Comments

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Comment on "New methods for solving the Bethe-Goldstone equation"*

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With an (ω-QTQ) type energy denominator in the propagator of the Bethe-Goldstone equation, Znojil's recent exact solution for the defect wave function is shown to follow from Tsai and Kuo's earlier exact solution for the G matrix.

[NUCLEAR STRUCTURE Accurate methods for calculating nuclear reaction matrix.]

An exact method has been proposed recently by Znojil[1] to solve the Bethe-Goldstone equation with an (ω-QTQ) type energy denominator in the propagator. Despite Znojil's claim for its being new, it must be noted, however, that the same solution had essentially been given before by Tsai and Kuo.[2] In this note, we show that one can obtain Znojil's solution by renaming parts of Tsai and Kuo's explicit solution and casting the result into a set of coupled equations.

To see this, we follow the notation of Ref. 1 and begin by giving the Tsai-Kuo solution for the defect wave function χ

$$\chi = \frac{1}{\omega - T - V} V\phi - \frac{1}{\omega - T - V} \times P \frac{1}{P[1/(\omega - T - V)]} P \frac{1}{\omega - T - V} V\phi, \tag{1}$$

which is obtained from Eq. (14) of Ref. 2 and the following equation relating the G matrix and the defect wave function

$$V\chi = V(\psi - \phi) = (G - V)\phi. \tag{2}$$

For ease of comparison, we will also give the equation number in Ref. 1 whenever applicable. Znojil's solution for the defect wave function can then be seen to follow from Eq. (1) by making the following identifications:

$$\chi = \kappa + \rho \tag{3}$$

[Eq. (33) of Ref. 1], in which we have

$$\kappa = \frac{1}{\omega - T - V} V\phi \tag{4}$$

and

$$\rho = \frac{-1}{\omega - T - V} P\lambda, \tag{5}$$

provided we also define

$$\lambda = P \frac{1}{P[1/(\omega - T - V)]} P \frac{1}{\omega - T - V} V\phi. \tag{6}$$

In fact, from Eqs. (4) and (6), we have immediately

$$P \frac{1}{\omega - T - V} P\lambda = P\kappa \tag{7}$$

which, when written in its vector component form using an orthonormal basis ϕ_i which spans the model space P, gives the set of equations

$$\langle\phi_i|\kappa\rangle + \sum_j \langle\phi_i|\rho_j\rangle\langle\phi_j|P\lambda\rangle = 0, \quad (i,j) \in P \tag{8}$$

[Eq. (36) of Ref. 1]. Note that in Eq. (8) we have defined

$$\rho_i = \frac{-1}{\omega - T - V} \phi_i \tag{9}$$

in agreement with Eq. (35) of Ref. 1,

$$(\omega - T - V)\rho_i = -\phi_i. \tag{10}$$

Furthermore, if we rewrite Eqs. (4) and (5) as

$$(\omega - T - V)\kappa = V\phi \tag{11}$$

[Eq. (34) of Ref. 1] and

$$(\omega - T - V)\rho = -P\lambda, \qquad (12)$$

we then obtain Znojil's solution for χ by combining Eqs. (11) and (12) with Eq. (3):

$$(\omega - T - V)\chi = V\phi - P\lambda \qquad (13)$$

[Eq. (32) of Ref. 1], which is to be solved in conjunction with Eqs. (8), (10), and (11).

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[1]M. Znojil, Phys. Rev. C 12, 2077 (1975).
[2]S. F. Tsai and T. T. S. Kuo, Phys. Lett. 39B, 427 (1972).