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Plasma Wakefield Accelerator Research at FACET-II[1]

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Plasma-based particle accelerators offer an opportunity to significantly reduce the size and cost of high-energy particle beams for applications ranging from ultrafast electron diffraction, to X-ray free electron lasers, to high-energy particle colliders. These applications in turn serve users in a variety of research fields by permitting access to ultrafast dynamics at atomic scales, or even fundamental particle interactions. Plasma wakefield accelerators (PWFAs) can sustain accelerating electric fields that are orders of magnitude greater than conventional metallic accelerating structures due in part to the fact that the plasma medium cannot itself be destroyed by the fields, in contrast to metallic structures. Researchers have shown that PWFAs can provide the promised large rates of acceleration to electron bunches, and the next great challenge for the field is to is to preserve the quality (i.e. emittance) of the accelerated bunches. This will be achieved by utilizing the plasma source itself to precisely focus the electron bunches into the PWFA, matching the natural divergence of the electron beam to the strong focusing force experienced in the plasma. Experiments planned at the currently-commissioning FACET-II facility at SLAC National Accelerator Laboratory aim to accomplish this alongside other tangential research goals utilizing relativistic particle beams and plasmas.

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