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The Particle in Cell Method Does Not Always Approximate the Vlasov Equation BRETT SCHEINER, Los Alamos National Laboratory, PATRICK ADRIAN, Massachusetts Institute of Technology — Recently, the theory of instability enhanced (IE) collisions [1] has been used to explain ionic transport in multi-ion species sheaths [2] and the electron transport in Hall effect thrusters (HET)[3]. In studies of both phenomenon, IE collisionality was observed in particle-in-cell simulations. However, the PIC method is well documented for its inability to capture coulomb collisions, and as such it has been stated that the PIC method approximates the Vlasov equation. These results raise a discrepancy in how PIC is able to resolve the particle-wave collisions predicted by the IE collision theory, but unable to resolve coulombic particle-particle scattering. In this work, a PIC relevant collision operator is derived, including the PIC generalization of IE collisions. This collision operator illustrates that PIC exactly captures IE behavior provided that the grid resolves the real frequency and growth rate. Furthermore, the present theory demonstrates that under such circumstances PIC self-consistently captures quasilinear behavior, with the initial electric field fluctuations being due to the collisionality of the discrete particle motion, a feature that cannot be self-consistently captured by the Vlasov equation. [1] S. D. Baalrud, C. C. Hegna, and J. D. Callen *Phy. Rev. Lett.* 103, 205002 (2009) [2] S. D. Baalrud, T. Lafleur, W. Fox and K. Germaschewski *PSST* 24, 015034 (2015) [3] T. Lafleur, S. D. Baalrud, and P. Chabert *Phys. Plasmas* 23, 053502 (2016)

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