3. Design of superconducting coils

Coil design
The HTS coils were designed based on the required intensity, quality, and spatial size of the magnetic field.

- Dipole field \( |B| \approx 5.8\ T\)
- Quadrupole fields \( |B| \approx 15.5\ T/m\)
- Dipole magnetomotive force \( |B|=83\ kA\)
- Quadrupole magnetomotive force \( |B|=21\ kA\)
- Core iron thickness \( 400\ mm\)
- 4 blocks/pole with 50 turns/block
- Field quality within the reference radius of \( 20\ mm\ \times \ 2.75 \times 10^{-3}\)

4. Thermal runaway properties

It is difficult to use coolant for the magnets mounted on the rotating gantry because they are rotating. Therefore, conduction cooling should be employed. As a first step, the thermal stability of the conduction-cooled HTS coils under a static condition is considered.

Analysis model
- The coils were impregnated with an epoxy resin.
- Aluminum conduction plate with a thickness of 0.25 mm was fixed on the entire upper side of the coil.
- 1/4 cut model was used in the analysis.
- 49 mesh elements in the longitudinal direction.
- 5 mesh elements in the thickness direction.
- Temperature in the aluminum plate of coil end is constant.

5. Conclusion

- Thermal runaway analysis for the conduction-cooled HTS saddle-shaped was carried out.
- Thermal runaway currents are calculated, and the difference between the coil critical current and thermal runaway current was almost the same as 4.5-7.5%.
- It is considered that this result is due to the high n-value of the HTS conductor, and the high n-value causes the rapid heat generation.

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