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Design, Fabrication and Installation of the Steering Magnet with High Uniformity of Magnetic field for KOMAC Beamline.

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1. Introduction

The steering magnet is used in order of the alignment of the charged particle beam in the accelerator and to transport the beam precisely on the target at the beamline. The KOMAC (Korea Multi-Purpose Accelerator Complex) provides user and the proton beam at a 20-MeV and a 100-MeV beamline as it forms a proton beam transport [1]. The purpose of the steering magnet is to provide a beam to a target accurately and used for this reason. The most important factor of the steering magnet is integrated magnetic field. The beam is steered this factor. The following factors is magnetic field uniformity for steering evenly the whole of beam cross section. Also alignment of the device by this factor is relatively ease.

The field uniformity was under 2% at transverse section of a steering magnet as simulation condition. The kick angle was 4-mrad by characteristics of KOMAC beamline, and the integration field was calculated as 0.0050-Tm. The 2-demensional (2D) design was simulated by Poisson code, and the 3-dimensional (3D) was simulated by CST EM Studio. The steering magnet was installed in the beamline and bipolar DC power supply was consist of EPICS control by RS-232 communication.

2. Design and Set-up

2.1. Simulation and Fabrication

The 2D simulation was computed by Poisson code, and the steering magnet was designed with three ribs on yoke for improvement for uniformity of a magnetic field as shown in Fig. 1 [2, 3]. The uniformity of the magnetic field was below 0.15% with rib at transverse section of the beam direction.

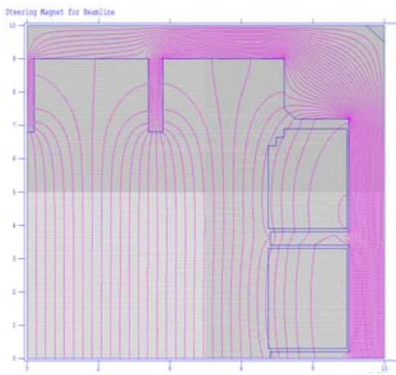

Fig. 1. 2D Poisson calculation for the steering magnet with 3-Ribs.

The 3D simulation was conducted by CST EM Studio as shown in Fig. 2. The integration magnetic field (*BL*) was 0.005356-Tm, and the center of magnetic field was 185.38-G. Table 1 shows the specification of steering magnet.

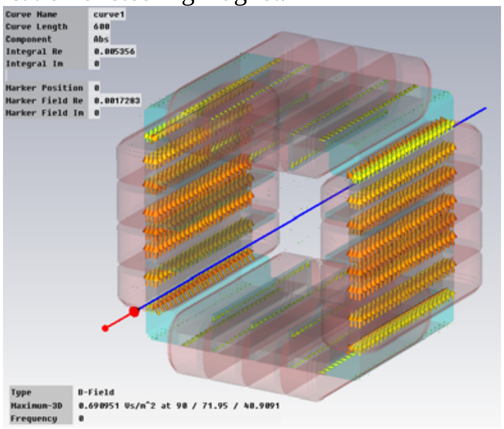

Fig. 2. Integration field of the steering magnet calculated by CST EM studio.

Table 1. Specification of Steering Magnet

Conductor Size	mm^2	2.5
No. of Turns	AT	868 / coil
Current	A	2.57
Weight	kg	< 60
Magnetic Field of Center	Gauss	185
Uniformity	%	< 2
Integration Field	Tm	0.0054
Cooling type		Air

2.2. Test

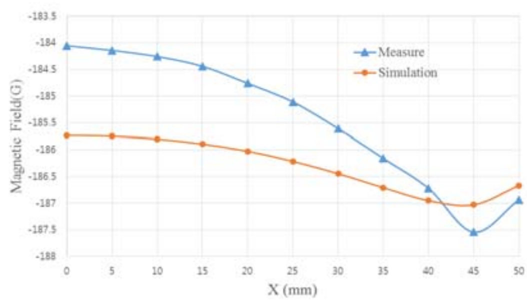

Fig. 3. Measurement of a magnetic field uniformity

Fig. 3 shows the magnetic field uniformity compare simulation and measure on x-axis. The field uniformity was under ±1.5 G with 1% error. Fig. 4 shows the integration field compare simulation and measure on z-axis.

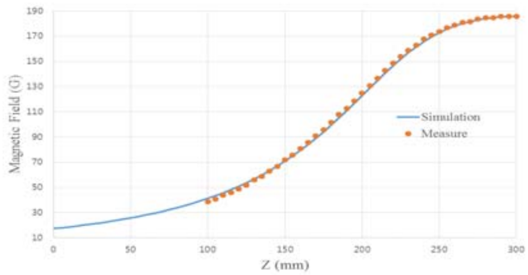

Fig. 4. Measurement of a integrated magnetic field

2.3. Installation

The steering magnets and the bipolar DC power supplies were installed at beamline and control rack as shown in Fig. 5. The bipolar DC power supply was controlled by using EPICS on RS-232 communication for remote system at control room. as shown in Fig. 6.

Fig. 5. Installation of steering magnet and power supply

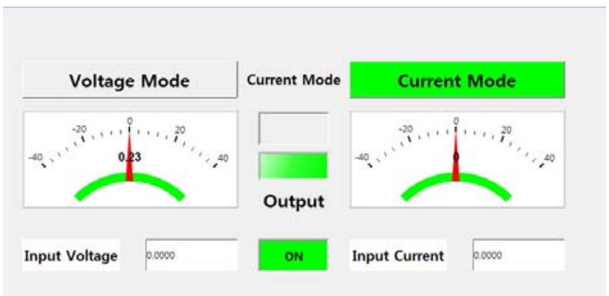

Fig. 6. The bipolar DC power supply consist of EPICS software

3. Conclusion

The steering magnet was designed, fabricated and installed to steer the 100-MeV proton beam. The uniformity of a magnetic field was tested below 1% by using three ribs at yoke, and 185-G at the center of the cross-section. The uniformity of the magnetic field for the steering magnet equipped with three ribs was better than that for the steering magnet without rib. Integrated magnetic field was measured 0.0053-Tm for the steered 4 mrad at 100-MeV proton beam. The steering magnet was installed at beamline and the power supply was controlled by EPICS for remote system. The steering magnets are expected to improve the beam performance of accurate delivery to the target.

ACKNOWLEDGEMENT

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