

## Index

### a

AC Zeeman effect 132  
 Addressability 127  
 adiabatic limit 75  
 adiabatic suppression 75  
 adiabatic transport 86  
 algorithmic cooling 114, 383  
 algorithms 69  
 analogue complexity 390  
 analogue-to-digital conversion 388  
 anharmonic dispersion 59  
 annihilation and creation operators 79  
 approximate trajectories 86  
 array of microcondensates 150  
 aspect-ratio rule 87  
 associated Laguerre polynomials 77  
 asymmetric Mach-Zehnder interferometer 327  
 atom chip 127, 185  
   Bose-Einstein condensation 185  
   integrated optics 185  
 atom-surface distance 131  
 atom-surface interactions 131  
 Autler-Townes splitting 222  
 autoionization 240

### b

bang-bang operations 393  
 BB84 308  
 BB84 protocol 315  
 Bell state 250, 252, 288  
 BEM 66  
 Bessel function 345  
 bistability  
   one-atom maser 11  
 bit-flip noise 266  
 Bloch-Redfield approach 267  
 blockade 231, 239  
 Bose-Einstein condensate 122, 128, 145, 224, 483  
 Bose-Hubbard model 102  
 Boundary Element Method 66  
 Bragg scattering 176  
 Breidbart 308

### c

Carr-Purcell-Meiboom-Gill (CPMG) 261  
 cascade 320  
 cavity finesse 136, 138  
 cavity QED 136  
 cavity quantum electrodynamics 1  
   strong coupling 1  
 cavity-cooling 181  
 central limit theorem 149  
 cheating 308  
 chip surface 128, 131  
 chirped pulses 340  
 chromatic index 391  
 class number 360  
 class number formula 368  
 classical dynamics 72  
 classical energy transfer 77  
 cluster state 124  
 CNOT gate 275  
 CO<sub>2</sub>-laser 146  
 coherence lifetime 127, 131  
 coherence measurement 129  
 coherent collisions 124  
 coherent destruction of tunneling 272  
 coherent state 77, 80  
 collapse and revival 8, 26  
   one-atom maser 8  
 collective atomic recoil laser 156  
 collective coupling 157  
 collective instability 168  
 collisional interaction 127  
 collisional phase 126  
 collisional phase gate 133  
 collisional shifts 107  
 color centers 33  
 complementary error function 342  
 computational complexity 385  
 continuous complexity 390  
 continuous variable system 389  
 controlled collisions 124  
 conveyer belt 123  
 cooling 378, 383  
 cooperativity 136, 138  
 coplanar waveguide 133

- correlation function 304, 306, 307
- coupling strength 2
- cryptography 303
- cumulant generating function, CGF 428, 430
  
- d**
- dark MOT 147
- decoherence 29, 129, 260
- density matrix 245, 246
- dephasing time 444
- depth 377
- detection of atoms 186
  - absorption 187
  - cavity enhanced detection 189
  - cavity with small mode waist 205
  - fluorescence 186
  - refraction 189
- Deutsch-Josza algorithm 246
- dipole
  - blockade 228
  - induced 234, 240
  - interaction 228, 235
  - moment 235, 237
  - permanent 235, 240
  - resonant 236
  - trap 146, 160
- dipole-dipole coupling 255
- discrete ill-posed problem 89
- discriminant 359
- dispersion 77
- dispersive detection 135
- distance function 364
- disturbance 404
  - minimal 404
- double well potential 133
- dragged quantum harmonic oscillator 78
- dynamical decoupling 271
  
- e**
- eavesdropping 307
- Electron Nuclear Double Resonance (ENDOR) 251, 252
- Electron Paramagnetic Resonance (EPR) 251, 252
- electron spin echo 258
- electron-electron interaction 434, 443
- endohedral fullerene 251
- ENDOR-spectrum 255
- energy transfer 228, 236, 237, 240
- ensemble quantum computation 108
- entanglement 27, 378, 381
  - distillation 287
  - multiparticle 29
  - verification 331
- EPR pulses 256
- Ermakov equation 73
  
- error correction 311, 319
- error function transport 84
- error rate 311
- evaporative cooling 147
- extended Gaussian wave packet dynamics 64
  
- f**
- Fabry-Perot cavity 136, 137, 485
- factoring algorithms 356
- factorization 347
- Fano-Mandel-Q parameter 6
- FDM 66
- FEM 66
- fiber cavity 192
  - CQED 191
  - Fresnel reflections 197
  - loss mechanisms 193
  - miniaturization 191
  - strong coupling 191
  - transfer mirror coatings 192
- fiber Fabry-Perot cavity 137, 485
- fidelity 289
- field ionization 216
- filtering 107, 112
- finesse 136
- Finite Difference Method 66
- Finite Element Method 66
- finite resources 288, 293, 300
- first and second order perturbation to transport 94
- Floquet ladder 345
- Floquet theory 269
- Fock state 3
  - dynamical preparation 18
  - Rabi oscillations 21, 23
- Fock state space 80
- FORT 31
- free induction decay (FID) 260
- free space link 317
- frequency standards 380
- Fresnel transform 29
- friction force 162
- full counting statistics, FCS 425, 428
- Förster 228, 236, 238, 240
  
