<table>
<thead>
<tr>
<th><strong>Index</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrikosov lattice, 239</td>
</tr>
<tr>
<td>absence of transition in 1D Ising model, 197</td>
</tr>
<tr>
<td>absolute temperature, 8</td>
</tr>
<tr>
<td>absorptive power, 100</td>
</tr>
<tr>
<td>additional conservation law, 364</td>
</tr>
<tr>
<td>adiabatic demagnetization, 10</td>
</tr>
<tr>
<td>adiabatic expansion of a gas, 51</td>
</tr>
<tr>
<td>advanced Green function, 325</td>
</tr>
<tr>
<td>amorphous alloys, 376</td>
</tr>
<tr>
<td>Anderson localization, 375</td>
</tr>
<tr>
<td>Anderson–Morel state, 264</td>
</tr>
<tr>
<td>annihilation operator, 125</td>
</tr>
<tr>
<td>anomalous dimensions, 279, 359</td>
</tr>
<tr>
<td>anomalous index, 368</td>
</tr>
<tr>
<td>anomalous Luttinger liquid, 358</td>
</tr>
<tr>
<td>anomalous metallic phase, 271</td>
</tr>
<tr>
<td>anti-localizing term, 396, 405</td>
</tr>
<tr>
<td>availability, 16</td>
</tr>
<tr>
<td>Avogadro’s number, 156</td>
</tr>
<tr>
<td>Balian–Werthamer state, 264</td>
</tr>
<tr>
<td>barometric formula, 155, 474</td>
</tr>
<tr>
<td>BCS model, 249</td>
</tr>
<tr>
<td>binary collision, 30</td>
</tr>
<tr>
<td>black body, 101</td>
</tr>
<tr>
<td>block variables, 296</td>
</tr>
<tr>
<td>Bogoliubov transformations, 243</td>
</tr>
<tr>
<td>Bogoliubov–Valatin transformations, 249</td>
</tr>
<tr>
<td>Bohr magneton, 89</td>
</tr>
<tr>
<td>Boltzmann counting, 50</td>
</tr>
<tr>
<td>Boltzmann relation, 18</td>
</tr>
<tr>
<td>Boltzmann’s constant, 18</td>
</tr>
<tr>
<td>Boltzmann’s equation, 30</td>
</tr>
<tr>
<td>Born approximation, 384, 485</td>
</tr>
<tr>
<td>Bose–Einstein condensation, 90</td>
</tr>
<tr>
<td>Bose–Einstein integrals, 87</td>
</tr>
<tr>
<td>Bose–Einstein distribution, 79, 133, 428</td>
</tr>
<tr>
<td>Boyle’s law, 3</td>
</tr>
<tr>
<td>Brillouin function, 114</td>
</tr>
<tr>
<td>canonical partition function, 61</td>
</tr>
<tr>
<td>Carnot cycle, 7</td>
</tr>
<tr>
<td>central limit theorem, 19, 296</td>
</tr>
<tr>
<td>charge and spin separation, 359</td>
</tr>
<tr>
<td>charge conservation, 348, 355</td>
</tr>
<tr>
<td>chemical equilibrium, 55</td>
</tr>
<tr>
<td>chemical potential, 13</td>
</tr>
<tr>
<td>Clapeyron’s equation, 22</td>
</tr>
<tr>
<td>classical fluctuation–dissipation theorem, 121</td>
</tr>
<tr>
<td>classical limit, 87</td>
</tr>
<tr>
<td>classical linear response theory and fluctuations, 121</td>
</tr>
<tr>
<td>Clausius–Clapeyron equation for a Bose gas, 94</td>
</tr>
<tr>
<td>coexistence curve, 20</td>
</tr>
<tr>
<td>coherence distance, 217, 253</td>
</tr>
<tr>
<td>cold alkali atoms, 91</td>
</tr>
<tr>
<td>colloid, 155</td>
</tr>
<tr>
<td>commutation rules for creation and annihilation operators, 125</td>
</tr>
<tr>
<td>condensate wave function, 221</td>
</tr>
<tr>
<td>condensation criterion, 218</td>
</tr>
<tr>
<td>conductance at the scale $L$, 381</td>
</tr>
<tr>
<td>conjugate variables, 5, 12</td>
</tr>
<tr>
<td>continuity equation, 144, 346</td>
</tr>
<tr>
<td>continuous symmetry, 196</td>
</tr>
<tr>
<td>continuous symmetry breaking, 195</td>
</tr>
<tr>
<td>convexity of free energy, 74</td>
</tr>
<tr>
<td>cooperon ladder, 391</td>
</tr>
<tr>
<td>correlation function, 145, 189</td>
</tr>
<tr>
<td>correlation length, 190, 294</td>
</tr>
<tr>
<td>creation operator, 125</td>
</tr>
<tr>
<td>critical current, 214</td>
</tr>
<tr>
<td>critical indices, 110, 120, 196, 275</td>
</tr>
<tr>
<td>critical magnetic field, 214</td>
</tr>
<tr>
<td>critical phenomena, 22</td>
</tr>
<tr>
<td>critical point, 22, 24, 25</td>
</tr>
<tr>
<td>critical slowing down, 241, 285</td>
</tr>
<tr>
