

Index

- G*-invariant polynomial basis, 136
- abscissa
 - absolute conv., 334
 - conditional conv., 334
- accelerator mode, 441
- action, 272, 539, 552, 562
 - helium, 621
 - relation to period, 628
- adjacency matrix, 220, *see* transition matrix
- admissible
 - periodic points, 234
 - trajectories, number of, 231
- Airy
 - equation, 545
 - function, 545
- Airy function, 546, 547, 610, 613, 618
 - at a bifurcation, 547
- Airy integral, 545
- algebra, 701
 - associative, 701
 - Lie, 701
- allowable itinerary, *see* admissible
- alphabet, 162
- alternating binary tree, 179, 196
- analyticity
 - domain, 303
- anomalous diffusion, 449
- Anosov flows, 193
- antiharmonic extension, 722
- arc, 222
- area preserving
 - Hénon map, 115
 - map, 773
- Artin-Mazur zeta function, 238
- associative algebra, 701
- attractor, 36
 - basin, 36
 - Hénon, 287
 - strange, 36, 41, 281
- Aubry-Mather theory, 501
- autonomous flow, 38
- average
 - chaotic, 422
 - space, 260, 274
 - time, 260, 272
- averaging, 24
- Axiom A, 386, 393
- baker's map, 128
- Balmer spectrum, 528
- basin of attraction, 36
- basis vector, 700
- BER
 - approximation, 433
- Bernoulli, 680
 - polynomials, 373
 - shift, 171, 368, 373, 381, 392, 394, 413, 431, 448, 683, 684, 812
 - shift eigenfunctions, 388
 - shift return times, 431
- Berry-Keating conjecture, 695
- Bessel function, 601
 - addition theorem, 603
- bi-infinite itinerary, 176
- bifurcation
 - Airy function approximation, 547
 - bizarre, 722
 - generic, 128
 - Hopf, 505
 - saddle-node, 59
- billiard, 123–128
 - map, 124
 - stability, 89, 125
 - stadium, 123, 129, 152, 407, 434, 770, 773
- binary
 - prime cycles, 165, 184
 - symbolic dynamics
 - collinear helium, 624
 - tree, alternating, 179, 196
- Birkhoff
 - coordinates, 51, 124, 129
 - ergodic theorem, 260
- block
 - finite sequence, 176
- block, pruning, 178
- Bohr
 - de Broglie picture, 528
 - Sommerfeld quantization, 528, 579, 691
 - helium, 620, 630
- Uetli Schwur, 691
- Bohr-Sommerfeld quantization, 546
- Boltzmann
 - equation, 453
- Boltzmann, L., 22
- boredom, 401, 661
- Borges, J.L., 661
- boundary orbits, 150, 348
- bounded operators, 787
- Bourbaki, N., 58
- Bowen, R., 26
- brain, rat, 3, 27
- branch cut, 417
 - singularity, 418
- Bunimovich
 - stadium, *see* stadium billiard
- Burnett coefficient, 446
- butterfly effect, 59
- C_{3v} symmetry, 186, 352
- canonical transformation, 113, 114, 707
- Cartwright M.L., 683
- Cartwright, M.L., 152
- Cauchy criterion, 785
- caustic, 556
- ceiling function, 301, 393
- center, 69
- center manifold, 471
- center of mass, 217
- chain rule
 - matrix, 783
- change
 - of coordinates, 96
- chaology, *see* chaos
- chaos, 5, 7
 - caveats, 8
 - deterministic, 25
 - diagnostics, 43
 - quantum, 26
 - skeleton of, 11, 12
 - spatiotemporal, 460
 - successes, 8
- character
 - representation, 753
- characteristic
 - equation, 704
 - exponent, 69
 - function, 253
 - multiplier, 87
 - polynomial, 236, 705, 754
 - value, 69
- chicken heart palpitations, 5
- circle map
 - critical, 508
- class algebra, 773
- Clebsch-Gordan
 - coefficients, 703
- coarse-graining, 253
- coding, *see* symbolic dynamics
- collinear helium, 530
 - symbolic dynamics, 624
- combinatorics
 - teaching, 171
- compact group, 136
- complete
 - N*-ary dynamics, 162
 - symbolic dynamics, 163
- completeness
 - relation, 71, 702, 705, 755
- complex eigenvalues, 71, 710
- complexity
 - algorithmic, 247
- confession
 - C.N. Yang, 259
 - Kepler, 680
 - St. Augustine, 253
- configuration space, 42
- conjugacy, 97
 - invariant, 106
 - smooth, 96, 105, 108
 - topological, 172
- conjugate, hermitian, 751
- connection formulas, 545
- conservation
 - equation, 479
 - phase space volume, 112, 114, 115, 118, 265
- continuity equation, 262, 265, 479, 482, 554
- contour integral, 309
- contracting
 - Floquet multipliers, 87
 - flow, 36, 41, 78
 - map, 83, 180
 - stability eigenvalues, 292
- contraction
 - state space
 - Rössler, 83, 339
- convergence
 - abscissa of, 334
 - mediocre, 779
 - radius, 303
 - super-exponential, 378, 489
- convexity, 286
- coordinate
 - change, 96, 97
 - longitudinal, 564
 - transformations, 108
- Copenhagen School, xi, 691

- correlation
 - decay
 - power law, 411
 - function, 388
 - spectrum, 388
 - time, 363
 - cost function, 490
 - covering
 - symbolic dynamics, 176
 - creeeping
 - 1-disk, 611
