

Phase and Amplitude Calibration of the Sub-harmonic Buncher for the High Energy Photon Source Linac

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The High Energy Photon Source (HEPS) Linac is a normal conducting electron linear accelerator capable of producing high bunch charge beam. Its bunching system includes two Sub-harmonic buncher (SHB), one pre-buncher, one buncher, and one accelerating structure. To achieve high bunch charge beam, it is often necessary for the electron gun to operate with high current and long pulse, which implies strong bunch length compression and significant space charge effects.

The SHB is commonly used in the low-energy section for longitudinal bunching to increase the bunch charge. The phase and amplitude of the SHB is crucial for achieving high-quality electron beam in Linac. This paper presents a method for calibrating the phase and amplitude of the SHB using the time-of-flight technique, and experiments were conducted based in the HEPS Linac and employing two Beam Position Monitors (BPMs).

According to the simulations, we found that bunch length and space charge effect have a significant impact on the results, and we propose corrective measures to address them. In beam experiments, the method for BPM signal is crucial. To enhance experimental efficiency, we propose a data processing method called the truncated averaging technique that eliminates the need for corrective measures, which has been validated through both simulations and experiments, yielding outstanding results.

This paper presents detailed insights into both the simulation and experimental procedures.

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