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Design of a cosine-theta dipole magnet considering influence of shielding-current-induced field on field quality

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Magnets wound with coated conductors are attractive for the applications to accelerator systems because of high magnetic field generation and easy cooling by using cryocooler. In accelerator systems, the time-dependent and precise magnetic fields are sometimes required. However, large magnetization in wide coated conductors deteriorates field qualities of magnets, and the temporal behavior of magnetization could be complicated. We have been developing a model for electromagnetic field analyses of a multilayered cosine-theta dipole magnet wound with coated conductors with iron yoke. In this model, the influence of iron yoke is considered as the image currents in the iron yoke. We conducted the electromagnetic field analyses using this model for a dipole magnet designed based on specifications for a rotating gantry of carbon cancer therapy and evaluated the time-dependent shielding-current-induced field (SCIF). The temporal profile of magnet current was determined referring to that of the magnets in a rotating gantry. Using the calculated field affected by SCIF, we redesigned the arrangement of the coated conductors in the magnet and adjusted the temporal profile of the magnet excitation in order to reduce the influence of SCIF on the field quality.
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