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Towards 20 T hybrid accelerator dipole magnets

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The most effective way to achieve very high collision energies in a circular particle accelerator is to maximize the field strength of the main bending dipoles. In dipole magnets using Nb-Ti superconductor the practical field limit is considered to be 9-10 T. When Nb3Sn superconducting material is utilized, a field level of 15-16 T can be achieved. To further push the magnetic field beyond the Nb3Sn limits, High Temperature Superconductors (HTS) need to be included in the magnet design. The most promising HTS materials for particle accelerator magnets are Bi2212 and REBCO. However, their outstanding performance comes with a significantly higher cost. Therefore, an economically viable option towards 20 T dipole magnets could consist in an "hybrid"solution, were both HTS and Nb3Sn materials are used. We present in this paper a preliminary conceptual design of different 20 T hybrid magnet concepts. After the definition of the overall criteria and specifications, the general coil dimensions and parameters are investigated with analytical models based on simple sector coils. Preliminary 2D cross-section computation results are then presented and three main lay-outs compared: cos-theta, block and common-coil. Both traditional designs and more advanced stress-management options are considered. Finally, quench protections and mechanical issues will be addressed.

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