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Wed-Af-Po3.20-15 [67]: Topology Optimization of the Pole Shape in Passive Magnetic Channel using MMA Method

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Passive magnetic channel is a kind of beam focusing elements in cyclotron. It consists of several soft iron bars which are magnetized by the main field in cyclotron. One of the common method to design pole shape of the magnetic channels is based on a current sheet analytical model. Geometry parameters of the rectangular pattern pole shape are designed using this model. In this paper, we proposed a topology optimization method to design the pole shape in passive magnetic channel, this method does not require any fixed geometry pattern or initial design. The nonlinear static magnetic finite-element analysis model is used to calculate the objective magnetic field function. Persuade iron material with variable density is used to describe the iron distribution. Method of Moving Asymptotes (MMA) is used to optimize the control variable of iron density distribution on magnetic channel cross section. A penalization factor is used to get a thresholding iron distribution results. It ensures the final design without density related persuade iron material. In three numerical examples, magnetic channels for a 250 MeV superconducting cyclotron is provided, where the design goal is to provide the given magnetic field gradient and bending angle. The relationship between the design goal and the pole shape pattern is discussed. It reveals that magnetic channel pattern with only 2 iron bars is possible for some design goals.

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