Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

Studies of Spectral Modification and Limitations of the Modified Paraxial Equation in Laser Wakefield Simulations WENXI ZHU, JOHN PALASTRO, THOMAS ANTONSEN, University of Maryland — Laser pulses propagating through plasma undergo spectra broadening through local energy exchange with plasma waves. For propagation distances of a depletion length frequency shifts can be comparable to the laser central frequency. Over these distances, the electromagnetic dispersion predicted by the modified paraxial equation is no longer valid, due to its reliance on slow temporal variation. Here we examine the local frequency shift, energy depletion, and action conservation of nonlinear laser pulses using the modified paraxial simulation WAKE. Although action is theoretically conserved, we observe that for large red shifts, the numerical dispersion results in decay of the action. Numerical analysis of the propagation algorithm verified the observed behavior. While increased resolution improved action conservation, increased simulation times eliminated the strength of the modified paraxial solver–efficiency. We show that algorithms for the full second order wave equation are more conservative with the potential to be more efficient when propagation over several depletion lengths is important.

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Date submitted: 19 Aug 2011 Electronic form version 1.4