Analysis of Coupled Electromagnetic-Thermal Effects in Superconducting Accelerator Magnets

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Abstract - The planned facility FAIR will include 5 magnet rings including two superconducting synchotrons. The SIS100 synchrotron is the core component of the facility and will be equipped with 2 Tesla dipole magnets pulsed with 4 Tesla/s. The cable of the magnet coils is made of a hollow NbTi composite cable of about 7 mm outer diameter, cooled with two-phase helium flow at 4.5 K. We calculate the heat load, the eddy and the hysteresis losses, investigate the impact of the ramping on the magnetic field, on the safety margin of the conductor and the required cooling for all different elements of the magnet including the coil, the yoke, the bus bars and the beam pipe. This analysis is based on properties measured at cryogenic temperatures and fine detailed FEM models.

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