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Finite Element Analysis of Transverse Compressive Loads on Superconducting Nb3Sn Wires Containing Voids LUC D'HAUTHUILLE, Univ of California-Santa Cruz, YUHU ZHAI, Princeton Plasma Physics Lab, PRINCETON PLASMA PHYSICS LAB COLLABORATION, UNIVERSITY OF GENEVA COLLABORATION — High field superconductors play an important role in many large-scale physics experiments, particularly particle colliders and fusion devices such as the LHC and ITER. The two most common superconductors used are NbTi and Nb3Sn. Nb3Sn wires are favored because of their significantly higher Jc, allowing them to produce much higher magnetic fields. The main disadvantage is that the superconducting performance of Nb3Sn is highly strain-sensitive and it is very brittle. The strain-sensitivity is strongly influenced by two factors: plasticity and cracked filaments. Cracks are induced by large stress concentrators due to the presence of voids. We will attempt to understand the correlation between Nb3Sn's irreversible strain limit and the void-induced stress concentrations around the voids. We will develop accurate 2D and 3D finite element models containing detailed filaments and possible distributions of voids in a bronze-route Nb3Sn wire. We will apply a compressive transverse load for the various cases to simulate the stress response of a Nb3Sn wire from the Lorentz force. Doing this will further improve our understanding of the effect voids have on the wire's mechanical properties, and thus, the connection between the shape & distribution of voids and performance degradation.

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