III. NOTES ON THE RRGM IMPLEMENTATION

The expansion of the 3-helium ground state

We approximate the antisymmetric nuclear three-body state with the expansion

$$\begin{aligned} \left\langle \boldsymbol{\rho}_1, \boldsymbol{\rho}_2 \,\middle|\, {}^3\mathrm{He} \right\rangle &= \sum_i \; c_i \, e^{-\gamma_i \boldsymbol{\rho}_1^2} \, e^{-\delta_i \boldsymbol{\rho}_2^2} \cdot \Big[\big[\mathcal{Y}_{l_{1,i}}(\boldsymbol{\rho}_1) \otimes \mathcal{Y}_{l_{2,i}}(\boldsymbol{\rho}_2) \big]^{L_i} \otimes \big[[\xi_1 \otimes \xi_2]^{\mathscr{S}_i} \otimes \xi_3 \big]^{S_i} \Big]^J \\ &\equiv \sum_i \; c_i \; \phi_i(\boldsymbol{\rho}_1, \boldsymbol{\rho}_2) \;\; . \end{aligned} \tag{50}$$

A single basis vector is parametrized by two width parameters γ and δ, and a (spin) angular-momentum coupling scheme which specifies two angular-momentum quanta $l_{1,2}$ (one for each Jacobi coordinate $\boldsymbol{\rho}_{1,2}$), a total orbital angular momentum L, an intermediate spin coupling $\mathscr{S}$, and the total spin S.
In practise, we proceed as follows:

1. Fix an orbital-angular-momentum cutoff $l_{\max}$ and add **all** spin- and orbital coupling schemes to the basis with $l_{1,2} \leq l_{\max}$ and intermediate/total angular momenta which contribute to a total J and parity.

   The structure $\left[[\mathcal{Y}_1(\boldsymbol{\rho}_1) \otimes \mathcal{Y}_1(\boldsymbol{\rho}_2)]^2 \otimes \left[[\xi_1 \otimes \xi_2]^1 \otimes \xi_3 \right]^{3/2} \right]^{1/2^+}$, for example, would be included if $l_{\max} = 2$ and combines two negative-parity solid harmonics to form a of positive parity.

2. For each of the above blocks, two sets of width parameters are chosen. At present, this means selecting upper and lower bounds $\gamma/\delta_{\min,\max}$ of geometric grids with a fixed number of nodes n.

   For a particular coupling block, one uses $\gamma \in \{\gamma_{\min}, \gamma_{\max}\}_{\mathrm{geom}}^{n(l_{1,2,i}, L_i, \mathscr{S}_i, S_i)} \equiv w_\gamma$ and $\delta \in \{\delta_{\min}, \delta_{\max}\}_{\mathrm{geom}}^{m(l_{1,2,i}, L_i, \mathscr{S}_i, S_i)} \equiv w_\delta$. Hence, for each coupling block there are $m \cdot n$ ("in principle") independent Gaussian prefactors. To select those combinations which form a numerically stable and yet complete-for-its-purpose set is an unsolved problem, if the state should be fed into a LIT calculation.