<td>critical surface, 294</td>
</tr>
<tr>
<td>critical temperature for superfluidity and superconductivity, 171</td>
</tr>
<tr>
<td>critical velocity for dissipation in superfluids, 206</td>
</tr>
<tr>
<td>Crooks’ relation, 152</td>
</tr>
<tr>
<td>crossed ladder, 391</td>
</tr>
<tr>
<td>current–current response function, 144</td>
</tr>
<tr>
<td>cumulant expansion, 299</td>
</tr>
<tr>
<td>cuprates, superconducting, 266</td>
</tr>
<tr>
<td>Curie susceptibility, 114</td>
</tr>
<tr>
<td>Curie temperature, 112</td>
</tr>
<tr>
<td>Curie–Weiss equation, 114</td>
</tr>
<tr>
<td>$d$-wave symmetry, 271</td>
</tr>
<tr>
<td>dangerous irrelevant variable, 281</td>
</tr>
</tbody>
</table>
De Broglie wavelength, 78
Debye temperature, 105
density–density response function, 144
density matrix, time evolution of, 82
density of states, 87
dephasing length, 392
dephasing time, 458
detailed balance, 469
detailed balance relation, 146
diamagnetic contribution to the current, 132
diffusion coefficient, 156
diffusion constants, 407
renormalization, 408
diffusion equation, 157, 158
diffusion ladder, 391
diffusive pole, 388
diffusive process, 155
dimensionless conductance, 381
discrete symmetry, 188
displacement law, 102
distribution function, 29
doped semiconductors, 376
Drude’s formula for electrical conductivity, 164
effective action for Ising model, 199
effective mass equation in Fermi-liquid theory, 174
effective potential, 108
Einstein relation, 156
elastic relaxation time, 385
electron–electron interaction effects, 397
emissive power, 100
empirical temperature, 3
energy gap, 215
energy surface, 45
ensembles, 43, 48
enthalpy, 13
entropy, 7
entropy of a quantum system, 84
equation of motion for field operators, 131
equation of state, 3
equipartition theorem, 103
ergodic theorems, 53
evolution equation for density matrix, 82
exact cancellation of diagrams, 373
exclusion principle, 79, 88, 429
extended vs. localized states, 378
extensive variables, 1
f-sum rule, 148
factorizing the two-particle correlation function, 136
fast modes, 297, 299
Fermi energy, 88
Fermi Golden Rule, 165
Fermi points, 359
Fermi temperature, 89
Fermi wave vector, 88
Fermi wavelength, 78, 88
Fermi–Dirac distribution, 79, 133, 429
Fermi–Dirac integrals, 87
Fermi-liquid interaction function, 173
fermions in constant force field, 106
Feynman diagrams, 309, 336
Fierz identities, 395
first order phase transitions, 22
fixed points of RG transformations, 294
flow stability, 206
flow to strong coupling, 302
fluctuation–dissipation theorem, 189
fluctuations from equilibrium, 14
flux quantization, 233, 234
flux quantum, 433
Fokker–Planck equation, 158
fountain effect, 208
Four-leg interaction vertex, 158
Gibbs free energy, 13
Gibbs rule, 3, 21
Gibbs–Helmholtz equation, 14
Ginzburg criterion, 202, 275
grand canonical partition function, 201
golographic model, 360
Galilean invariance, 185, 488
Galilean transformations, 206
gas constant $R$, 3
gauge invariance, 144
Gaussian fixed point, 300
Gell-Mann–Low beta-functions, 315
generalized displacements, 5
generalized force, 5
generating functional, 308
Gibbs free energy, 13
Gibbs rule, 3, 21
Gibbs–Helmholtz equation, 14
Ginzburg criterion, 202, 275
grand canonical partition function, 65, 85
grand potential, 13
graphene, 106
Green function poles, 330
Green function singularities, 327
gyromagnetic factor, 89, 113
Hamilton’s equation of motion, 29, 45
hard spheres, 225
hard-core potential, 69, 107
Hartrree-type scattering, 370
heat, 5
heat bath, 7
heavy fermions, 174
Heisenberg operators, 140
Helmholtz free energy, 12, 61
hidden quantum criticality, 273
Hilbert space, 80
