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Broadband electron gun design for a 5T solenoid EBIS for cancer therapy accelerators

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We present an adaptation of the broadband electron gun concept [1] for use within a 5 T solenoid, optimised for an Electron Beam Ion Source (EBIS) designed for medical accelerators in cancer therapy. Building upon previous developments utilizing non-adiabatic magnetic field shaping with coils and iron rings, this approach provides a laminar electron beam across a wide range of current densities by reduction of the amplitude of the cyclotron motion [2]. We explore the impact of the axial position of the cathode on beam quality, identifying optimal configurations for minimizing electron beam angles in the operational range 0-3 A. The system is further optimized for a target working point of 2 A and 1000 A/cm² current density. A schematic overview of the cryogenic 5 T EBIS layout is also showcased. This work contributes to the development of high-performance, tuneable EBIS sources for the next-generation of cancer therapy accelerators.

[1] High perveance electron gun with controllable current density. A. Pikin et al. (2025)
[2] Effect of a nonadiabatic magnetic field on the amplitude of cyclotron motion. J. Etxebarria et al. (2025)

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