

NEW FRONTEERS IN QUANTUM MECHANICS

2011/12

1 Decoherence and open quantum systems.

The aim is to provide the basic tools for working with open quantum systems, i.e. those systems whose interaction with the surrounding environment cannot be neglected. The general formalism will be revised, and the most important master equations will be introduced.

- 1.1 The master equation for open quantum systems.
- 1.2 The Lindblad equation.
- 1.3 Examples.
- 1.4 Joos+Zeh model.
- 1.5 Caldeira+Leggett model.
- 1.6 Quantum Brownian motion.

2 Stochastic Processes

We will provide the basic concepts of stochastic processes and stochastic differential equations, with application to complex systems, in particular quantum systems.

- 2.1 Probability theory.
- 2.2 Markov processes.
- 2.3 Ito calculus.
- 2.4 Fokker-Planck equation.
- 2.5 Examples.

3 Foundations of Quantum Mechanics

We will review the basic problems in quantum mechanics: the measurement problem, entanglement and nonlocality, Bell's inequalities, alternative formulations of quantum mechanics

- 3.1 Entanglement and nonlocality.
- 3.2 Bell's inequalities
- 3.3 Measurement Problem.
- 3.4 Alternative formulations of quantum mechanics.
- 3.5 Collapse models.

4 Laboratory

We will discuss relevant research articles in theoretical physics, related to the topics of the course.

Suggested books.

Gardiner C.W.: "Handbook of stochastic methods for physics, chemistry, and the natural sciences"

Breuer H.-P. and petruccione, F. "The theory of open quantum systems"

Ghirardi G.C. "Un'occhiata alle carte di Dio".

Plus: articles discussed during the classes.