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M3Or1A-04: Modelling of Field Error and Field Error Drift of CORC®-based Prototype Accelerator Magnets

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YBCO coated conductors are being considered for use in high-field magnets for future particle accelerators, as they allow the development of very high field dipoles and quadrupoles. However, the field quality of these magnets, critical for beam steering and control, is well known to be influenced by conductor persistent currents, or magnetization. Some estimates of how coated conductors might influence field error have been made, but much work remains. In particular, there is a need to model the magnetization of HTS cables in accelerator magnets and the resulting field error. Here we focus on conductor on round core (CORC®) cable and make field error estimates based on both direct measurements as well as models based on direct data. This data was then input into finite-element analysis software in order to calculate errors for a block design dipole magnet using CORC® cable as a drop-in replacement. Specifically, the magnetic field quality of a prototype accelerator magnet built from CORC® cable is predicted using the results of magnetization hysteresis measurements, performed on ˜3 cm long samples of the cable, as inputs. The magnet was of block design and consisted of 2 layers with 84 turns in layer 1 and 105 turns in layer 2. Additionally, flux creep in HTS-based composites, which is significant even at low temperature, was shown to contribute to a notable temporal drift in the magnet field quality. The drift in the field error is predicted from magnetic decay measurements performed on the same sample. The reported work is expected to provide a useful tool for the design of accelerator magnets using HTS conductors.

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