

The EPS Edison Volta Prize 2012: a reward to CERN LHC

"Building on decades of dedicated work by their predecessors, the 2012 EPS Edison Volta Prize has been awarded to: Rolf Dieter Heuer, CERN Director General, Sergio Bertolucci, CERN Director for Research and Computing, and Stephen Myers, CERN Director for Accelerators and Technology, for leading the culminating efforts in the direction, research and operation of the CERN Large Hadron Collider (LHC), which resulted in many significant advances in high energy particle physics, in particular, the first evidence of a Higgs-like boson in July 2012."

The European Physical Society (EPS), the Centro di Cultura Scientifica "Alessandro Volta" (Centro Volta) and Edison SpA have established the prize to promote excellent research and achievement in physics, its terms of reference and the process leading to the final decision. The Prize Selection Committee was composed of: L. Cifarelli (EPS President), C. Hidalgo (EPS Plasma Physics Division Chair), M. Huber (EPS Honorary Member), V. Matveev (JINR Director), and G. Casati (Centro Volta Scientific Coordinator). The EPS Edison Volta Prize is awarded in 2012 for the first time. The prize consists in €10,000 and is accompanied by a silver medal and a diploma.

The Large Hadron Collider (LHC) has already delivered a billion millions of proton-proton collisions at an unprecedented energy level of 8 TeV in the centre-of-mass frame, and at an unprecedented luminosity; moreover collisions between accelerated Pb nuclei in the same energy/nucleon pair scale have been achieved. The particles emerging from the collisions are detected, filtered and analysed by two gigantic general purpose experiments, ATLAS and CMS, and, focussed on specific scopes, by ALICE, LHCb, TOTEM and LHCf. Already many important physics results have been published.

These achievements are the result of the efforts over more than 20 years by thousands of scientists, engineers and technicians operating at the European Organization for Nuclear Research (CERN), in Universities and in Laboratories all over the world, and of the Agencies supporting, coordinating and guiding the activities.

Initially, the LHC was the vision of a few farsighted scientists. Already at the end of the 1970s, a working group chaired by Antonino Zichichi, and charged by the European Committee for Future Accelerators (ECFA) to define the design of the Large Electron Positron collider (LEP), underlined in its "White Book" (the ECFA-LEP 1979 Progress Report) the importance of building the LEP in a 27 km long tunnel, with a wide enough cross section to be able in a future, after the completion of LEP operations, to host a ring of superconducting magnets for a proton-proton collider.

LEP Note 440, published in April 1983 by Stephen Myers and Wolfgang Schnell gave birth to the LHC concept. The "official" kick-off of the LHC project is generally considered to be a workshop held in 1984 in Lausanne, led by Giorgio Brianti, where the community of physicists and machine experts reached the agreement on a collider for protons and nuclei. The following phases were difficult, due, in particular, to the approval in the USA of the Superconductive Super Collider (SSC), with a centre-of-mass energy of 40 TeV, much greater than anything that could be built at CERN. The vision and the conviction of Carlo Rubbia, the then CERN Director General, kept the project alive up to its approval, without increasing the CERN budget, by the CERN Council in 1993 and further in 1994. In the following years, the Director General Christopher Llewellyn Smith led the effort of enlarging the participation in CERN of non-Western European Countries. Japan, India, Russia, Canada and the USA entered with the status of CERN observer States in the 1990s.



The design physics performance of the LHC could compete with that of the much larger SSC (which was finally cancelled by the USA Congress in 1993) as a result of the superior applied superconductivity skills present in Europe. These in turn had been developed and transferred to European industry by the HERA project at DESY in Hamburg and by other projects. The efforts to develop the superconductive magnet technology at CERN, under the leadership of Romeo Perin, and in the collaborating States led to the delivery of the first INFN-CERN dipole, which reached 8.73 T in 1994.

The LHC Project Leader was Lyn Evans. After Christopher Llewellyn Smith, the construction effort was sustained by the General Directorates of Luciano Maiani, who started the installation of the LHC elements, and Robert Aymar, who led the installation to completion. The last dipole magnet, of the necessary 1232, was installed in 2007.

A long commissioning phase followed, under the direction, since 2009, of the three Prize Laureates – Rolf Heuer, Sergio Bertolucci and Stephen Myers – with the first physics data taking runs at LHC in 2010. Even if the maximum design energy (14 TeV) is foreseen to be reached only in 2014-2015, after two years of technical works, the current CERN Directorate succeeded in smoothly providing to the experiments the data needed for a wealth of physics results and for a major break through.

In July 2012, ATLAS and CMS announced the first solid evidence for a new particle and the determination of its first features. The latter likely correspond to those of the only element still missing of the Standard Model, the scalar boson responsible of the mass of all the other particles, called "the Higgs". Additional work is on going to further check the predictions of the theory. The discovery was made possible by the very advanced technology of both detector systems, developed in the past two decades. This regards the basic detector elements, the read-out electronics, the software to analyse the data and to simulate the background sources and, in addition, the distributed computing infrastructure, the GRID, developed to provide the required huge computing power to process the data. As a matter of fact the Higgs particle production, immediately followed by a decay into a final state that can be reliably detected, happens once every in around 10^{14} (one hundred million millions) collisions.

Concerning the LHC experiments, their various detector components were not all built at CERN, where they were finally assembled and tested, but rather in a large number of Laboratories and Universities on all the Continents.

The construction of CMS and ATLAS experiments were led by Michel Della Negra and Peter Jenni respectively. In the next phases the Spokespersons were changed by the Collaborations on a rotation basis: Jim Virdee, Guido Tonelli and Joe Incandela for the former, Fabiola Gianotti for the latter. Many other scientists and technicians made vital contributions to the experiments, in addition to all those who contributed to the collider. There are far too many to be mentioned here, but this prize is meant to encompass them all.

Background Information

The European Physical Society (EPS) provides an international forum for physicists and acts as a federation of national physical societies. Founded in 1968 in Geneva, the EPS now has around 3000 individual members, and brings together 41 national physical societies which themselves represent together over 100,000 physicists. The EPS Secretariat is based in Mulhouse, France. (www.eps.org)

The other partners and sponsors of the joint EPS Edison Volta Prize are:

- **Centro di Cultura Scientifica "Alessandro Volta" (www.centrovolta.it)**
- **Edison Spa (www.edison.it)**

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