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Study on Thermionic RF Electron Gun Properties after the Resonant Frequency Retuning

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Relativistic femtosecond electron bunches can be produced from the electron linear accelerator (linac) system at the Plasma and Beam Physics (PBP) Research Facility, Chiang Mai University (CMU). A thermionic radio-frequency (RF) electron gun is used as an electron source for this accelerator system. The RF gun has a 1.6-cell S-band standing-wave structure, which has two main resonant cavities called half-cell and full-cell. The 2856 MHz RF wave is transmitted from the klystron to the full-cell through a rectangular waveguide input-port and is coupled to the half-cell via a side-coupling cavity. So far, two RF guns have been used at the PBP-CMU Electron Linac Laboratory. The first gun was designed and constructed mostly in-house. The commissioning and operation of the gun were done with reliable performance. The second one was constructed at the National Synchrotron Radiation Research Center (NSRRC), Taiwan, R.O.C. The gun was transported from NSRRC to our laboratory and was tested after the cavity re-tuning process. The low-level and high-level RF measurements were conducted. This RF gun has a resonant frequency of 2855.68 MHz at 26.2^{o}C with a quality factor of 12264. The high-power RF measurements showed that an optimal operating temperature of the gun was 34^{o}C with an RF coupling coefficient of 4.57. The electromagnetic field distribution inside the gun was simulated by using the 3D-model created with the program CST Microwave Studio 2012$^{@}$. Study of electron beam dynamics in the gun using program PARMELA was done to estimate the beam properties at the gun exit. Moreover, measurements of electron beam properties were performed to investigate the performance of this RF gun. The results showed that at optimal conditions the gun could produce the beam of about 2 μs (FWHM) pulse width with a maximum kinetic energy of around 2.8 MeV and a macropulse charge of 850.1±34.7 nC. Results from both beam dynamic simulations and measurements are presented and discussed in this paper.

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