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Wakefield Acceleration and Phase Space Manipulation at the Argonne Wakefield Accelerator Facility (AWA)

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The AWA facility is dedicated to the study of beam physics and the development of technology for future accelerators. Two independent electron linacs are used to study wakefield acceleration: 70MeV high charge electron bunches of up to 100nC are used to drive wakefields, which can be probed by bunches originating from the same linac or from the 15MeV linac. Recent Two-Beam-Acceleration (TBA) experiments reached accelerating gradients of 150MV/m. The wakefields were generated by the passage of the 15–45nC drive bunches through iris-loaded metallic structures operating at 11.7GHz. No indication of witness beam quality degradation was observed, and bunch charge was preserved during the acceleration process. Another series of experiments was conducted using two TBA stages, demonstrating acceleration of the witness beam in these two subsequent stages by means of two independent drive bunch trains. Other TBA experiments used dielectric loaded structures operating at 26GHz. Another main thrust of the research program consists of exploring and developing techniques to manipulate the phase space of electron bunches, including bunch shaping and the exchange of emittances in the transverse and longitudinal phase spaces. Especially shaped bunches can achieve higher transformer ratios in collinear wakefield acceleration experiments.

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