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Review of Higher Order Modes Effects in the LCLS-II Superconducting Linac

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Suppression of the higher order modes (HOMs) is one of the most critical issues in an accelerator dealing with the intense bunches and the high beam repletion rate. In a superconducting (SC) machine like the LCLS-II, intense short bunches passing through SC cavities (1.3 GHz and 3.9 GHz 9-cell), interconnecting cavity bellows and beam pipe transition at intermediate warm sections excites the broad-spectrum of the HOMs that extends up to terahertz. These high frequency modes (above cut-off) cannot be extracted by HOMs coupler effectively and therefore, they deposit a significant portion of their power at 2K after several reflections. This additional power deposited by HOMs not only increases operating cost of the SC machine but also enhances potential risk of cooper pair breaking due to excessive power dissipation at surface of the SC cavity that might eventually lead to a quench. In this paper we review HOMs effects in electron machine in framework of the LCLS-II SC linac. A study is performed to analyze power losses due to transient modes, probability of resonance excitation of HOMs and emittance dilution due to HOMs cumulative effects. Damping requirements of HOMs are outlined and an assessment for need of the beamline absorber is also discussed.

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