

Physics 4410
Quantum Mechanics 2

Lecture 24

Time-independent perturbation theory: introduction

October 23, 2020

1. In a nutshell, what is perturbation theory?

2. What are the eigenvalues of

$$H = \begin{pmatrix} \tilde{E}_1 + \lambda\epsilon_1 & \lambda\eta \\ \lambda\eta & \tilde{E}_2 + \lambda\epsilon_2 \end{pmatrix}?$$

3. Taylor expand in λ the eigenvalues of

$$H = \begin{pmatrix} \tilde{E}_1 + \lambda\epsilon_1 & \lambda\eta \\ \lambda\eta & \tilde{E}_2 + \lambda\epsilon_2 \end{pmatrix}.$$

4. Consider a system with a discrete non-degenerate spectrum. Set up the perturbative expansion in λ .

5. Solve for the first order correction to the energies.

Activity: Consider $H = H_0 + \lambda V$. Show that the true ground state of H has lower energy than we predict with first order perturbation theory. (*Hint:* combine two different methods!).