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Upgraded Photoinjector Laser Pulse Train Generator at the Argonne Wakefield Accelerator

Wednesday 13 August 2025 16:00 (2 hours)

The Argonne Wakefield Accelerator (AWA) facility operates a high-charge (100s of nC) electron beam in a bunch train, with eight electron bunches at a 769 ps spacing matching the linac operating frequency of 1.3 GHz. AWA's electron beam is optimized for producing large wakefields in resonant structures to study structure wakefield acceleration. This is achieved by maximizing total beam charge, and by correct bunch train timing to enhance the wakefield via inter-bunch coherence. The properties of the bunch train are determined by a "multisplitter"in the photoinjector laser system, in which a series of beamsplitters splits one laser source into eight - ideally equal - pulses. However, AWA's previous system did not split pulses evenly, with up to a 2:1 ratio between pulse energies within a train. Damaging electrical breakdown events within the electron gun, driven by high single bunch charge, occurred at lower total charge in this non-uniform set-up, limiting maximum charge. Thus, a new multisplitter using polarizing beamsplitters and half-wave plates (HWPs) was implemented. Unlike the previous fixed-ratio beam-splitter design, the new system enables tuning the splitting ratio for each beamsplitter, resulting in a more uniform pulse train. Large 2"optics and uncoated HWPs are also used to increase the laser intensity damage threshold (LIDT). This paper presents the design, characterization and lessons learned in early commissioning of AWA's upgraded laser pulse train generator.

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No

Would you like to submit this poster in student poster session on Sunday (August 10th)

No

Footnotes

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Yes

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