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Intrabeam Scattering Effects in High-Brightness Photoinjectors

The present study examines an approach for calculating intrabeam scattering (IBS) effects in a high-brightness electron beams, based on a thermodynamic model that considers slice-to-slice temperature variations within the bunch. Despite advances in computing, the estimation of granular space-charge effects in photoinjectors remains largely intractible for non-trivial bunch charges without significant computational resources. In this work, we approach the problem probabilistically to circumvent these restrictions and calculate the effects of IBS during the emittance compensation and acceleration processes in an ultra-high brightness FEL injector design, and compare our results to those computed from first principles in the General Particle Tracer (GPT) code. The study is motivated by the desire to evaluate the impact on efficacy of FEL lasing and transport stability: in particular, the so-called microbunching instability (MBI). The development of design tools that carry out such calculations efficiently is of increasing relevance to accelerator physicists as technology allows for unprecedented beam brightness.

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