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Linear Electrostatic Waves in Unmagnetized Arbitrarily Degenerate Quantum Plasmas SHANE RIGHTLEY, DMITRI UZDENSKY, CIPS, University of Colorado — Plasmas in which the inter-particle spacing approaches the thermal de Broglie wavelength are subject to quantum statistical effects due to Pauli exclusion, and many familiar plasma phenomena are modified on such length scales because of the Heisenberg uncertainty principle. The question of how to model these quantum plasmas is a naturally interesting one, as it pushes the envelope of our knowledge of plasma physics and applies the well-established principles of quantum mechanics in a novel context. Such models are important for microelectronic systems, dense laser-produced plasmas, and some extreme astrophysical environments. For completely degenerate plasmas, both kinetic and fluid theories have already been developed. In this presentation, unmagnetized Fermi-Dirac equilibrium plasmas with finite temperature and arbitrary degree of degeneracy are considered. Linear dispersion relations for electrostatic waves and oscillations, including Landau damping, are derived and analyzed. The analysis is carried out using a self-consistent mean-field quantum kinetic model (the Wigner-Poisson system). Growth of waves due to kinetic instabilities, such as the Buneman and bump-on-tail instabilities, is also considered.

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