The ground state energy of $^3$He droplet in the LOCV framework

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Abstract
The (extended) lowest order constrained variational ((E) LOCV) method was used to calculate the ground state energy of liquid helium 3 ($^3$He) droplets at zero temperature. Different types of density distribution profiles, such as the Gaussian, the Quasi-Gaussian and the Woods-Saxon were used. It was shown that at least, on average, near 20 $^3$He atoms are needed to get the bound state for $^3$He liquid droplet. Depending on the choice of the density profiles and the atomic radius of $^3$He, the above estimate can increase to 300. Our calculated ground state energy and the number of atoms in liquid $^3$He droplet were compared with those of Variational Monte Carlo (VMC) method, Diffusion Monte Carlo (DMC) method and Density Functional Theory (DFT), for which a reasonable agreement was found.

Keywords: normal liquid helium 3, helium 3 droplets, LOCV, ELOCV, ground state energy, density distribution profile, Gaussian distribution profile, quasi-Gaussian distribution profile, Wood-Saxon distribution profile, Lennard-Jones potential

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