- g**
- gate fidelity 280
- Gauss sum 339
  - periodicity of the 339
- generalized invariant method 78
- Generalized Riemann Hypothesis 367
- generating function 77
- geometry of numbers 357
- GHZ 304
- Green's function 74
- Greenberger-Horne-Zeilinger state 250

- group representation 407
  - equivalence 407
  - irreducible 408
  - projective 408
  - unitary 407
  
- h**
- Hadamard transform 259
- Hahn echo 260
- Hallgren's algorithm 371
- harmonic driving 279
- harmonic potential 71
- heat engine 378, 388
- Heisenberg interaction 276
- Heisenberg operators 79
- Heisenberg picture 78
- Heisenberg-Weyl group 419
- heralded single photon source 310
- high-finesse cavity 155
- high-frequency limit 86
- holonomic quantum computing 395
- hot electron 453
- hyperfine states 127
- hyperfine structure 130
- hyperfine tensor 255
- hysteresis
  - one-atom maser 11
  
- i**
- ideal minimum 362
- information exchange 303
- infrastructure 363
- integer Factorization 356
- integral elements 359
- integral expansion 96
- integrated optics 201
  - dipole trap 199
  - fiber cavities 201
  - mounting of fibers
    - SU-8 fiber splice 204
    - SU-8 resist 203
  - tapered lensed fiber 199
- intercept/resent 308
- interference pattern 122, 145, 483
- intermediate entanglement 250
- intertwining space 410
- ion trap 34
- ion-trap laser 34
- ionization 232
- Ising interaction 124, 276, 392
- iterative process 294, 295
  
- j**
- Jaynes-Cummings Hamiltonian 2, 389
  
- k**
- Keldysh partition function 431, 442
  
- Klyver's formula 149
- knapsack problem 385
- Kraus operator 402
- Kuramoto model 174
  
- l**
- Lüders' postulate 382
- laser surface processing 138
- lasing threshold 173
- lattice shifts 107
- Lewis-Riesenfeld method 72
- limit cycle oscillator 174
- line broadening 232
- linewidth
  - one-atom maser 24
- LOCC 288
- long-range order 168
  
- m**
- macrorealism 378, 380
- macroscopic observables 380
- magnetic field 128, 130
- magnetic field fluctuations 129
- magnetic microtrap 127
- magnetic moment 129
- magnetic near-field noise 129
- magneto-optical trap 146, 212
- majority function 383
- many-body diffusion 239
- matrix symmetry 410
- matter wave 122, 483
- mean energy 77
- measurement
  - accuracy 386
  - disturbance 404
  - generalized 401
  - orthogonal 403
  - projective 403
  - von Neumann 403
- measurements 379
- microcavity 137
- microcondensates 145
- microfabrication 127
- micromaser 1
- micromotion 49
- microtrap 127
- microtraps 147
- microwave 130
- microwave current 133
- microwave near-fields 132, 134
- microwave potentials 132
- mode volume 138
- momentum-diffusion 173
- MOT 212
- Mott insulator 122, 483
- MQE-tomography 260
- multi-electrode structure 90

