PROJECTION OF ANGULAR MOMENTUM EIGENSTATES FROM THE TWO-CENTRE GENERATOR COORDINATE MODEL FUNCTIONS

M.V.Mihailović and M.Poljšak

J.Stefan Institute, University of Ljubljana, Ljubljana, Yugoslavia

A method for projecting a two-centre generator coordinate method (GCM) function [1]) onto the subspace of eigenfunctions of the angular momentum operators $\underline{J}^2$ and J_z is outlined.

In the GCM for scattering one starts with a model function of the form [1])

$$\phi_\chi(\underline{x},\underline{S}) = \mathcal{A}\{\phi_{A\chi_1}(\underline{x}_1,..,\underline{x}_A;\underline{S}_A)\ \phi_{B\chi_2}(\underline{x}_{A+1},..,\underline{x}_{A+B};\underline{S}_B)\}$$

$$\underline{S} = \underline{S}_A - \underline{S}_B, \qquad \chi = (\chi_1,\chi_2), \qquad \underline{x} = (\underline{x}_1,\ldots,\underline{x}_{A+B}) \qquad (1)$$

The functions $\phi_{A\chi_1}$ and $\phi_{B\chi_2}$ are Slater determinants constructed out of single particle functions which are eigenfunctions of harmonic oscillator potentials centred at $\underline{S}_A$ and $\underline{S}_B$, respectively. The indices χ_1 and χ_2 denote particular shell model configurations. The antisymmertizer $\mathcal{A}$ takes care of the exchange of nucleons between the two fragments. In order to avoid the problem of spurious centre-of-mass motion we restrict ourselves to configurations with no holes in the closed shells and to cases where the oscillator parameters of both wells are equal. The GCM function labeled by angular momentum quantum numbers J and M is obtained by applying to the function (1) the projection operator

$$P^J_{MK} = \frac{2J+1}{3\pi^2}\int d\Omega \mathcal{D}^J_{MK}(\Omega)^* R(\Omega)$$

where $R(\Omega)$ is the rotation operator that rotates the coordinates $\underline{x}$ through the Euler angles Ω and $\mathcal{D}^J_{MK}$ form its matrix representation.

First we prove the following relation which expreses the effect of the rotation of the coordinates $\underline{x}$ in terms of the rotation of the vector $\underline{S}$

$$R(\Omega)\,\phi_\chi(\underline{x},\underline{S}) = \sum_{\chi'} c_{\chi'\chi}(\Omega)\,\phi_{\chi'}(\underline{x},R(\Omega^{-1})\,\underline{S})$$

where the coefficients $c_{\chi'\chi}$ are expressed in terms of the $\mathcal{D}$ functions The index χ' runs only over different configurations of valence nucleons in the major shell.

Then we show that the matrix elements of the Hamilton and the identity operators between the projected model functions can be expressed by the matrix elements between unprojected functions (1).

The projection method has been used to calculate molecule-like states of ^{7}Li, treating it as a composite of two fragments ^{4}He and ^{3}H, and the elastic cross section for the reaction ^{3}H + ^{4}He [2]).

References

1) M.V.Mihailović, L.J.B.Goldfarb and M.A.Nagarajan, Preprint Daresbury Lab. 1975 DL/NSF/P32(theory); Nucl. Phys. in press.
2) M.V.Mihailović,M.Poljšak, another contribution to the same Proceedings.