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Thu-Mo-Or16-06: Prediction of the Reversible Critical Current Degradation in Nb3Sn Superconducting Accelerator Magnets

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The design of Nb₃Sn superconducting magnets for particle accelerators requires the evaluation of the loads applied to the conductor. It was in fact clearly shown by numerous experiments that the loads applied to Nb₃Sn conducting elements can reduce their critical current, potentially compromising the magnet performances. This reduction can be reversible or not. Experiments, performed on uniaxially loaded strands, allowed to define clear laws to describe the evolution of the critical surface as a function of the applied current, field, temperature and strain. Among these laws, it was shown that the exponential scaling laws can be used to match the available data in the reversible region on both strands and Rutherford cables subject to transverse pressure. In this paper we explore the potential application of this law to superconducting magnets. The methodology was verified against the available test data on cables and strands. Furthermore, it was applied on the MQXF magnet, a quadrupole developed for the High Luminosity LHC project. The maximum critical current reachable as a function of the applied prestress was studied and compared with the results available from tested magnets.

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