

Lucio Rossi - short CV – August 2020

Lucio Rossi became doctor in Physics at the University of Milan in April 1980, with full score *cum laude* discussing a thesis on Plasma Physics, then university researcher (permanent position) in 1983 and then professor of experimental physics in the physics department of University of Milan in 1992.

In the 1980's he carried out his first researches in applied superconductivity for particle accelerators and detectors at University of Milano-*Physics department* with *INFN (the Italian Institute for Nuclear and Particle Physics)* working on applied superconductivity for accelerators. He contributed to the design and construction of the magnet for a **superconducting cyclotron (CS)**, installed in 1990 at INFN-LNS in Catania-Italy, one of the first superconducting accelerator in the world), and for the thin superconducting solenoid for the **ZEUS Experiment** at the collider HERA in Hamburg (De).

In the 1990's he carried out researches also in superconducting material development by pursuing high-field high-current density Nb₃Sn of the type Internal Tin Diffusion (reaching world record results for the time). In those years, he was also the leader of a project of a large bore superconducting facility composed by multiple solenoid designed for 18 T (**SOLEMI facility**), installed and operated at LASA laboratory in Milan.

In 1989-1998, in the same frame of a collaboration CERN-INFN, he contributed to design and was responsible of the construction of **the first superconducting cables for the LHC projects**. He was also in charge of the construction (with CERN, in the early R&D time) of **the first LHC prototype dipoles for the LHC project**. In particular the success of the first 10 m dipole in 1994 (and still in operating at 9 T for the CAST experiment at CERN), allowed the first approval of LHC project by the CERN Council.

In 1994 he launched a further collaboration with CERN aiming at exploring the high current/high field Nb₃Sn for a future possible upgrade of the low-beta quadrupoles of the just approved LHC, with preliminary works on high field quadrupole designs, beside the Nb₃Sn development above mentioned.

In 1998-2001, as responsible of the INFN-Milano group, he joined the ATLAS collaboration (the largest experiment at the LHC) and became responsible for the R&D and the production of the high current **superconducting cable (60 kA, aluminium stabilized)** and of construction of the **large Barrel Toroid coils (25 m long)**. In the year 1999-2003 INFN-Milano team supplied to the ATLAS collaboration most the superconducting cable and the eight large BT coils, rated for 4 T, beside the "small scale" (9m x 5 m) B0 model coil. The BT coils are the largest superconducting coils ever built.

L. Rossi joined CERN in May 2001 (remaining professor on leave from University of Milano), where until June 2011 **he led the Magnet, Superconductor and Cryostat Group for the LHC Project**. His responsibility comprises: i) the construction of about 300,000 km of Nb-Ti strand and the construction of 7000 km of high quality superconducting Rutherford cable for the LHC magnets; ii) the construction of 1700 large Two-in-One superconducting magnets – with magnetic field of 8.3 T for the dipoles and with a stored energy of nearly 10 GJ - operating in superfluid helium. The magnet system is the backbone of the LHC, it is worth 1200 M€ (more than 50% of the total LHC material budget), and is the most complex and technological advanced system of the collider. It is the largest enterprise in superconductivity ever accomplished. The LHC magnets have all been delivered on

time, November 2006, and successfully tested up to 8.4 or 8.65 T (40% up to the ultimate field of 9 T).

As Leader of the CERN Magnet Group L. Rossi has contributed to the study of the LHC luminosity upgrade already in 2001-2002, by participating to a Working Group that devised an upgrade configuration based on higher field/gradient quadrupoles using Nb₃Sn technologies. He was then the CERN link-person to the US-LARP program for the upgrade and in particular giving the guidance for the parameters. **In 2009-10, he launched the CERN high field program**, with a new development of Nb₃Sn superconductor in Europe and a development of a high field-large bore dipole, called FRESCA-2, with a CERN-CEA collaborations. FRESCA-2 magnets, supported by the LHC upgrade program, since 2017 holds the record field for dipole, of 14.6 T, and record stored energy of 5 MJ/m.

In 2007-08 he was among the proponents of a close collaboration between CERN and the newly formed ITER project. From 2008 to 2014 he was co-leader and CERN link person of this collaborations which was instrumental for setting up various technologies and process for ITER (Superconducting cable tests, Current Leads, advanced magnet protection, etc...).

