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Electron energy boosting in laser-wake-field acceleration with transient plasma micro-optics

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Hundred-MeV electron beams with quasi-mono energetic distribution, and a transverse geometrical emittance as small as ~ 0.02 π mm mrad are generated by low power (7TW, 45 fs) laser pulses tightly focused in helium gas jets with a transient plasma micro-optics (TPMO) [1, 2]. The transient optical scheme is based on the plasma consisting of two parts: a focusing cone produce by the nanosecond-pedestal (amplified spontaneous emission) pulse (NPP) before the main pulse approaches and a guiding channel drilled by the picosecond pedestal pulse (PPP) or an artificial picosecond pulse through the heating of plasma electrons and consequent evacuation of ions in front of the main pulse. In the workshop, we report an experimental realization LWFA with TPMO including formation of a transient plasma channel which produced by NPP and PPP co-propagating with a main laser pulse in an external magnetic field, B ~1 T. This enables the stable and repeatable generation of higher-energy, mono-energetic, and very low TGE electron beams with use of low energy, tightly focused laser pulses. In addition, an asymmetric gas-gas-jet target for the LWFA is also presented.

[1] T.Hosokai, et.al., Phys. Rev. Lett. **97**, 075004 (2006)

[2] T.Hosokai, et.al., Appl. Phys. Lett. **96,** 121501 (2010)