

---

## Contents

### Classical Percolation

<i>D. Stauffer</i> .....	1
1 Introduction .....	1
2 Methods .....	3
3 Quantities and Exponents .....	6
4 Fractal Dimension: Incipient Infinite Cluster .....	9
5 Simple Renormalisation Group .....	12
6 Diffusion and Percolation .....	14
7 Summary .....	18
References .....	18

### Nonlinear Response, Semi-classical Percolation and Breakdown in the RRTN Model

<i>A.K. Sen</i> .....	21
1 Introduction .....	21
2 The Origin of the RRTN Model and Its Percolative Aspects .....	27
3 Nonlinear Steady-State $I$ - $V$ Characteristics .....	35
4 Periodic Driving and AC-Response in the RRTN/CRC Model .....	46
5 VRH and Low Temperature Conduction in the RRTN .....	55
6 Slow Power-law Dynamics Far-from-Equilibrium .....	59
7 Aspects of Reversible Breakdown in the RRTN Model .....	65
8 Dynamical Characteristics of Breakdown .....	73
9 Summary and Further Works .....	77
References .....	78

### Quantum Transmittance Through Random Media

<i>A. Mookerjee, T. Saha-Dasgupta, and I. Dasgupta</i> .....	83
1 Introduction .....	83
2 One Parameter Scaling Theory of Localization .....	84
3 Transport Mechanisms in Disordered Media .....	85
4 Some Models of Disordered Systems .....	87

5	Some Earlier Studies on the Quantum Percolation Model .....	89
6	The Vector Recursion Method and Its Applications .....	92
7	Conclusions .....	105
	References .....	106

**Quantum Percolation in Two Dimensions**

<i>H. Nakanishi, and Md. Fhokrul Islam</i> .....		109
1	Introduction .....	109
2	Resonances and Phase Variations in Ordered Limit .....	116
3	Time-Independent Schrödinger Equation for Finite Disorder .....	120
4	Time-Dependent Schrödinger Equation: Sending a Wave Packet Through a 2D Cluster .....	125
5	Summary .....	132
	References .....	133

**Quantum Percolation in Disordered Structures**

<i>G. Schubert and H. Fehske</i> .....		135
1	Introduction .....	135
2	Local Distribution Approach .....	137
3	Localization Effects in Quantum Percolation .....	144
4	Percolative Effects in Advanced Materials .....	154
5	Conclusions .....	159
	References .....	160

**Quantum Percolation in the Quantum Hall Regime**

<i>C. Sohrmann, J. Oswald and R.A. Römer</i> .....		163
1	Introduction .....	163
2	The Quantized Hall Effect and Classical Percolation .....	165
3	Network Models at the IQHE .....	168
4	Hartree-Fock Approach to the IQHE .....	184
5	Conclusions .....	189
	References .....	190

**Percolative Quantum Transport in Manganites**

<i>P. Majumdar</i> .....		195
1	Introduction .....	195
2	Standard Quantum Percolation .....	196
3	Manganites: Phenomenology and Model .....	198
4	Percolative Effects in a One Band Model of Phase Competition .....	205
5	Percolation in Two Band Models with Electron-Phonon Coupling .....	217
6	Connection with Quantum Percolation and Resistor Networks .....	221
7	Conclusions .....	225
	References .....	225

**Classical and Quantum Breakdown in Disordered Materials**

*D. Samanta, B.K. Chakrabarti and P. Ray* ..... 227

1 Introduction ..... 227

2 Analysis of the Fuse Problem ..... 229

3 Dielectric Breakdown Problem ..... 238

4 Zener Breakdown in Anderson Insulators ..... 247

5 Conclusions ..... 249

References ..... 249

**Nonequilibrium Quantum Breakdown in a Strongly Correlated Electron System**

*T. Oka and H. Aoki* ..... 251

1 Introduction ..... 251

2 Nonadiabatic Evolution and Pair Creation of Carriers ..... 256

References ..... 283

**Percolation in Quantum Computation and Communication**

*K. Kieling and J. Eisert* ..... 287

1 Introduction ..... 287

2 Percolation and Quantum Computing ..... 290

3 Quantum Repeater Networks for Quantum Communication ..... 307

4 Summary and Open Problems ..... 315

References ..... 317

**Index** ..... 321