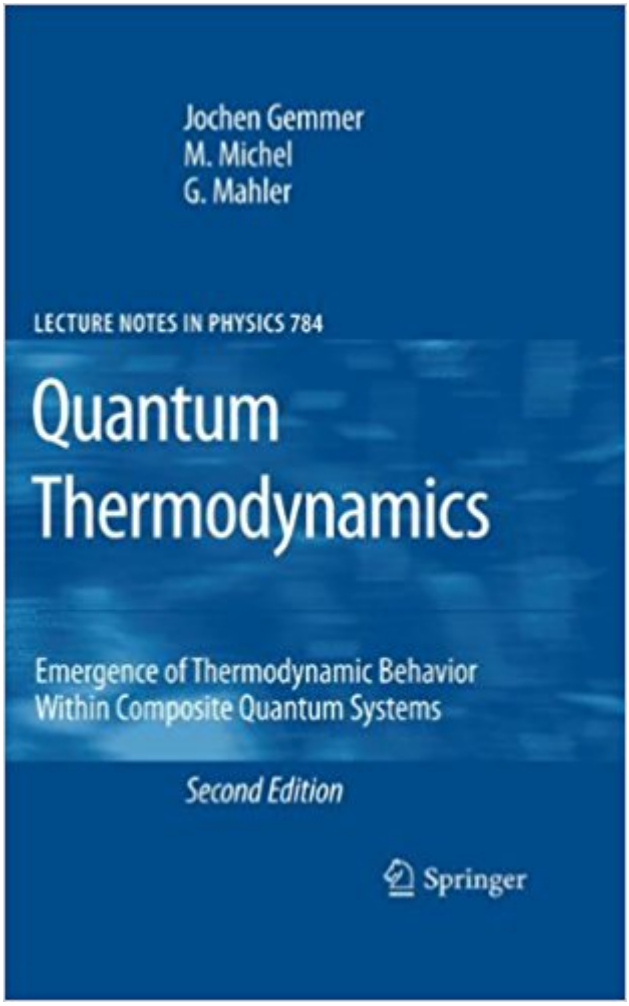
Quantum Thermodynamics: Emergence Of Thermodynamic Behavior Within Composite Quantum Systems (Lecture Notes In Physics)



Synopsis

Over the years enormous effort was invested in proving ergodicity, but for a number of reasons, con?dence in the fruitfulness of this approach has waned. Ã¢â ¬â ¢ Y. Ben-Menahem and I. Pitowsky [1] Abstract The basic motivation behind the present text is threefold: To give a new explanation for the emergence of thermodynamics, to investigate the interplay between quantum mechanics and thermodynamics, and to explore possible ext- sions of the common validity range of thermodynamics. Originally, thermodynamics has been a purely phenomenological science. Early s-entists (Galileo, Santorio, Celsius, Fahrenheit) tried to give de?nitions for quantities which were intuitively obvious to the observer, like pressure or temperature, and studied their interconnections. The idea that these phenomena might be linked to other ?elds of physics, like classical mechanics, e.g., was not common in those days. Such a connection was basically introduced when Joule calculated the heat equ- alent in 1840 showing that heat was a form of energy, just like kinetic or potential energy in the theory of mechanics. At the end of the 19th century, when the atomic theory became popular, researchers began to think of a gas as a huge amount of bouncing balls inside a box.

Book Information

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Customer Reviews

From the reviews of the second edition:Ã¢â ¬Å“The aim of this textbook is to show how thermodynamic behavior can emerge for a given finite quantum system. Ã¢â ¬Â¦ The book is written in a conceptually simple language, the focus being rather on the careful interpretation of the

concepts at hand and their illustrations on model systems. Ã¢â ¬Â¦ presents some applications to model systems, which allows one to illustrate more precisely previously introduced notions.Ã¢â ¬Â• (Gabriel Stoltz, Mathematical Reviews, Issue 2011 f)Ã¢â ¬Å“This book introduces into the emergent field of the application of thermodynamics to describe phenomena arising with open quantum systems which consist in one or few particles. Ã¢â ¬Â¦ A clue of this book is that ergodicity or mixing are replaced by a kind of typicality which is introduced and used as a basic concept to define equilibrium. Ã¢â ¬Â¦ This is a heuristic approach and the results derived show how it works well.Ã¢â ¬Â• (K.-E. Hellwig, Zentralblatt MATH, Vol. 1221, 2011)

This introductory text treats thermodynamics as an incomplete description of quantum systems with many degrees of freedom. Its main goal is to show that the approach to equilibriumÃ¢â ¬â ¢with equilibrium characterized by maximum ignorance about the open system of interestÃ¢â ¬â ¢neither requires that many particles nor is the precise way of partitioning, relevant for the salient features of equilibrium and equilibration. Furthermore, the text depicts that it is indeed quantum effects that are at work in bringing about thermodynamic behavior of modest-sized open systems, thus making Von NeumannÃ¢â ¬â„¢s concept of entropy appear much more widely useful than sometimes feared, far beyond truly macroscopic systems in equilibrium. This significantly revised and expanded second edition pays more attention to the growing number of applications, especially non-equilibrium phenomena and thermodynamic processes of the nano-domain. In addition, to improve readability and reduce unneeded technical details, a large portion of this book has been thoroughly rewritten. Ã Â Ã Â From the reviews of the first edition: This textbook provides a comprehensive approach, from a theoretical physics point of view, to the question of emergence of thermodynamic behavior in quantum systems... [Its] strength lies in the careful development of the relevant concepts, in particular the question how large a system needs to be to exhibit thermodynamic behavior is addressed. Luc Rey-Bellet (Amherst, MA), Mathematical Reviews 2007e

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