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Peer Review

Review of: "On the Application of the Rayleigh-Ritz Method to a Projected Hamiltonian"

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The paper applies the Rayleigh-Ritz method (RRM) to the Hamiltonian H_D, eq. (3). It concludes that the "RRM eigenvalues approach to those of the projected Hamiltonian from below." If I understand the statement correctly, it means that the expression of the l.h.s. of the inequality (4) is less than or equal to the eigenvalues E_k showing up in eq.1 and the construction of H_D. A simple example is given to prove this statement.

I think that the numerical example is correct, but not the conclusions. In my understanding, H_D has eigenvalues E_k for all D eigenstates showing up in the definition of H_D. However, it has a 0 eigenvalue for all states orthogonal to the eigenstates present in H_D, as can be seen from the definition of H_D. Let E_0 be the lowest eigenvalue of H. If 0 < E_0 < ... an admixture of the states orthogonal to those present in the definition of H_D lowers the energy. In fact, a sufficiently flexible ansatz for the wave function should obtain any of the eigenstates of the space orthogonal to the D eigenstates present in H_D because the lowest eigenvalue of H_D is 0. When E_0 < 0, one approaches E_0 from above, in contrast to the statement made by the author.

In order to substantiate my statement with a numerical example, let me slightly change the example used in the paper and shift the potential by a constant, c. To recover the results of the paper, we can set c=0. We have: E_0=pi^2/2+c and W_0=(480/pi^4)(1+2 c/pi^2). As in the paper, W_0-E_0 is negative for c=0, but becomes positive when c < -pi^2/2.

Of course, one could easily produce more counter-examples, e.g., the H atom.

In conclusion, in my opinion, the paper should not be published in its present form. Even if corrected (in the spirit described above), I abstain from giving a recommendation for or against its publication for the following reason. The paper looks to me more like an exercise to give to students than a scientific paper. However, I cannot draw a sharp limit between these.

Declarations

Potential competing interests: No potential competing interests to declare.

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