

Index

- H*-theorem, 61, 122
- Active matter, 587
- Activity expansions, 312
- AdS/CFT duality, 588
- Aggregation, 586
- Albers, J., 584
- Alder, B. J., 7, 303, 439, 498, 509, 513, 524, 533, 580
- Algebraic long time decay, 513
- Alley, W. E., 533
- Anderson phase transition, 388
- Anomalous diffusion, 11
- Anti-de Sitter space, 588
- Araki, S., 385
- Auto-correlation function, 331
- Baldassarri, A., 374
- Balescu-Lenard-Guernsey equation, 8, 13, 583
- Ballentine, L. E., 434
- Barajas, L., 260, 264
- Baras, F., 14
- Barber, M., 350
- Bargmann, P.G., 48
- Barrat, A., 386
- BBGKY hierarchy equations, 16, 206, 230, 256, 418, 439, 445, 478, 544, 545, 578, 583
- hard spheres, 233
 - soft potentials, 231
 - time correlation functions, 250
- Bedeaux, D., 148, 529
- Belitz, D., 501, 540, 584
- Bellomo, N., 587
- Ben-Naim, E., 17, 374, 586
- Berlin, T., 18
- Berne, B., 332
- Bernoulli numbers, 162
- Bernoulli, D., 1
- Berry, M., 385
- Bessel functions, 170
- BGK model, 115, 122, 159, 372, 373, 380, 498
- linearized equation, 116
- Bhatnagar, P. L., 115
- Biben, T., 378
- Binary collision expansion, 214, 219
- hard spheres, 227, 457
 - induction hypothesis, 240
 - soft potentials, 209
- Binary collision operators, 36, 205
- barred, 235
 - barred particle-wall, 211
 - hard spheres, 214, 235
 - negative time, unbarred, hard sphere, 220
 - negative times, barred, hard spheres, 223
 - particle-wall, 211
 - positive or negative times, barred, hard spheres, 224
 - positive time, unbarred, hard sphere, 218
 - real part, 221
 - soft potentials, 210
 - stochastic wall-particle, 241
 - unbarred, 235
 - unbarred particle-wall, 213
 - virtual part, 221, 238
- Binary collisions
- action sphere, 23
 - apse line, 27, 151
 - azimuthal angle, 23
 - collision cylinders, 24
 - correlated sequences, 437, 469
 - cyclic collision sequences, 457
 - direct or loss, 21, 26
 - energy transfer, 259
 - frequency, 329
 - hard spheres, 153
 - hypothetical collision sequences, 457
 - impact parameter, 23, 27
 - inelastic, 351
 - instantaneous, 242
 - momentum transfer, 259
 - orbiting, 252

- orbiting collisions, 37
- pre- and post- correlations, 56
- quasi-bound states, 33
- recollision sequences, 457
- reduced mass, 124
- restituting, 21, 26, 30
- uncorrelated, 437
- virtual, 219, 457
- Bird, R. B., 144
- Birkhoff's ergodic theorem, 186
- Bixon, M., 13, 18, 318, 349, 536
- BKW solutions, 117
- Blatt, J., 350
- Blawdziewicz, J., 270
- Bloch waves, 201
- Bobylev Fourier transform method, 374
- Bobylev, A. V., 60, 111, 117, 203, 374
- Bocquet, L., 583
- Bogoliubov excitations, 407, 415, 416, 578
 - kinetic equation, 417
- Bogoliubov transformation, 405
 - local, 408
- Bogoliubov's functional assumption, 448, 464
- Bogoliubov, N. N., 5, 18, 251, 403, 440, 453, 464
- Boldrighini, C., 111
- Boltzmann collision operator
 - linearized, 548
 - spectrum of linearized, 329
- Boltzmann equation, 3, 19, 33, 37, 60, 437, 452, 575, 578
 - H -theorem, 29, 41, 46, 48, 51, 114
 - H -theorem for mixtures, 125
- BGK model, 94
- Chapman-Enskog solution, 60, 61, 71, 72, 104, 325, 339, 366, 428, 439, 541, 575
 - mixtures, 132
 - solubility conditions, 74
- collision cylinder, 23, 27
- collision integral, 32
- derivations from BBGKY hierarchy
 - equations, 455
- direct collision, 27
- discrete velocity models, 119
- exact solutions, 111
- existence theorems for solutions, 112
- extended, 581, 583
- first Sonine polynomial approximation, 98
- generalized, 317, 437, 456, 475
- Grad thirteen moment method, 60, 113
- granular, 354
- granular gases, 354
- hard spheres, 453
- Hilbert expansion, 73
- Lanford's derivation, 466
- lattice gas models, 119
- linearized, 100
- linearized collision operator, 322
- linearized collision operator-mixtures, 136
- mixtures, 125
- moment methods, 112
- normal solution, 60, 63, 73
- restituting collision, 27
- spectrum of linearized collision operator, 79, 155
- variational methods, 94, 114
- Boltzmann propagator, 486
- Boltzmann, L., 2, 3, 122
- Boltzmann-Grad limit, 111
- Boltzmann-Langevin equation, 16, 58, 317, 324, 334
- Boltzmann-Langevin equation, 321
- Boon, J. P., 540
- Borel summation method, 567
- Born, M., 251
- Bose-Einstein condensate, 388
- Bose-Einstein condensation, 397, 398, 579
- Bose-Einstein gas, 11
 - dilute, 468
- Bosons, 387, 395
- Bosse, J., 531
- Boundaries
 - accommodation coefficient, 92
 - boundary conditions, 33, 43
 - collision kernel, 35
 - conditions for normal solution, 91
 - diffuse collisions, 92
 - interaction potential, 19
 - interactions, 19, 33, 42
 - kinetic boundary layer, 93
 - Maxwell boundary conditions, 92
 - slip coefficients, 93
 - slip conditions, 92
 - specular collisions, 91
 - stick conditions, 93
 - temperature jump distance, 93
 - thermal creep coefficient, 93
 - thermal reflection kernel, 43
 - thermostat condition, 42, 46
 - wall collision operator, 35, 36
 - wall temperature, 92
- Boundary conditions, 16
- Boundary effects
 - for Couette flow, 557
- Bracket integral, 139
- Brey, J. J., 527
- Brilliantov, N. V., 367, 385
- Brillouin peaks, 107
- Brinser, G. B., 498
- Brito, R., 363, 370
- Broken symmetry, 588
- Brownian motion, 12, 33, 317, 318, 521, 582
- Bruin, C., 500
- Brush, S., 147, 464
- Bunimovich, L. A., 14, 111
- Burgers equation, 116
- Burgers, J., 116