 - critical
 - point, 89, 167, *see* equilibrium point
 - value, 169, 444
 - cumulant
 - expansion, 235, 238, 324
 - Plemelj-Smithies, 791
 - curvature
 - correction, 321
 - expansion, 23, 321
 - cycle, 11, *see* periodic orbit
 - expansion, 17, 321, 578
 - 3-disk, 337
 - finite subshift, 329
 - Lyapunov exponent, 329
 - stability ordered, 330
 - fundamental, 236, 321, 777
 - limit, 281
 - Lyapunov exponent, 88
 - marginal stability, 65, 91, 150
 - point, 11, 20, 173, 176, 724
 - admissible, 234
 - count, 239
 - prime, 177, 201, 249, 294
 - 3-disk, 202, 499
 - Hénon map, 492
 - pruning, 242
 - Rössler
 - flow, 204
 - stability, 85–93
 - Gauss map, 516
 - stable, 89
 - superstable, 89
 - unstable, 12
 - weight, 306
 - cycle point, *see* periodic point
 - cycles
 - Rössler flow, 216
 - cyclic
 - invariance, 201
 - symmetry, 233
 - cyclic group, 748, 749
 - damped Newton method, 207
 - Danish pastry, *see* symbol plane
 - de Broglie wavelength, 548
 - Debye approximation, 618
 - decay
 - rate, 313
 - rate of correlations, 388
 - decomposition
 - irreducible, 757
 - defining
 - rep, 751
 - vector space, 750
 - degree of freedom, 8, 111, 475, 540
 - delta function
 - Dirac, 255, 535
 - density, 253, 479
 - evolution, 22
 - phase space, 265
 - density of states
 - average, 574
 - Green's function, 536
 - quantum, 536
 - desymmetrization
 - 3-disk, 356
 - determinant
 - for flows, 305
 - Fredholm, 794
 - graph, 247
 - Hadamard, 303
 - spectral, 21, 235, 303
 - trace relation, 235
 - trace-class operator, 788
 - deterministic dynamics, 5, 33, 261
 - diagonalizing matrix, 754
 - differential equations
 - ordinary
 - almost, 44
 - diffraction
 - Green's function, 645
 - Keller, 653
 - Sommerfeld, 653
 - diffusion
 - anomalous, 449
 - constant, 276
 - equation, 480
 - Diffusion Limited Aggregates, 27
 - digraph, *see* transition graph
 - dihedral group, 748, 749
 - dike map, 174, 180
 - dimension
 - box counting, 404
 - fractal, 404
 - generalized, 9
 - information, 404, 405
 - intrinsic, 8, 475
 - Dirac delta derivatives, 268
 - Dirac delta function, 19, 239, 255, 268, 279, 294, 480, 537, 557, 569
 - Dirac path integral, 568
 - Dirichlet series, 333
 - dissipative
 - map, 83, 180
 - divergence rate
 - local, 284
 - divergence ultraviolet, 576
 - dof, *see* degree of freedom
 - doubling map, 171, 384
 - dual
 - rep, 700, 750, 751
 - space, 700, 750
 - vector space, 750
 - Duffing oscillator, 38, 42, 51, 111
 - dynamical
 - system, 33, 34
 - deterministic, 33
 - gradient, 44
 - smooth, 34
 - systems
 - equivalent, 106
 - transitivity, 221
 - zeta function, 16, 307
 - Euler product rep., 307
 - dynamical system
 - infinite, 476
 - smooth, 18, 19, 23, 245, 683, 812, 815, 817
 - dynamics
 - deterministic, 5
 - hyperbolic, 164
 - irreversible, 37
 - reversible, 37
 - spatiotemporal, 26
 - stochastic, 5
 - symbolic, 10, 161, 175
 - symmetry, 134, 146
 - topological, 161, 175, 177, 220
 - edge, 222
 - eigen-direction, 64
 - eigenfunction
 - Perron-Frobenius operator, 371
 - energy, 533
 - eigenfunctions
 - Perron-Frobenius, 371
 - eigenstate, *see* eigenfunction
 - eigenvalue, 313
 - Perron-Frobenius operator, 371
 - exponential spacing, 304
 - zero, 546, 561
 - eigenvalues
 - complex, 71, 710
 - Einstein
 - diffusion formula, 480
 - Einstein, A, 695
 - elastic
 - scattering, 586
 - elliptic
 - stability, 116
 - enemy
 - thy, 413
 - English
 - plain, 176
 - ensemble
 - microcanonical, 286
 - entire function, 371
 - entropy
 - barrier, 336
 - Gauss map, 523
 - Kolmogorov, 128, 247, 399, 401, 406, 407
 - topological, 6, 231, 243, 247
 - equation
 - of variations, 63
 - equilibria
 - Kuramoto-Sivashinsky, 467
 - equilibrium
 - Lorenz flow, 39, 53
 - point, 38, 72, 259, 468, 492
 - Rössler flow, 40, 44, 73
 - equilibrium measure, *see* natural measure
 - equivalence
 - of dynamical systems, 106
 - equivariance, 134
 - equivariant, 134, 147, *see* relative
 - ergodic
 - average, 260
 - theorem
 - multiplicative, 286
 - theory, 260
 - escape rate, 12, 13, 268, 277, 278, 309, 311, 316, 325, 329, 337, 360, 367, 374, 394, 401, 405, 406, 482, 745, 776, 838
 - 3-disk, 328, 337, 358
 - intermittency, 421
 - vanishing, 269, 327, 720
- essential
 - spectral radius, 381
 - spectrum, 380
- essential spectral radius, 390
- Euler
 - formula, 67, 373
 - limit, 76
 - product, 76, 311
 - product rep.

