Contents

	Cuvening the quantum	į
	1.1 One century of quantum physics	4
	1.2 Emergence of the microscopic world	10
	1.3 Thought experiments coming of age	14
	1.4 Aims and outline of this book	20
2	Strangeness and power of the quantum	25
	2.1 The superposition principle and the wave function	26
	2.2 Quantum interference and complementarity	34
	2.3 Identical particles	42
	2.4 Entanglement and non-locality	52
	2.5 The quantum–classical boundary	68
	2.6 Taming the quantum to process information	83
3		101
	3.1 The field oscillator	106
	3.2 Coupled field modes	126
	3.3 The spin system	143
	3.4 Coupling a spin and a spring: the Jaynes-Cumming	gs model 151
4		163
	4.1 Quantum description of open systems	165
	4.2 Quantum maps: the Kraus sum representation	173
	4.3 The Lindblad master equation	178
	4.4 Quantum Monte Carlo trajectories	189
	4.5 Damped spin-spring system: from Rabi to Purcell	203
	4.6 Kicking a spring with spins: the micromaser	208
	4.7 Collective coupling of $\mathcal N$ spins to a spring: superrac	diance 220
5	Photons in a box	231
	5.1 A short history of cavity QED	232
	5.2 Giant atom in a cavity: an ideal cavity QED situation	
	5.3 Two experiments unveiling the quantum in a cavity	
	5.4 An atom-photon entangling machine	278
6	Seeing light in subtle ways	297
	6.1 Complementarity at quantum-classical houndary	200

	6.2	Non-destructive photon number measurement	313
	6.3	A quantum gate for multi-particle entanglement engineering	326
	6.4	The quantum analogue/digital converter	334
	6.5	Photon number parity and Wigner function measurements	348
7	Tam	ing Schrödinger's cat	353
	7.1	Representations of photonic cats	358
	7.2	A thought experiment to generate optical cats	364
	7.3	Dispersive cats in cavity QED	369
	7.4	Resonant cats in cavity QED	385
	7.5	Decoherence of cavity cats	405
	7.6	Non-local cats	430
8	Ato	ms in a box	443
	8.1	Ion trap physics	446
	8.2	Engineering ionic states of motion	471
	8.3	Ion relaxation and engineered environments	478
	8.4	Quantum logic with trapped ions: individual qubit addressing	489
	8.5	Quantum logic with trapped ions: collective qubit addressing	501
	8.6	Perspectives of ion traps for quantum information	513
9		angling matter waves	517
	9.1	Second quantization of matter waves	520
	9.2	Main features of Bose–Einstein condensation	525
	9.3	The phase in Bose–Einstein condensate interference	526
	9.4	Coherent collisions and cat-state generation	53 4
	9.5	Matter waves in periodical lattices	546
	9.6	Entangling collisions in a Bose–Einstein condensate	556
10	Con	clusion	565
Appendix		569	
	A.1	Characteristic functions	570
	A.2	The Wigner distribution	572
	A.3	The Husimi- Q distribution	579
	A.4	Phase-space representations of relaxation	582
Bibliography		587	
Inc	dex		603