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Sat-Mo-Po.01-02: Advancements in Superconducting Magnet Design for Hadron Therapy: Design, Construction Readiness, and Assembly Challenges of a Curved CCT Magnet in the HITRIplus project

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A detailed overview of the ultimate magnet design developed within Work Package 8 of the collaborative European project HITRIplus is presented. Focused on the development of superconducting magnets for ion therapy synchrotron and gantry systems, the study introduces an innovative approach utilizing a curved Canted Cosine Theta layout magnet based on NbTi superconductor. The design targets a central magnetic field strength of 4 T, an 80 mm aperture, and a maximum ramp rate of 0.4 T/s, while addressing the challenge of a tight 1.65 m bending radius. This paper highlights the latest advancements in magnetic and mechanical designs, as well as the construction and assembly procedures for the curved former. The rope cable conductor utilizes a 2×7 layout, optimizing current density distribution with a 1.5 kA current per rope. Key advancements include magnetic and mechanical design improvements, construction readiness, and a detailed comparison of assembly procedures with and without an iron yoke. The vertically split iron yoke design manages thermal contraction through innovative approaches, including tapered iron laminations and aluminium clamps. Aluminium bronze is selected for the curved former, with machining and validation tests highlighting its suitability. Additionally, the paper explores field quality analysis before and after magnet energization, addressing geometric yoke optimization to enhance field uniformity. Progress in conductor development, winding and wax impregnation tests, and assembly trials are presented, with a focus on ensuring robustness and field accuracy in both yoke-inclusive and yoke-free configurations.

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