

Contents

Preface	ix
Acknowledgments	xi
1 Introduction	1
1.1 Introduction	1
1.2 Mean-Field Description of Bose–Einstein Condensates	7
2 The One-Dimensional Case	17
2.1 General Background for the Study of Dark Solitons	17
2.2 Matter-Wave Dark Solitons in Quasi-1D Bose Gases	32
2.3 “Low-Dimensional” Multidimensional Dark Solitons	49
2.4 Matter-Wave Dark Solitons in Multicomponent BECs	66
2.5 Some Distinct One-Dimensional Settings	109
2.6 Dissipative Effects: Finite-Temperature Condensates	130
3 The Two-Dimensional Case	157
3.1 Ground State, Fundamental Vortex, and Other Radially Symmetric Solutions: Existence, Stability, and Dynamics	157
3.2 Stability and Dynamical Properties of a Single-Charge Vortex	165
3.3 Dark Soliton Stripes	173
3.4 Few-Vortex Clusters/Crystals: The Low Density Limit of Bifurcation from Linear States	179
3.5 Few-Vortex Clusters/Crystals: The High Density Limit of Interacting Particles	187
3.6 Using the Handle of Anisotropy: Modifications of Existence, Stability, and Dynamics of Vortices in Anisotropic BECs	228
3.7 Two-Dimensional Few-Well Potentials	239
3.8 A Generalization: Two-Dimensional Nonlinear States in a Combination of a Magnetic Trap and an Optical Lattice	243
3.9 The Role of Impurities in Two-Dimensional BECs: Some Case Examples	266
3.10 Quantum Turbulence in Two-Dimensional BECs	295
3.11 Multicomponent Two-Dimensional BECs	301
3.12 Exciton-Polaritons: An Emerging (Open System) Variant of Two-Dimensional BECs	329
4 The Three-Dimensional Case	335
4.1 Introduction	335

4.2	Vortex Lines	335
4.3	Vortex Rings	344
4.4	Multicomponent BECs	362
4.5	New Computational Tools	370
	Bibliography	379
	Index	425