- dynamical zeta function, 307
- totient function, 509
- Euler-MacLaurin formula, 388
- Eulerian
 - coordinates, 65
- evolution
 - group, 44
 - kernel
 - probabilistic, 261
 - operator, 19, 280
 - quantum, 535
 - semigroup, 280
- expanding
 - Floquet multipliers, 87
 - stability eigenvalues, 292
- expectation value, 274, 287
- exponent
 - Floquet, 87, 88
- exponential
 - convergence, 303, 378
 - decay rate of correlations, 388
 - of a matrix, 68
- exponential proliferation, 20, 247
- extremal point, 541
- factor group, 138
- false zeros, 311
- Farey
 - map, 411, 433
 - mediant, 510
 - series, 508
 - tree, 510
- Feynman path integral, 560, 568
- Fick law, 480
- finite group, 748
- finite subshift
 - cycle expansion, 329
- first return function, 47
- first return time, 430
- fixed point, 201
 - maps, 60
 - marginally stable, 411
- Floquet
 - exponent, 78, 87, 88, 115
 - exponents, 88
 - multiplier, 69, 87, 89, 292
 - multiplier, metric invariant, 105
 - theorem, 87
- flow, 32–41
 - autonomous, 38
 - contracting, 36, 41, 78
 - deterministic, 261
 - elliptic, 88
 - generator of, 263, 712
- Hamiltonian, 111, 773
 - hyperbolic, 88, 116, 313
 - incompressible, 78, 265
 - infinite-dimensional, 459–475
 - inverse hyperbolic, 116
 - linear, 66, 82
 - linearized, 64
 - nonhyperbolic, 88
 - spectral determinant, 305
 - stability, 72
 - stationary, 38
 - stochastic, 261
 - stretch & fold, 167
- Fokker-Planck equation, 481
- form
 - normal, 104
- Fourier
 - mode
 - truncation, 462
- fractal, 402
 - aggregates, 9
 - dimension, 404
 - geometry of nature, 9
 - probabilistic, 9
 - science, 8
- Fredholm
 - determinant, 794
- Fredholm theory, 378, 379
- Frenkel-Kontorova model, 501
- frequency analysis, 43
- Fresnel integral, 541, 547
- full shift, 163
- function
 - space
 - piecewise constant, 295
- functional, 260
 - composition, 37
 - Lyapunov, 36
- functions
 - L^2 square-integrable, 390
 - analytic, 389
- fundamental
 - cycle, 236
 - cycles, 777
 - domain, 184
 - collinear helium, 623
 - matrix, 14, 64
- fundamental matrix, 716
- Galerkin truncation, 464
- Galilean invariance, 462, 476
- Gatto Nero
 - professor, 170
- gauge fixing, 53
- Gauss
 - shift, *see* Gauss map
- Gauss map, 269, 433, 509, 510, 520
 - cycle stability, 516
 - metric entropy, 523
- Gaussian
 - integral, 268, 446, 486, 569
 - integral, d -dimensional, 486, 557
 - noise, 822
 - probability density, 481
- generating function, 294, 502
- generating partition, 177
- generator
 - of flow, 263, 712
- Gilmore, R., 152
- $GL(n, \mathbb{F})$, 749
- golden mean
 - pruning, 237
- gradient
 - algorithm, 490
 - system, 44
- grammar
 - symbolic dynamics, 177
- graph
 - irreducible, 222
 - strongly connected, 222
 - transition, 220
- Gray codes, 179
- Green's function, 537
 - analogue of, 716
 - density of states, 536
 - diffraction, 645
 - energy dependent, 535
 - regularized, 576
 - scattering, 592
 - semiclassical, 566, 568, 569
 - short distance, 565, 566
 - trace, 535
 - long orbits, 565
- group, 748
 - S^1 , 748
 - compact, 136
 - cyclic, 748, 749
 - dihedral, 748, 749
 - dynamical, 37
 - evolution, 44
 - finite, 133, 748
 - general linear, 749
 - Lie, 748
 - matrix, 752
 - not a, 773
 - order of, 133, 748
 - representation, 752
 - semi-, 262, 712
 - symmetric, 748
- Gutzwiller
 - trace formula, 574
- Gutzwiller path integral, 568
- Gutzwiller, M., 686
- Hadamard determinant, 303
- Hadamard product, 577
- Hamilton
 - Jacobi equation, 549
 - equations, 549
 - principal function, 483, 552
- Hamilton-Cayley theorem, 702, 705
- Hamiltonian, 533, 550
 - dynamics, 110–119
 - flow, 773
 - spectral determinant, 307
 - stability, 112, 708
 - flows, stability, 706
 - Hénon map, 115
 - repeller, periodic orbits, 216
- Hankel function, 565, 601, 618
- Harter, W. G., 773
- Heaviside function, 536
- Heisenberg, 692
 - picture, 785
- Heisenberg, W, 711
- Helfand moments, 445
- helium, 620, 691
 - collinear, 45, 60, 112, 530, 639
 - cycles, 216, 639
 - eigenenergies, 640
 - fundamental domain, 623
 - Poincaré section, 639
 - stabilities, 639
 - stability, 216
- Helmholtz equation, 601
- Hénon map, 57, 59, 116
 - attractor, 261, 287
 - cycles, 217, 490
 - fixed points, 60, 188
 - Hamiltonian, 115
 - horseshoe, 188
 - inverse, 188
 - Lyapunov exponent, 287
 - natural measure, 258
 - prime cycles, 492, 503
 - pruning, 780
 - stability, 79, 89
