Lecture Notes in Physics 782

Quantum Trajectories and Measurements in Continuous Time

The Diffusive Case

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Preface

Quantum trajectory theory is largely employed in theoretical quantum optics and quantum open system theory and is closely related to the conceptual formalism of quantum mechanics (quantum measurement theory). However, even research articles show that not all the features of the theory are well known or completely exploited. We wrote this monograph mainly for researchers in theoretical quantum optics and related fields with the aim of giving a self-contained and solid presentation of a part of quantum trajectory theory (the diffusive case) together with some significant applications (mainly with purposes of illustration of the theory, but which in part have been recently developed). Another aim of the monograph is to introduce to this subject post-graduate or PhD students. To help them, in the most mathematical and conceptual chapters, summaries are given to fix ideas. Moreover, as stochastic calculus is usually not in the background of the studies in physics, we added Appendix A to introduce these concepts. The book is written also for mathematicians with interests in quantum theories. Quantum trajectory theory is a piece of modern theoretical physics which needs an interplay of various mathematical subjects, such as functional analysis and probability theory (stochastic calculus), and offers to mathematicians a beautiful field for applications, giving suggestions for new mathematical developments. Appendix B presents the modern formalism of quantum mechanics and has the double role of collecting notions and results used throughout the book and of introducing to this subject peoples without a background in the axiomatic of quantum mechanics.

The so-called stochastic Scrödinger equation and stochastic master equation, which are the key equations of quantum trajectory theory, have been introduced also in different contexts, such as dynamical reduction theories. So, we developed the theory of such equations (existence of solutions, properties, etc.) also independently of the theory of measurements continuous in time.

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