

STUDIES ON CONSTRUCTION OF THE TRIAL WAVE FUNCTION BY PARAMETERIZATION GIVEN BY THE COUPLED CLUSTER METHOD (CCM)

B.M. Fulmante¹ and Sharma Umashankar²

¹ Head Dept. of Physics, Sanjeevane College, Chapoli, Dist. Latur 413513 (M.S) INDIA; ²RJIT,
BSF, Tekanpur, Gwalior (M.P.)

Corresponding author:fulmantebhagwat@gmail.com

One way of doing the construction of the trial wave function is by appropriately approximating some rather complicated, usually non-linear parameterization. The Coupled Cluster Method (CCM) gives one type of such parameterization. This paper gives a brief description of the CCM wave function and the ways of performing approximations appropriate to this study. The final form of the wave function that we shall make use of is obtained by combining these two methods in a way appropriate for a linear variation method. The effectiveness of the approximation scheme is illustrated by considering the calculation for the ground state of the alpha particle. For this purpose we quote results from a number of authors as well as our own. Apart from the ground state energy, we also examined the calculation of the one and two-body density distributions that can be used to provide qualitative information about the wave function. Combining the simplest approximation of the CCM, namely the TICI(2), with the Jastrow correlation factor leads to a variational calculation that is easily accessible both analytically and numerically, termed as the J-TICI(2) scheme. When compared with the statistically exact GFM and DMC methods the results obtained are in close agreement. Despite the complexity of such methods both in implementation and computer time, the J-TICI(2) scheme was relatively easy and straightforward to apply. It could be mentioned that the closed shell structure of the alpha particle ground state provided an easy ground for the calculations. Our objective was the cluster description of light halo nuclei in terms of an alpha particle accompanied by a number of neutrons. Although the J-TICI(2) scheme can be applied beyond the alpha particle it is by no means implied that an extension of this method to the open shell structure of halo nuclei will lead to any fruitful results.

Keywords: Alpha particle, Coupled Cluster Method (CCM), Halo, Parameterization