

Improved variational many-body wave function in light nuclei

We propose and implement a simple method for improving the variational wave function of a many-body system. We have obtained a significant improvement in the binding energies, wave functions, and variance for the light nuclei H_3 , He_4 , and Li_6 , using the fully realistic Argonne (AV18) two-body and Urbana-IX (UIX) three-body interactions. The energy of He_4 was improved by about 0.2 MeV and the Li_6 binding energy was increased by ≈ 1.7 MeV compared to earlier variational Monte Carlo results. The latter result demonstrates the significant progress achieved by our method, and detailed analyses of the improved results are given. With central interactions the results are found to be in agreement with the "exact" calculations. Our study shows that the relative error in the many-body wave functions, compared to two-body pair correlations, increases rapidly at least proportionally to the number of pairs in the system. However, this error does not increase indefinitely since the pair interactions saturate owing to convergence of cluster expansion.