Addendum

The Ground State Energy of a 2-D Electron Gas*

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In a recent article in this Journal [1], we have evaluated the correlation energy of a three-dimensional electron gas. The energy was evaluated most accurately by a grand ensemble method. By applying the same method to a two-dimensional electron gas, we have evaluated the ground state energy. In this evaluation, we have taken into consideration the first and second order exchange graphs and the ring diagrams. In the units in which $\hbar=1$ and $2m=1$, where m is the electron mass, and in terms of a dimensionless density parameter r_s defined by

$$r_s = e^2 2^{-1/2} p_0^{-1}$$

where p_0 is the Fermi momentum for an ideal case given by

$$p_0^2 = 2\pi n$$

and where n is the number density, we have found that the ground state energy is given by

$$\varepsilon_0 = r_s^{-2} - 1.2 r_s^{-1} + \varepsilon_c$$

where

$$\varepsilon_c = -(0.166 \pm 0.002) + (0.541 \pm 0.002)r_s - 0.0216r_s \ln r_s$$

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The errors are due to numerical evaluations of integrals.

In contrast to the ground state energy of the 3-D case, the kinetic energy for the same r_s is much less. On the other hand, the exchange and correlation effects are much larger. The correlation energy is negative for small r_s and becomes positive for r_s of order 0.29 or larger. The r_s variation is almost linear for r_s of this order. This is because that the last logarithmic term is very small. Different from the 3-D case, a simple $\ln r_s$ term without a factor r_s does not appear. This is due to the dimensionality.

References

1. Kojima, D., Isihara, A.: Z. Physik B **25**, 167 (1976)

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