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Magnet systems

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As part of the conceptual design of the Future Circular Collider for hadron-hadron collisions (FCC-hh), new detector magnet designs are required. Due to the need to provide a magnetic field of 5-6 T over a very large volume, these detector magnets have stored magnetic energies as high as 50 GJ. The two main designs currently under consideration are the 'Minimum Yoke Solenoid'and the 'Twin Solenoid'designs.

Key questions in the design of these magnets are which materials should be used and how this impacts the mechanical and thermal behavior of the magnet. In this investigation the feasibility of using copper, a combination of copper and stainless steel, and aluminum are evaluated. These material options are compared to see how a given choice in materials, weight and volume affects the stress and strain in the coils. Subsequently, the implications for quench protection are given in terms of hot-spot temperature and energy extraction under regular and fault conditions.

Given the very large size and weight of the detector magnets needed to meet the needs of the Future Circular Collider, a detailed stocktaking of the mechanical and thermal properties resulting from material choices is an important step towards finding a suitable design.

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