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A HIGH CURRENT ELECTRON GUN FOR THE IEAv LINAC

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This work presents the design, construction and chacterization of a new electron gun for the linear electron accelerator (linac) which is under construction at the Instituto de Estudos Avançados (IEAv).

Technological applications of radiations and some type of nuclear physics experiments are the intended uses for the IEAv linac. Therefore, to meet the requirements of such applications, the electron gun has as design goal a pulsed beam with peak currents of 10 A (□50 ns pulse width) or 1 A (□1 μs pulse width). The maximum short pulse repetition rate is 400 pps.

This gun (a planar cathode, Pierce-type geometry design) was the result of the optimization of an old prototype developed to test the ceramic-to-metal sealing process that was implemented at the IEAv.

The new gun was designed with the help of the W. Herrmannsfeldt code EGN87c that was developed to run in PC microcomputers [1]. Thus, by means of the computer simulations, it was possible to obtain a new configuration for the electrodes, the control grid, and the support assembly [2]. Also, by improving the gun design, it was possible to correct the heat dissipation problems of the old gun. The auxiliary systems (vacuum and pulsing electronics) were also modified to improve the performance of the gun system (namely, the stability and reproductibility of beam parameters).

As an important part of the development of the gun, an intense effort was dedicated to produce and evaluate the emissive pastes (a composition of rare-earth elements such as Ba, Sr and Ca) for the oxide-cathode. A "cathode testing chamber" was constructed to measure the emissivity of the pastes. Based on these measurements, it was possible to optimize the cathode painting process, and thereby, to obtain a good reproductibility of the emissive layer deposits [3].

After the assembly of the gun system, several measurements were performed to characterize the beam parameters to obtain an optimum operating point (the quiescent point). The beam current was measured with both an electron collector device (a Faraday cup) and a ferrite transformer. The gun emission characteristic curve (Fig. 1) shows the measured pulsed peak current as a function of the heater current for an accelerating potential of 90 kV. The flat portion of this curve shows a saturation of the anode current; this is the desirable operating region of the gun because small variations of the heater current will not cause significant changes of the gun emission current.

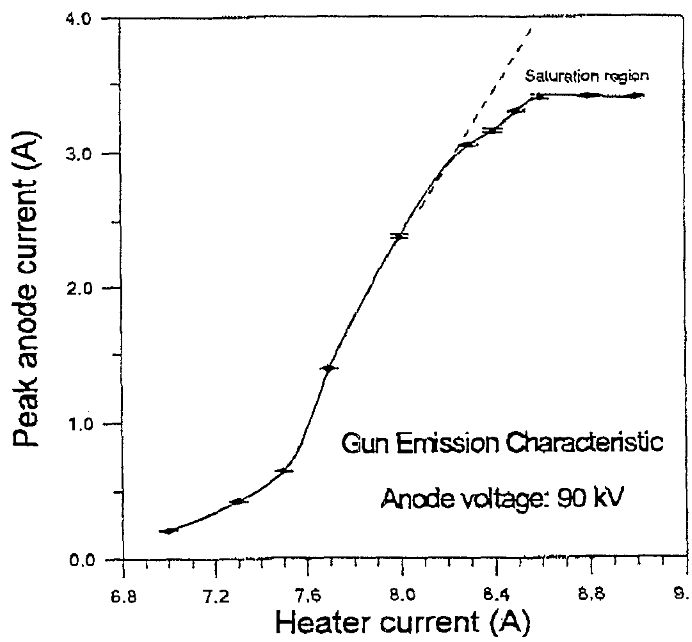

FIG. 1 – Gun emission characteristic curve as a function of the heater current. The flat portion is the best operating region.

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