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(A Preliminary Study)

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Abstract

Numerical experiments based on adequate, self-consistent physical models implemented in simulation codes are widely used for computer-aided design (CAD), analysis and optimization of the electron optical systems (EOS) of the gyrotrons. An essential part of the physical model is the emission model, i.e., the relations that govern the value of the beam current extracted from the emitter as well as its energy spectrum, spatial and angular distribution. In this paper, we present a compendium of the basic theory, the most essential formulas and discuss the most important factors responsible for the nonuniformity of the emission and velocity spread. We also review the emission models realized in various ray-tracing and Particle-In-Cell (PIC) codes and present a general formulation of a 3D emission model based on the principle of decomposition of the region near the cathode to a set of equivalent diodes. It is believed that the information summarized in this compendium will be helpful for the development of novel modules for calculation of the initial distribution in both the available 2D computer programs that are being upgraded now and in the novel 3D simulation tools development of which is in progress now.