

Contents

1. Introduction	1
2. Short Pulses in Optical Fibres	5
2.1 Solitons in Single-Mode Fibres.	6
2.2 Self-Phase Modulation of Pulses	11
2.3 Soliton Regime of Ultrashort Pulse Propagation.	
Bright and Dark Solitons	13
2.3.1 Presoliton Region	16
2.3.2 Near-Soliton Region	17
2.3.3 Multi-Soliton Region	18
2.4 Observations of Solitons	21
2.5 Electromagnetic Shock Waves	23
2.6 Influence of Higher Order Dispersion and Dissipation on Soliton Dynamics	27
2.7 Amplification of Optical Solitons in Fibres	30
2.8 Modulation Instability of Electromagnetic Waves	37
2.9 Generation of Periodic Pulse Sequences	39
2.10 Multi-Mode Effects on Soliton Regimes of Propagation	46
2.11 The Soliton Laser	48
2.12 The Soliton Self-Frequency Shift	52
2.13 Multi-Component (Vector) Optical Solitons	54
3. Soliton Interaction	57
3.1 General Representations in Integrable and Nonintegrable Systems:	
Direct and IST-Based Methods	57
3.2 Interaction Between Optical Solitons	62
3.3 Inelastic Soliton Interactions	66
3.4 Interaction Between a Soliton and a Nonlinear Periodic Wave in an Optical Fibre	71
3.5 Solitons in Two Tunnel-Coupled Optical Waveguides	76
4. Statistical Dynamics of Optical Solitons	81
4.1 Random Pulses in an Optical Fibre.	
Numerical Simulation in the Presoliton Region	81

4.2	Noise Signals in the Near Field	86
4.3	Noise Signals in the Far Field	88
4.4	Random Pulses in Fibres (Soliton Region)	91
4.5	Solitons in Random Nonuniform Fibres	97
4.6	Random Amplification of Solitons	101
4.7	Dynamic Chaos of Optical Solitons	105
4.8	Optical Turbulence in Passive Optical Resonators	110
5.	Optical Solitons in Resonant and Active Media	115
5.1	The Maxwell-Bloch System. Soliton Solutions	115
5.2	Optical Solitons in an Active Fibre	119
5.3	Scattering of a Weak Wave on an Optical Soliton	121
5.4	Theory of Superfluorescence	125
5.5	Solitons in Stimulated Raman Scattering	130
5.6	The Evolution of SRS Solitons Under the Action of Molecular Relaxation	133
6.	Quantum Optical Solitons	139
6.1	Hamiltonian Formulation of the IST-Method and Classical r-Matrix	140
6.2	Quantum Nonlinear Schrödinger Equation (QNLSE)	144
6.3	Quantum Sine-Gordon System	149
6.4	The Dicke Model	152
7.	Conclusion	159
Appendix		161
References		181
Subject Index		189