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Mon-Af-Or5-01: Magnet Designs for the Future Circular Collider ee, eh and hh Detectors

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A design study started in 2014 at CERN for a Future Circular Collider. A new 100 km ring-tunnel for the collider magnets is foreseen as well as new particle detectors 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 detectors two variants were defined: (1) a 7.6 m bore and 7.9 m long classical 2 T / 600 MJ superconducting solenoid surrounding the calorimeter; and (2) a very challenging 4 m bore, 6 m long, ultra-thin and radiation transparent 2 T / 170 MJ superconducting solenoid surrounding the tracker only.
In the case of the FCC-eh, the detector solenoid is combined with a dipole magnet for guiding the electron beam in and out the collision point. This detector comprises a 3.5 T / 230 MJ, 2.6 m free bore and 9.2 m long superconducting solenoid.
Demanding is the FCC-hh detector featuring a 14 GJ magnet system of three series connected solenoids, comprising a 4 T superconducting main solenoid with 10 m free bore, 20 m long, in line with two 3.2 T superconducting forward solenoids with 5.1 m free bore, 4 m long.
A quite challenging family of detector magnets has been proposed that need further engineering in the years to come. However, the conductor technology is essentially the same in all solenoids, using Ni doped and structurally reinforced pure Al stabilized NbTi/Cu strands based Rutherford cables, conduction cooled solenoid windings, almost entirely comprising high yield strength Al alloy. A survey of the various magnets is presented and the engineering challenges highlighted, in particular focusing on superconductor requirements and structural aspects.

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