Quantality parameter

In quantum mechanics, the zero-point kinetic energy, $\sim \hbar^2/Ma^2$, involved in the localization of a particle within a volume of radius a implies that the lowest energy state, the particle may be delocalized because the potential energy gain of the classical configuration of fixed particles, which minimize U is overwhelmed by the quantal kinetic energy. Such delocalized quantal fluids provide the basis for discussing the state of electrons in atoms, and metals, of the He atoms in the ground state of the He liquids (bot fermionic ^3He, and bosonic ^4He), and the state of nucleons in the ground state of atomic nuclei, a (non-newtonian) quantum fluid.

The relative magnitude of the quantal kinetic energy of the localized state compared with the potential energy can be qualitatively characterized by the quantality parameter (Mottelson, 1998)

$$\Lambda = \frac{\hbar^2}{Ma^2}\frac{1}{|V_0|},$$

where M is the mass of the individual particles, while V_0 and a measure the strength of the attraction and the range corresponding to the minimum of the potential, respectively. When Λ is small, quantal effects are small and the lowest state of the system