

HIGH AVERAGE CURRENT INJECTORS FOR FREE ELECTRON LASERS*

P. Sprangle, J. Peñano, S. Gold,
D. Gordon and A. Ting
Plasma Physics Division, Naval Research Laboratory
Washington DC 20375

B. Hafizi
Icarus Research, Inc., Bethesda, MD 20824

C. Mitchell
National Research Council Fellow

High average power FELs require high average current electron injectors capable of generating high quality electron bunches with a short bunch duration and a repetition rate equal to the frequency of the rf linac. In this talk the use of rf-gated gridded thermionic electron guns is proposed as a solution for high average power operation¹. In the proposed configuration, the rf-gated grid employs a superposition of the fundamental and 3rd harmonic of the rf linac frequency, e.g., 700 MHz and 2.1 GHz. The cathode-grid gap can support a wide frequency band including both the fundamental and 3rd harmonic of the linac frequency. The addition of the 3rd harmonic is shown to provide shorter bunches and improve the bunch current structure. In addition, the electron bunches, upon exiting the rf-gated gun, are accelerated and further bunched in cavities operating at both the fundamental and 3rd harmonic of the rf linac. The use of the 3rd harmonic in the accelerating/bunching cavities improves the degree and quality of longitudinal bunching. In the proposed configuration, every rf bucket of the linac field is filled with an electron bunch. Simulations of the bunch dynamics, which are fully electromagnetic and include self-field effects, indicate that this approach can provide the appropriate injector beam, i.e., charge per bunch, bunch duration, longitudinal emittance, transverse emittance, bunch radius and repetition rate, for high average power FELs operating in the IR regime.

1. "High Average Current Injectors for High-Power FELs", NRL Memo. Report (2009), NRL/MR/6790—09-9230.

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