

Who ordered that? PT-symmetric non-Hermitian Quantum Mechanics

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In 1998, it was found that non Dirac Hermitian systems can still have real energy levels if their Hamiltonian is PT-symmetric. Since the condition of PT symmetry is weaker than the requirement of Dirac Hermiticity the question arises, whether or not allowing for a new class of Hamiltonians is a true extension of conventional quantum mechanics.

To date, over 1000 published papers and a dozen international conferences have addressed this and other open questions and have been devoted to the consequences of PT-symmetric non-Hermitian Quantum Mechanics (PTQM).

The past two years, however, have shown most remarkable experimental progress in the field, not only verifying the theoretical predictions of PTQM, but also directly demonstrating its application and showing some of its strange and unexpected properties. In addition, PTQM offers the possibility of developing new kinds of devices and materials and may provide new analytical tools for attacking some of the current puzzles in physics: Is there a Higgs particle, is there dark matter, how can one quantize gravity, and why is there more matter than antimatter in the universe?

In my talk I will introduce the concepts of PT-symmetric non-Hermitian Quantum Mechanics and report on some of its latest developments, as they were presented recently at the PTQM-2011 symposium, that took place here in Heidelberg at the end of September. I will then turn to an experiment currently in progress in my Atomic Beam Spin Echo laboratory, that focusses on revealing the quantum mechanical essence of the theory and its connection to conventional quantum mechanics.