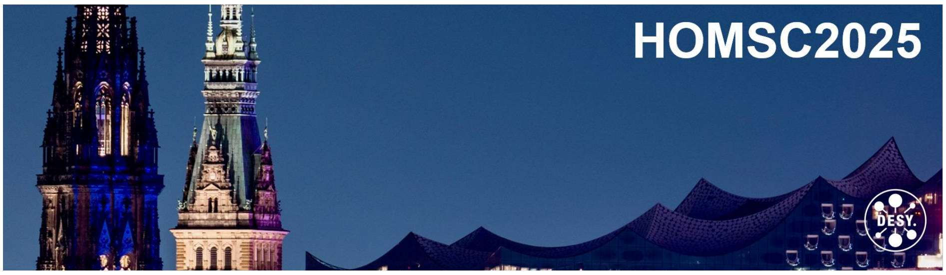

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Higher Order Mode Damping Assessment for Conduction-Cooled 915 MHz SRF Cavities in High-Power Industrial Electron Beam Accelerators

Monday 6 October 2025 16:30 (30 minutes)

The development of compact, high-current superconducting electron linacs for industrial applications requires balancing system simplicity, thermal management, and beam stability. In this work, we investigate the higher order mode (HOM) characteristics and damping requirements for 915 MHz superconducting accelerating structures specifically designed for conduction-cooled operation. Two cavity configurations are studied: a 2-cell cavity intended for a 5 mA, 4 MeV beam delivering 20 kW of power, and a 5-cell cavity designed for a 100 mA, 10 MeV beam with a beam power of 1 MW. Electromagnetic eigenmode simulations are performed to characterize the HOM spectra, focusing on monopole and dipole modes relevant to beam-induced instabilities. Beam breakup (BBU) analyses evaluate the threshold currents for instability under scenarios with no dedicated in-cell HOM couplers. The feasibility of relying solely on external beam line absorbers (BLAs) to extract HOM power is assessed. The results show that, given the beam quality requirements of industrial irradiation processes, sufficient beam stability can be maintained without active in-cell HOM damping. This finding opens the possibility for simplified cavity designs optimized for conduction cooling and easier manufacturability, informing future design strategies for high-efficiency, high-power industrial SRF accelerators.

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