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Numerical Analysis of cool-down and warm-up of multipoles for Low energy beam line for FAIR

Content :

The superconducting magnets of the Low Energy Beamline are the superferric type. The magnetic field is shaped by the magnetic iron such as for a normal conducting magnet, but the coils of the magnet are wound with superconductors. The cooling of the magnets will be done by a liquid Helium bath. The design pressure of the Helium containers is set to 20 bar. It is foreseen to do the cooldown and filling from the bottom of the He-vessel and the refill to replace evaporated He from the top. Thermal shield and 4k cold mass will be cooled by one common circuit of helium flow. The cool-down of all cryogenic components of the magnet system should be analyzed and optimized. The cold mass is around 38 tomes. The main constraint for the cool down from 300 to 80K is to limit the thermal stresses of the components. In order to satisfy this condition, a gradual cool-down should be performed in order to maintain a small temperature gradient. And the main constraint for cool-down from 80 to 4 K is the available cooling power and the flow rate of the cryo plant working.
This present presents a scheme for the cooldown of the multipole magnets.
After which a mathematical model for transient heat transfer, such as cool-down and warm-up of the multipoles is presented. The mathematical model is then solved numerically and the heat transfer studied. Optimization is done considering different cool-down rates.

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