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Development status of a NbTi conduction-cooled superconducting quadrupole magnet combined with dipole correctors for the ILC main linac

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In the International Linear Collider (ILC) main linac, superconducting quadrupole (SCQ) magnets combined with dipole correctors, together with superconducting radio frequency (SRF) cavities, will be used to transport and accelerate electron and positron beams to the collision point. The SRF cavity accelerates the beam up to 125 GeV per side, the SCQ focuses the beam, and the dipole collectors steer the beam and transport it along with the geoid.
SRF cavities need to be assembled in a clean room in order to minimize dust intrusion for keeping the best performance. On the other hand, SCQs are not recommended to be brought into the clean room because it is difficult to produce SCQs clean compared to SRF cavities. Therefore, the ILC-SCQ was designed to be split into two parts to allow assembly outside the clean room. In addition, it is cooled by thermal conduction from a liquid helium supply pipe not by liquid helium immersion, contributing to cryomodule simplification.
A 5-year plan to manufacture one ILC-type cryomodule began at KEK in 2023 with international collaboration.

A prototype SCQ is being manufactured in JFY2024, and a stand-alone performance evaluation test in a cryostat is scheduled to be conducted in JFY2025. For this purpose, a cryocooler-cooled cryostat has been designed and the fabrication is in progress. In the ILC, because of the high accelerating gradient of the SRF cavities and the high magnetic field gradient of the SCQs, it has been pointed out that field-emitted electrons, so called "dark current", from the cavity inner surface may cause SCQ's quench by absorbing their energy at superconducting coils. In this presentation, the status of SCQ fabrication, cryostat for stand-alone testing, and dark current countermeasures will be reported.

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