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Wed-Af-Or13-06: Comparison between measurements and calculations of shielding-current-induced field in a small dipole magnet wound with coated conductors

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Shielding-current-induced fields (SCIFs) in magnets wound with coated conductors are one of the most serious problems for application. SCIFs cause changing of magnitude of magnetic field, error field components, and drift of magnetic field during when transport current is constant. Especially, because magnets for accelerator systems are sometimes required to generate precise magnetic field with different load ratio during repeated ramping up and down, behavior of the SCIFs in the magnets is difficult to predict. Therefore, in order to understand behavior of SCIFs in magnets for accelerator systems, comparison between measurements of SCIFs with high precision and calculations of SCIFs by precise electromagnetic field analyses is quite important.
We conduct magnetic field measurements for a small dipole magnet wound with coated conductors. The magnet is composed of four racetrack coils. Number of turns, length of straight section, and inner radius of each racetrack coil are 110, 250 mm, and 48 mm, respectively. Typical operation temperature is 20 K, and designed magnetic flux density at the center of the magnet is about 500 mT with 200 A. We measure the field quality of the small dipole magnet by rotating pick-up coil method which is able to directly measure the multipole components of the magnetic field. Current profiles are decided based on typical operation pattern of magnets in the rotating gantry of HIMAC.
Also we conduct electromagnetic field analyses in order to calculate the SCIFs in various current profiles of the magnets. In the electromagnetic field analyses, the magnet is modelled considering its exact three-dimensional geometry. Because the magnet is composed of the four racetrack coils with different coated conductors, electric field E-current density J characteristics of the conductors are formulated based on short sample measurements of them and used in the simulations. We study how shielding currents distribute in the racetrack coils and how shielding-current-induced fields change with different load ratio of the magnet.

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