Burnett equations, 8, 61, 87, 93, 109, 438, 526
 boundary conditions, 94
 transport coefficients, 580
 Burns, J. A., 385
 Cage effect, 288, 536
 Canonical ensemble, 323, 443
 Casimir effect
 giant, 569
 Cellular automata lattice gas, 515
 Cercignani, C., 17, 94, 120, 122
 Chaos, 180
 Conjugate pairs of Lyapunov exponents, 181
 contracting directions in phase space, 182
 contracting factors, 194
 expanding directions in phase space, 182
 fractal attractor, 194
 Lorentz gas, 501, 579
 Lyapunov exponents, 14, 150, 180, 194, 579
 negative Lyapunov exponents, 198
 stable manifold, 198
 stretching factors, 194
 topological pressure, 14
 Chaotic motion, 14
 Chaotic systems, 150, 180
 Chapman, S., 3, 17, 144, 147
 Chapman-Enskog method, 15
 Charnoz, S., 386
 Chemical reaction rates, 242
 Chernov, N., 14
 Chiu, S. C., 582
 Choh, S. T., 440, 456
 Choh-Uhlenbeck term, 456, 477
 Cichocki, B., 544
 Clausius' inequality, 48
 Cluster expansions, 441, 442, 545
 distribution functions, 479
 in revised Enskog theory, 261
 Cluster functions, 310, 446
 Husimi, 445, 449, 450
 Ursell, 442, 479
 Cluster property, 443
 Coarse graining method
 hard sphere crystals, 308
 Coefficient of restitution, 359
 Cohen, E. G. D., 5, 7, 11, 17, 18, 121, 148, 288,
 303, 345, 349, 350, 441, 453, 464, 489,
 505, 509, 533, 536, 545, 572, 576, 583
 Coleman, S., 148
 Collective modes, 586, 587
 Collision integral
 particle-particle for Bose gas, 422
 three body, 470
 Collision integrals, 450
 logarithmic divergence, 472
 Collision operator
 ring, 484, 490, 493
 virial expansion, 467

Collisional damping, 491, 493
 Collisional transfer effects, 488
 Collisions
 correlated sequences, 6, 17, 111, 345
 overlapping configurations, 462
 real, 495
 sequences, 457
 thermostat condition, 270
 transfer contributions to transport coefficients, 297
 triple, 456
 virtual, 495
 Colloidal suspensions, 12
 Colloidal systems, 532
 Commutation rules
 bosons, 400, 405
 Computer simulated molecular dynamics, 5, 7, 254,
 286, 477, 501, 514
 Condensed Bose gas, 16
 bulk viscosities, 430
 Chapman-Enskog solution of kinetic equation, 423
 chemical potential, 427
 depletion of the ground state, 402, 406
 distribution function, 409
 entropy density, 427
 kinetic equations-source term, 433
 shear viscosity, 430
 thermal conductivity, 430
 time correlation functions, 435
 transport coefficients, 431
 Condiff, D. W., 498
 Conformal field theory, 588
 Conjugate currents and forces, 128, 291, 299
 Conservation equations, 424, 546
 Conservation laws, 402
 Conservation of phase space volume, 181
 Contraction of phase space volumes, 194
 Convex functions, 47
 Cooling coefficient, 367
 Cooling of granular gases, 352
 Cooling state
 homogeneous, 357, 363, 366, 371, 372, 377
 Coriolis force, 44
 Correlation functions
 density-density, 334, 581
 direct, 272, 280, 281, 292
 equal time, 340
 force-force, 320
 pair, 258, 261
 Correlations
 dynamic, 318
 dynamical, 256, 301, 438
 long range, 343, 476
 static, 318
 Corresponding states method, 96
 Couette flow, 113, 549, 570
 Coulomb forces, 583
 Cowling, T. G., 144
 Critical point, 343

