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Narrow Energy-Spread Proton Beams Generated in a Gas Jet by High-Power CO_2 Laser Pulses[1] D. HABERBERGER, S. TOCHITSKY, C. GONG, W. MORI, C. JOSHI, University of California Los Angeles, F. FIUZA, R. FONSECA, L. SILVA, Instituto Superior Tecnico — At the UCLA Neptune Laboratory, we have investigated laser driven ion acceleration using a high-power CO_2 laser pulse in a H_2 gas jet tuned around the critical plasma density of 10^{19}cm^{-3} for 10μm light. The CO_2 laser pulses consist of a train of 3ps pulses separated by 18ps with a peak power of up to 4TW and total energy of 50J [1]. Protons have been accelerated from this interaction to energies up to 22MeV, which far exceeds that predicted by ponderomotive force scaling for our vacuum $a_o \sim 2$. Furthermore, these high energy protons are contained within an energy spread of $\Delta E/E_{FWHM} \sim 1\%$, and have an estimated transverse emittance of down to ~1mm·mrad. The evolution of the plasma density profile was probed with 532nm interferometry revealing a steep rise ($< 10\ \lambda$) to overcritical densities followed by long exponential fall on the back side of the plasma. 2D OSIRIS simulations run with the experimentally measured plasma density profile have uncovered a multistage process for the production of monoenergetic protons based on the shock acceleration mechanism which will be discussed.

[1] D. Haberberger et. al., Opt. Exp. 18, 17865 (2010)

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