of MS contributions in 1995-97, with 1% indexation thereafter. Germany's post-unification discounted contribution kept at 22.5% until the end of 1998. Future financial decisions need a double majority (the support of a majority of MS representing at least 70% of the budget).

ELFE Seeks Synergies

The Nuclear Physics European Collaboration Committee (NuPECC) has recommended the construction of an Electron Laboratory for Europe (ELFE) based on an accelerator producing a high-intensity, 15-30 GeV continuous electron beam (a design study was presented last April). To make the goal affordable, NuPECC recommends more work on cryogenic components carried out in conjunction with the development of a future linear collider for particle physics. A group should then coordinate technical work and integrate experimental programmes. NuPECC also says that it is essential to explore right away potential applications outside the study of nuclei and hadrons, notably those involving high-intensity X-ray beams produced using the electron beam.