- multi-quantum ENDOR (MQE) 255, 257, 259
- multiple quantum ENDOR (MQE) 253
- n**
- near-optimum transport 86
- neutral atoms 121
- NMR-experiment 350
- NP-complete problems 385
- number fields 357
- o**
- on-chip atom detection 138
- on-chip fiber cavity 137, 485
- one-atom laser 30, 34
- one-atom maser 1
  - bistability 11
  - collapse and revival 8
  - cyclic operation 17
  - experimental set-up 3
  - hysteresis 11
  - linewidth 24
  - phase transition 11
  - phase-diffusion constant 25
  - photon statistics
    - steady state 5
    - sub-Poissonian 9
  - pump curve 7
  - pump parameter 6
  - quantum jumps 11
  - single-atom-effect region 8
  - spectrum 24
  - threshold 6
  - trapping states 13
  - Wigner function 29
- optical cavity 135
- optical dipole force trap 31
- optical fiber 137, 485
- optical lattice 122
- optical lattice 147, 155, 224
- optical molasses 162
- optical potential 122
- optimal control method 55
- overdamped motion 173
- p**
- $8\pi$  pulse sequence 262
- $\pi$ -pulse 279
- parallel quantum gate array 126, 485
- parametric heating 59
- parametrically driven and forced harmonic oscillator 72
- particle transfers 106
- Paul trap arrays 69
- periodic potential 122, 483
- perturbation theory 344
  - first order 344
  - second order 342
- phase diffusion 39
- phase estimation 379
- phase gate 28, 132
- phase modulation 251
- phase transition
  - one-atom maser 11
- phase-locking 171
- phase-sensitivity of transport 84
- photon statistics
  - one-atom maser 5
  - Poissonian 6
  - sub-Poissonian 6, 9, 31, 34
  - super-Poissonian 6
- plasma 229, 233
- pointer 109
- Poissonian 77
- Poissonian process 432, 439
- positive operator-valued measure 379, 403
- potential fluctuations 87
- potential optimization 51
- POVM 403
  - symmetric 411
- prime number theorem 366
- privacy amplification 319
- pseudo-entangled state 252
- pseudo-pure state 248, 258
- PSPACE-complete problems 385
- pure state 245
- purity decay 268
- q**
- 2-qubit Deutsch-Josza algorithm 259
- 3-qubit Deutsch-Josza algorithm 247
- QBER 311
- quadrature squeezing 326
- quantum communication 303
- quantum complexity 379
- quantum cryptography 315
- quantum dot 33, 282
- quantum gate 127
- quantum jumps
  - one-atom maser 11
- quantum key distribution 303, 315
- quantum nondestructive-measurement 28
- quantum phase gate 132
- quantum point contact 432
- quantum state engineering 69
- quantum-bus 253
- qubit register 122
- r**
- Rabi oscillations 8, 130
  - Fock state 21, 23
- Rabi splitting 32

- radio frequency 47, 130
  - Raman sideband cooling 229
  - Ramsey fringes 126, 131
  - Ramsey spectroscopy 131, 378, 380
  - random-walk model 148
  - Rayleigh scattering phase 180
  - recoil-induced resonances 165
  - reduced ideal 362
  - refridgerator 384
  - regularized trap-electrode waveforms 87
  - regulator 361
  - resonator mode 139
  - ring cavity 155
  - ring laser gyroscopes 171
  - rotary echo 260
  - rotating-wave approximation 273
  - Rubidium 130, 146
  - running time 392
  - Rydberg atom 2, 29, 211
  - Rydberg spectroscopy 211
  - Rydberg state
    - circular 26
- S**
- S-bus concept 253
  - scalability 127
  - Schrödinger picture 80
  - Schrödinger cat 29
  - secret sharing 303
  - secular motion 49
  - security 307
  - self-organization 168
  - self-synchronization 168
  - sequential communication 306
  - shot noise 425, 444, 449
  - sideband entanglement 326
  - sideband picture 325
  - sideband separation 326, 327
  - sifting 319
  - simulation of Hamiltonians 392
  - sine transport 82
  - single crystal 255
  - single electron transistor 435
  - single qubit 306
  - single-atom detection 141
  - single-atom detector 135
  - single-atom preparation 141
  - single-photon generation 33
  - solid state 253
  - solid-state quantum information 426
  - SPDC 309, 310
  - spectrum
    - one-atom maser 24
  - spin 243
  - spin Echo Double Resonance (SEDOR) 261
  - spin locking 260
  - spin-dependent periodic potential 123
  - spin-dependent potential 126, 485
  - squeezing 81
  - stability parameter 50
  - standing wave 124, 483
  - Stark map 212, 235
  - state preparation 378
  - state-dependent double well potential 134
  - state-dependent microwave potentials 132
  - state-selective potential 127
  - STIRAP 34
  - strong coupling regime 136
  - surface effects 131
  - system-bath model 266
- t**
- thermodynamic machines 383
  - Tikhonov regularization 89
  - transition probabilities 77
  - transmission lines 134
  - transport 54
  - transport dynamics 69
  - transport function 71
  - trap frequency 47
  - trapped atoms 31
  - trapping states
    - one-atom maser 13
  - truncated density matrix 256
  - two-dimensional regime 149
  - two-photon transition 130
- u**
- universal coupling 175
- v**
- vacuum state 80
  - van der Waals interaction 230
  - vibrational modes 69
  - Vollmer's algorithm 373
  - von-Neumann measurements 379, 387
- w**
- waveguide 130
  - wavepacket 54
  - weighted chromatic index 391
  - weighted depth 390
  - weighted graph 391
  - well-controlled regime 81
  - Wigner function 29
    - one-atom maser 29
  - work extraction 378
- z**
- Zeeman shift 129, 130
  - Zeeman splitting 244
  - zero point energy 78, 80
  - Zeta-Function 366