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Laser Acceleration of Electrons in Shock Wave Enhanced Gas Jets[1] DMITRI KAGANOVICH, MICHAEL HELLE, DANIEL GORDON, ANTONIO TING, Naval Research Laboratory, Washington, DC — Controlling the gas density gradient and profile is important for electron and proton acceleration. Using an optimized gas density profile, we have demonstrated 40 times higher electron energy compared to a Gaussian gas jet without lost of charge or stability. Propagation of a shock wave through a gas jet can modify the gas density profile and create sharp density gradients [1, 2]. Using different shock waves energies and shock originating positions, we were able to modify the plasma density profile of a "typical" Gaussian gas jet into a variety of profiles, from thin (foil-like) structure to elongated profiles with fast rise and slow fall. We used a plasma bubble Cherenkov diagnostic [3, 4] to optimize the acceleration process. Accelerated electron energy and charge were cross-correlated with the second harmonic diagnostic signal. The optimized gas density profile generated stable 0.5 nC of 40 MeV electrons using a 10 TW laser. The shock wave modified gas jet can be used as a stand alone electron source or as an injector coupled to additional acceleration structures. We demonstrated stable injection of electrons from the shock wave modified gas jet into a lower density plasma. The results are also being studied with numerical simulations.

[1] D. Kaganovich et al., Physics of Plasmas **18**, 120701 (2011)
[2] D. Kaganovich et al., Applied Physics Letters **97**, 191501 (2010)
[3] D. F. Gordon, et al., Phys. Rev. Lett. **101**, 045004 (2008)
[4] M. H. Helle et al., Phys. Rev. Lett. **105**, 105001 (2010)

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