ELECTROMECHANICAL STUDIES OF SUPERCONDUCTORS AND REFERENCE MEASUREMENTS FOR HEP PARTICLE COLLIDERS

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The ongoing development of very high critical-current superconducting wires, such as Nb_3Sn $Bi_2Sr_2Ca_1Cu_2O_{8+x}$, and $ReBa_2Cu_3O_{7-x}$, is stimulated by the prospect of their extensive use in large magnet systems intended for HEP particle colliders. However, since most technologically important high-field superconductors are brittle, their critical current is susceptible to mechanical degradation during strand handling and magnet fabrication and operation, especially when used in ultra-high field and large-size magnets where the Lorentz force on the conductor is very high. Therefore, stress and strain management is one of the key technologies that need to be developed and implemented, and require a sound understanding of the conductors' strain properties. An example of such studies on Nb_3Sn conductors for the HL-LHC can be found at https://rdcu.be/5pZK and https://rdcu.be/bulV0. There are very few laboratories in the world specialized in electro-mechanical characterization of superconductors and DOE/HEP maintains an activity dedicated to this topic at the NHMFL. Given the critical role that the electromechanical studies can play in the process of conductor and magnet development, especially that higher magnetic-field particle colliders are being pursued, the community should give them more weight and attention. This is increasingly relevant that the community is moving away from the ductile but intrinsically limited Nb-Ti to the more advanced and promising but brittle LTS and HTS conductors.

On a broader scope, the community needs reference measurements and standards in areas related to superconductors, magnets, and materials properties, to fill a void left by NIST when it ceased its support for superconductor measurement science in 2015. The new generation of particle colliders will be pushing the frontier of materials routine characterization to magnetic fields in the range of 20 T. This will need activities dedicated to measurement science to help the community deliver reliable data in these conditions.