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Self-guiding of a high-power laser MICHAIL TZOUFRAS, WEI LU, CHENGKUN HUANG, FRANK TSUNG, WARREN MORI, UCLA, JORGE VIEIRA, RICARDO FONSECA, LUIS SILVA, IST (Portugal), JAMES COOLEY, THOMAS ANTONSEN, Univ. of Maryland — The realization of high quality LWFA-produced electron beams requires laser pulses that remain focused for distances greatly exceeding the Rayleigh length. It is often thought that a short pulse laser cannot be self-guided and some form of external optical guiding is needed. As short pulse lasers with higher power are rapidly coming online to test the LWFA concept it is vital to understand the nature of their propagation through centimeters of plasma. Furthermore, if a single 100+ GeV LWFA stage is to be generated then the high-power laser (P/Pc>>1) will need to propagate through meters of plasma. We use the PIC codes OSIRIS and QuickPIC to study guiding of such pulses. We argue that a degree of self-guiding is possible for short ultra-intense pulses that have been shown to lead to complete ponderomotive expulsion (blowout) of the plasma electrons. For sufficiently high powers and intensities, the index of refraction at the leading edge of the laser changes in a distance much shorter than the pulse length. This combined with the local pump depletion can lead to a larger degree of self-guiding than had been previously thought. We investigate the parameter space in which such guiding can be effective enough that external guiding may not be required.

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