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Design of a large aperture Canted Cosine Theta (CCT) combined function curved superconducting bending magnet

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Large aperture superconducting combined function magnets with the magnetic rigidity of 13Tm will be utilized in the Spectrometer-Ring for the HIAF (High Intensity heavy-ion Accelerator Facility) project. The magnet is designed to provide a dipole field of 3.0 T and a quadrupole field of 11.3 T/m in a large aperture of 240 mm. The Canted Cosine Theta (CCT) superconducting magnet had been well developed recently in particle accelerators and proton therapy facility with the advantages of low higher-order harmonics (quadrupole, sextupole, etc.) and the low cost. However, the large aperture and curved structure make it difficult to guarantee the field quality for the combined function magnet. Additionally, due to large aperture, the Lorentz forces cause more structure problem on superconducting coil which has negative effects. To overcome the problems above, the optimal design of combined function CCT magnet has been presented in this paper. Based on finite element method (FEM) in OPERA and ANSYS, the electromagnetic and structure optimal design have been finished with new structure of superconducting cable and bobbin. Then, the tested coil winding and bobbin manufacture are under the way.

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