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Delta-f particle-in-cell simulation of X-B mode conversion N. XIANG, J.R. CARY, D.C. BARNES, Univ. of Colorado, J. CARLSSON, Tech-X Corp. — Low-noise, delta-f particle-in-cell algorithm has been implemented in VORPAL, a massive parallel, hybrid plasma modeling code (Chet Nieter and John. R. Cary, J. Comp. Physics 196, 448 (2004)). This computation method allows us to simulate the mode conversion between the extraordinary wave (X) and electron Bernstein wave (EBW) in both linear and nonlinear regimes. In the linear regime, it is found that a full X-B mode conversion can be obtained for optimized parameters as $\omega/\omega_{ce} < 2$ (ω is the driving frequency and ω_{ce} is the electron cyclotron frequency). No 100% conversion is found for ω/ω_{ce} moderately larger than 2. The simulation results agree with the predictions of Ram's theory (Ram & Schultz, Phys. Plasma 4084 (2000)). The agreement indicates that X-B mode conversion can be well described by the quadratic wave equation based on cold plasma approximation, and this is consistent with the phase-space picture of mode conversion. It is also shown that the conversion efficiency is significantly affected by the gradient of magnetic fields. When the amplitude of the incident X wave increases, it is shown that the nonlinear self-interaction of the electron converted EBW gives rise to the second harmonic generation at a pump power as low as three orders smaller than the electron thermal energy. If the fundamental EBW is sufficiently large, the non-propagating third and fourth harmonic modes are also generated. *The work was supported by DOE Contract No.DE-FG02-04ER54735.

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