L. Rossi in 2010 lead a Task Force at CERN that culminated with the proposal of an ambitious LHC upgrade, called **High Luminosity LHC (HL-LHC or HiLumi LHC)**, a project aimed at increasing by a factor of 10 the luminosity performance of the LHC above its nominal value. The project, **which he is leading since beginning in 2010**, has now a total budget of 1500 M€ (2/3 in material and 1/3 in personnel), and includes the development and the use in LHC operation of cutting edge technologies, which are all absolutely new for accelerators. First of all, about 40 superconducting magnets rated for 11-12 T high field (dipoles and quadrupoles, mostly with large bore (150 mm) and large stored energy. ii) special SRF Cavities (compact crab cavities), used to deflect proton beams with high accuracy. iii) a novel type of cold powering based on high current (100 kA) superconducting links in MgB₂ superconductor, connected to unprecedented accuracy power converters, of 18 KA each, 2-Quadrants and 0.1 ppm ripple. iv) many other innovative technologies for very intense beam collimations (e.g., low impedance collimator to handle 700 MJ beams without losing stability), for complete e-cloud suppression (e.g., a-C coating at cryogenic temperature and/or Laser Engineering Structured Surfaces) and for on-line remote alignment to better than 1 micron of cryogenic equipment (SC Magnets, SRF cavities). L. Rossi coordinated the **European FP7-Desing Study HiLumi LHC**, awarded with maximum score and maximum budget of 5 M€ by the EC in 2011-15, for the initial design phase. The project has been eventually fully approved by CERN Council in June 2016 for installation in 2024-2026. From its conception, High Luminosity LHC has been an international project, involving more than 30 Institutions and Laboratories, in Europe, in North America and in Asia. The international collaboration, of which USA is the major player after CERN, involves about 400 researchers and engineers, it contributed decisively to the design and R&D and it is now delivering about 40% of the equipment of HL-LHC to CERN as in-kind contribution.

L. Rossi has step down as HL-LHC Project Leader on 1 July 2020, in view of his retirement from CERN (30 September 2020) and the return to the University of Milano as Professor of Physics (as from 1 October 2020)

Besides leading HL-LHC, L. Rossi has been working in the period 2010-2020 on high field magnets beyond the 12 T regime of HiLumi in view of next generation hadron collider. In 2010, he has been among the proponent of a High Energy LHC, with magnet design up to 20 T, by using the HiLumi

Nb₃Sn and the High Temperature Superconductors (HTS). In 2013, he has been among the first proponents of a ring for 80-100 km at CERN as post-LHC machine, at that time called VLHC that then became FCC-hh. Since 2013, he is also leading a development of HTS for 20 tesla magnets (for HE-LHC or FCC-hh) by managing international collaborations via two European Programs, **FP7-Eucard2 and H2020-ARIES**, both with specific tasks on rear earth-based coated superconductors (REBCO/YBCO). In 2017 the collaboration has tested the first HTS accelerator magnet, a small model of 3.5 T and now is heading to make one for 7 T, to be inserted in Fresca-2 to demonstrate 20 T principle feasibility.

L. Rossi received the **IEEE Council of Superconductivity Award** for sustained contributions in the field of Applied Superconductivity in August 2007 in Philadelphia. The award is *for his leadership of the LHC Magnet and Superconductor, the largest single acquisition of superconducting devices in the world, for his contributions in the design of various earlier superconducting magnet systems such as the ATLAS BT toroid detector at CERN, and, for his mentoring and training, while he was at the University of Milan and INFN, of many of the next generation of leaders in the superconducting magnet community*. L. Rossi has been elevated to the grade of IEEE fellow in 2013 and has been selected as the 2013-2014 IEEE-Council of Superconductivity Distinguished Lecturer. He has authored 150+ publications in international journals and reviews.

L. Received has been awarded in 14 May 2020 by the European Physical Society **the EPS-AG/IPAC'20 Rolf Wideröe Prize** for outstanding work in the accelerator field, with no age limit, *for his pioneering role in the development of superconducting magnet technology for accelerators and experiments, its application to complex projects in High Energy Physics including strongly driving industrial capability, and for his tireless effort in promoting the field of accelerator science and technology*.

He received three awards from his native town (Piacenza, Italy) as most distinguished citizen.

Professor Rossi is active in public outreach, and is founding member (1985) of “Euresis”, an association for the promotion of scientific culture established in Milan. He frequently (about 10 times a year) gives talks to the public and at cultural events, on science and large projects, developing themes like the relation between science and technology, “certainty and truth.”

