Highlights

Novel superconducting and functional materials for energy and environment - 2019

The CERN FCC Conductor Development Program: A Worldwide Effort for the Future Generation of High-Field Magnets

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High Energy Physics has a long history of driving the development of superconducting magnets, and improvements in the design and performance of the superconducting wires used to produce them. In the context of the High-Luminosity LHC (HL-LHC) project, a major upgrade program to increase the luminosity of the LHC, Nb_3Sn accelerator magnets will be installed for the first time. The requirement for larger-aperture quadrupole magnets, and shorter dipole magnets to allow space for additional collimators, necessitates a significant increase in magnetic field, from a peak field of up to 8.6 T on the conductor in LHC, to 11.6 T for HL-LHC. SInce this cannot be achieved with Nb–Ti, as used for the LHC, suitable Nb_3Sn conductors have been developed, and series production of these wires is advancing towards completion. The proposed Future Circular Collider (FCC) would require another substantial step forward. The FCC Study is developing a number of conceptual designs for a successor particle collider to LHC, and the baseline is a 100 TeV hadron collider in a 100 km tunnel with 16 T dipole magnets. CERN has therefore launched a Conductor Development Program to drive the development of a suitable wire in partnership with industry and academia, as sketched below. The program is centered on Nb_3Sn wires, but also supports activities seeking a breakthrough in the high-field performance or cost effectiveness of alternative superconducting materials, currently including studies of MgB_2, BSCCO 2212 and iron-based superconductors at CNR-SPIN Genova.