

4 Results and Conclusions

In this paper, I derived first and second order energy and wavefunction correction to the new quantum system after the original quantum state is perturbed by small perturbation in a simple and short way.

By using perturbation theory approximation method, I calculated first and second order correction for both non-degenerate and degenerate states.

Therefore, the first-order energy correction for non-degenerate states are given by

$$E_n^1 = \langle \psi_n^0 | H' | \psi_n^0 \rangle = H'_{nn} \quad (33)$$

First-order correction to the wave function for non-degenerate states are given by

$$\psi_n^1 = \sum_{m \neq n} \frac{\langle \psi_m^0 | H' | \psi_n^0 \rangle}{E_n^0 - E_m^0} \psi_m^0 \quad (34)$$

The second-order correction to the energy for non-degenerate states are given by:

$$E_n^2 = \sum_{m \neq n} \frac{\langle \psi_m^0 | H' | \psi_n^1 \rangle \langle \psi_n^0 | H' | \psi_m^0 \rangle}{E_n^0 - E_m^0} = \sum_{m \neq n} \frac{|\langle \psi_m^0 | H' | \psi_n^0 \rangle|^2}{E_n^0 - E_m^0} \quad (35)$$

The first order correction to the energy for degenerate states are given by:

$$E_{\pm}^1 = \frac{1}{2} \left[H'_{aa} + H'_{ab} \pm \sqrt{(H'_{aa} - H'_{ab})^2 + 4|H'_{ab}|^2} \right] \quad (36)$$

Then by using the same methods, we can calculate third and fourth order correction to Energy and wavefunction and so on.

5 Reference

1. John S. Townsend, A Modern Approach to Quantum Mechanics, 2 nd University Science Books, (2000)
2. W. Greiner, Quantum Mechanics (An Introduction), 4 th ed., Springer (2008).
3. David Griffith, Introduction to Quantum Mechanics: Benjamin Cummings, (2004).
4. J. J. Sakurai, Modern Quantum Mechanics Revised edition, (1993).
5. R. Shankar, Principles of Quantum Mechanics, 2 nd ed., (2008)
6. J. Singh, Quantum Mechanics: Fundamentals and Applications to Technology 1 st ed., (1996).
7. David A.B. Miller, Quantum Mechanics for Scientists and Engineers, (2008).
8. Byron, F. W. and Fuller, R. W. (1969) Mathematics of Classical and Quantum Physics. Addison-Wesley, Reading, Massachusetts.
9. B. H. Branden and C. J. Joachain, Quantum Mechanics, 2 nd ed., Benjamin Cummings, (2000)
10. John Taylor, Modern Physics for Scientists and Engineers, Pearson Education, (2003).