

The Large Hadron Collider Project and Superconductivity

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Abstract - The Large Hadron Collider project, comprising the accelerator and the experiments, aims to tackle some of the most fundamental questions about the origin, evolution and composition of our universe. Potential discoveries include new forms of matter, new forces of nature, new dimensions of space and time. Particular questions to be addressed include: what is the origin of mass, what constitutes dark matter, why is the universe composed of matter, not antimatter, and more. The discoveries have the potential to alter our perception of how nature operates at the fundamental level.

It is opportune to give this talk on the 100th anniversary of the discovery of superconductivity. Superconductivity plays a central role in the LHC project especially in high field superconducting magnets. This has allowed the LHC to deliver high-energy collisions and their study by powerful general-purpose experiments, ATLAS and CMS. The LHC project owes a great debt of gratitude to the work of Kammerlingh Onnes whose laboratory was nearby in Leiden.

After a brief physics introduction, the talk will outline what it has taken to get to this point, after 20 years of design, prototyping, construction, installation, commissioning, data-taking and distributed data analysis.

The LHC accelerator has collided protons and lead ions at unprecedented high energies. Outstanding progress has seen the proton-proton interaction rate increase to about 300 million per second. All the LHC experiments are also performing very well, close to their desired and ambitious design performance set down some fifteen years ago. Physics measurements are confronting, more and more precisely, the predictions of the Standard Model of particle physics, whilst looking for a broad range of potentially new physics.

The talk will briefly recall the physics of the LHC, outline some of the challenges faced during construction of the accelerator and the experiments, especially of superconducting magnets, their operation and performance, the first physics results from the experiments, and the outlook.

Plenary presentation given on September 22, 2011 at SCC (annotated slides & videos)

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