- Cross effects in mixtures, 123, 126
- Cukier, R. I., 582
- Curie symmetry principle, 128
- Curie's Law., 300
- Currents
 - conserved quantities, 290
 - energy, 299
 - momentum, 298
 - particle, 298
- Curtiss, C. F., 144
- de Boer, J., 251
- de Broglie wavelength, 387, 502
 - thermal, 387
- de Gennes narrowing, 262, 288, 533, 534
- de Gennes, P. G., 534
- de Graaf, L. A., 529
- de Groot, S. R., 148
- de Leener, M., 17
- de Schepper, I. M., 288, 529, 531, 533, 536
- de Wit, M., 94
- Degeneracy parameter, 388
- Dellago, C., 14, 190
- Density
 - microscopic, 323
- Density expansions
 - logarithms in density, 200
- Density fluctuations
 - granular gases, 368, 370
- Density matrix, 389
- Differential cross section, 392
 - classical, 40
 - quantum, 40
- Differential geometry, 588
- Diffusion
 - subdiffusion, 247
 - super-diffusion, 247
 - tagged particle, 486
 - tracer-tagged particle-self, 243
- Diffusion equation
 - generalized, 246
- Diffusion thermo-effect, 138
- Dilute gases, 20, 71
- Distribution functions, 266
 - n -particle, 206, 229, 230
 - equilibrium for bosons, fermions, 397
 - few particle, 545
 - functional form, 76, 155
 - granular gases, 362
 - initial, assumptions about, 448
 - linearized about Maxwell-Boltzmann, 482
 - local, 87
 - local equilibrium, 60, 72, 339, 547
 - local equilibrium for bosons, 426
 - local equilibrium for mixtures, 133
 - Maxwell-Boltzmann, 40, 72, 171, 239
 - mixtures, 124
 - N -particle, 265, 310, 446
 - one particle, 549
 - pair, 312, 443
 - single particle, 21, 444
 - two particle, 257, 310
 - Wigner, 390, 408, 414
- Dones, L., 386
- Donnay, V., 14
- Dorfman, J. R., 7, 181, 345, 350, 421, 433, 434, 441, 489, 505, 509, 529, 544, 576, 582, 583
- Drag coefficient, 319
- Drag force, 319
- Drude formula, 165
- Drude's Law, 165
- Dufty, J. W., 575
- Dynamic structure factor., 530
- Dynamical systems theory, 14, 371
- Eckern, U., 421, 434
- Edwards, S. F., 386
- Ehrenfest model, 11
- Ehrenfest, P. and T., 11
- Einstein equation
 - for diffusion, 245
- Einstein equations
 - general relativity, 588
- Einstein, A., 2
- Elasticity
 - ideal equations, 307
- Electron mobility, 501
- Elliptic islands, 14
- Ensemble average, 320
- Enskog approximation
 - first, 82
- Enskog contributions
 - three body collision operator, 460
- Enskog equation, 16, 37, 95, 206, 256, 258
 - revised, 95, 147, 458, 488
 - revised. linearized, 489
- Enskog propagators, 518
- Enskog theory, 251, 258, 385, 437, 587
- Enskog, D., 3, 4, 147, 255, 579
- Entropy
 - current, 89
 - fluctuations, 342
 - Gibbs, 265
 - ideal gas, 41
 - local, 327
 - local density, 90
 - negative rate of production in granular gases, 372
 - non-equilibrium, 89
 - production, 63, 88, 90, 130, 290
 - production in mixtures, 128, 146
- Equation of state, 281
- Ergodicity, 14
- Ernst, M. H., 4, 16, 18, 122, 147, 255, 260, 349, 360, 370, 371, 374, 386, 463, 466, 489, 529, 531, 544, 553

624

Erpenbeck, J. J., 303, 513, 536
 Esposito, L. W., 386
 Estrada, P. R., 386
 η -ensemble, 408, 413
 Eucken factor, 85, 95
 Euler equations, 61, 67, 77, 115
 from revised Enskog equation, 283
 local temperature, 69
 mixtures, 132
 momentum density, 67
 Evans, D. J., 533
 Exchange operator, 36
 Excitations
 Collective, 399
 free particle, 399
 Phonon, 402
 Thermal, 402
 Excluded volume effects, 259, 488
 Extended pseudo-Liouville equations, 233
 External potentials, 241

 Felderhof, B. U., 120
 Fermi “golden rule”, 420
 Fermi gas
 dilute, 468
 Fermions, 166, 387, 394
 Ferziger, J. H., 17, 136, 144, 148
 Field operators, 408
 bosons, 400
 current, 407
 density, 407
 non-condensate, 405
 Finite size effects
 in non-equilibrium steady states, 570
 Fixman, M., 7, 540
 Florkovski, W., 586
 Fluctuating hydrodynamics, 464
 Fluctuation-dissipation theorem, 321, 324
 Fluctuations, 12, 56, 57, 317
 currents, 329
 density, 13, 334
 entropy, 342
 force, 319, 322
 hydrodynamic, 324, 347
 Fluid mixtures
 temperature or concentration gradients, 569
 Foch, J., 110
 Fokker-Planck equation, 378, 379, 582
 Ford, G. W., 465
 Forster, C., 14
 Forster, D., 348, 524, 540
 Fox, R., 13, 318, 349
 Fractal structures, 120
 Fractional powers, 539
 Fractional powers of gradients, 438
 Fractional powers of the wave number, 542
 Free streaming operators
 infinitesimal, 220, 235

Index

Frenkel, D., 515, 524
 Frieman, E. A., 7, 540
 Frisch-Hasslacher-Pomeau lattice, 516
 Fugacity, 265, 310
 Functional dependence of distribution
 function, 88

