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Nota di contenuto	One Dimensional Superconductivity in Nanowires; Contents; Preface; Abbreviations and Symbols; Color Plates; Part One Theoretical Aspects of Superconductivity in 1D Nanowires; 1 Superconductivity: Basics and Formulation; 1.1 Introduction; 1.2 BCS Theory; 1.3 Bogoliubov-de Gennes Equations - Quasiparticle Excitations; 1.4 Ginzburg-Landau Theory; 1.4.1 Time-Dependent Ginzburg-Landau Theory; 1.5 Gorkov Green's Functions, Eilenberger-Larkin-Ovchinnikov Equations, and the Usadel Equation; 1.6 Path Integral Formulation; References; 2 1D Superconductivity: Basic Notions; 2.1 Introduction 2.2 Shape Resonances - Oscillations in Superconductivity Properties 2.2.1 Early Treatments of Shape Resonances in 2D Films; 2.2.2 Bogoliubov-de Gennes Equations, Finite Temperature, and Parabolic-Band Approximation for Realistic Materials; 2.2.3 Numerical Solutions and Thin Film Shape Resonances; 2.2.4 1D Nanowires - Shape Resonances and Size Oscillations; 2.3 Superconductivity in Carbon Nanotubes - Single-Walled Bundles and Individual Multiwalled Nanotubes; 2.4 Phase Slips; 2.4.1 Finite Voltage in a Superconducting Wire and Phase Slip; 2.4.2 Phase Slip in a Josephson Junction

2.4.3 Langer-Ambegaokar Free Energy Minima in the Ginzburg-Landau Approximation 2.4.4 Transition Rate and Free Energy Barrier; 2.4.5 Free Energy Barrier for a Phase Slip in the Ginzburg-Landau Theory; 2.4.6 Physical Scenario of a Thermally-Activated Phase Slip; 2.4.7 McCumber-Halperin Estimate of the Attempt Frequency; References; 3 Quantum Phase Slips and Quantum Phase Transitions; 3.1 Introduction; 3.2 Zaikin-Golubev Theory; 3.2.1 Derivation of the Low Energy Effective Action; 3.2.2 Core Contribution to the QPS Action; 3.2.3 Hydrodynamic Contribution to the Phase-Slip Action 3.2.4 Quantum Phase-Slip Rate 3.2.5 Quantum Phase-Slip Interaction and Quantum-Phase Transitions; 3.2.6 Wire Resistance and Nonlinear Voltage-Current Relations; 3.3 Short-Wire Superconductor-Insulator Transition: Buchler, Geshkenbein and Blatter Theory; 3.4 Refael, Demler, Oreg, Fisher Theory - 1D Josephson Junction Chains and Nanowires; 3.4.1 Discrete Model of 1D Josephson Junction Chains; 3.4.2 Resistance of the Josephson Junctions and the Nanowire; 3.4.3 Mean Field Theory of the Short-Wire SIT; 3.5 Khlebnikov-Pryadko Theory - Momentum Conservation 3.5.1 Gross-Pitaevskii Model and Quantum Phase Slips 3.5.2 Disorder Averaging, Quantum Phase Transition and Scaling for the Resistance and Current-Voltage Relations; 3.5.3 Short Wires - Linear QPS Interaction and Exponential QPS Rate; 3.6 Quantum Criticality and Pair-Breaking - Universal Conductance and Thermal Transport in Short Wires; References; 4 Duality; 4.1 Introduction; 4.2 Mooij-Nazarov Theory of Duality - QPS Junctions; 4.2.1 QPS Junction Voltage-Charge Relationship and Shapiro Current Steps; 4.2.2 QPS Qubits 4.3 Khlebnikov Theory of Interacting Phase Slips in Short Wires: Quark Confinement Physics

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## Sommario/riassunto

The book introduces scientists and graduate students to superconductivity, and highlights the differences arising from the different dimensionality of the sample under study. It focuses on transport in one-dimensional superconductors, describing relevant theories with particular emphasis on experimental results. It closely relates these results to the emergence of various novel fabrication techniques. The book closes by discussing future perspectives, and the connection and relevance to other physical systems, including superfluidity, Bose-Einstein condensates, and possibly cosmic strings.

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