BEAM HALO FORMATION AND BEAM LOSS INDUCED BY IMAGE-CHARGE EFFECTS IN A SMALL-APERTURE ALTERNATING-GRADIENT FOCUSING SYSTEM*

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The image-charge effects on an intense charged-particle beam propagating through an alternating-gradient focusing channel with a small aperture, circular, perfectly conducting pipe are studied using a test-particle model. For a well-matched elliptical beam with the Kapchinskij-Vladimirskij (KV) distribution, it is found that halo formation and beam loss is induced by nonlinear fields due to image charges on the wall. The halo formation and chaotic particle motion dependent sensitively on the system parameters: filling factor of the quadrupole focusing field, vacuum phase advance, beam perveance, and the ratio of the beam size to the aperture. Furthermore, the percentage of beam loss to the conductor wall is calculated as a function of propagating distance and aperture. The theoretical results are compared with PIC code simulation results.

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