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Design of a Curved Superconducting Combined Function Bending Magnet Demonstrator for Hadron Therapy

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Curved superconducting bending magnets have clear potential for compact hadron therapy gantries and medical synchrotrons. A combined function superconducting bending magnet design based on collared cos-theta coils is proposed for a novel compact hadron therapy gantry initiative, SIGRUM. These 3 T magnets, based on the technologies extensively developed for the LHC project, include several gantry-specific features that shall be developed and validated by a demonstrator magnet. The main development areas include fabrication of epoxy-impregnated cos-theta Nb-Ti coils with 2.2 m radius of curvature along with the assembly of the surrounding curved cold mass. The demonstrator magnet test will also serve to validate and fine-tune the advanced numerical models for the electromagnetic and thermal optimization of the final conduction cooled gantry magnet. This paper presents the magnetic and mechanical design optimization of the demonstrator magnet, the results of the numerical modelling of the transient losses during operation as well as the magnet quench protection analysis.

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