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Nb3Sn SRF cavities: from R&D to real accelerator – overview of recent developments

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The superior superconducting properties of Nb3Sn promise enhanced RF performance (Q and E_{acc}) compared to Nb at any given temperature. The potential deployment of Nb3Sn-coated superconducting radiofrequency (SRF) cavities at 4 K, achieving performance comparable to Nb cavities at 2 K, signifies a transformative technology poised to enable innovative classes of SRF accelerators and improve the efficiency and cost-effectiveness of future accelerators. State-of-the-art Nb3Sn-coated single-cell Nb cavities have achieved accelerating gradients of ~ 20 MV/m with quality factors of $\sim 1E10$ at 4 K. Comparable performance has been demonstrated in cavities of different frequencies and multi-cell accelerator cavities currently in use. With these achievements, several ongoing projects are adopting Nb3Sn cavity technology to develop practical particle accelerators for industrial, environmental, and nuclear physics applications. This presentation provides an overview of recent developments in Nb3Sn cavity technology, transitioning from research and development to real-world accelerators while discussing the current challenges in the field.

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