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Nota di contenuto	Preface; Foreword; Participants of FINES 2009 (Durham); Contents; Common Symbols/Expressions and their Meanings; Part I. Introductory Material; Editorial Notes; I.A. Quantum Gases: The Background; 1. Quantum Gases: Setting the Scene N.P. Proukakis & K. Burnett; 1.1. Introduction: Background to Quantum Fluids and Gases; 1.2. History of Non-Equilibrium and Finite-Temperature Pure BEC Experiments; 1.2.1. The Search for Idealised Systems: Spin-Polarised Hydrogen; 1.2.2. The Twist to an Unlikely Candidate: The Scene Opens up for Alkali Atoms; 1.2.3. Rival Candidates Gaining Ground? 1.3. Modelling Quantum Degenerate Gases 1.3.1. The Success of Phenomenology; 1.3.2. Ab Initio Modelling; 1.3.2.1. The Gross-Pitaevskii Equation; 1.3.2.2. Generalised Kinetic Theories; 1.3.3. Classical-Field and Stochastic Approaches; 1.3.4. Modelling Related Systems; 1.4. Unified Features of Quantum Gases; 1.4.1. Non-Equilibrium BECs and the Thermal Phase Transition; 1.4.2. Thermal and

Quantum Fluctuations; 1.4.3. Quantum Phase Transitions and Disorder; 1.4.4. The Superfluid Fraction, its Relation to the Condensate and the Issue of Fragmentation; 1.4.5. Strongly Correlated Physics 1.4.6. Ultracold Fermions 1.4.7. Potential Applications; 1.4.8. Other Systems Exhibiting Condensation; Acknowledgements; I.B. Quantum Gases: Experimental Considerations; 2. Ultracold Quantum Gases: Experiments with Many-Body Systems in Controlled Environments P. Kruger; 2.1. Introduction; 2.2. Condensate Formation and Growth; 2.3. Excitations of Bose-Einstein Condensates; 2.4. Strongly Correlated and Phase-Fluctuating Systems; 2.4.1. Feshbach Resonances; 2.4.2. Optical Lattices; 2.4.3. Low-Dimensional Systems; Acknowledgements 3. Ultracold Quantum Gases: Key Experimental Techniques S.A. Hopkins & S.L. Cornish 3.1. Introduction; 3.2. Basic Experimental Techniques; 3.2.1. Overview; 3.2.2. Laser Cooling and Trapping of Atoms; 3.2.3. Magnetic Traps; 3.2.4. Dipole Traps; 3.2.5. Evaporative (and Sympathetic) Cooling; 3.2.6. Feshbach Resonances; 3.2.7. Manipulation and Visualisation; 3.2.8. Cold Molecules; 3.3. High-Level Techniques; 3.3.1. Interferometry; 3.3.2. Optical Lattices; 3.3.3. Rotation, Vortices, and Phase Imprinting; 3.3.4. Microtraps (or 'Atom Chips'); 3.3.5. Matter-Wave Lasers (or 'Atom Lasers') 3.4. New Tools and Topical Areas 3.5. Summary and Outlook; Acknowledgements; I.C. Quantum Gases: Background Key Theoretical Notions; 4. Introduction to Theoretical Modelling M.J. Davis, S.A. Gardiner, T.M. Hanna, N. Nygaard, N.P. Proukakis & M.H. Szymanska; 4.1. Introduction; 4.2. Second Quantisation; 4.3. Effective Interactions; 4.4. Broken Symmetry Versus Number Conservation; 4.5. Fluctuations and Degeneracy in Low Dimensions; 4.6. Periodic Potentials ('Optical Lattices'); 4.7. Fermionic Issues; 4.8. Feshbach Resonances; 4.9. Summary; Acknowledgements

Part II. Ultracold Bosonic Gases: Theoretical Modelling

Sommario/riassunto

The 1995 observation of Bose-Einstein condensation in dilute atomic vapours spawned the field of ultracold, degenerate quantum gases. Unprecedented developments in experimental design and precision control have led to quantum gases becoming the preferred playground for designer quantum many-body systems. This self-contained volume provides a broad overview of the principal theoretical techniques applied to non-equilibrium and finite temperature quantum gases. Covering Bose-Einstein condensates, degenerate Fermi gases, and the more recently realised exciton-polariton condensates, it fills a gap