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Quasi-matched propagation of an ultrashort and intense laser pulse in a plasma channel[1] CARLO BENEDETTI, CARL SCHROEDER, ERIC ESAREY, WIM LEEMANS, Lawrence Berkeley National Laboratory — The propagation of an ultrashort and relativistically-intense laser pulse in a preformed parabolic plasma channel is investigated. The nonlinear paraxial wave equation is solved both analytically and numerically. Numerical solutions are obtained using the 2D cylindrical, envelope, ponderomotive, hybrid PIC/fluid code INF&RNO, recently developed at LBNL. For an arbitrary laser pulse profile with a given power for each longitudinal slice (less then the critical power for self-focusing), we determine the laser intensity distribution ensuring matched propagation in the channel, neglecting non-paraxial effects (self-steepening, red-shifting, etc.). Similarly, in the case of a Gaussian pulse profile, we determine the optimal channel depth yielding a quasi-matched laser propagation, including the plasma density modification induced by the laser-pulse. The analytical results obtained for both cases in the weakly-relativistic intensity regime are presented and validated through comparison with numerical simulations.

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