 - structural stability, 196
 - symmetries, 772
 - time delay map, 209
 - transient, 492
- Hénon, M., 59
- Hénon-Heiles
 - symbolic dynamics, 152

- hermitian
 - conjugation, 751
 - matrix, 751
- heroes
 - unsung, xi, xv
- Hessian matrix, 113
- Hilbert
 - space, 534
- Hilbert-Schmidt
 - condition, 379
 - operators, 787
- Hilbert-Weyl theorem, 136
- Holmes, P., 475
- Hopf
 - bifurcation, 505
 - Hopf's last hope, 689
 - Hopf, E., 688
 - Hopf, Ebehardt, 505
 - Hopf, Eberhard, 687
 - Hopf, Heinz, 637
 - horseshoe, 188
 - complete, 190
- hydrodynamical
 - interpretation of QM, 568
- hyperbolic
 - flow, 88, 116, 313
 - non-, 22
- hyperbolicity assumption, 15, 293
- in/out nodes, 69
- inadmissible symbol sequence, 177
- incommensurate, 35
- incompressible flow, 78
- indecomposability, 221
 - metric, 162
- index
 - Maslov, *see* topological index
- index summation, repeated, 749
- indifferent
 - stability, 64
- induced map, 425
- inertial manifold, 463, 475
- infinite-dimensional flows, 459–475
- inflection point, 506
- information
 - dimension, 404
- information dimension, 405
- initial
 - conditions
 - sensitivity to, 6
 - point x_0 , 14, 34, 64
 - state x_0 , 14, 34
- injective, 58
- integrable system, 95, 112
- integrated observable, 272, 273, 280, 284, 294, 308, 320, 778
- integration
 - Runge-Kutta, 44
- intermittency, 128, 384, 410
 - escape rate, 421
 - piecewise linear model, 413
 - resummation, 427
 - stability ordering, 332
- invariance
 - cyclic, 201
 - Galilean, 462, 476
 - of flows, 90
 - symplectic, 113, 706
- invariant, 752
 - matrix, 751
 - measure, 258
 - metric, 86, 106
 - topological, 86
 - tori, 151
 - vector, 751
- invariant density, *see* natural measure
- invariant measure
 - Gauss map, 269
- invariant subgroup, 138
- inverse
 - hyperbolic flow, 116
- inverse iteration, 206
 - Hamiltonian repeller, 216
- inversion, 133
- involution, 749
- inward/outward spirals, 69
- irreducible
 - decomposition, 757
 - graph, 222
 - matrix, 221
 - segment, 142
- irrep, 757
- irreversibility, 22, 37
- Ising model, 152, 185, 351, 356, 800, 802, 813, 814, 819, 820
- isotropy, 151
- isotropy subgroup, 136
- iteration, 34
 - inverse, 206
 - Hamiltonian repeller, 216
 - map, 56
- itinerary, 10, 12, 51, 162, 202
 - bi-infinite, 164, 176
 - future, 170, 175
 - past, 176
- Jacobi, C.G.J., 82
- Jacobian, 77, 254
 - matrix, *see* fundamental matrix
- Jonquière function, 415, 434, 450, 456
- Jordan form, 705
- KAM
 - tori, 410
- Keller
 - diffraction, 653
- Keller, J.B., 686
- Keplerian orbit, 528
- kernel
 - resolving, 379
- kneading
 - determinant, 195
 - sequence, 174, 180
 - theory, 173
 - value, 174, 180
- Kolmogorov entropy, 128, 247, 399, 401, 406, 407
- Koopman operator, 711, 716
- Kraichnan, R., 688
- Kramers, 692
- Krein-Friedel-Lloyd formula, 593
- Kronecker delta, 700, 750
- KS, *see* Kustaanheimo-Stiefel
- Kuramoto, Y., 475
- Kuramoto-Sivashinsky
 - equilibria, 467, 470
 - system, 465, 468, 471, 475
- kurtosis, 287, 445
- Kustaanheimo-Stiefel transformation, 100, 621
- L^2 function space, 390
- Lagrangian, 552
 - coordinates, 65
 - manifold, 553
- laminar states, 410
- Langevin equation, 481, 485
- Laplace
 - transform, 21, 239, 263, 296, 297, 301, 535, 566, 713
 - transform, discrete, 234, 294, 432
- Laplace, Pierre-Simon de, 4
- Laplacian
 - diagonalization, 774
 - non-local, 774
- last hope, Hopf's, 689
- least action principle, 202, 499
- Legendre transform, 552
- Leibniz, Gottfried Wilhelm, 4
- Letellier, C., 152
- level set, 111
- libration orbit, 626, *see* self-retracing
- Lie
 - algebra, 148, 701
- group, 748
 - product, 701
- lifetime, 12
- lifetime matrix, 596
- limit
 - cycle, 281
- linear
 - flow, 66, 82
 - space, 699
 - stability, 62, 85, 468
- linearized
 - flow, 64
- link, 222
- Liouville
 - equation, 265
 - operator, 266
 - theorem, 112, 114, 115, 118, 265
- Littlewood J.E., 683
- local
 - divergence rate, 284
 - stability, 62, 85, 468
- logistic map, *see* unimodal
- longitudinal
 - coordinate, 564
- loop
 - intersecting, 236
- Lorentz gas, 410, 433
- Lorentzian, 537
- Lorenz flow, 39, 53, 74, 75, 140, 155, 168
 - polar coordinates, 155, 156
 - proto-Lorenz, 155
 - symmetry, 135, 155
- Lorenz, E.N., 59, 152
- loxodromic, 115, 708
- Lozi map, 57, 59
- Lyapunov exponent, 6, 78, 107, 281
 - cycle, 88
 - cycle expansion, 329
 - equilibrium, 468
