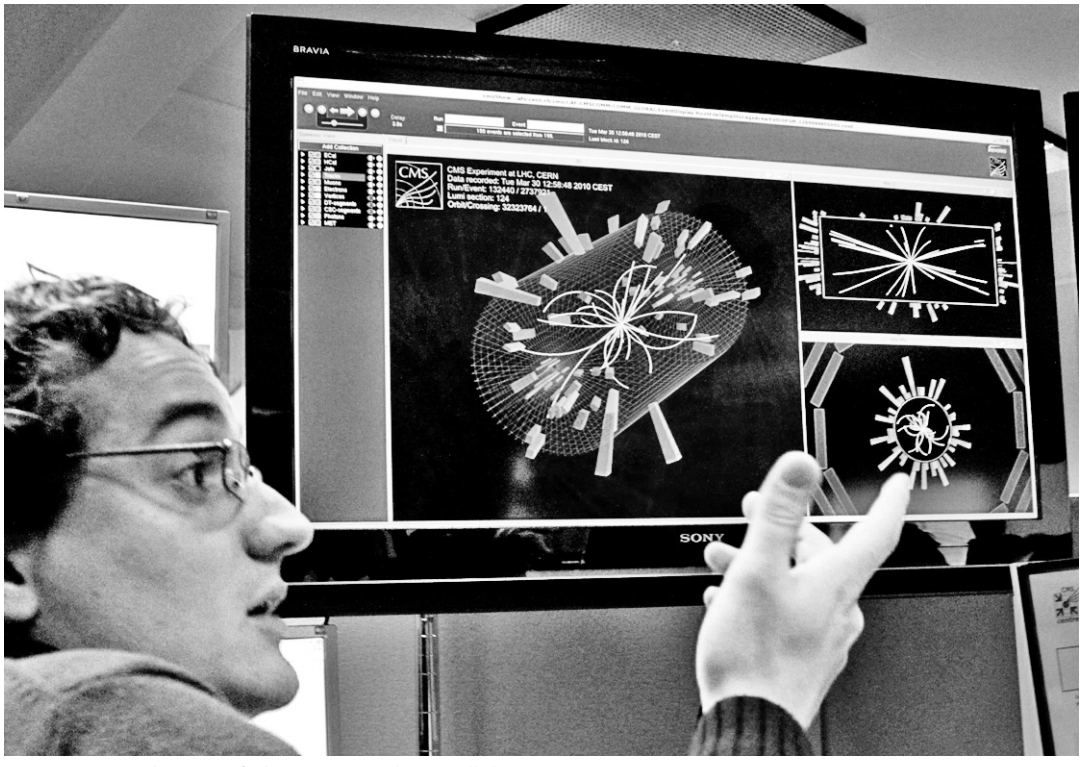
Crossing a new threshold in science

International scientific projects of large scale are not for faint-hearted nations – they require long-term sustained funding and support, and capacity to deal with unexpected situations, says **BHASKAR BALAKRISHNAN.**



At the control room of the Large Hadron Collider at CERN in Meyrin, near Geneva. — Reuters

Deep beneath the border with France, near Geneva, in a 27-km long circular tunnel, mankind has crossed a new threshold of science. After years of persistent effort, proton beams circulating in opposite directions at a record energy of 3.5 Tera electron volts (TeV) were made to collide with each other, producing reactions or "events" as they are known in particle physics.

Media reports have highlighted the sensational aspects such as the "big bang," the "god particle" and so on. But we need to look at the reality behind the accomplishment at the Large Hadron Collider (LHC) and its possibilities for Indian science.

This much sought after event in which new particles are created is captured by detectors and data disseminated via the LHC network to research groups worldwide for analysis and study. The whole system is a marvellous feat of engineering, basic science, and international collaboration on an unprecedented scale.

Already results indicate a higher than rate of creation of charged particles in the energy range up to 2.4 Tev than is predicted by present theories.

There will be new thresholds to cross, as the beams are only at 50 per cent of their design energy level of 7 TeV each, because of the delicate problems of managing over 9,300 superconducting magnets that focus and steer the beams around the enormous circular track.

