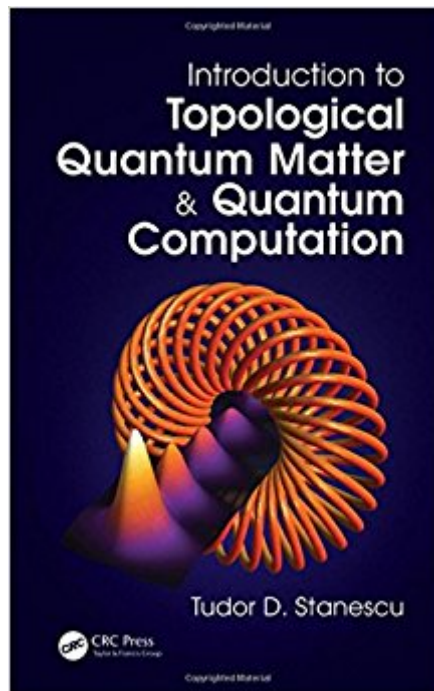




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# Introduction To Topological Quantum Matter & Quantum Computation



## Synopsis

What is "topological" about topological quantum states? How many types of topological quantum phases are there? What is a zero-energy Majorana mode, how can it be realized in a solid state system, and how can it be used as a platform for topological quantum computation? What is quantum computation and what makes it different from classical computation? Addressing these and other related questions, *Introduction to Topological Quantum Matter & Quantum Computation* provides an introduction to and a synthesis of a fascinating and rapidly expanding research field emerging at the crossroads of condensed matter physics, mathematics, and computer science. Providing the big picture, this book is ideal for graduate students and researchers entering this field as it allows for the fruitful transfer of paradigms and ideas amongst different areas, and includes many specific examples to help the reader understand abstract and sometimes challenging concepts. It explores the topological quantum world beyond the well-known topological insulators and superconductors and emphasizes the deep connections with quantum computation. It addresses key principles behind the classification of topological quantum phases and relevant mathematical concepts and discusses models of interacting and noninteracting topological systems, such as the toric code and the p-wave superconductor. The book also covers the basic properties of anyons, and aspects concerning the realization of topological states in solid state structures and cold atom systems. Quantum computation is also presented using a broad perspective, which includes fundamental aspects of quantum mechanics, such as Bell's theorem, basic concepts in the theory of computation, such as computational models and computational complexity, examples of quantum algorithms, and elements of classical and quantum information theory.

## Book Information

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"In the last twenty years, several themes have come to the forefront of quantum condensed matter physics research through cross-fertilization with other disciplines, such as: topological matter and its emergent quasiparticles, quantum information theory, and quantum computation. This new book from Tudor Stanescu provides a much needed comprehensive introduction to this area of research. Clearly written, it takes the reader from the relevant concepts in quantum mechanics, to physical realizations in cold atom systems and heterostructures, going through the necessary concepts and multiple examples. Written from a condensed matter physics perspective, it will be a valuable reference and will serve as an advanced textbook at the graduate level in this important disciplinary area."â •Gabriel Kotliar, Rutgers University

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