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An equation for pressure of a two-dimensional Yukawa liquid[1]
YAN FENG, WEI LI, QIAOLING WANG, WEI LIN, Soochow University, Suzhou, Jiagsu, China, JOHN GOREE, BIN LIU, Dept. of Physics and Astronomy, The Univ. Iowa, Iowa City, IA — Thermodynamic behavior of two-dimensional (2D) dusty plasmas has been studied experimentally and theoretically recently. As a crucial parameter in thermodynamics, the pressure of dusty plasmas arises from frequent collisions of individual dust particles. Here, equilibrium molecular dynamical simulations were performed to study the pressure of 2D Yukawa liquids. A simple analytical expression for the pressure of a 2D Yukawa liquid is found by fitting the obtained pressure data over a wide range of temperatures, from the coldest close to the melting point, to the hottest about 70 times higher than the melting points. The obtained expression verifies that the pressure can be written as the sum of a potential term which is a simple multiple of the Coulomb potential energy at a distance of Wigner-Seitz radius, and a kinetic term which is a multiple of the one for an ideal gas. Dimensionless coefficients for each of these terms are found empirically, by fitting. The resulting analytical expression, with its empirically determined coefficients, is plotted as isochors, or curves of constant area. These results should be applicable to 2D dusty plasmas.

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