

# Index

abscissa  
    absolute conv., 911  
    conditional conv., 911  
abscissa of absolute convergence, 429  
accelerator mode, 442  
action, 379, 665, 678, 687  
    helium, 742  
    relation to period, 750  
adjacency matrix, 309, 338, *see* transition matrix  
admissible  
    periodic points, 325  
    sequence, 279  
    trajectories, number of, 322  
Airy  
    equation, 670  
    function, 670, 671, 673, 731, 732,  
        734, 739  
    at a bifurcation, 673  
    integral, 670  
algebra, 829  
    associative, 829  
    Lie, 829  
allowable itinerary, *see* admissible  
alphabet, 238  
alternating binary tree, 253  
analyticity  
    domain, 397  
anomalous diffusion, 449  
Anosov flows, 281  
anti-hermitian  
    generator, 204, 206  
antiharmonic extension, 886  
arc, 311  
area preserving  
    Hénon map, 142  
    map, 876  
Artin-Mazur zeta function, 329  
associative algebra, 829  
atlas, 278  
attractor  
    basin, 41  
    Hénon, 123  
    strange, 41, 57, 115  
Aubry-Mather theory, 648

autonomous flow, 44  
average  
    chaotic, 550  
    space, 354, 367  
    time, 354, 366  
averaging, 28  
axiom A, 430, 527, 532, 534, 848  
baker's map, 157, 270  
Balmer spectrum, 655  
basin of attraction, 41  
basis vector, 828  
BER  
    approximation, 562  
Bernoulli, 788  
    polynomials, 515  
    shift, 256, 448, 510, 515, 523, 533,  
        535, 542, 560, 791, 793, 951  
    shift eigenfunctions, 529  
    shift return times, 560  
Berry-Keating conjecture, 807  
Bessel function, 723  
    addition theorem, 725  
bi-infinite itinerary, 250  
bifurcation  
    Airy function approximation, 673  
    bizarre, 885  
    generic, 157  
    Hopf, 591  
    saddle-node, 74  
billiard, 152–157  
    map, 153  
    stability, 113, 154  
    stadium, 152, 158, 183, 563, 874,  
        877, 934  
binary  
    prime cycles, 275, 284, 338  
    symbolic dynamics  
        collinear helium, 745  
        tree, alternating, 253  
Birkhoff  
    coordinates, 153, 158, 286  
    ergodic theorem, 354  
block  
    finite sequence, 250  
block, pruned, 252

## INDEX

783

Bohr  
    helium, 741, 751  
    Uetli Schwur, 803  
Bohr-de Broglie picture, 655  
Bohr-Sommerfeld quantization, 655, 672,  
    702, 804  
Boltzmann  
    equation, 24, 452  
    stosszahlansatz, 24  
Boltzmann, L., 24, 790  
boredom, 781, 930  
Borges, J.L., 781  
Botox, 65  
boundary orbits, 468  
bounded operators, 964  
Bourbaki, N., 77  
Bowen, R., 31  
brain, rat, 5, 32  
branch cut, 546  
    singularity, 547  
Brownian noise, 617  
Bunimovich  
    stadium, *see* stadium billiard  
Burnett coefficient, 446  
Burnett coefficients, 25, 446, 453  
butterfly effect, 32  
 $C_{3v} = D_3$  symmetry, 286, 470  
canonical transformation, 139, 140, 839  
Cartan  
    -Killing classification, 139  
Cartan, É., 225  
Cartwright, M.L., 183, 791  
Cauchy criterion, 963  
Cauchy-Green strain tensor, 117  
caustic, 681  
ceiling function, 393, 534  
center, 94  
center manifold, 582  
center of mass, 133  
central moment, 370  
centralizer, 168, 193  
chain rule, matrix, 961  
chain-recurrent, 42  
change  
    of coordinates, 46  
chaology, *see* chaos  
chaos, 7–9  
    caveats, 10  
    deterministic, 30  
    diagnostics, 54  
    quantum, 31  
    skeleton of, 13, 14  
    spatiotemporal, 48, 567  
    successes, 10  
Character  
    tables, 857  
character, 487, 494  
    orthonormality, 487  
    representation, 856  
character table  
    dihedral group, 476  
characteristic  
    equation, 833  
    exponent, 118  
    function, 347  
    polynomial, 327, 834, 859  
    value, 118  
chart, 39, 278  
section border, 68  
chicken heart palpitations, 8  
circle group, *see* SO(2)  
circle map, 256, 311, 343, 444, 449, 591,  
    592, 597, 604, 607, 779, 948,  
    976, 982  
    critical, 593, 599  
class, 166  
class algebra, 492  
Clebsch-Gordan  
    coefficients, 830  
    series, 486  
closed orbit, 112, *see* periodic orbit  
co-moving frame, 107  
coarse-graining, 347  
cocycle, 93  
coding, *see* symbolic dynamics  
collinear helium, 657  
    symbolic dynamics, 745  
combinatorics  
    teaching, 245  
compact  
    group, 182  
    invariant set, 167  
complete  
    *N*-ary dynamics, 316  
    symbolic dynamics, 316  
completeness relation, 283, 830, 834, 860  
complex eigenvalues, 841  
complex Ginzburg Landau equation, 208  
complexity  
    algorithmic, 336, 432  
computational degrees of freedom, 50  
confession  
    C.N. Yang, 353  
    Kepler, 788  
    St. Augustine, 347  
configuration space, 48, 54  
conjugacy, 816  
    invariant, 109

