

Physics and Applications of High Brightness Beams



Contribution ID: 50

Type: Poster

An Analytical Study of Space Charge Fields in the Emittance Compensation Process

Space charge forces are a major contributing factor that adversely affect beam quality in an RF-injector. The laser distribution sent to the photocathode plays a crucial role in the emittance compensation process, as evidenced by slice analysis. To derive self-induced force expressions for bunches with arbitrary charge distributions, a new model of space charge forces has been proposed. The model's efficacy is being analyzed in the low-charge regime by studying the fields' performance near the cathode. The model has been benchmarked against previously studied distributions and new ones. It has also been employed to optimize a C-band hybrid photoinjector, currently being commissioned, resulting in a factor of two reduction in emittance observed at the exit of the gun by changing the initial distribution at the cathode.

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Session Classification: Poster