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Design and construction of a permanent magnet quadrupole at NSRRC

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Increasingly, synchrotron facilities are being developed as green accelerators focused on energy efficiency and low-emittance rings to achieve high brilliance. The emittance size of the electron beam is closely related to the number of bending magnets used. To economically upgrade and optimize the current synchrotron facility, it is crucial to minimize revisions to the existing infrastructure. As a result, more lattice magnets should be installed within the previously constrained achromat space to maximize the available area for the straight section. Consequently, permanent magnet technology offers significant advantages due to its compactness, lack of power consumption, and elimination of the need for cooling circuits with deionized water. This study presents the design of a hybrid-type permanent magnet quadrupole, which consists of permanent magnets and soft magnetic materials, similar to the hybrid configuration of insertion devices. The model, with a bore radius of 11.5 mm, achieves a magnetic field gradient exceeding 90 T/m. Additionally, the practical engineering process used to realize this design is described. Finally, the magnetic field performance is characterized.

Footnotes

Paper preparation format

Region represented

Asia

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