 Götze, W., 540
 Gallavotti, G., 111
 Galliero, G., 303
 Gamma function, 281
 Γ -space, 206
 Garcia-Colin, L. S., 62, 147, 260, 264
 Gaspard, P., 14, 181
 Gass, D. M., 315, 498, 524
 Gauss, C. F., 191
 Gaussian thermostat, 44, 164, 570
 Gelation, 586
 General relativity, 588
 Generalized Boltzmann equation, 450
 Generating functions, 80
 Generic scale invariance, 540
 Gibbs free energy, 66
 Gläser, W., 531
 Glass transition, 9
 Goldhirsch, I., 364, 371
 Goldman, R., 7, 464, 540
 Goldreich, P., 384
 Goldshtein, A., 357
 Goldstone modes, 304, 402, 584, 588
 Goldstone’s theorem, 8, 304
 Grad, H., 17, 81, 113, 120
 Gradient length, 333
 Graham, T., 1
 Granular flows, 241
 Granular gases
 driven, 377, 382
 mode-coupling, 537
 Granular matter, 13, 16, 351
 Granular temperature, 358, 373
 Green, H. S., 251
 Green, M. S., 5, 18, 242, 249, 440, 453, 456, 464, 505
 Green-Kubo formulas, 5, 7, 17, 84, 86, 242, 244, 278,
 288, 435, 439, 475, 486, 504, 508, 512, 580,
 584
 quantum, 506
 time correlation functions, 507, 516
 Greenspan, M., 108
 Grew, K. E., 148
 Griffin, A., 397, 399, 422, 432–434, 436
 Gronemeyer, C., 531
 Gross, E. P., 115
 Gunton, J., 505, 545
 Gust, E. D., 397
 Gust, G. D., 434
 Gyromagnetic radius, 203

- H-function, 3
- Haff's law, 359, 369, 373
- Haff, P. K., 359
- Hamiltonian equations of motion, 206
- Hamiltonian operator, 389
- Hanley, H. J. M., 99, 148
- Hansen, A., 203
- Hard sphere crystals
 - elastic properties, 256
- Hard sphere gas, 10, 255
- Hauge, E. H., 11, 18, 122, 155, 159, 203, 349, 583
- Heat flow vector, 329
- Heaviside function, 34
- Hedman, M., 386
- Helfand moments, 243, 244, 247, 249
- Helimagnets, 8
- Heller, M. L., 586
- Helmholtz free energy, 48, 49, 66
- Hemmer, P. C., 168
- Herapath, J. J., 1, 2
- Herman, R., 586
- Hermite polynomials, 82
- Hertzsch, J.-M., 385
- Heyes, D. M., 303
- High energy particles
 - overpopulation, 360, 374, 382
- High energy tails, 373, 377
 - granular gases, 361
- Hilbert's Uniqueness Theorem, 121
- Hirschfelder, J. O., 144
- Hohenberg, P. C., 407, 434
- Holographic duality, 588
- Huang, K., 434
- Hubeny, V., 588
- Huthman, M., 363
- Hydrodynamic densities, 64, 66, 70, 76, 325, 541
 - energy, 64, 66
 - entropy, 66
 - local, 546
 - mass, 66
 - mean velocity, 66
 - momentum, 64
 - number, 64
- Hydrodynamic equations
 - generalized, 529
- Hydrodynamic fluctuations, 9
- Hydrodynamic modes, 6, 60, 105, 284, 328, 335, 395, 398, 518
 - for revised Enskog equation, 256
 - general fluid, 529
 - hard sphere crystals, 305
 - heat, 106, 281, 284
 - large wave number, 288
 - revised Enskog equation, 277, 279
 - shear, 106, 281, 284
 - softening of heat mode, 288
 - sound, 106, 281, 284
- Hydrodynamic stage, 440
- Hydrodynamic time, 86
- Hydrodynamics
 - conservation equations, 63
 - conservation equations-mixtures, 130
 - conservation laws, 63
 - constitutive laws, 63, 66
 - Euler equations-mixtures, 134, 135
 - Fick's law of diffusion, 63
 - finite size effects, 543
 - Fourier's law of heat conduction, 63, 69, 127
 - generalized equations, 331, 494
 - generalized for Lorentz gas, 158
 - granular gases, 365, 368
 - heat current-mixtures, 132
 - heat flow vector, 68
 - linearized equations, 274, 438
 - linearized equations for granular gases, 367
 - linearized equations for solids, 304
 - linearized Navier-Stokes equations, 248
 - microscopic, 491
 - momentum current tensor, 65
 - Navier-Stokes equations, 247, 544
 - Newton's law of friction, 63, 68, 83, 127
 - nonlinear equations, 274
 - pressure tensor, 65
 - pressure tensor-mixtures, 131
 - stress tensor, 68
 - temperature field in Couette flow, 571
- Hypercubic lattice, 516
- Ideal fluids, 77
 - Euler equations, 77
- Incoherent dynamic structure factor, 530
- Incoherent intermediate scattering function, 531
- Indistinguishable particles, 392
- Inelastic collapse, 365
- Inelastic hard spheres, 354
- Inelastic soft spheres, 356, 372, 373, 380
- Initial correlations, 451, 456
- Initial stage, 440
- Initial state conditions, 443
- Insulators, 585
- Interaction potentials
 - 11 – 6 – 8 model, 99
 - cut-off, 80
 - effective, 38
 - Lennard-Jones, 20, 38, 96, 97, 145, 252
 - Maxwell molecules, 33, 80, 82, 110, 113
 - WCA, 19
- Ionic solutions, 469
- Irreducible tensors, 79, 429, 548
- Irreversibility, 54
- Irreversible energy flow, 299
- Irreversible processes, 50

