§15. Design Study of the Superconducting Split Coil Based on the Cosθ Current Distribution

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The test facility of NIFS enables large superconductors to be tested under maximum magnetic field of 9 T generated by superconducting split coils. The distribution of the magnetic field is not uniform at mid-plane in the whole of the region where the superconductors are set. The coil configuration has an effect on the magnetic field distribution. In the case that the magnetic field strength is 9 T at the coil center, the field strength decreases 5 % at the position where it is 100 mm apart from the coil center as shown in Fig.1. Hence, the corrector coil is designed to realize a uniform magnetic field in the conductor test region by overlapping the magnetic field generated by the existing split coils.

In the design of the corrector coil, a $\cos\theta$ current distribution is used. The current distribution is utilized generally in the design of the coil cross-section for superconducting accelerator magnets. The configuration of the corrector coil is a split coil. The corrector coils are set between the existing coils as illustrated in Fig.2. In the design process of the corrector coil, first of all, the magnetic field generated by the existing split coil is evaluated in the conductor test region by using multi-pole expansion. Based on the evaluation of the magnetic field, the 3D configuration of the corrector coil is optimized so as to generate the uniform field at the test region with the existing magnetic field. Fig.1 shows the magnetic field distributions generated by the corrector coil and the existing split coil. By using the corrector coil, the magnetic field distribution can be uniform in the conductor test region.

In order to confirm the validity of the design method for the corrector coil taking into account $\cos\theta$ current distribution, a model coil was designed and manufactured experimentally. The parameter of the model coil is as follows: the number of the layer is 2, the coil winding is double pancake coil, the coil radius is 58 mm, the coil configuration is semi-sphere, and the number of the turn is 20 for one layer. Fig.3 shows the model coil of the corrector coil. In the process of the coil winding, first of all, a position of the conductor is ditched on the coil winding frame. After the process, the conductor is mounted in the ditch and is bonded. The manufacture of the model coil is completed as shown in Fig.3. The magnetic field measurement of the model coil will be conducted.

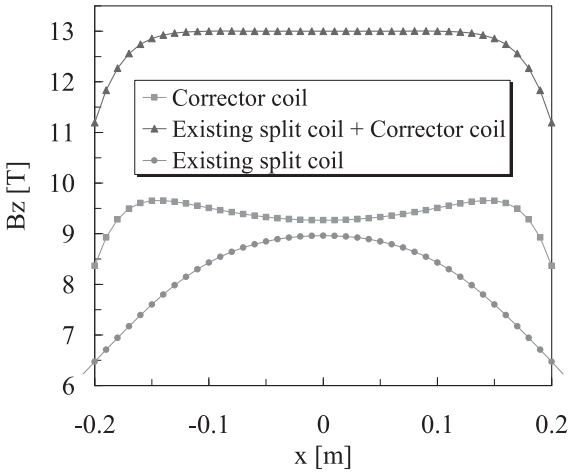

Fig. 1. Magnetic field distributions generated by the existing coil and corrector coil.

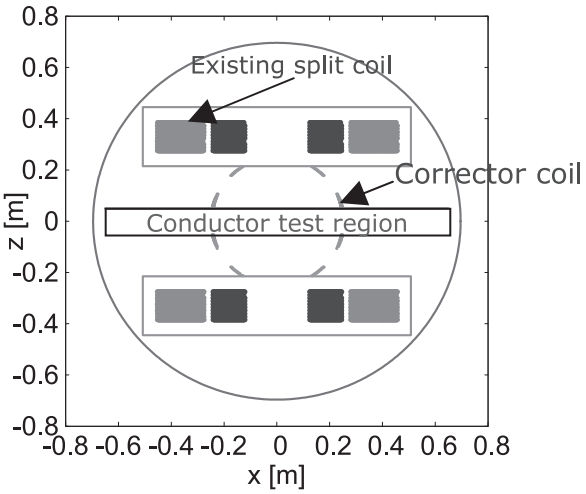

Fig. 2. Layout of the existing coil and the corrector coil in the cryostat.

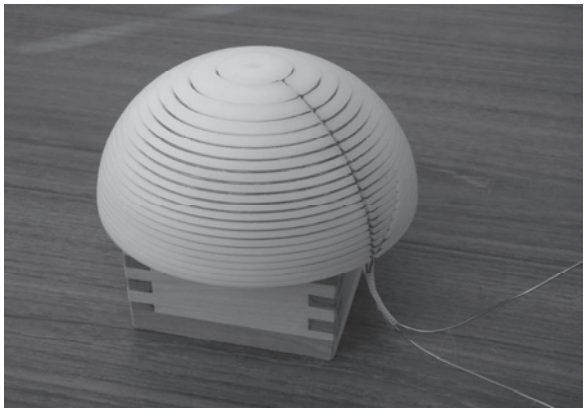

Fig. 3. Model coil of the corrector coil.