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Superconducting Detector Magnets for Particle Physics Experiments at the Future Circular Collider

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New general-purpose particle detectors are foreseen to probe electron-positron (ee), electron-hadron (eh) and hadron-hadron collisions (hh). A conceptual design report is due in 2019 for all FCC collider and detector options. Baseline designs for the various Detector magnets were developed.
For FCC-ee two detector magnet variants were defined, a 7.6 m bore and 7.9 m long classical 2 T solenoid of about 600 MJ surrounding the calorimeter, and a very challenging 4 m bore, 6 m long, ultra-thin and radiation transparent 2 T solenoid with 170 MJ stored energy surrounding the tracker only.
For FCC-eh the detector solenoid is combined with a dipole magnet required for guiding the electron beam in and out the collision point. This detector requires a 3.5 T solenoid, 2.6 m free bore and 9.2 m length with some 230 MJ stored energy.
Most demanding, however, is FCC-hh's detector with a 14 GJ stored energy magnet system comprising three series connected solenoids, requiring 4 T in the main Solenoid with 10 m free bore and length of 20 m, in line with two 3.2 T forward solenoids with 5.1 m free bore and 4 m length.
We see a challenging landscape of detector magnets that need to be further engineered in the years to come. The superconductor technology though is essentially the same in all solenoids, to use Ni doped and structurally reinforced pure Al stabilized NbTi/Cu strands based Rutherford cables, conduction cooled in solenoid windings almost entirely comprising high yield strength Al alloy. The design of the various baseline magnets is presented as well as their engineering challenges.

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