626

Irreversible thermodynamics, 90
 Irving, J. H., 434
 Isobe, M., 515
 Isothermal compressibility, 281
 Isotropic operators, 79, 158

Jaynes, E. T., 265
 Jenkins, J. T., 385
 Jensen's inequality, 46
 Joule heating, 544, 574

Kac ring model, 15, 53, 149, 578
 Kac, M., 53, 116
 Kac-Boltzmann equation, 116
 similarity solutions, 118
 Kadanoff, L. P., 7, 9, 512
 Kan, Y. H., 498
 Kaper, H. G., 17, 136, 144, 148
 Kawasaki, K., 7, 17, 441, 475, 476, 505, 512, 524, 545, 580
 Kawasaki-Oppenheimer resummation, 477
 quantum, 585
 Keizer, J., 148, 349
 Kestin, J., 98, 145
 Khalatnikov, I. M., 422, 432
 Khalifa, H. E., 145
 Kinetic energy operator, 410
 Kinetic equations
 ring, 482
 Kinetic stage, 440
 Kinetic theory
 granular gases, 351
 quantum, 584
 Kinkaid, J. M., 303
 Kirkpatrick, T. R., 343, 345, 350, 421, 433, 434, 501, 533, 535–537, 540, 545, 567, 576, 581, 583, 584
 Kirkwood, J., 251
 Kjelstrup, S., 148
 Klages, R., 181
 Klein, M., 99
 Knauf, A., 15
 Knudsen number, 12, 70, 504, 581
 Kolmogorov-Arnold-Moser (KAM) theorem, 385
 Kolmogorov-Sinai (KS) entropy, 14
 Krapivsky, P. L., 17, 374, 586
 Krook, M., 60, 115, 117
 Krylov, N., 190
 Kubo, R., 5, 242

Lachowicz, M., 587
 Ladd, A. J. C., 533
 Laguerre polynomials, 80
 Lambda point temperature
 weakly interacting bosons, 407
 Landau damping, 13, 120
 Landau, L., 12, 324, 422, 434
 Lanford, O., 350, 466

Index

Lanford, O. E. III, 111
 Langer, J. S., 584
 Langevin equation, 12, 317, 319
 Larmor rotation, 172
 Lattice Boltzmann equation, 10
 Latz, A., 204
 Lawney, B. P., 385
 Lebowitz, J. L., 48
 Lee, T. D., 434
 Legendre polynomials, 168
 Leggett, T., 434
 Length scales, 69
 Lifshitz tails, 56
 Lifshitz, E. M., 12, 324, 585
 Lifting operator, 236
 Light scattering, 8, 13, 16, 331, 581
 Brillouin spectrum, 332, 337
 Brillouin spectrum, non-equilibrium, 350
 integrated intensity, 337
 Lorentzian peaks, 337
 Rayleigh peak, 337
 scattering region, 332
 small angle, 342
 Liouville equation, 5, 65, 193, 205, 388, 437, 529, 578
 quantum, 391
 Liouville operators, 9, 207, 208, 210, 447
 Liquid crystals, 8, 504
 Littlejohn, R. G., 434
 Local
 caloric equation of state, 67
 pressure, 66
 rate of entropy production, 90
 temperature, 66
 Local thermodynamics, 88
 Localization, 11, 202, 388, 584
 Logarithmic terms
 in non-equilibrium density expansions, 464
 London, F., 434
 Long time tails, 7, 17, 107, 202, 388, 439, 490, 507, 508, 515, 539, 584
 granular gases, 538
 Long-range correlations, 539, 544, 575, 587
 long-range correlations, 542
 Lopez de Haro, M., 303
 Lorentz force, 172
 Lorentz gas, 10, 14–16, 119, 123, 149, 245, 499, 544, 579
 classical, 584
 collision frequency, 160
 cyclotron orbits, 171
 defocusing property of collisions, 182
 diffusion coefficient, 157
 diffusion coefficient for hard hard spheres in 2 and 3 dimensions., 158
 diffusion coefficients in magnetic field, 175
 diffusion equation, 157
 diffusion tensor in magnetic fields, 179
 divergent non-ring terms, 500

