Two Dimensional Particle-In-Cell Code for Simulation of Quantum Plasmas

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We have developed a code for simulating one and two dimensional quantum plasmas on a grid(1). Our goal is to model the statistical properties of interacting quantum particles from first principles. These properties are important for quantum plasmas where the de Broglie wavelength and the Debye length are on the same scale, as is the case for the hot high density plasmas found in stellar interiors(2). The code propagates many quantum particles forward in time self-consistently using the semi-classical approximation of Feynman path integrals. We have applied this code to model problems such as the bound states of a harmonic oscillator to test the accuracy of the code. In addition we have begun to explore the statistical properties of a quantum plasma by running simulations with small numbers of particles to represent an electron gas.

(1) D. Dauger, Semiclassical Modeling of Quantum-Mechanical Multiparticle Systems using Parallel Particle-In-Cell Methods, PHD Thesis
(2) M. Opher et. al. , Nuclear reaction rates and energy in stellar plasmas: The effect of highly damped modes, Physics of Plasma, 8, No. 5, p. 2454

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