 - natural measure, 284
 - numerical, 286
 - numerically, 283
- Lyapunov functional, 36
- Lyapunov time, 6, 8, 37, 272
- M state space volume, 277
- manifold
 - stable, 186
- map, 34, 55–58
 - area preserving, 773
 - contracting, 83, 180
 - dike, 174, 180
 - dissipative, 83, 180
 - expanding, 163

- fixed point, 60
- Hénon, 57, 490, 772
 - Hamiltonian, 115
 - prime cycles, 492
- Hamiltonian
 - Hénon, 115
- iteration, 56
- logistic, *see* unimodal
- Lozi, 57, 59
- once-folding, 188
- order preserving, 172
- orientation preserving, 773
- orientation reversing, 773
- quadratic, 58, 167
- return, 14, 47–49, 51, 188
- sawtooth, 135, 139, 342
- stability, 78
- tent, 167
- unimodal, 167
- marginal
 - stability, 14, 64, 87, 149, 292, 384, 411
 - cycle, 65, 91, 150
 - fixed point, 411
- Markov
 - chain, 176
 - graph, *see* transition graph
 - matrix, 256, 329
 - partition, 446
 - finite, 163, 164
 - infinite, 228
 - not unique, 183
- Maslov index, *see* topological index
- material invariant, 479
- Mather, *see* Aubry-Mather theory
- matrix
 - diagonalizing, 754
 - exponential, 68, 714
 - group, 752
 - hermitian, 751
 - invariant, 751
 - irreducible, 221
 - of variations, *see* stability matrix
 - product, 701
 - rep, 701
 - stability, 63, 483
- Maupertuis, P.L.M. de, 202, 499
- measure, 253
 - continuous, 107
 - invariant, 258
 - natural, 59, 259, 267, 274, 364, 366, 437, 688, 694
- mechanics
 - quantum, 533
- mediocre
 - convergence, 779
- memory
 - finite, 224
- metric
 - indecomposability, 162, 781
 - invariant, 86, 106
 - Floquet multiplier, 105
 - transitivity, 781
- metric entropy
 - Gauss map, 523
- microcanonical ensemble, 286
- Mira, C., 59
- Misiurewicz, M., 59
- mixing, 6, 7, 15, 261
- mode
 - normal, 774
- Moebius inversion, 241
- monodromy matrix, 78, 92, 292, 707
- Morse index, *see* topological index
- multi-scattering matrix, 604
- multifractals, 809
- multiplicative ergodic theorem, 286
- multiplier
 - characteristic, 87
 - Floquet, 69, 87
- multi-point shooting method, 207
- natural density, *see* natural measure
- natural invariant, *see* natural measure
- natural measure, 59, 214, 259, 267, 274, 284, 364, 366, 387, 437, 688, 694
- nature
 - geometry of, 9
- Navier-Stokes equation, 459
- neighborhood, 62, 92
- Nero, G., 170
- neutral, *see* marginal
- Newton method, 206
 - convergence, 207
 - damped, 207
 - flows, 210
 - optimal surface of section, 734
- Newtonian dynamics, 110
- node, 222
- noise
 - Gaussian, 481, 484, 822
 - white, 481
- non-wandering set, 35, 190
- nonequilibrium, 437
- nonhyperbolic
 - flow, 88, 91
- norm, 785
- normal
 - divisor, 138
 - form, 104
 - mode, 774
- observable, 260, 266, 272, 292, 363, 422, 430, 437, 448, 686, 711, 797, 802, 819, 820
 - integrated, 272, 273, 280, 284, 294, 308, 320, 778
 - vector, 287
- observables, simultaneous, 756
- ODE, *see* ordinary differential equations
- ODEs, 459
- $O(n)$ group, 748
- 1-disk
 - creeping, 611
 - scattering, 602
 - semiclassical scattering, 608
- Onsager-Machlup, 485
- open systems, 12, 276
- operator
 - evolution, 280
 - Hilbert-Schmidt, 787
 - Koopman, 711, 716
 - Liouville, 266
 - norm, 785
 - Perron-Frobenius, 255, 286
 - positive, 787
 - regularization, 793
 - resolvent, 234, 264, 713
 - semigroup
 - bounded, 263, 713
 - shift, 175, 176
 - trace-class, 786
- orbit, 34, 56, 137
 - inadmissible, 173
 - Keplerian, 528
 - periodic, 35, 176, 320, 572, 573
 - returning, 571
- order preserving map, 172
- ordering
 - spatial, 170, 190
- ordinary differential equations
 - almost, 44
- partial differential equations, 459
- orientation
 - preserving map, 773
 - reversing map, 773
- orthogonality
 - relation, 71, 702, 705, 755
- Oseledec multiplicative ergodic theorem, 286
- palpitations, chicken heart, 5
- paradise
 - this side of, 358
- partial differential equations, 459
- partially hyperbolic invariant tori, 151
- partition, 162, 177
 - generating, 177
 - infinite, 180, 243, 247
 - Markov, 163
 - state space, 253
- partition function, 286
- passive scalar, 479
- past topological coordinate, 192
- path integral
 - stochastic, *see* Wiener integral
- PDE, *see* partial differential equations
- PDEs, 459
- period
 - relation to action, 628
- periodic
 - orbit, 35, 176, 320, 572, 573
 - condition, 201, 214, 489
 - extraction, 201–215, 489–499
 - Hamiltonian repeller, 216
