Phys 412-3 Quantum Mechanics

Kaan Simsek

ksimsek@u.northwestern.edu | kagsimsek.github.io

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Abstract

This document contains the TA notes for the course Phys 412-3 Quantum Mechanics in the spring quarter of the academic year 2022-2023.

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I. DISCUSSION 1 (APR 5)

We have discussed essentially the following five items:

- Consider two charged particles q_1 and q_2 in an otherwise empty universe. How do you write down the classical Hamiltonian using particle indices 1 and 2 for relevant dynamical variables? Can you separate the Hamiltonian into two independent motions using a proper transformation of coordinates? What are these two independent components of the motion? When does this system admit a bound state?

- Do you know how to write the Laplacian if I hand you the metric of a curved space (or heck, even a spacetime)?

- Can you compute (some of) the averages given in Eq. (14.22) of the professor's notes without using the wave function?

- What's up with that confluent hypergeometric function of the first kind?

- Suppose you have a particle in the ground state of an infinite box of length L. Suppose the width doubles instantly at $t = 0$. What does the new wavefunction look like at $t = 0^+$? Can you write down the expressions for the probability of finding the particle in the ground or first-excited state of the new box. Can you compare the sizes of these probabilities intuitively?

Join the discussion sessions and office hours or reach out to me to find out answers to these and other questions!

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Quantum mechanics is like jazz—there are no wrong answers, you just lack confidence.

II. DISCUSSION 1 (APR 12)

We have discussed essentially the following two items:

- What is the philosophical difference between the Rayleigh-Schrödinger and Brillouin-Wigner perturbation frameworks? Can you build your own framework of perturbation? Short answer: yes.
- What happens if the perturbation can't fully break the degeneracy of the unperturbed level? Do we just give up on life or what?

Join the discussion sessions and office hours or reach out to me to find out answers to these and other questions!

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Numbers don't matter. It's more important to relax and have some fun.