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Underdense Passive Plasma Lens Experiments at FACET-II

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The underdense passive plasma lens (UPPL) has several features that make it uniquely attractive for the focusing high-energy electron beams. Nominally formed via laser ionization of gas in the outflow of a supersonic jet, it is a simple, ultra-compact, and easily tunable device. Because it operates in the nonlinear blowout regime, the focusing strength scales with the plasma density and lens thickness, which can be controlled via the gas jet backing pressure and the focal properties of the laser, respectively. In contrast to active plasma lenses, the UPPL always acts as a linear focusing optic, preserving emittance even for the most intense beams. Potential use cases include matching and staging for plasma accelerators, as well as the final focus for a future collider or for HED physics. By introducing a modest transverse density gradient, the UPPL can even behave like a "micro-dipole"or "micro-sextupole". We will present theoretical descriptions of the UPPL under various conditions, along with a summary of early commissioning data from FACET-II and future experimental plans.

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