

AbstractID: 13993 Title: A Study of the Effect of Inline and Perpendicular Magnetic Fields on Beam Characteristics of Medical Linear Accelerator Electron Guns

Purpose: Integrated MRI-linacs have the potential for real-time volumetric imaging and targeting. Both inline (main MRI field parallel to linac beam) and perpendicular (main field orthogonal to linac beam) configurations are considered. The MRI fringe fields affect beam generation and transport, particularly the electron gun, where the electron energy is the lowest and thus magnetic fields have the largest effect. This work characterizes the electron gun behavior in external magnetic fields for inline and perpendicular configurations.

Methods: Two electron guns were studied, the Litton L2087 and Varian VTC6364. Based on fringe field measurements of a 0.5T open bore MRI scanner (GE Signa SP), field strengths of 0-0.16T were computed with the finite elements method. Space charge beam simulations were performed for both inline and perpendicular configurations. Emitted current and beam deflection were determined.

Results: For the inline configuration, the electron beam remains aligned with the gun axis. As the field strength increases, the emitted current has an initial plateau of constant value after which its value decreases to a minimum near 0.06T. The minimum of the emitted current is 26% and 21% from the zero field value for Litton and Varian guns respectively. Above 0.06T, the emitted current increases monotonically. For the perpendicular configuration, the electron beam is deflected from the gun axis even at small field strengths. The beam deflection increases with the magnetic field value, leading to a sharp decrease of the emitted current which completely vanishes at about 0.007T for Litton and 0.006T for Varian.

Conclusion: For the inline configuration, there is always emitted current along the gun axis thus leading to the possibility to adapt the gun geometry for optimal beam generation compatible with the inline configuration. For the perpendicular configuration, magnetic shielding of the electron gun is required to avoid beam bending.

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