hole, 266
homogeneity property, 279
homogeneity relations, 280
Hubbard model, 268

imaginary time, 319
imaginary time-ordered product, 319
impurity technique, 384
integrating factor, 9
intensive variables, 1
interaction picture, 331
internal energy, 5
internal field, 114
Ioffe–Regel criterion, 378
irreducible self-energy, 343
irreversibility, 7, 51
irreversible process, 4
Ising model, 115
isothermal compressibility of the Fermi gas, 89
isotope effect, 214, 253, 270

Jarzynski’s relation, 152
Johnson–Nyquist formula, 162
Josephson current, 234
Josephson effect, 233
Josephson junction, 234
Josephson scaling, 283
Kramers–Kronig relations, 142
Kubo formula for electrical conductivity, 144
ladder diagrams, 387
Landau diamagnetism, 433
Landau functional, 190
Landau gauge, 433
Landau levels, 433
Landau parameters, 175, 406
Langevin equation, 158
Langevin stochastic force, 156
large momentum transfer process, 403
latent heat, 22
law of corresponding states, 109
left–right separate charge and spin conservation, 363
Legendre transformation, 14
linearized transformation, 293
Lehmann decomposition, 323
Liouville’s theorem, 29, 45
liquid Helium, 170
local equilibrium, 181, 470
localization length, 378
London’s equation, 217
longitudinal fluctuations, 196, 238
loop cancellation, 372
Lorentz transformations, 101
Lorentz’s number, 168
low-temperature enhancement of spin susceptibility, 416, 418
Luttinger liquid behavior, 365

m-particle Green function, 323
m-particle Matsubara Green function, 319
macroscopic variables, 50
magnetic impurities, 395
magnetic moments in disordered electron systems, formation of local, 416
many-body theory, 346
mass renormalization, 311
Matsubara frequencies, 320
 Matthiessen rule, 377
maximally crossed diagrams, 391
Maxwell construction, 25
Maxwell’s relations, 12, 13
Maxwell–Boltzmann distribution, 36, 38, 49
mean free path, 39, 163, 385
mean square displacement, 159
Messner–Ochsenfeld effect, 214
Mermin–Wagner theorem, 197, 202
metal–insulator transition, 376, 382, 420
in three dimensions, 420
metallic phase at low temperature, 416
micro-state, 18, 45, 47
microscopic reversibility, 148
minimal coupling, 143
minimum metallic conductivity, 378
mobility edge, 378
molecular chaos, 32, 47
most probable distribution, 85, 428
Mott insulator, 268
multiplicative transformation, 312

N-body system, 45
n-dimensional solid angle, 58
negative magnetoresistance, 395
Nernst’s principle, 10, 64, 104
noise power spectrum, 162
non-trivial fixed point in $d < 4$, 304
normal modes, 104
normalization point, 312
normalized measure, 46
number of collisions per unit time, 30
occupation numbers, 125, 428
off-diagonal long range order, 219, 222
Ohm’s law, 163
one-particle irreducible self-energy, 343
operators, Heisenberg, 140
optimal doping, 268
order parameter, 186, 215, 291
Ornstein–Zernike response function, 19
osmotic pressure, 155
pair formation, 222
pair wave function, 247
pair-breaking temperature, 258
paraconductivity, 242
paraconductivity, Aslamazov–Larkin, 448
particle relaxation time, 344
Pauli susceptibility, 89
penetration depth, 214, 216
perfect gas, 9
periodic boundary conditions, 86
perturbative expansion for the Green function, 342
phase diagram, 3
phase separation, 25
phase-space, \( \Gamma \), 45, 48
phase-space, \( \mu \), 29, 48
phonon, 104, 209
photon, 101
Planck's constant, 38, 50, 61
Poincaré's theorem, 45
Poisson summation formula, 434
polar approximation, 331
possibility of a metallic phase in two dimensions, 420
power counting, 370
power spectrum of fluctuations, 146
power-law behavior close to critical point, 275
principle of detailed balance, 33
