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Theory of Longitudinal Beam Halo in RF Linacs: 1. Effects of Transverse/Longitudinal Coupling JOHN J. BARNARD, STEVEN M. LUND, *Lawrence Livermore National Laboratory*[1] — Ion linacs with high average current are being considered for applications such as the production of tritium and the transmutation of radioactive wastes. Because beam particle losses can be problematic in these applications, the structure and control of the so-called halo components of the particle distribution surrounding the beam core is a critical issue. Recently, the understanding of transverse beam halo has been advanced through analytic theory and numerical simulations. Here, we present theoretical and numerical work on longitudinal beam halo. A core/test particle model with uniform transverse focusing and coupled transverse/longitudinal oscillations is employed to calculate trajectories of test particles in the presence of longitudinal focusing fields from the rf bucket and space charge defocusing fields under the assumption of uniformly distributed charge within an azimuthally symmetric ellipsoidal beam envelope. The ellipsoidal beam envelope undergoes coupled longitudinal-transverse mismatch oscillations. These envelope eigenmodes are calculated and the resonant particle response to these oscillations is characterized. The dependence of the halo structure on parameters such as envelope mismatch amplitude, beam current, particle energy, and particle transverse betatron amplitude are presented.

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