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Mon-Mo-Po1.03-14 [33]: A High Precision Magnetic Field Shimming algorithm for Inclined 45° Continuous Cutting on Spiral Pole of SC Cyclotron

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Due to the small size and low power consumption, compact superconducting cyclotron are suitable to be installed in hospital for cancer therapy, which becomes a research hotspot in recent years. China Institute of Atomic Energy has been developing a 230MeV compact superconducting cyclotron CYCIAE-230 to meet the demands of proton therapy in China. Accelerator physics design requires a strict control of the average field error and first harmonic in the main field. A processing method of inclined 45o continous cutting on the two pole edges is proposed to shim the field in CYCIAE-230. For a spiral sector magnet, the 45o continous cutting generates an asymmetrical magnetic field on both sides, and the field change is not proportional to the milling depth, which makes the establishment of the shimming algorithm much more complicated. In this paper, a Mathematica model of the linear equation for field shimming calculation is established. The field change caused by the local cutting is calculated numerically by the integral equation method to describe the nonlinear relation of the complex shape cutted parts. And then the shimming process is built with multi-iterative simulation based on the least squares method. The finite element model is built to confirm the field change brought by the inclined 45o cutting value, which is added to the iterative calculation for cutting value correction and expecting the shimming effect. The new shimming algorithm is applied for the field measurement, amending and processing of CYCIAE-230, which achieve significant results to reduce the shimming times and further the fabrication period. The process of the shimming algorithm and the corresponding shimming effect of CYCIAE-230 will be presented as well.

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