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Electron beam optimization using 3D printed gas cells in a laser-plasma accelerator KEEGAN BEHM, MICHAEL VARGAS, WILLIAM SCHUMAKER, ZHEN ZHAO, VLADIMIR CHVYKOV, ANATOLY MAKSIMCHUK, VICTOR YANOVSKY, ALEXANDER THOMAS, KARL KRUSHELNICK, Center for Ultrafast Optics — Laser driven tabletop accelerators have made it possible to produce tunable relativistic beams of electrons. One of the ways in which these electron beams can be optimized is by changing the plasma environment that creates and accelerates the electrons. Using a rapid prototyped gas cell built with a 3D printer to create a relatively contained environment for the plasma has increased the electron beam pointing stability and has created more monoenergetic beams than what was achieved with a gas jet. Several different gas cell designs have been studied and tested to determine the optimum configuration and gas mixture for stable, monoenergetic electron beams. Two-staged gas cells have produced the highest quality electron beams with greatest pointing and beam stability. The purpose of the two-staged gas cell is to divide the laser wakefield acceleration process into two steps, an injection stage, where a helium-nitrogen mixture is used to inject more charge into the wake of the laser, and an acceleration stage where pure helium is used to create a plasma conducive for accelerating the electrons captured in the first stage.

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