

Further Quantum Mechanics

Hilary term (9 lectures) and Trinity terms (11 lectures)

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These lectures are a sequel to Prof Fabian Essler's course. The two courses together are intended to provide an introduction to quantum mechanics. No particular significance is attached to the way that material is divided between the two courses.

Course synopsis

- **Hilary term**

1. Motion of a charged particle in a magnetic field.
2. Time-independent perturbation theory.
3. The Stark effect.
4. The Zeeman effect.
5. The variational principle.
6. WKB approximation.

- **Trinity term**

7. Time-dependent problems: the sudden and adiabatic approximations.
8. Time-dependent perturbation theory.
9. Fermi golden rule.
10. Radiative transitions.
11. Selection rules.
12. Identical particles.
13. Gross structure of He.
14. Density operators.

I will not issue lecture notes because the material is well covered in many text books. Instead I give specific suggestions here of reading for each section of the course. These suggestions are from the books:

The Physics of Quantum Mechanics, J. Binney and D. Skinner (OUP), denoted **B&S**.

Principles of Quantum Mechanics, R. Shankar (Springer), **RS**.

Introduction to Quantum Mechanics, D. J. Griffiths (Pearson), **DG**.

Modern Quantum Mechanics, J. J. Sakurai and J. Napolitano (Pearson), **S&N**.

Recommended Reading

Motion of a charged particle in a magnetic field, and the Zeeman effect: **B&S Chapter 9 and Section 10.1.3**.

Time-independent perturbation theory and degenerate time-independent perturbation theory: **B&S Section 10.1, RS Chapter 17, DG Chapter 6, S&N Sections 5.1 and 5.2**.

The Stark effect: **B&S Section 10.1, RS Chapter 17**.

The variational principle: **B&S Section 10.2, RS Section 16.1, DG Section 8.1, S&N Section 5.4**.

WKB approximation: **B&S Section 12.6, RS Section 16.2, DG Chapter 9**.

Time-dependent problems: the sudden and adiabatic approximations, time-dependent perturbation theory, Fermi's golden rule, radiative transitions, and selection rules: **B&S Sections 10.3 and 12.1, RS Chapter 18, DG Chapter 7**.

Identical particles: **B&S Sec 11.1, RS Section 10.3, DG Chapter 5, S&N Chapter 7**.

Gross structure of He: **B&S Section 11.2, S&N Section 7.4**

Density operators: **B&S Section 6.3, RS Sec 4.2**.