EXPENSIVE VENTURE

The partial success of CERN marks a triumph for European-led scientific research, in which European organisations took the lead in building this expensive and complicated machine, with collaboration from other non-European Union countries such as the US, Japan, China, Russia, and also India as observers.

The cost of building the machine is some €3 billion, and there were cost over-runs on some of its components, especially superconducting magnets.

But the spin-offs of this project have also been impressive — in terms of technology in areas such as superconductivity, sensors, and information technology. After all, it must be recalled that CERN had originated the ideas of the World Wide Web (WWW) which has now become a household world.

Frontiers in science are becoming increasingly difficult and expensive to cross for any single nation, unless, of course, there is a military reason to do so. This is why the US had to give up its own particle accelerator project in Texas some years ago, and put its efforts into the LHC project. In nuclear fusion research also, national projects are giving way to joint efforts. In space research projects such as setting up and operating satellites and space stations also international collaboration is the norm.

In areas such as biotechnology and nanotechnology, due to the comparatively lower investments involved, national efforts are viable. This is one reason why CERN and the LHC project deserve commendation for its outstanding achievements over the years.

However, CERN's experience of management of such complex multinational scientific projects and the problems that had to be overcome could be valuable lessons for the future. International scientific projects of large scale are not for faint-hearted nations — they require long-term sustained funding and support, and capacity to deal with unexpected situations.

CERN FUTURE

The future of CERN after the LHC project remains uncertain. The LHC project was considered overambitious in the beginning and it has its detractors.

The failure of magnets last year led to increased criticism. Many question the wisdom of spending such huge sums of money and specialised manpower for such an arcane task as colliding protons at high energies to find out what happens and why. But the counter arguments are also compelling — the spin-offs in terms of engineering, IT, nanotechnology, and sensors is only one. The employment generated and specialised service companies spun off is another.

CERN would need to work much harder to secure funding for its future major projects, due to the current economic difficulties in Europe, especially when the search for new breakthroughs in physics does not produce results quickly.

CERN would need to diversify away from excessive dependence on large single super projects to a more diverse range of projects as well as more diverse sources of funding away from purely governmental. Competition for resources from other large international projects such as the ITER, which promises to provide cheap fusion energy also needs to be factored in.

Today, CERN's research output is remarkably diverse. The subjects covered range from engineering, information technology, materials science, chemistry, biology, space sciences, global climate models, social sciences, and so on.

CERN has developed into a vast multidisciplinary multinational research institution, where there is much cross-fertilisation among its creative researchers.

Researchers come and go to CERN, and take back to their parent institutions the vision and inspiration that drives CERN, making an important contribution to strengthening national institutions and science.

INDIA'S ROLE

India has taken advantage of the opportunities for collaboration with CERN in several fields. This includes supply of superconducting sextupole and decapole spool pieces amounting to half of the total LHC requirement for such corrector magnet equipment, 7,080 LHC magnet support jacks and quench heater power supplies.

India is responsible for the necessary electronics for Russian made circuit breakers. India's contribution is in kind valued at some 34 million Swiss francs, with CERN assessing the value at 50 per cent of the European standard cost and crediting the remaining 50 per cent to an "Indian fund" to support Indian scientists working at CERN and for other expenses. This form of collaboration is mutually beneficial. Indian scientists are also participating in building of the detectors (ALICE and CMS), the associated infotech aspects, and LHC Grid software. Besides Bhabha Atomic Research Centre, Tata Institute of Fundamental Research, universities such as Delhi and Punjab are also involved.

The positive results of India-CERN collaboration in the LHC has led to further collaboration projects and this area could see rapid development in future.

This is provided sufficient resources are allocated by our policy makers and the approval process for such collaboration is streamlined and stripped of all unnecessary bureaucratic procedures. The importance of this stems from the fact that with a relatively small contribution, India can gain access to this frontier area of physics and engineering that could be beneficial for a whole generation of Indian scientists and institutions.

India on its own would not be able to afford the kind of research that goes on at CERN, nor would the public agree to such heavy expenditures. Therefore, the international collaboration route pioneered by the Department of Atomic Energy and CERN is a must.

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