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Design Studies of High-Field Nb₃Sn Dipoles for a post-LHC pp Collider

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Cost-effective superconducting dipole magnets with operating fields up to 16 T are being considered for the LHC energy upgrade (HE-LHC) or a Future Circular Collider (FCC). To demonstrate feasibility of 15 T accelerator quality dipole magnets, Fermilab as a part of US-MDP has started the development of a single-aperture Nb₃Sn dipole demonstrator based on a 4-layer graded cos-theta coil with 60 mm aperture and cold iron yoke. In parallel, to explore the limit of the Nb₃Sn accelerator magnet technology, optimize magnet design and performance parameters, and reduce magnet cost, magnet design studies are also being performed based on 3- and 4-layer 50 mm aperture cos-theta coils with and without stress management elements. Results of these studies are reported and discussed in this paper.

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Primary authors: ZLOBIN, Alexander (Fermilab); Dr KASHIKHIN, Vadim (Fermilab); NOVITSKI, Igor (FERMILAB)

Presenter: ZLOBIN, Alexander (Fermilab)

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