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Electron Beam Shaping for High Efficiency Acceleration at the AWA Facility.

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A central challenge for next generation accelerator facilities (Linear Colliders and FELs) is to operate at high wall plug efficiency. However, the fraction of energy that can be transfer from the accelerating fields to the charge particle bunch is limited by beam loading. This is true for advanced acceleration schemes, Structure Wakefield Acceleration (SWFA), Plasma Wakefield Acceleration (PWFA) and Laser Wakefield Acceleration (LWFA) as well as conventional acceleration. In the typical case of a beam with a longitudinally Gaussian shape, heavy beam loading can induce an unacceptably high energy spread on the bunch. On the other hand, if the beam shape is chosen correctly then energy spread can be controlled. At the Argonne Wakefield Accelerator (AWA) facility, we are exploring several bunch shaping methods (emittance exchange based, laser controlled and deflecting cavities method) to address this issue. Plans to demonstrate high efficiency acceleration of a longitudinally shaped electron beam in a SWFA scheme called Two-Beam acceleration will be presented.

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