smooth, 46, 109, 825  
 topological, 246

conjugate momentum, 136

conjugate, hermitian, 855

connection formulas, 670

connection method of, 226

conservation

- equation, 614
- phase-space volume, 138, 140, 142, 144, 357

continuity equation, 356, 357, 614, 619, 679

contour integral, 401

contracting

- Floquet multipliers, 105, 386
- flow, 41, 57, 90
- map, 100, 258
- state space, Rössler, 99, 436

convergence

- abscissa of, 911
- abscissa of absolute, 429
- abscissa of abysmal, 429
- mediocre, 907
- radius, 397
- super-exponential, 519, 636

convexity, 379

coordinate

- change, 46, 816
- longitudinal, 688
- transformations, 825

Copenhagen School, xiv, 804

correlation

- decay
- power law, 541
- function, 529
- spectrum, 529
- time, 505

coset, 165

cost function, 637

counter-clockwise rotation, 204

covariant Lyapunov vector, 120–122

covariant vector, 103, 120, 836

covering

- symbolic dynamics, 250

creeping

- 1-disk, 733

critical

- point, 113, 244, 246, *see equilibrium point*
- value, 244, 444

cross-section, 214, 226

cumulant, 370, 433

- expansion, 326, 328, 419
- Plemelj-Smithies, 968

cumulant-generating function, 370

curvature

- correction, 415
- expansion, 28, 416

cycle, 112, *see periodic orbit*

- expansion, 19, 415, 701
- 3-disk, 435
- finite subshift, 426
- Lyapunov exponent, 426
- stability ordered, 427

fundamental, 327, 415, 905

limit, 42, 105, 112, 115

Lyapunov exponent, 118

marginal stability, 108, 201, 490

prime, 127, 250, 293, 342, 387

- 3-disk, 301, 646
- Hénon map, 639

pruning, 341

Rössler flow, 131, 133, 303

stability, 102–111

- Gauss map, 601
- stable, 113
- superstable, 113
- weight, 399

cycle point, *see* periodic point

cyclic

- group, 853
- invariance, 127, 293
- permutation matrix, 863
- symmetry, 338

damped Newton method, 128

Danish pastry, *see* symbol plane

Darboux basis, 138, 147

de Broglie wavelength, 674

Debye approximation, 739

decay

- rate, 404
- rate of correlations, 529

decomposition

- irreducible, 861

defining

- representation, 855
- vector space, 855

deformation gradient, 93

degenerate

- eigenvalues, 832

degree of freedom, 10, 136, 583, 666

degrees of freedom

- computational, 50

delta function, *see* Dirac delta

- Dirac, 662

density, 347, 614

- evolution, 24
- phase space, 357

density of states

- average, 698
- Green's function, 662
- quantum, 662

derivative cocyle, 93

derivative, lattice, 862

desymmetrization

- 3-disk, 480

desymmetrized state space, 214

determinant

- for flows, 398
- Fredholm, 971
- graph, 337
- Hadamard, 397
- spectral, 23, 326, 397
- trace relation, 326
- trace-class operator, 965

deterministic dynamics, 7, 38, 355

diagonalizing matrix, 859

diffeomorphism, 73

differential equations

- almost ordinary, 58

diffraction

- Green's function, 766
- Keller, 773
- Sommerfeld, 773

diffusion

- anisotropic, 615
- anomalous, 449
- constant, 380
- equation, 615, 616
- limited aggregates, 32
- tensor, 615

digraph, *see* directed graph

dihedral group, 853

dike map, 248, 259

dimension

- box counting, 932
- fractal, 932
- generalized, 11
- information, 932, 933
- intrinsic, 10, 583
- symplectic, 146

