

# Modern Physics

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# Contents

<b>I</b>	<b>Quantum mechanics</b>	<b>3</b>
<b>1</b>	<b>Quantization</b>	<b>4</b>
1.1	Interpretations of quantum mechanics . . . . .	4
1.2	Canonical commutation relation . . . . .	4
<b>2</b>	<b>Schrödinger equation</b>	<b>5</b>
2.1	Time-independent potentials . . . . .	5
2.2	Approximation methods . . . . .	5
2.3	Atoms . . . . .	5
2.4	Scattering theory . . . . .	5
<b>3</b>	<b>Spin</b>	<b>6</b>
3.1	. . . . .	6
3.2	Dirac equation . . . . .	6
3.3	Wigner classification . . . . .	6
<b>II</b>	<b>Statistical physics</b>	<b>7</b>
<b>4</b>	<b>Statistical mechanics</b>	<b>8</b>
4.1	Ensembles . . . . .	8
4.2	Quantum statistics . . . . .	8
<b>5</b>	<b>Condensed matter physics</b>	<b>9</b>
5.1	Solid state physics . . . . .	9
5.2	Quantum Hall effect . . . . .	9
<b>6</b>	<b>Renormalization group</b>	<b>10</b>
6.1	Phase transition . . . . .	10
<b>III</b>	<b>Quantum field theory</b>	<b>11</b>
<b>7</b>	<b>Perturbative field theory</b>	<b>12</b>
7.1	Path integral formulation . . . . .	12
7.2	Field equations . . . . .	12
7.3	Interacting fields . . . . .	12
<b>8</b>	<b>Non-perturbative field theory</b>	<b>13</b>
8.1	Algebraic quantum field theory . . . . .	13

9 Nonabelian gauge theory	14
IV	15
10 Supersymmetry	16

## **Part I**

# **Quantum mechanics**

# Chapter 1

## Quantization

### 1.1 Interpretations of quantum mechanics

Pictures Hilbert space, wave functions, Dirac notation Copenhagen interpretation and measurement observables and self-adjoint operators EPR paradox, Bell's inequality, CHSH inequality

### 1.2 Canonical commutation relation

canonical quantization Weyl quantization fourier transform Stone-von Neumann theorem

## Chapter 2

# Schrödinger equation

### 2.1 Time-independent potentials

Infinite well Harmonic oscillator Free particle Hydrogen atom

### 2.2 Approximation methods

WKB approximation

### 2.3 Atoms

### 2.4 Scattering theory

## Chapter 3

# Spin

### 3.1

### 3.2 Dirac equation

Pair production(1941)

### 3.3 Wigner classification

**Part II**

**Statistical physics**



## Chapter 4

# Statistical mechanics

### 4.1 Ensembles

ensembles microcanonical, canonical, grand canonical classical gas Boltzmann distribution

### 4.2 Quantum statistics

Two statistics Fermi sea Bose-Einstein condensation

## **Chapter 5**

# **Condensed matter physics**

### **5.1 Solid state physics**

phonon

### **5.2 Quantum Hall effect**

## Chapter 6

# Renormalization group

### 6.1 Phase transition

Magnetic models Ginzburg Landau theory

## **Part III**

# **Quantum field theory**

## Chapter 7

# Perturbative field theory

### 7.1 Path integral formulation

### 7.2 Field equations

### 7.3 Interacting fields

Feynman diagram

## **Chapter 8**

# **Non-perturbative field theory**

### **8.1 Algebraic quantum field theory**

## **Chapter 9**

# **Nonabelian gauge theory**

## **Part IV**



## **Chapter 10**

# **Supersymmetry**