Preface

In the fourteen years since the appearance of the first edition, the subject kept freshness. There have been interesting theoretical progress, important new applications and lots of stunning new experiments in the field.

The present edition of *Quantum Dissipative Systems* reflects two endeavours on my part: the improvement and refinement of material contained already in the second edition; the addition of new topics (and the omission of few).

The emphasis and major intensions are still the same, but there are changes, augmentations and additions. The major extensions, altogether about 60 pages, are:

- Chapter 3 contains a more detailed discussion of the quasiclassical Langevin equation and a subsection on Josephson flux and charge qubits.
- Chapter 4 gives wider space to the basics of path integration and to the treatment of an electromagnetic environment.
- Chapter 5 discusses the stochastic unraveling of path integrals for the reduced density matrix.
- Chaper 6 gives an extended discussion of the damped quantum harmonic oscillator. It includes discussion of internal energy, purity, and uncertainty.
- Chapter 15 presents a generalization of the Smoluchowski diffusion equation which includes quantum effects.
- Chapter 20 offers a broader discussion of single-charge tunneling in the weak-tunneling or Coulomb blockade regime.
- Chapter 21 discusses relaxation and decoherence in the spin-boson model at zero temperature. It presents analytical results for the relaxation and decoherence rate at general damping strength which cover the entire regime extending from weak to strong tunneling.
- Chapter 24 includes a discussion of the full counting statistics for Poissonian quantum transport and presents many analytical results available in special cases.
- Chapter 25 presents the scaling-invariant solution of the full counting statistics in diverse limits and discusses application to charge transport in Josephson junctions.

- Chapter 26 gives an extended discussion of charge transport in quantum impurity systems, including full counting statistics. It points out an intimate connection of these systems with models for coherent conductors and with others discussed in the preceding Chapters 23 – 25.

- The bibliography is updated.

This new edition has benefited from comments, suggestions and criticisms from many students and colleagues. Among those to whom I owe specific debt of gratitude are Holger Baur, Pino Falci, Hermann Grabert, Milena Grifoni, Yuli Nazarov, Elisabetta Paladino, Jürgen Stockburger, and Ruggero Vaia.

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Finally, I am grateful to my wife Christel for her sympathy and constant encouragement.

Stuttgart
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Preface to the Second Edition

Since the first publication of this book in 1993, there have been enormous research activities in quantum dissipative mechanics both experimentally and theoretically. For this reason, it has been highly desirable after the book has been sold out almost three years ago to undergo a number of extensions and improvements. I have been encouraged by the positive reception of this book by a large community and by many colleagues to write not simply an updated second edition. What came out now after all is almost a new book of roughly double content.

In an extensive rewriting, the 19 Chapters of the First Edition have been expanded by about one third to better meet the desires of both the newcomers to the field and the advanced readership, and I have added 7 new chapters. The most relevant extensions are as follows. In the first part, I have added a section on stochastic dynamics in Hilbert space and I have extended the discussion of relevant microscopic global models considerably. Now, there are also treated acoustic phonons with two-phonon coupling, a microscopic model for tunneling between surfaces, charging and environmental effects in normally conducting and superconducting tunnel junctions, and nonlinear quantum environments. Part II now contains an extended discussion of the damped harmonic oscillator (e.g., a study of the density of states is added), and new chapters on the thermodynamic variational approach and variational perturbation expansion method, and on the quantum decoherence problem. Part III, which deals with quantum-statistical decay, is extended by two chapters. In the new edition, the turnover theory to the energy-diffusion limited regime is discussed, and the treatment of dissipative quantum tunneling has been extended and improved. Ample space is now provided in Part IV to a thorough discussion of the dissipative two-state system. A number of new results on the thermodynamics and dynamics of this archetypal system are presented. An extensive discussion of electron transfer in a solvent, incoherent tunneling in the nonadiabatic regime, and single-charge tunneling is provided in a unified framework. Regarding dynamics, new sections on exact master equations, improved approximation schemes, and recent results on correlation functions have been written, and a new chapter on the driven dissipative two-state is included. Part V, which deals with the dissipative multi-state system, is completely rewritten. It now contains four chapters on quantum Brownian motion in a cosine potential, multi-state dynamics, duality symmetry, and tunneling of charge through an impurity in a quantum wire. Many new results available only very recently are presented. The about 460 references are suggestions for additional reading on particular subjects and are not intended as a comprehensive bibliography.

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