Dirac delta, 21, 23, 329, 349, 361, 371, 387, 394, 405, 523, 616, 663, 683, 693

- derivatives, 361
- Jacobian, 356

Dirac path integral, 692

Dirichlet

- series, 910

Dirichlet series, 433, 904, 911

discrete

- Fourier transform, 866

dissipation

- rate, Kuramoto-Sivashinsky, 587
- rate, Navier-Stokes, 587

dissipative

- map, 100, 258

divergence rate, local, 381

divergence ultraviolet, 699

DLA, 32

dof, *see* degree of freedom

dot product, 195

doubling map, 256, 526

drift, along group tangent, 192

dual

- representation, 828, 854, 855
- space, 828, 854
- vector space, 855

Duffing oscillator, 54, 56, 75, 136

dynamical

- localization, quantum, 148
- transitivity, 309
- zeta function, 18, 400
- Euler product rep., 400

dynamical system, 37, 39

- axiom A, 430, 532, 848
- equivalent, 824
- gradient, 58
- hyperbolic, 409, 526
- infinite, 587
- smooth, 19, 20, 28, 39, 332, 791, 951, 954, 955

dynamics, 38

- deterministic, 7, 38
- hyperbolic, 316
- irreversible, 43
- reversible, 43
- spatiotemporal, 31
- stochastic, 8
- symbolic, 12, 237, 249
- symmetry, 164, 191, 212, 488
- topological, 237, 249, 251, 310

edge, 311

eigendirection, 84

eigenfunction

- Perron-Frobenius operator, 513
- energy, 660
- Perron-Frobenius, 513

eigenstate, *see* eigenfunction

eigenvalue, 404

- Perron-Frobenius operator, 513
- complex, 841
- degenerate, 832
- exponential spacing, 408
- zero, 671, 686

Einstein diffusion formula, 616, 627

Einstein, A, 807  
 elastic scattering, 708  
 elliptic stability, 142  
 empirical mean, 369  
 enemy thy, 541  
 energy Kuramoto-Sivashinsky, 587  
 Navier-Stokes, 587  
 English plain, 203, 250  
 ensemble microcanonical, 381  
 entire function, 513  
 entropy barrier, 429, 796, 911  
 Gauss map, 607  
 Kolmogorov, 157, 337, 927, 929, 934  
 topological, 8, 322, 330, 337  
 equations of variations, 82  
 equilibrium, 197  
   Kuramoto-Sivashinsky, 586  
   Lorenz flow, 56, 76  
   point, 44, 103, 352, 580, 639  
   Rössler flow, 57, 58, 95, 255  
   relative, 197  
 equilibrium measure, *see* natural measure  
 equivalence of dynamical systems, 824  
 equivariance, 164  
 two-mode flow, 207  
 equivariant, *see* relative state space, 215  
 ergodic average, 354  
   theorem multiplicative, 121  
   theory, 354  
 error correlation matrix, 118, 624  
 error matrix, 93  
 escape rate, 14, 15, 362, 376, 380, 382, 402, 403, 421, 426, 433, 435, 496, 503, 516, 535, 619, 850, 904, 929, 933, 934, 974  
 3-disk, 425, 435, 501  
 intermittency, 549  
 vanishing, 362, 425, 882  
 essential spectral radius, 522, 531  
 spectrum, 522