- drift velocity in electric fields, 170
- electrical conductivity, 165, 192
- magneto-transport, 172
- mean square velocity in electric fields, 170
- quantum, 11, 388, 501, 584
- steady state drift velocity, 171
- thermostatted, 192
- Lorentz model, 111
 - stochastic, 247
- Lorentz, H. A., 10, 149, 540, 583
- Lorentz-Boltzmann equation, 150, 151, 574, 579
 - H -theorem, 154
 - anti-extended, 198
 - Chapman-Enskog solution, 152, 155
 - collision operator, 157
 - comparison of exact and normal solutions, 163
 - conservation equation, 156
 - electric fields, 164, 168
 - extended, 187, 197
 - external fields, 164
 - external magnetic field, 171
 - Grad limit, 164
 - gravitational fields, 164
 - hydrodynamic pole, 161, 162, 172, 175
 - magnetic fields, 164
 - solution for hard spheres, 161
 - spectrum of collision operator, 155
- Losa, J. M., 110
- Lotka, A.J., 586
- Lowe, C. P., 524
- Lutsko, J. F., 575
- Lyapunov exponents, 501
 - electrical conductivity, 196
 - Lorentz gas, 505
- Ma, S. K., 204, 432
- Maaø, F. A., 203
- Mach number, 113, 582
- Machlup, S., 349
- Mahan, G. D., 585
- Marchetti, M. C., 583, 587
- Mareschal, M., 270
- Markov processes, 317
- Martin, P. C., 407, 434
- Martin, Ph. A., 378
- Martin-Löf, A., 349, 583
- Mason, E. A., 144, 145
- Maximum entropy ensemble, 265
- Maxwell demon, 192
- Maxwell models, 117, 380
- Maxwell molecules, 3
- Maxwell, J. C., 1–3, 122, 147, 382
- Mayer f -functions, 238, 261, 280, 292
- Mayer graphs, 273
 - irreducible, 272
- Mazenko, G., 516, 540
- Mazur, P., 148, 529
- McLennan's convergence theorem, 87
- McLennan, J. A., 61, 87, 108, 582
- McNamara, S., 364
- Mean free path, 61, 66, 69, 437
- Mean free path damping, 475, 490, 495
- Mean free path length, 288
- Mean free time, 66, 70, 86, 155, 158, 437, 513
- Mehaffy, J. R., 582
- Memory effects, 6, 318
- Metal-insulator phase transition, 388
- Microscopic foundations of hydrodynamic equations, 574
- Mobility edge, 202
- Mode-coupling, 6, 7, 568
- Mode-coupling phenomena, 202
- Mode-coupling theory, 16, 25, 105, 328, 439, 464, 512, 515, 533, 580, 584, 587
 - self-consistent, 524
- Model potential method, 96
- Moderately dense gases, 16
- Molasses tails, 288, 533
- Mori, H., 100, 249
- Morkel, C., 531
- Morozov, V., 540
- Mouhot, C., 120
- Nano-structures, 70
- Nasser, L., 378
- Navier-Stokes equations, 3, 7, 12, 60, 73, 77, 100, 115, 297, 324, 388, 402, 422, 438, 494, 507, 578
 - dilute gas, 86
 - energy density, 69
 - fractional power corrections, 527
 - linearized, 286, 329, 526
 - mixtures, 132
 - non-equilibrium steady state, 347
 - velocity, 68
- Navier-Stokes equations in AdS/CFT theory, 588
- Neal, T., 584
- Nelson, D. R., 348, 524
- Neutron scattering, 530, 531
- Nieuwoudt, J. C., 533, 535, 536
- Nikuni, T., 397, 399, 422, 432–434, 436
- Non-equilibrium correlations, 17
- Non-equilibrium is different, 569
- Non-equilibrium spatial and temporal correlation functions, 569
- Non-equilibrium stationary states, 318, 338
 - temperature gradient, 581
- Non-equilibrium structure functions, 530
- Non-equilibrium systems
 - stationary, 246
- Non-integrable systems, 14
- Normal fluid, 399, 402
- Novikov, M. Yu., 585
- Nuclear matter, 395

628

Nucleation, 586
 Number density
 reduced, 21

 Ogilvie, G. I., 386
 Ohm's law, 164, 570, 574, 579
 Olausen, K., 168
 Onsager reciprocal relations, 4, 16, 89, 95, 123,
 127–129, 146, 179, 255, 290, 301, 431
 Onsager regression hypothesis, 127
 Onsager, L., 243, 271, 274, 349, 435
 Onuki, A., 544, 576
 Opie, A., 350
 Oppenheim, I., 7, 17, 441, 475, 476, 524, 580, 584
 Optical depth, 384
 Ordering scheme for bosons, 416
 Ornstein-Zernike equation, 272, 292
 Ortiz de Zárate, J. M., 344
 Orza, J. A., 363
 Overlap function
 hard spheres, 214, 239
 Overlapping configurations
 hard spheres, 217

 Pöschel, T., 360, 367
 Pair correlation function, 345
 Pair distribution function
 equilibrium, 444
 Paradox
 Loschmidt's, 42, 51
 Zermelo's, 42, 51
 Park, W., 501
 Particle-wall collision kernel, 91
 Pattern formation
 granular gases, 364
 Pecora, L., 332
 Peletminskii, S. V., 434
 Penrose, O., 435
 Perrin, J. B., 2
 Phase space, 206
 velocity, 207
 Phase space trajectories, 181
 Phonons, 399, 585
 Piña, E., 260, 264
 Piasecki, J., 168, 270, 378, 583
 Piston model, 11
 Pitaevskii, L. P., 324, 585
 Planetary rings, 16, 351, 382, 579
 Keplerian description, 383
 transport processes, 384
 Plasmas, 8
 Poincaré Recurrence Theorem, 51
 Poiseuille flow, 113
 Pomeau, Y., 7, 399, 434, 464, 465, 506, 509, 529, 540
 Popov, V. N., 432
 Posch, H., 14, 190

