Solenoid Magnet R&D Letter of Intent

The Circular Electron Position Collider (CEPC) detector magnet system is designed to provide an axial magnetic field over a tracking volume with 6.8 m in diameter and 8.05 m in length. Particle detectors within this volume will measure the trajectories of charged tracks emerging from the collisions. Based on studies of the CEPC compensating magnet, the technology development expected in coming years for the construction of compensation solenoids capable of providing cancelation of the central magnetic field and avoid beam disturbances, limits the superconducting solenoid central field to 3 T.

The detector magnet research contains all activities related to the design of field distribution, solenoid coil, specific superconductor, cryogenics, quench protection and power supply, and yoke. For the first time, we explored the possibility of using high temperature superconductor (HTS) to build the CEPC detector magnet. Benefitting from the development of HTS in recent years, the advantages of using YBCO winding is higher operating temperature and better stability to resist transient disturbances when operating the magnet. The baseline design iron yoke consists of barrel yoke and end yoke. It has three main functions: first is shielding the magnetic field; second is providing the install space for the muon detector which sandwiched between the iron plates; in addition, the yoke serves as the main mechanical structure of the CEPC detector. We are also studying the possibility of positioning the solenoid between the electromagnetic and hadronic calorimeters, for which we need to develop an ultra-thin superconducting magnet.

Questions

To maximize the performance of the superconducting solenoid magnet, optimizations of the magnet design, and a set of R&D tasks need to be studied. Some of the key challenges to be address in the near future are:

Ultra-thin, low radiation thickness cryostat development.

The low temperature superconductor (LTS) version:

1. Aluminum stabilized Rutherford cable development;
2. Large superconducting coil winding process study.

The high temperature superconductor (HTS) version:

1. Aluminum stabilized ReBCO stacked tape cable development;
2. Large HTS coil winding process study;
3. Winding process, No-insulation or insulation? Epoxy impregnating or not?
4. Quench detection and protection;
5. Current distribution in the cable;
6. Cooling methods research;
7. HTS cable joint;

Contacts

The contact people from the Solenoid magnet studies for CEPC to the Snowmass 2021 study groups are as follows:
Solenoid magnet: Feipeng Ning (IHEP, CAS), Zian Zhu (IHEP, CAS)

References

[1] The CEPC-SPPC Study Group, CEPC-SPPC Preliminary Conceptual Design Report, Volume II - Accelerator, 2015. http://cepc.ihep.ac.cn/preCDR/volume.html. IHEP-CEPC-DR-2015-01, IHEP-AC-2015-01. 1
[2] The CEPC Study Group, CEPC Conceptual Design Report, Volume I - Accelerator, arXiv:1809.00285 [physics.acc-ph]. 1
[3] The CEPC Study Group, CEPC Conceptual Design Report, Volume II - Physics and Detector, arXiv:1811.10545 [physics.hep-ex]. 1