

Fast Method to Quantify the Collective Magnetization in Superconducting Magnets

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Abstract - The magnetization of the superconductor is one of the most important parameters determining the field quality of accelerator magnets. A fast method to quantify the magnetization effect in an entire magnet was developed at CERN based on a voltage-current measurement during a powering cycle. The collective magnetization includes the effect due to hysteresis losses in the magnet superconducting filaments, coupling losses in the magnet conductor, and magnetization of the iron yoke. It is calculated by means of an energy balance between the work done by the power converter and the change of magnetic energy in the system. Also, the energy dissipated at any time is calculated. In the magnet test facility at CERN, LHC dipole magnets have been cycled between ± 600 A with a ramp-rate of 10 A/s. The magnetization curves deduced from these measurements show a good precision and high reproducibility, mainly due to the high precision of the power converter and the current-measurement system. The results have been compared with numerical simulations performed with the computer code ROXIE. The proposed test method can be applied to any type of magnet, is rather easy and fast, and is therefore interesting for checking the reproducibility of the magnetization among a series production of magnets.

Keywords - Accelerator magnets, Magnetization, Measurement techniques, Superconducting magnets.

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