Index

Pressure
 additional isotropic term, 572
 hard sphere solid, 304
 hydrostatic, 69
 local, 327
 Pressure tensor, 67, 298, 329
 local, 547
 nonlinear, non-analytic terms, 557
 singular part, 555, 556
 Prigogine, I., 127, 586
 Procaccia, I., 350
 Projection operator, 100, 116, 315
 Lorentz gas, 160
 Projection operator method, 60, 325
 Propagators
 time displacement operators, 210
 Pseudo-Liouville equation, 193, 205
 hard spheres, 228
 Pseudo-Liouville operators, 227, 255, 447
 Pseudo-Maxwell particles, 372, 373
 Pseudo-potentials, 400, 404

 Quantum gases, 16
 Quark-gluon plasma, 585, 587

 Résibois, P., 17, 264, 540
 Radius of curvature
 Lorentz gas, 182
 optical equation, 184
 time averages of inverse, 185
 Rainbows, 39
 Ramaswami, S., 386
 Random first order transition theory(RFOT), 9
 Rapaport, D., 254
 Rarefied gas, 12, 33
 Rarefied gas dynamics, 71
 Rarefied gas flows, 581
 Rayleigh model, 11
 Rayleigh peak, 107, 539
 enhancement, 543
 Reciprocal lattice vectors, 306
 Recurrence, 53
 Recurrence time, 56
 Redner, S., 17, 586
 Regimes
 hydrodynamic, 70
 Knudsen gas, 70, 71
 Rarefied gas, 70, 71
 Reichl, L. E., 397, 434, 465
 Restituting velocities, 354
 Restitution coefficient, 352
 normal, 353
 tangential, 353
 Revised Enskog equation, 4, 259, 260, 262, 289, 313,
 328
 H-theorem, 263, 264, 267
 Chapman-Enskog solution, 274
 hard sphere crystals, 303

- linearized, 256, 271, 273
- local H -theorem, 270
- mixtures, 291
- spectrum of linearized operator, 276
- Revised Enskog theory, 255, 259, 515
 - mixtures, 290
- Riemann zeta function, 401
- Riesco, N., 301
- Ring collision operator, 484, 490, 493
- Ring diagrams, 441, 469
- Ring events, 474, 587
 - repeated, 481
- Ring kinetic equation, 478, 482, 485, 507, 515, 529, 539, 543
 - Enskog modification, 489
 - tagged particle, 486
- Ring kinetic operator, 497
- Ring resummation, 544
- Ring terms, 471, 477
- Rivet, J. P., 540
- Ro, S. T., 98
- Roche limit, 382
- Rom-Kedar, F., 14
- Romatschke, P. and U., 586
- Ronis, D., 350, 572
- Saturn
 - rings, 382, 383
- Scattering cross section
 - differential, 392
- Scattering length, 401, 502
- Scharf, G., 582
- Schmidt, J., 385
- Schmitz, R., 572
- Schrödinger equation, 392
- Schröter, M., 363
- Schramm, P., 17
- Second Law of Thermodynamics, 42
- Second sound, 422
- Second virial coefficient, 96, 97, 281
- Secular terms in density expansions, 448
- Self diffusion, 286
- Self-propelled particles, 587
- Sengers, J. V., 8, 148, 343, 344, 441, 456, 460, 464, 498, 540, 545, 569, 581
- Shapiro, M., 357
- Sharma, J., 544
- Shchelokov, V. S., 434
- Shear flow, 549
- Sigurgeirsson, H, 303
- Simanyi, N., 14
- Sinai, Ya. G., 14, 111, 186, 204
- Sirovich, L., 122
- Snook, I. K., 537
- Softening of the heat mode, 534
- Sokolovskii, A. I., 434
- Sone, Y., 94
- Sonine polynomials, 80, 288, 360
- Sound
 - dispersion relation, 108
 - frequency, 109
 - phase velocity, 108
 - propagation, 88, 95, 108
- Sound velocity
 - adiabatic, 281
- Spahn, F., 385
- Spalinski, M., 586
- Spatio-temporal fluctuations
 - from Revised Enskog equation, 271
- Specific velocity of species in a mixture, 131
- Sperl, M., 363
- Spherical harmonics, 79, 80
- Spohn, H., 17, 111, 318
- Staten, G., 572
- Static structure function, 533
- Stationary heat flow, 558
- Stationary shear flow, 545
- Stephen, M. J., 348, 524
- Stochastic behavior, 180
- Stochastic forces, 378
- Stokes flow, 12, 113
- Stokes' law, 349, 529, 582
- Stokes-Einstein formula, 583
- Stosszahlansatz*, 4, 5, 24, 25, 29, 53, 54, 111, 149, 151, 164, 172, 186, 198, 257, 317, 321, 324, 345, 354, 378, 393, 394, 437, 457, 578
- Strange attractor, 371
- String theory, 588
- Structure function
 - dynamic, 289, 336
 - static, 261, 288
- Super-Burnett equations, 8, 61, 88, 109, 526
 - transport coefficients, 580
- Superfluid, 388, 399, 402, 427
 - velocity, 409
- Superfluid component, 423
- Superfluid phase transition, 388
- Superfluid velocity
 - equation, 430
- Suspensions, 246
- Swift, J., 7, 9, 512
- Symmetry relation for diffusion, 139
- Szasz, D., 14, 203
- Tagged particle diffusion, 286, 539
- Tangential stress on wall, 92
- Tatarski, V. I., 434
- Temperature
 - local, 327
- Temperature gradient
 - stationary, 559, 568
- Ter Haar, D., 395
- Thermal diffusion, 3, 123, 138
- Thermal diffusion ratios, 140