 - inverse iteration, 206
 - multi-point shooting, 207
 - Newton method, 206–207
 - relative, 149
 - relaxation algorithm, 490
 - point, 173, *see* cycle point, 724
 - unstable, 12
- Perron-Frobenius
 - matrix, 221
 - operator, 255, 286, 371
 - theorem, 387, 393, 812
- phase space, 33, 119, *see* state space
- 3-disk, 781
- density, 265
 - vs. state space, 42
- piecewise constant function, 295
- piecewise linear map, 433
 - intermittency, 413
 - repeller, 278
- pinball, *see* 3-disk
 - simulator, 129
- plain English, 176
- Plemelj-Smithies cumulants, 791
- Poincaré invariants, 118
- Poincaré return map, 47, 48
 - cycle, 91
 - polynomial, 56
 - stability, 80

- Poincaré section, 11, 47–55, 188
 - 3-disk, 124
 - Hénon trick, 59
 - hyperplane, 49
- Poincaré, H., 3, 7, 13
- point
 - non-wandering, 35
 - periodic, 11, 176
 - scatterer, 654
 - wandering, 35
- Poisson
 - bracket, 264, 265, 267, 706
 - resummation, 21, 428
- Pollicott, M, 431
- Pollicott, M., 286
- polylogarithm, 415
- polynomial
 - characteristic, 236
 - topological, 238
- Pomeau, Y., 59
- positive operators, 787
- potential
 - problems, 44
- power law
 - correlation decay, 411
- pressure, 286
 - thermodynamic, 286
- prime cycle, 177, 201, 249, 294
 - 3-disk, 163, 249, 499
 - binary, 165, 184
 - count, 240
 - Hénon map, 492, 503
 - ternary, 184
- primitive cycle, *see* prime cycle
- probabilistic zeta function, 431
- probability
 - matrix, 221
- probability density
 - Gaussian, 481
- product
 - Lie, 701
 - matrix, 701
- profile
 - spatial, 34
- projection operator, 705, 754
- propagator, 535
 - semiclassical, 557
 - short time, 558, 565
 - Van Vleck, 559
- pruning, 10, 411
 - block, 178
 - front, 193
 - golden mean, 237
 - individual cycles, 242
 - primary interval, 175
 - rules, 164
 - symbolic dynamics, 177
- pruning front
 - 3-disk, 197
- pseudocycle, 320
- quadratic map, 58
- quantization
 - Bohr-Sommerfeld, 528
 - semiclassical, 571
 - WKB, 538, 542
- quantum
 - chaos, 531, 577
 - evolution, 535
 - interference, 548
 - mechanics, 533
 - potential, 567
 - propagator, 535
 - resonances, 528
 - theory, old, 691
- quantum chaology, *see* chaos, quantum
- quasiperiodicity, 35
- quotient
 - state space, 53
- quotient group, 138
- radius
 - of convergence, 303
- random matrix theory, 531
- Rayleigh-Benard flow, 39
- recoding, 178, 184
- rectangle, 191
- rectification
 - flows, 97
 - maps, 103
- recurrence, 35, 161
 - time, *see* return time
- reflection, 133
- regularization, 100, 577
 - Green's function, 576
 - operator, 793
- relative
 - periodic orbit, 149
 - solutions, 297
- relaxation algorithm, 490
- renormalization, 128
- rep
 - defining, 751
 - dual, 700, 750, 751
 - matrix, 701
 - standard, 749
- repeated index summation, 749
- repeller, 12, 36, 277, 530
 - piecewise-linear, 278
 - single fixed point, 371
- representation
 - character, 753
 - equivalent, 753
 - faithful, 753
 - matrix, 752
 - regular, 753
- representation space, 749
- representative point, 33
- residue, 118
 - stability, 116
- resolvent
 - kernel, 379
 - operator, 234, 264, 713
- resonances
 - complex, 530
 - quantum, 528
 - Ruelle-Pollicott, 286, 431
- resummation
 - intermittency, 427
- return map, 14, 49, 51, 188
- return time, 431
 - distribution, 431
- returning orbit, 571
- reversible
 - dynamics, 37
- Riemann zeta function, 333, 433
- Rössler
 - attractor, 51
 - cycles, 204, 216
 - equilibria, 44, 73
 - flow, 40, 42, 44, 51, 60, 83, 160, 167, 188, 283
 - Lyapunov exponent, 287
- Roux
 - Henri, 25, 78
- Ruelle
 - Pollicott resonances, 286, 431
 - zeta function, *see* dynamical zeta function
- Ruelle, D., 26, 286, 431
- Runge-Kutta integration, 44
- running orbit
 - Lorentz gas, 441
- Rutherford, 620
- Rydberg series, 630
- S^1 group, 748
- saddle, 69
- saddle point, *see* stationary phase
- saddle-node bifurcation, 59
- sawtooth map, 135, 139, 342
- scalar multiplication, 699
- scattering
 - 3-dimensional spheres, 128
 - elastic, 586
 - Green's function, 592
 - matrix, 587
 - phase shift, 594
 - point, 654
- Schrödinger
 - equation, 533
 - time independent, 533
 - picture, 785
- Schrödinger, E, 711
- Schwartzian derivative, 107
- section
 - Poincaré, 11, 47, 49, 51, 124
- secular equation, 704, 705, 754
- self-retracing cycle, 626
- self-similar, 20
- semiclassical
 - approximation, 549
 - Green's function, 566, 569
 - propagator, 557
