

"Fenômenos Quânticos Macroscópicos e Dissipação Quântica"

1 Introduction

2 Elements of magnetism

- 2.1 Macroscopic Maxwell equations: the magnetic moment 6
- 2.2 Quantum effects and the order parameter 9
 - 2.2.1 Diamagnetism
 - 2.2.2 Curie-Weiss theory: ferromagnetism
 - 2.2.3 Magnetization: the order parameter
 - 2.2.4 Walls and domains
- 2.3 Dynamics of the magnetization
- 2.3.1 Magnetic particles
- 2.3.2 Homogeneous nucleation
- 2.3.3 Wall dynamics
- 2.4 Macroscopic quantum phenomena in magnets

3 Elements of superconductivity

- 3.1 London theory of superconductivity
- 3.2 Condensate wave function (order parameter)
- 3.3 Two important effects
 - 3.3.1 Flux quantization
 - 3.3.2 The Josephson effect
- 3.4 Superconducting devices
 - 3.4.1 Superconducting quantum interference devices (SQUIDs)
 - 3.4.2 Current biased Josephson junctions (CBJJs)
 - 3.4.3 Cooper pair boxes (CPBs)
- 3.5 Vortices in superconductors
- Contents v
- 3.6 Macroscopic quantum phenomena in superconductors

4 Brownian motion

- 4.1 Classical Brownian motion
- 4.1.1 Stochastic processes
- 4.1.2 The master and Fokker-Planck equations
- 4.2 Quantum Brownian motion
- 4.2.1 The general approach
- 4.2.2 The propagator method

5 Models for quantum dissipation

- 5.1 The bath of non-interacting oscillators: the minimal model
- 5.2 Particle in general media : non-linear coupling model
- 5.3 Collision model
- 5.4 Other environmental models

6 Implementation of the propagator approach

- 6.1 The dynamical reduced density operator
- 6.1.1 The minimal model case
- 6.1.2 The non-linear coupling case
- 6.1.3 The collision model case
- 6.2 The equilibrium reduced density operator

7 The damped harmonic oscillator

- 7.1 Time evolution of a Gaussian wave packet
- 7.2 Time evolution of two Gaussian packets: decoherence

8 Dissipative quantum tunnelling

- 8.1 Point particles
- 8.1.1 The zero temperature case
- 8.1.2 The finite temperature case
- 8.2 Field theories
- 8.2.1 The undamped zero temperature case
- 8.2.2 The damped case at finite temperatures

9 Dissipative coherent tunnelling

- 9.1 The spin-boson Hamiltonian
- 9.2 The spin-boson dynamics
- 9.2.1 Weak-damping limit

9.2.2 Adiabatic renormalization

9.2.3 Path integral approach

10 Outlook

10.1 Experimental results

vi Contents

10.2 Applications: superconducting qubits

10.2.1 Flux qubits

10.2.2 Charge qubits

10.2.3 Phase qubits and transmons

10.2.4 Decoherence

10.3 Final remarks

Appendix A Path integrals, the quantum mechanical propagator and density operators

A.1 Real time path integrals

A.2 Imaginary time path integrals

Appendix B The Markovian master equation

Appendix C Coherent state representation

Appendix D Euclidean methods

References

Index