630

Thermodynamic forces, 128, 290
 Thermodynamic temperature, 68
 Thermoelastic equations, 247
 Thermostatted dynamical systems, 191
 Thurber, J. K., 122
 Time average, 319
 Time correlation functions, 5, 7, 508, 542
 kinetic-kinetic terms, 487
 shear viscosity, 533
 stress-stress, 533
 Time correlation functions, 487
 Time displacement operators, 208, 446
 adjoint, 209, 211
 barred, 212
 free particle, 215
 hard spheres, 226, 240
 unbarred, 212
 Time reversal invariance, 129
 Time scales, 70
 natural for granular gases, 359
 Time-ordered exponential, 480
 Tiscareno, M. S., 386
 Tisza, L., 434
 Tolman, R., 395
 Tracer diffusion, 286
 Tracer particle models, 124
 Tran, M.-B., 399, 434
 Transport coefficients, 15, 60, 72, 329, 438
 bare, 523
 bulk viscosity, 68, 286, 313, 336
 coefficient of mutual diffusion, 138
 collective, 247
 condensed Bose gas, 403
 density expansions, 475
 dilute Bose gas, 430
 divergences in density expansions, 6
 divergent, 539
 divergent Burnett coefficient, 573
 divergent thermal conductivity, 561
 Enskog, 519
 Enskog theories, 263
 from Enskog equation, 256
 generalized, 492
 Green-Kubo for shear viscosity, 248
 Green-Kubo for thermal conductivity, 249
 Green-Kubo formulas, 243
 hard sphere crystals, 309
 kinematic viscosity, 107
 mutual diffusion, 139
 partial for thermal conductivity, 141
 self diffusion, 288, 313
 shear and bulk viscosity, 68
 shear viscosity, 15, 77, 85, 95, 286, 301, 313
 shear viscosity for mixtures, 143
 sound damping, 286, 313, 556
 tagged particle diffusion, 243
 thermal conductivity, 15, 68, 77, 83, 85,
 95, 313

Index

thermal conductivity for mixtures, 142
 thermal diffusion- mixtures, 139
 thermal diffusivity, 107, 286, 336
 Tremaine, S., 384
 Trizac, E., 386
 Truesdell, C., 148
 Turaev, D., 14
 Two-fluid equations, 417
 Euler, 426
 Landau-Khalatnikov, 388, 399, 402, 422, 424, 579
 Landau-Khalatnikov equations, 12
 U(1) gauge symmetry, 403
 Uehling-Uhlenbeck equation, 388, 391, 399, 422,
 433, 585
 H-theorem, 395, 396
 bosons and fermions, 395
 Chapman-Enskog solution, 388
 fermions, 395
 hydrodynamic modes, 397
 linearized, 395, 398
 Uhlenbeck, G. E., 13, 251, 318, 349, 440, 456, 463,
 465
 Ursell functions, 310
 van Beijeren, H., 4, 16, 147, 255, 260, 465, 489, 505,
 516, 529, 533, 535, 540, 544, 582
 van der Hoef, M. A., 515
 van Kampen, N., 120, 349
 van Leeuwen, J. M. J., 18, 500, 506
 van Megen, W., 537
 van Noije, T., 360, 371
 van Well, A. A., 529
 Velocity autocorrelation function, 7, 512
 hard disks, 524
 intermediate times, 535
 negative region, 537
 Verkerk, P., 529
 Vibrating platforms, 378
 Villani, C., 111, 112, 120, 386
 Virial expansions, 6, 438, 471
 equilibrium pair distribution function, 256
 non-equilibrium, 579
 non-equilibrium, divergence difficulties, 438, 441,
 471, 473
 Visco-elastic
 particles, 361
 property, 536
 Viscous heating, 570
 Vlasov equation, 13, 395
 Vlasov-Uehling-Uhlenbeck equation, 395, 586
 Volterra, V., 586
 von Neumann equation, 389
 quantum Liouville equation, 389
 Wainwright, T. E., 7, 439, 498, 509, 513, 524, 580
 Wajnryb, E., 168
 Wakeham, W. A., 98, 145

Index

631

- | | |
|------------------------------|--|
| Wang-Chang, C. S., 251 | Yamada, T., 505, 545 |
| Waterston, J. J., 2 | Yang, C. N., 434 |
| Weijland, A., 500, 506 | Yip, S., 540 |
| Weiss, G. H., 148 | Young, W., 364 |
| Welander, P., 115 | Yu, P., 363 |
| Weyl representation, 390 | Yuan, H. H. H., 524 |
| Widom-Rowlinson model, 147 | Yvon, J., 251 |
| Wigner, E., 388, 390 | |
| Wilkinson, D. R., 386 | Zárate, J. M., 545 |
| Williams, S. R., 537 | Zanetti, G., 364, 371 |
| Wind-tree model, 11, 15, 504 | Zaremba, E., 399, 422, 432–434, 436 |
| Wood, W. W., 513, 536 | Ziman, J. M., 585 |
| Wu, T. T., 60, 117 | Zubarev, D. N., 540, 585 |
| Wysokinski, K. I., 501 | Zwanzig, R., 13, 18, 100, 318, 325, 349, 434, 536, 540 |