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# Tue-Mo-Po2.03-04 [11]: Conductor development and Cold mass design for an ultra-thin 2T, 4m bore, 6m long detector solenoid for the FCC-ee IDEA detector

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The proposed IDEA Experiment (International Detector for Electron-positron Accelerator) for probing ee+ collisions at the Future Circular Collider FCC is conceptualised around an ultra-thin, radiation transparent 150 MJ superconducting solenoid of 6 m length and 4 m free bore providing a magnetic field of 2 T for the inner tracking detector. Positioning the solenoid around the inner detector, thus inside the calorimeters requires the cold mass and cryostat to be ultra-radiation transparent (< 1 radiation length) to not hinder too much through particle scattering the signal in the calorimeters.
The magnetic pressure of 16 bar and the thin wall cold mass impose high mechanical requirements on the conductor like some 230 MPa yield strength. A new high-yield strength aluminium stabilized NbTi/Cu Rutherford cable has been developed comprising 0.1% w.t. Nickel doped, precipitation hardened high purity Aluminium for thermal stability, and 7068-T6511 Aluminium alloy as mechanical reinforcement. To achieve intermetallic bonding between stabilizer and reinforcement constituents, electron beam welding, friction stir welding, and cold welding based on the so called FORTE process have been investigated. They are compared for bonding strength, lifetime, scalability and cost.
Besides the conductor, the mechanical and thermal designs of the cold mass comprising the conductor windings are presented. A conduction based cold mass cooling system using high-purity Aluminium heat drain strips thermally connecting the windings to the cold mass liquid helium cooling tubes is proposed. The thermal considerations include the cool down process, energizing the solenoid and stationary operation, as well as multiple quench scenarios. Given the stored energy the light solenoid mass may require maximum energy extraction and use of quench heaters to warrant safe operation.
The conductor, cold mass and quench protection developments highlighted above are presented and detailed in the paper.

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