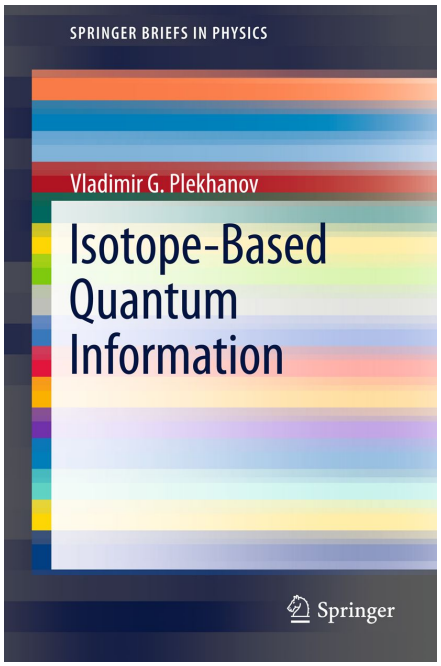

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Physics : Quantum Information Technology, Spintronics

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Isotope-Based Quantum Information

- Introduces the new field of isotope-based quantum information
- Provides the main ideas and techniques of the rapid progressing field of quantum information and quantum computation using isotope-mixed materials
- Presents how to design innovative devices with potential application in quantum computing
- Explains the origin of isotope effects relevant to quantum information and compiles the important concepts
- Presents the different new models of quantum computers

The present book provides to the main ideas and techniques of the rapid progressing field of quantum information and quantum computation using isotope - mixed materials. It starts with an introduction to the isotope physics and then describes of the isotope - based quantum information and quantum computation. The ability to manipulate and control electron and/or nucleus spin in semiconductor devices provides a new route to expand the capabilities of inorganic semiconductor-based electronics and to design innovative devices with potential application in quantum computing. One of the major challenges towards these objectives is to develop semiconductor-based systems and architectures in which the spatial distribution of spins and their properties can be controlled. For instance, to eliminate electron spin decoherence resulting from hyperfine interaction due to nuclear spin background, isotopically controlled devices are needed (i.e., nuclear spin-depleted). In other emerging concepts, the control of the spatial distribution of isotopes with nuclear spins is a prerequisite to implement the quantum bits (or qbits). Therefore, stable semiconductor isotopes are important elements in the development of solid-state quantum information. There are not only different algorithms of quantum computation discussed but also the different models of quantum computers are presented. With numerous illustrations this small book is of great interest for undergraduate students taking courses in mesoscopic physics or nanoelectronics as well as quantum information, and academic and industrial researches working in this field.

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