Derivation of Trial Wave Function for Nuclear Monte Carlo

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1 Trial Wave Function

To obtain the trial wave function for nuclear Monte Carlo there are two parts, the antisymmetric long range part ($|\Phi\rangle$) and the symmetric short range correlation operator ($\mathcal{F}$). That is

$$|\psi_T\rangle = \mathcal{F}\,|\Phi\rangle\,. \tag{1}$$

The antisymmetric part is made up of single particle orbitals in the form of a slater determinant. It is the symmetric correlation operator that I am not sure about. By reading other papers this is what I have understood. If you ignore three-body correlations then

$$\mathcal{F} = \mathcal{S}\prod_{i<j} F_{ij}, \tag{2}$$

where

$$F_{ij} = \sum_p f^p(r_{ij})\mathcal{O}^p_{ij}, \tag{3}$$

where $\mathcal{S}$ is the symmetrization operator and $\mathcal{O}^p_{ij} = 1, \sigma_i\cdot\sigma_j, 3\sigma_i\cdot\hat{r}_{ij}\sigma_j\cdot\hat{r}_{ij} - \sigma_i\cdot\sigma_j$ plus each of these terms times $\tau_i\cdot\tau_j$. To write this more like what other papers have written it I will pull the 1 term out of the sum and let $f^1(r_{ij}) = f^c(r_{ij})$ since that term is a central term and I will call $u^p_{ij} = f^p(r_{ij})/f^1(r_{ij})$. This gives us

$$F_{ij} = \sum_p f_c(r_{ij})\left(1 + \sum_p u^p(r_{ij})\right). \tag{4}$$

Putting all of these pieces together the trial wave function becomes

$$|\Phi_T\rangle = \left[\mathcal{S}\prod_{i<j} f_c(r_{ij})\left(1 + \sum_p u^p(r_{ij})\mathcal{O}^p_{ij}\right)\right]|\Phi\rangle\,. \tag{5}$$

When we spoke the trial general trial wave function was supposed to be

$$|\Phi_T\rangle = \left[\prod_{i<j} f_c(r_{ij})\left(1 + \sum_{i<j}\sum_p u^p(r_{ij})\mathcal{O}^p_{ij}\right)\right]|\Phi\rangle\,. \tag{6}$$

Where the only differences are $\mathcal{S}$ in equation 5 and the double sum in equation 6. Does the double sum come from the symmetrization operator or am I just wrong with my derivation?