

Preface

This volume collects the selected contributions presented at or inspired by the *15th International Workshop on Pseudo-Hermitian Hamiltonians in Quantum Physics* (PHHQP15), held in Palermo, Italy, from May 18 to 23, 2015. This workshop was the 15th in the series of international meetings that was started in 2003. These meetings were mainly attended by mathematicians and physicists interested in the study of non-Hermitian operators and Hamiltonians, and in their physical applications. About 80 mathematicians and physicists attended the 2015 Workshop in Palermo.

Even though mathematicians have deeply studied several aspects of the spectral theory of operators since long time, the realization that non-Hermitian Hamiltonians with PT symmetry may have a real spectrum has produced a growing interest in theoretical physicists for this subject. From the mathematical side this renewed perspective concerning operators with real spectrum has put on the stage new methods aimed to find conditions for a non-self-adjoint operator to have a real spectrum or it has led to revisiting (and, often, generalizing) older concepts (similarity, affinity, metric operators, etc.) as tools for studying this problem. From a physical point of view the main outcome of this unconventional approach to quantum mechanics has been the exploration of several new and interesting models.

Started as a pure mathematical problem, the subject of non-Hermitian Hamiltonians with PT (parity-time) symmetry has rapidly grown in the past years. It has also attracted much interest for its possible applications in physics, since when it was shown that non-Hermitian Hamiltonians with PT symmetry can have a real spectrum.

Nowadays, in fact, PT-symmetric non-Hermitian Hamiltonians have found application in several areas of physics, for example in quantum optics, condensed matter physics, non-equilibrium statistical physics, and quantum field theory, from both the theoretical and experimental points of view. Typical important systems that can be described by non-Hermitian Hamiltonians endowed with PT symmetry are open systems with balanced gain–loss terms, where gain–loss mechanisms break the Hermiticity while preserving the PT symmetry. Realistic examples are given by

optical waveguides and periodic lattices with balanced absorption or amplification. Other relevant aspects that have received great attention in recent times are, among the others, PT-symmetry breaking phase transitions and formation of exceptional points and spectral singularities.

The papers in this volume will cover several aspects of PT-symmetric non-Hermitian Hamiltonians, investigating both mathematical and physical aspects of the research topics mentioned above.

Palermo, Italy

Fabio Bagarello
Roberto Passante
Camillo Trapani

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