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QPIC: A Many-Fermion Quantum PIC Code CHRIS FICHTL, MICHAEL MURILLO, LANL, FRANK GRAZIANI, LLNL, CIMARRON COLLABORATION — We are developing a 3d-3v many-fermion quantum PIC code capable of simulating conditions in which the plasma electrons are weakly coupled and moderately degenerate, such that the quantum Vlasov (Wigner) equation appropriately describes their phase space dynamics according to an initial Wigner distribution. Since PIC relies on a grid to obtain the field equations, the quantum mechanical smearing term cannot be accurately resolved; the quantum Vlasov treatment then becomes numerically equivalent to the classical Vlasov treatment for an initial quantum distribution, chosen to be Fermi-Dirac. This allows us to use standard PIC techniques as a starting point. PIC codes are known to suffer from numerical errors which can cause relaxation of non-Maxwellian initial conditions over long simulation times. We have therefore developed a Langevin velocity-scaling approach designed to help mitigate these errors. Our approach, its associated implementation, and preliminary physics benchmarking results, such as nonlinear plasma waves and instabilities at various degeneracies, will be presented. Finally, methods for extending QPIC's current capability will be outlined.

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