 - quantization, 571
 - spectral determinant
 - collinear helium, 632
 - wave function, 555
 - semiclassical zeta function, 578
- semiclassical resonances
 - 3-disk, 835
- semigroup, 262, 712
 - dynamical, 37
 - evolution, 280
 - operator, 263, 713
- sensitivity to initial conditions, 6, 29, 59, 281
- set
 - non-wandering, 190
- shadowing, 17, 18, 245
- 3-disk, 328
- shift, 176
 - Bernoulli, 171, 373, 431
 - finite type, 178
 - full, 163, 176
 - map, 507
 - operator, 175, 176
 - sub-, 177
- similarity transformation, 106
- simultaneous observables, 756
- Sinai, Ya., 26
- Sinai-Bowen-Ruelle measure, *see* natural measure
- single fixed point
 - repeller, 371
 - spectral determinant, 372
- singular value decomposition, 68
- singular values, 68

- singularity
 - branch cut, 418
- Sivashinsky, G.I., 475
- skeleton of chaos, 11, 12
- Smale
 - wild idea, 305, 315
- Smale, S., 9, 26, 182, 195, 248, 315, 683
- small divisor problem, 293
- S -matrix, 587
- smooth, 146
 - conjugacy, 96, 105, 108
 - dynamical system, 476
 - dynamics, 18, 19, 23, 34, 245, 683, 812, 815, 817
 - Spectral determinant, 392
 - approximated, 776
 - interaction, 819
 - potential, 128
- smooth conjugacy, 105
- Sommerfeld
 - diffraction, 653
- space
 - analytic functions, 389
 - average, 260
 - averaging, 274
 - configuration, 42
 - defining vector, 750
 - density functions, 295
 - dual, 700, 750
 - linear, 699
 - phase, 42
 - state, 42
 - vector, 699
- span, 700
- spatial
 - profile, 34
- spatiotemporal chaos, 460
- spatiotemporal dynamics, 26
- spectral
 - determinant, 21, 235, 303
 - 1- d maps, 306
 - 2- d hyperbolic Hamiltonian flow, 307
 - entire, 304, 378
 - for flows, 305
 - infinite product rep., 305
 - single fixed point, 372
 - weighted, 312
- spectral determinant
 - 1-dof, 579
 - 2-dof, 580
- radius, 372, 381
 - essential, 390
- staircase, 536
- spectral decomposition, 71, 703, 706, 747, 756
- spectral stability, 448
- spectrum
 - Balmer, 528
- specular reflection, 123
- Spiegel, E.A., 688
- SRB measure, *see* natural measure
- St. Augustine, 253
- stability, 62–81
 - billiards, 89, 125
 - eigenvalue, *see* Floquet multiplier
 - eigenvalues, 292
 - elliptic, 293
 - exact, 93
 - exponent, *see* Floquet exponent
 - flow, 72
 - Hamiltonian flow, 708
 - Hamiltonian flows, 112, 706
 - indifferent, 64
 - linear, 62, 85, 468
 - maps, 78
 - marginal, 64, 149
 - matrix, 63, 483
 - multiplier, *see* Floquet multiplier
 - neutral, *see* marginal
 - ordering
 - cycle expansions, 330
 - intermittent flows, 332
 - Poincaré map cycle, 91
 - Poincaré return map, 80
 - residue, 116
 - spectral, 448
 - structural, 190, 193, 246, 448
 - window, 88
- stabilizer subgroup, *see* isotropy subgroup
- stable
 - cycle, 89
 - manifold, 14, 186–188
- stadium billiard, 123, 129, 152, 407, 434, 770, 773
- stagnation point, *see* equilibrium point
- staircase
 - mean eigenvalue density, 633
 - spectral, 536
- standard map, 410
- standard representation space, 749
- standing orbit
 - Lorentz gas, 441
- state, 161, 222
 - set, 162
- state space, 33
 - discretization, 286
 - partition, 253
- volume M , 277
 - vs. phase space, 42
- stationary
 - flow, 38
 - phase approximation, 541, 547, 559, 572, 645, 654
 - point, *see* equilibrium point
 - state, 258
- stationary phase, 261, 500, 541, 544, 546, 561, 569, 600, 615, 644, 646, 829
- statistical mechanics, 22
- steady state, *see* equilibrium point
- Sterling formula, 547
- stochastic
 - dynamics, 5, 261
 - matrix, 221
 - path integral, *see* Wiener integral
- Stokes theorem, 119, 553
- stosszahlansatz, 22, 453
- strange
 - attractor, 36, 41
- strange attractor, 281
- Rössler flow, 51
- stretch & fold, 57, 167
- strobe method, 47
- strongly connected graph, 222
- structural stability, 190, 193, 246, 448
 - Hénon map, 196
- structure constant, 701
- structure constants, 148
- subgroup
 - isotropy, 136
- subshift, 177
 - finite type, 164, 178, 193, 220, 225
- $SU(n)$ group, 748
- super-exponential
 - convergence, 489
- superstable cycle, 89
- superstable fixed point, 489
- surface of section
 - optimal, 734
- surjective, 58
- survival probability, 13, *see* escape rate
- symbol
 - sequence
 - inadmissible, 177
 - square, 191
- symbol square, 191
- symbolic dynamics, 10, 161–178, 718–726
 - 3-disk, 29, 154, 163
 - at a bifurcation, 128
 - binary
 - collinear helium, 624
