What We Learned From Operating Electron Accelerators with Variable bunch Frequencies at JLab

S. Zhang

Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, USA

Scientific programs at Jefferson Lab requires accelerator operation at various bunch frequencies. The Continuous Electron Beam Accelerator Facility (CEBAF) currently runs at either 499MHz or 249.5MHz to cover most of the physics projects, but new programs such as K-Long experiment and EIC Harmonic-kicker (HK) require much lower bunch frequencies down to below 10MHz range. HK, in particular, requires two distinctively different bunch frequencies in its recent proof of principle experiment. Operation of high current photo-gun based high energy accelerator at significantly different repetition rates can be challenging and may involves both costly design effort and hardware. For years we have been striving for viable approaches to accommodate such requirements and had the success providing flexible and robust operation at some of the JLab facilities. Recently we implemented a simple and flexible synchronization system on the Upgraded Injector Test Facility (UITF) and performed different beam tests. In this report, the pros and cons of our systems and what we have learned from years of operation experience will be presented. We also show ideas to improve the existing systems for applications that need similar or more challenging bunch configurations.

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