

Fig. 2 (color online) The left panel shows the new two prototype multipole of L800-I and L1200, and the right panel shows the training process of quadrupoles in L800-I and L1200.

7 - 6 Design of Leakage Field Shielding Structure of the Septum Magnet for HIAF

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Septum magnet is one of the key components of synchrotron injection and extraction system. Because the excitation current flows through the septum plate coil, the excitation current is subjected to a large electromagnetic force. At the same time, under the limitation of the septum plate size, the leakage field has an effect on the circulating beam near the septum plate^[1]. There are several septum magnets in the HIAF accelerator complex, so the shielding structure needs to be optimized and analyzed to further reduce the losses caused by magnetic leakage.

Based on the diversion plate type septum magnet at present, the leakage field is shielded by magnetic materials^[2]. End shielding plate is installed at both ends of the septum magnet to shield end leakage field, and septum shielding plate is installed at the septum plate position to reduce the influence of edge field on the circulating beam pipeline area. By optimizing and analyzing the shielding structure with different parameters, the shielding structure is proposed to effectively suppress the leakage field, as shown in Fig.1. At the same time, the problem of large leakage field at the corresponding position of the iron core end was solved by optimizing the coil model.

According to the final assembly, the height of the septum shielding plate is the same as that of the iron core, the length exceeds the core by 100 mm, and the thickness of the end shielding plate is 5 mm. It is compared with the leakage field distribution in the center of the circulating beam pipe without shielding, as shown in the Fig.2. As can be seen from the Fig.2, the shielding structure can effectively suppress the leakage field, especially in the part where the circulating beam is closest to the septum magnet. At present, the shielding structure has met the beam physics requirements, and the leakage field value is reduced from 0.549 to 0.036 T·mm, which is an order of magnitude smaller than that without shielding.

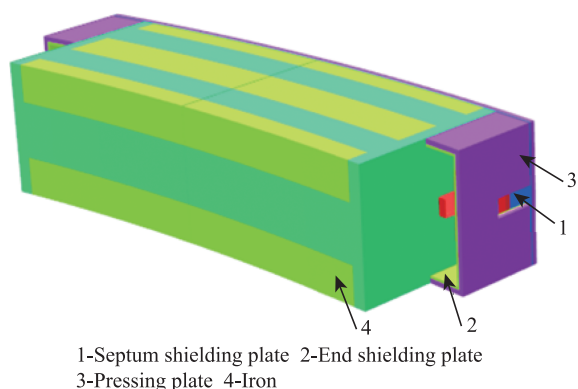


Fig. 1 (color online) The model of septum magnet with shielding.

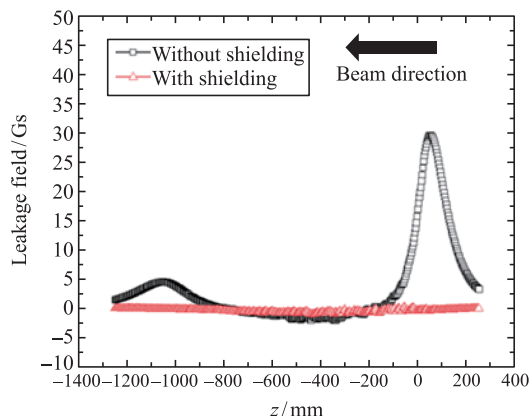


Fig. 2 (color online) Comparison of leakage field values with or without shielding.

References

- [1] M. Yoshimoto, Designs of Septum Magnet at 3 GeV RCS in J-PARC, (2006).
- [2] X. Zhang, S. Han, W. Yang, et al., High Power Laser and Particle Beams, (2015)27.

7 - 7 R&D Progress of HIAF-BRing Dipole Magnet Power Supply*

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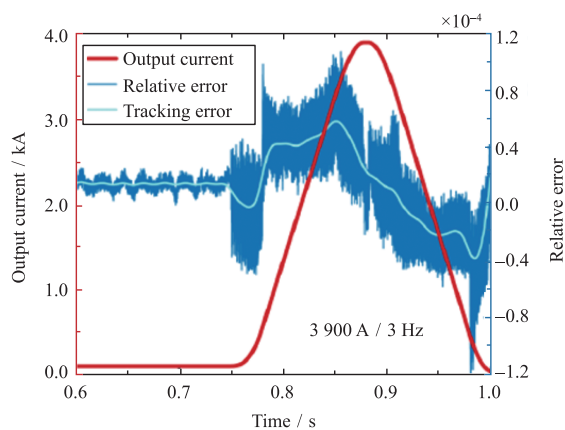


Fig. 1 (color online) The output result of BRing dipole power supply.

The Booster Ring (BRing) is the core of the acceleration unit to obtain high-current, high-energy and high-quality heavy ion beam in the High Intensity heavy ion Accelerator Facility (HIAF) [1]. To reduce the space charge effect and the dynamic vacuum effect, the fast-ramping rate of the dipole magnet power supply is up to 38 000 A/s, which poses great challenges to the power supply system. Therefore, variable forward excitation, full energy storage, and full switching technology are studied and used. In October 2022, this power supply prototype has been finished and completed the factory acceptance test. The production and tuning of the first whole set of the power supply system is currently underway. The onsite assembly and commissioning works are also in process. Figure 1 shows the one of acceptance test results of this power supply.

The output error can be $\pm 1.2 \times 10^{-4}$, which meets the design requirement. Figure 2 shows the physical image of the dipole power supply. They consist of multiple modules, including high-voltage sources and low-voltage sources, and some detail modules such as capacitor banks modules, AFE (Active Front End) modules, H bridge modules and so on.



Fig. 2 (color online) The image of one set of the dipole magnet power supply system.