

DESIGN and OPTIMIZATION OF ACCELERATOR MAGNETS

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For the LHC magnets, the coherence between beam-physics requirements, magnet design, and magnetic measurements has been well established. This is far less evident in future accelerator projects. Hysteresis and eddy currents in iron-dominated magnets affect accelerator performance during fast field ramps to gain circulating beam time or when suppressing demagnetization cycles to save energy.

We also review the challenges of the next generation of high-field superconducting magnets that will require coupled electromagnetic, mechanical, thermal, and electric simulations from the onset of the design process. We go through the different design steps and the required tools for numerical field computation and optimization. In simulating transient effects in quenching superconducting magnets, we are confronted with the coupling of physical subsystems and extreme nonlinearities and uncertainties in the material parameters.

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