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The E336 experiment at FACET-II: Wakefield acceleration and modulation of dense electron beams in nanostructures

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When a high intensity electron beam passes through a structured nano target, the created solid-state density plasma can support ultra-high accelerating gradients on the order of $1\,\mathrm{TeV\,m^{-1}}$ to $10\,\mathrm{TeV\,m^{-1}}$ with similarly strong focusing fields. This process may thus lead to an acceleration method with extremely high single-stage energy gains for electron or muon beams. Additionally, simulations indicate that structured solid targets can modulate electron beams to generate an effective and controllable seed for beam-plasma instabilities that are e. g. believed to be present in astrophysical phenomena.

Driving these extreme wakefields requires high energy and high-density electron bunches. Such bunches are now within reach at the FACET-II facility at SLAC National Accelerator Laboratory. The E336 experiment at FACET-II is a proof of principle experiment that will utilize the high-density electron beams produced by the facility to demonstrate the unique processes expected to occur in structured solid targets. We discuss the motivation, status, and future plans for the experiment. We will furthermore present particle-in-cell simulations that demonstrate fundamental processes of the interaction including magnetic trapping and beam deflection.