Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

Numerical Study of Quantum Effects on Non-Linear Plasma Waves MATTHEW LINK, Michigan State University, FRANK GRAZIANI, MARK SHERLOCK, Lawrence Livermore National Lab, ANDREW CHRISTLIEB, MICHAEL MURILLO, Michigan State University — Quantum plasmas have recently attracted attention due to the miniaturization of electronic devices, the study of warm dense matter and of white dwarf stars. As the quantum analog to Vlasov-Poisson, Wigner-Poisson provides a kinetic model for a quantum plasma but is computationally challenging to solve. We use a new numerical method which combines the techniques from the Vlasov and Wigner literature to study waves in a quantum plasma. We employ Strang splitting to divide Wigner-Poisson into an advection equation and a solve involving the pseudodifferential operator. A forward, Semi-Lagrangian scheme based on the Convected Scheme handles the advection piece which allows the bypassing of the restrictive CFL condition. A Fourier transform handles the pseudodifferential operator. High order is achieved by using WENO to calculate small corrections to the Convected Scheme. We use traditional problems such as Landau damping and the two-stream instability to validate our code with known results. In the context of nonlinear stationary states, KEEN waves attracted attention as an answer to how BGK-like states could be formed from a Maxwellian plasma. We simulate KEEN waves under the Wigner-Poisson model to examine their existence under quantum effects. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Matthew Link
Michigan State University

Date submitted: 03 Jul 2019 Electronic form version 1.4