Tue-Mo-Po2.08-06[59] :Design and Test of an Octupole Scanning Magnet for Proton Therapy

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Most particle therapy scanning systems use two independent dipole magnets for spot scanning in two orthogonal transverse directions. However, the space occupied by those two dipole magnets located after the final gantry bending magnet is usually large, which leads to bulk size of gantry. In order to construct a compact nozzle and decrease the size of the gantry, a prototype octupole scanning magnet for the particle therapy has been developed.

The octupole scanning magnet, which is completely different from a “true” octupole magnet, can generate a dipole magnetic field at any direction when the four pairs (two opposing coils as a pair) of coils are loaded with sinusoidal currents with different phases. To change the phases will change the direction of the field, and thus dynamic dipole magnetic fields along the longitudinal direction can be established.

In this paper, the static and dynamic optimization of the octu-pole scanning magnet has been carried out. The shape of the poles, the diameter of the bore, and the shims on the pole edges are thus determined. The dependence of the good field region on the size of the bore is investigated, and the effect of eddy currents on magnetic field stability is carefully analyzed.

A 350 mm long laminated steel magnet with 104 mm bore is fabricated, with peak coil currents of 496 amps giving deflection up to 90 mrad in any deflection direction. Static magnetic field measurement are completed, and the results show good agreement with the simulations.

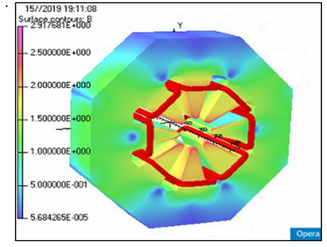


Fig.1 Bmod distribution in the magnet

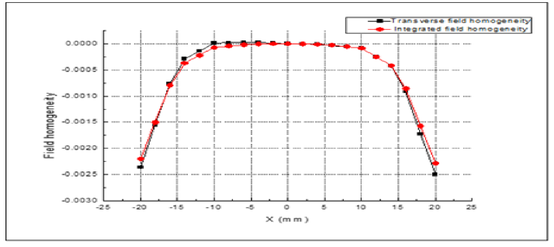
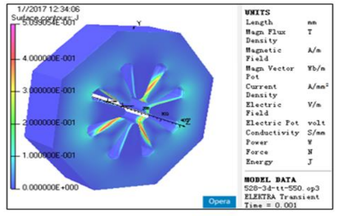
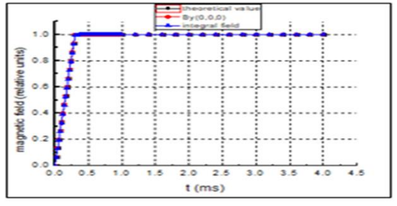


Fig.2 Homogeneity of field in the bore



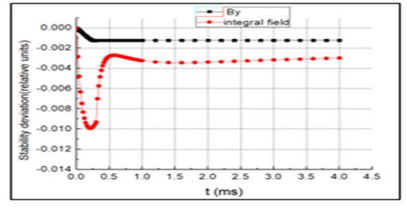
1ms时涡流分布云图 （场在 0.33ms 内旋转 2° ）

Fig.3 Eddy current distribution



场稳定性随时间分布

Fig. 4 Field stability and error caused by eddy currents



涡流引起的场偏差随时间分布

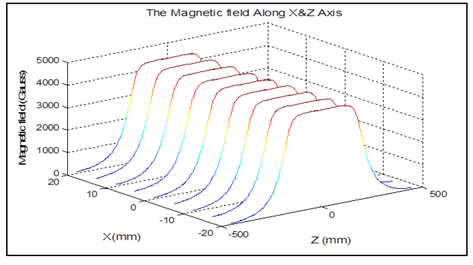


Fig.5 The distribution of measured field

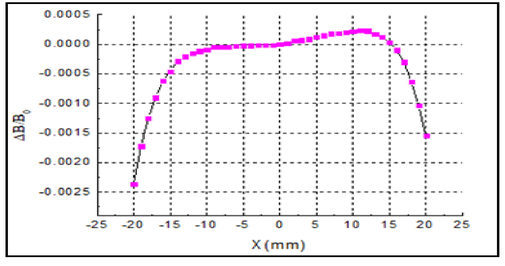


Fig.6 Transverse field homogeneity

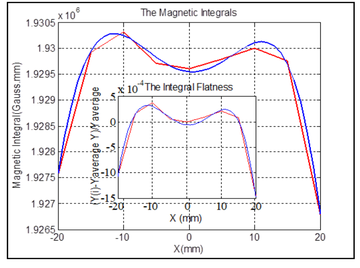


Fig.7 Field integral and homogeneity

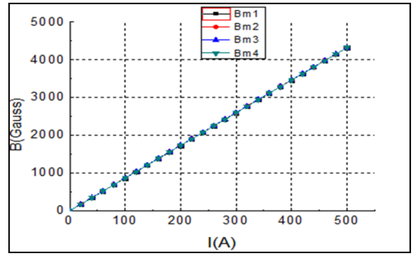


Fig.8 Magnetic field with excitation currents

Fig.9 Photo of the magnet

References

1 A Multipole Multipole Magnet for Pencil Beam Scanning, J. Gordon et al

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