 - coding, 178
 - transition graph, 329
 - complete, 163, 167, 190
 - complete N -ary, 162
 - covering, 176
 - grammar, 177
 - Hénon-Heiles, 152
 - pruned, 177
 - recoding, 178, 184
 - unimodal, 170
 - symmetric group, 748
 - symmetry, 132–150
 - C_3 , 186, 352
 - 3-disk, 143, 145, 184, 186, 352, 356
 - cyclic, 233
 - discrete, 183
 - dynamical system, 134, 146
 - Hénon map, 772
 - symplectic
 - form, 113
 - group $Sp(2D)$, 707
 - Hénon map, 115
 - integrator, 715
 - invariance, 113, 706
 - map, 114
 - transformation, 113, 195, 265
 - systems
 - open, 276
 - syzygy, 136, 154
 - tangent
 - bundle, 38, 63
 - space, 63
 - Tauberian theorem, 433
 - teaching
 - combinatorics, 171
 - template, 205
 - tent map, 107, 108, 167
 - ternary
 - prime cycles, 184
 - tessellation
 - smooth dynamics, 776
 - thermodynamical
 - pressure, 286
 - 3-body problem, 98, 530, 620, 680, 692
 - 3-dimensional sphere
 - scattering, 128
 - 3-disk
 - boundary orbits, 150, 348
 - convergence, 383, 776
 - cycle
 - analytically, 154
 - count, 151, 354, 731
 - expansion, 337

- escape rate, 287, 328, 337, 358
- fractal dimension, 402
- geometry, 124
- hyperbolicity, 293
- phase space, 781
- pinball, 4, 125, 128
- point scatterer, 654
- prime cycles, 16, 163, 202, 249, 499
- pruning front, 197
- semiclassical resonances, 835
- shadowing, 328
- simulator, 129
- state space, 12, 51, 402
- symbolic dynamics, 10, 29, 154, 163
- symmetry, 143, 145, 184, 186, 352, 356
- transition matrix, 163
- time
 - arrow of, 22
 - as parametrization, 97
 - average, 260, 272, 283
 - ceiling function, *see* ceiling function
 - ordered integration, 76, 81
 - turnover, 73, 75, 703
- time delay
 - Wigner, 594
- topological
 - conjugacy, 172
 - dynamics, 161, 175, 177, 178, 220
 - entropy, 6, 231, 243
 - future coordinate, 172
 - index, 556
 - topological index, 692
 - invariant, 86
 - parameter, 175
 - polynomial, 238
 - trace formula, 234
 - transitivity, 221
 - zeta function, 238, 239
- topological index, 574
- topological Markov chain, 176
- torus, 35
- totient function, 509
- t_p cycle weight, 306
- trace
 - class operators, 605
 - formula
 - classical, 21
 - flows, 296
 - Gutzwiller, 574
 - maps, 294, 372
 - topological, 234, 239
 - local, 233
- trace-class operator, 786
- determinant, 788
- trajectory, 34, 67
 - discrete, 56
- transfer
 - matrix, 256, 278
 - operator, 315
 - spectrum, 304
- transformation
 - canonical, 195
 - coordinate, 108
 - symplectic, 195
- transient, 35, 162, 227
- transition
 - graph, 220–228
 - infinite, 238
- transition matrix, 162, 220, 231, 233
 - 3-disk, 163
- transversality
 - condition, 48
- transpose
 - stability, 565
- traveling wave, *see* relative equilibrium
- Trotter product formula, 785
- truncation
 - Galerkin, 464
- truncations
 - Fourier, 462
- turbulence, 7, 8, 474
 - problem of, 459
- turnover time, 73, 75, 703
- Ulam
 - map, skew, 256, 368
 - map, tent, 269, 317
- Ulam map, 107, 108, 167, 216, 217
- ultraviolet divergence, 576
- unimodal
 - kneading value, 180
 - well ordered symbols, 180
- unimodal map, 167
 - symbolic dynamics, 170
- unstable
 - cycle, 12, 89
 - manifold, 14, 186–188
 - periodic point, 12
- unsung
 - heroes, xi, xv
- UPO (Unstable Periodic Orbit), *see* periodic orbit
- van Kampen, N. G., 485
- Van Vleck
 - propagator, 559
- variational principle, 484
- vector
 - basis, 700
 - field, 37
 - invariant, 751
 - observable, 287
 - space, 699
 - defining, 750
 - dual, 750
- vector fields
 - singularities, 97
- velocity gradient matrix, 63
- vertex, 222
- visitation frequency, 260
- visitation sequence, *see* itinerary
- volume preservation, 127
- von Neumann
 - ergodicity, 716
- Waleffe, F., 689
- walk, *see* itinerary
- wandering point, 35
- wave function
 - semiclassical, 555
 - WKB, 556
- weight
 - multiplicative, 24
- well ordered symbols
 - unimodal, 180
- Wentzel-Kramers-Brillouin, 538, *see* WKB
- Wentzel-Kramers-Brillouin, 549
- Weyl rule, 575
- Weyl, H., 754
- white noise, 481
- Wiener integral, 484
- Wigner delay time, 594
- winding number, 118, 506, 507
- WKB, 549
 - connection formulas, 545
 - quantization, 538, 542
 - wave function, 556
- Yang, C.N., 259
- Young, L.-S., 59
- zero eigenvalue, 546, 561
- zeros
 - false, 311
- zeta function
 - Artin-Mazur, 238
 - dynamical, 16, 307
 - probabilistic, 431
 - Ruelle, *see* dynamical
 - topological, 238, 239