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M2Po2C-04: The design and analysis of a superconducting magnet system for high field MRI

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A superconducting multi-coil magnet system has been designed, analyzed and optimized, serving as demonstrator for a high filed Magnetic Resonance Imaging (MRI). This work focuses on the design and optimization of superconducting magnet, cryogenic cooling and cryostat systems, as well as key components manufacture and verification.
The NbTi magnet system with multi-coils design has been optimized by balancing magnet performance, stability and offered field quality, against material- and cooling cost. The zero boil-off liquid He-cooled and conduction cooling system operated at 4.2 K, are both designed, analyzed and compared. For the cryostat, the space from inner surface of magnet to the room temperature bore should be kept narrow to maintain optimal field amplitude and homogeneity. This leads to the challenge of reconciling the mechanical constraints imposed by the coil geometry with the thermal insulation requirements. A straightforward structural elements is designed but with a high heat in-leak, while a local reinforced structure is also proposed and analyzed to achieve same space with less heat leak but with some manufacture difficulties. Here, the optimized design of the magnet system and its analysis (e.g. magnetic field, mechanical stress, thermal budget, etc.) are presented.

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