Fundamental mathematical structures of quantum theory. *Spectral theory, foundational issues, symmetries, algebraic formulation.*

The book starts from a comprehensive, self-contained and advanced treatment of the mathematical problems which arise in elementary Quantum Mechanics, especially about the spectral theorem and the use of unbounded operators.

On the basis of the analysis and interpretation of the associated spectral, projector-valued measures, it then proceeds to the reconstruction of Quantum Mechanics in terms of the logical structure of yes/no observables and of the corresponding notion of state,characterized by means of Gleason's theorem.

The framework so obtained allows for a concise, but substantially complete, exposition of the main results on the "non-classicality" of Quantum Mechanics and of the associated foundational questions.

A rather complete examination of the fundamental results about superselection rules and symmetries is then provided, by the use and elaboration of the previously introduced mathematical structures.

The last chapter gives an introduction to the algebraic formulation of Quantum Mechanics, as a general setting providing a synthetic reformulation of many of the previously discussed notions.

One may say that the aim of the book is to lead the reader from a systematic treatment of the questions which are "naturally" posed by a mathematically minded student of Quantum Mechanics to the examination of the most abstract and fundamental mathematical structures of Quantum Mechanics and Quantum Field Theory.

The exposition is abstract and aims to generality, in particular in the use of unbounded operators, but motivations are always discussed and many concrete examples are worked out.

The book can be read on the basis of an elementary knowledge of Hilbert spaces and measure theory. For mathematicians, it can be used as an introduction to Quantum Mechanics and a detailed guide to the associated mathematical problems; for the reader familiar with Quantum Mechanics, it provides an extensive insight into the mathematical discussion of its structural and foundational issues.

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