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Continuum Vlasov Simulation in Four Phase-space Dimensions B.I. COHEN, J.W. BANKS, R.L. BERGER, J.A. HITTINGER, LLNL, S. BRUNNER, EPFL, Lausanne — In the VALHALLA project, we are developing scalable algorithms for the continuum solution of the Vlasov-Maxwell equations in two spatial and two velocity dimensions. We use fourth-order temporal and spatial discretizations of the conservative form of the equations and a finite-volume representation to enable adaptive mesh refinement and nonlinear oscillation control [1]. The code has been implemented with and without adaptive mesh refinement, and with electromagnetic and electrostatic field solvers. A goal is to study the efficacy of continuum Vlasov simulations in four phase-space dimensions for laser-plasma interactions. We have verified the code in examples such as the two-stream instability, the weak beam-plasma instability, Landau damping, electron plasma waves with electron trapping and nonlinear frequency shifts [2]extended from 1D to 2D propagation, and light wave propagation. We will report progress on code development, computational methods, and physics applications. This work was performed under the auspices of the U.S. DOE by LLNL under contract no. DE-AC52-07NA27344. This work was funded by the Lab. Dir. Res. and Dev. Prog. at LLNL under project tracking code 08-ERD-031. [1] J.W. Banks and J.A.F. Hittinger, to appear in IEEE Trans. Plas. Sci. (Sept., 2010). [2] G.J. Morales and T.M. O'Neil, Phys. Rev. Lett. **28**,417 (1972); R. L. Dewar, Phys. Fluids **15**,712 (1972).

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