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Strand and Cable Development for 16 T Magnets for FCC

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A 100 TeV center of mass energy machine in a 100 km tunnel requires dipoles with a nominal operation field of 15-16 T and appropriate operation margins, which can presently be obtained only with the Nb3Sn technology. A practical demonstration of this field in accelerator-quality magnets and reduction of magnet costs are key conditions for the realization of such a machine. A decade-long investment in the Nb3Sn technology produced at FNAL the first series of 10 to 12 T accelerator-quality dipoles and quadrupoles, as well as their scale-up. Such advanced technology can now be pushed up to its limits by improving Nb3Sn strands and cables, and developing innovative design approaches. For cost-effective 15 T accelerator magnets, the critical current density Jc(15T,4.2K) of commercial Nb3Sn composite wires has to be pushed to ˜2000 A/mm2. In addition, wider cables are required to reduce the number of coil layers and decrease the number of turns. FNAL has started the development of a 15-16 T Nb3Sn dipole demonstrator for a 100 TeV scale HC based on the optimized "cos-theta"coil. A 4-layer graded coil design is foreseen to achieve the necessary coil width. The cable in the two innermost layers has 28 strands 1.0 mm in diameter and the cable in the two outermost layers has 40 strands 0.7 mm in diameter, same nominal width of 14.7 mm and keystone angle of 0.79 degree, and both use state-of-the-art RRP® wires. This presentation summarizes the results obtained in the strand and cable studies, and shows how an innovative Nb3Sn thin film technique under US patent application could help to test flux pinning properties of additional elements in Nb3Sn inexpensively and with fast turnaround before implementation in actual billets.

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