probability of a fluctuation from equilibrium, 18
probability of self-intersection, 379
propagator, 342
pseudogap, 270
pure state, 80
quadratic contraction, 300
quantization of superfluid velocity, 226
quantum interference in disordered systems, 392
quantum interference of time-reversed trajectories, 379
quasi-static process, 4
quasiparticle decay rate, 487
quasiparticle lifetime, 172
quasiparticle weight, 330
rainbow diagrams, 385
random phase postulate, 83
relativistic massless fermions, 106
relevant variables, 277
relevant, irrelevant and marginal quantities, 280
renormalized disordered Fermi liquid, 406
response function, 140
retarded Green function, 325
reversible process, 4
RG flow equations, 299
roton minimum, 209
roton spectrum, 209
running couplings, 406
running variables, 315
\( S \)-matrix, 331
Sackur–Tetrode's equation, 59
saddle-point approximation, 200, 298
scaling dimension, 278
scaling fields, 295
scaling laws, 280
scattering amplitude, 485
scattering cross section, 31, 485
scattering kernel, 35
second quantized form for the Hamiltonian, 131
second sound in helium, 209
self-consistency equation, 117
of BCS mean-field theory, 249
self-consistent potential, 136
self-consistent Born approximation, 385
self-consistent Hartree–Fock potential, 136
self-energy, 342
semiclassical approximation, 78
semigroup property, 293
Si-MOSFET device, 397
single-impurity scattering problem, 169, 484
singlet amplitude, 406
singlet component, 395, 404
skin effect, 216
Slater determinant, 128
slow modes, 297, 299
small and momentum transfer process, 403
solution, 155
Sommerfeld expansion, 89
specific heat of a biatomic gas, 68
specific heat of solids, 103
spectral radiation energy density, 101
spin conductivity, 169
spin of the photon, 102
spin–orbit coupling, 395
spin transport, 168
spontaneous magnetization, 115
spontaneous symmetry breaking, 186
stability of the Fermi-liquid, 177
state function, 7
static and dynamic limits, 145, 354
stiffness constant, 203
stimulated emission, 79
Stirling's formula, 49
Stokes formula for viscous force, 156
structure factor, 213
sum rule for the structure factor, 213
superconductive diamagnetism, 218
superfluid \(^{4}\)He, 91
superfluid transition, 170
symmetrization operator, 124
thermal equilibrium, 55
thermal transport, 167
thermal wave length, 62, 87, 91
thermodynamic density of states, 66, 89
thermodynamic stability, 74
thermodynamic stability conditions, 16
thermodynamic variables, 1
thermomechanical effect in helium, 208
thermostat, 60
Thomas–Fermi screening, 488
Thomas–Fermi wave vector, 488
Thouless energy, 381
time-ordered product, 323
time-reversal breaking, 394
time-reversal invariance, 380
transverse fluctuations, 196, 238
tricritical point scaling, 281
triplet amplitudes, 406
triplet component, 395, 404
two-dimensional electron gas, 397
type-I superconductors, 217, 218
type-II superconductors, 217, 218
ultracold alkali atoms, 95
uncertainty principle, 87
unity decomposition, 80
universality classes, 295
universality of phase transitions, 186
universality principle, 277
validity of Fermi-liquid theory, 357
van der Waals’ equation, 23
variables, extensive and intensive, 1
variance of fluctuations, 20
vertex order parameter, 195
vertex renormalization, 311
virial, 56
virial expansion, 109
virial theorem, 57
viscosity, 208
vortex line, 226
vortex rings, 227
Ward identities, 406
wave-function renormalization, 311, 407
weak localization, 379, 392, 397
Weiss field, 114
Wegner scaling relation for localization, 383
white-noise disorder, 383
Wiedemann–Franz law, 168
Zeeman term, 89, 400
zeroth law, 2