Euler formula, 86, 514  
 limit, 87  
 -MacLaurin formula, 529  
 product, 87, 403  
 product rep. dynamical zeta function, 400  
 totient function, 595  
 Eulerian coordinates, 45, 65, 83, 490  
 evolution group, 58  
   kernel probabilistic, 355  
   operator, 21, 372  
     quantum, 661  
     semigroup, 372  
 evolution operator, 93  
 expanding Floquet multipliers, 105, 386  
 expectation, 370  
 expectation value, 368, 381  
 expected value, 370  
 exponent Floquet, 105  
 exponential convergence, 397, 519  
 decay rate of correlations, 529  
 generating function, 366, 370, 515  
 of a matrix, 86  
 proliferation, 22, 336, 432  
 external node, 312  
 extremal point, 667  
 factor group, 166  
 false zeros, 403  
 Farey map, 240, 540, 543, 562  
   median, 596  
   series, 594  
   tree, 595  
 Feigenbaum constant, 394  
 Feynman path integral, 685, 692  
 fiber, 43  
 fiber bundle, 43  
 Fick law, 615  
 finite group, 853  
 finite subshift cycle expansion, 426  
 first return time, 65, 279, 559  
 fixed point, 127, 293  
   maps, 78  
   marginally stable, 540  
   subspace, 168, 193  
   under  $G$ , 168, 176, 177, 193  
 Floquet

exponent, 91, 105, 141  
 multiplier, 105, 262, 386, 836  
 multiplier, metric invariant, 109  
 theorem, 836  
 theory, 105, 112  
 vector, 103  
 flow, 37–52  
   -invariant set, 102  
   autonomous, 44  
   contracting, 41, 57, 90  
   deterministic, 355  
   elliptic, 106  
   generator of, 356, 488, 898  
   Hamiltonian, 136, 876  
   hyperbolic, 106, 142, 404  
   incompressible, 91, 357  
   infinite-dimensional, 49, 566–586  
   invariant subspace, 168  
   inverse hyperbolic, 142  
   linear, 85, 92  
   linearized, 93  
   map, 40  
   nonhyperbolic, 106  
   spectral determinant, 398  
   stability, 87  
   stationary, 44  
   stochastic, 355  
   stretch & fold, 247, 257  
   symplectic, 106  
 flow map, 54  
 flows, 73  
 Fokker-Planck equation, 619  
 form, normal, 822  
 Fourier mode, truncation, 49, 570  
 Fourier transform, discrete, 866  
 Fréchet derivative, 93  
 fractal, 32, 930  
   aggregates, 11  
   dimension, 102, 932  
   geometry of nature, 11  
   probabilistic, 11  
   science, 11  
 Fredholm determinant, 971  
   theory, 520  
 free energy, 371  
 free node, *see* external node  
 freezing, 214  
 Frenkel-Kontorova model, 648  
 frequency analysis, 54  
   visitation, 353  
 Fresnel integral, 629, 667, 673  
 full shift, 316

function, 73  
 $L^2$  square-integrable, 531  
 analytic, 530  
 space, piecewise constant, 395  
 functional, 354  
   composition, 42  
   Lyapunov, 41  
 fundamental cycle, 327  
 cycles, 905  
 domain, 167, 276  
   collinear helium, 744  
 matrix, 93, 831, 901  
 $G$ -equivariant, 193  
 $G$ -fixed, 168, 176, 177, 193  
 $G$ -invariant basis, *see* invariant polynomial basis  
   polynomial basis, 182, 222  
 $G$ -invariant polynomial basis, 173, 183, 187, 225  
 $G_p$ -symmetric, 176  
 Gårding truncation, 50, 576  
 Galilean invariance, 567, 587, 588  
 Gatto Nero, professor, 463  
 gauge fixing, 278  
   invariance, 278  
 gauge fixing, 69  
 Gauss map, 362, 562, 595, 605  
   cycle stability, 601  
   metric entropy, 607  
 Gauss shift, *see* Gauss map  
 Gaussian integral, 361, 446, 629, 693  
   integral,  $d$ -dimensional, 629, 683  
   noise, 912  
   probability density, 624  
 general linear group, 163  
 generating function, 17, 325, 373, 388, 444, 599, 648, 891, 945, 976  
   function, exponential, 366, 370, 515  
   orbit, 254  
   partition, 251  
 generator anti-hermitian, 204, 206  
   Lie algebra, 139, 195  
   of flow, 356, 488, 898  
 Gilmore, R., 183  
 Ginzburg Landau equation, complex, 208  
 $GL(d)$  general linear group, 163  
 $GL(n, \mathbb{F})$ , 854

golden mean, 311, 343  
 pruning, 259, 317, 339, 343, 410,  
   883, 980  
 renormalization, 597, 605  
 good taste, 253  
 gradient  
   algorithm, 637  
   system, 58  
 grammar  
   symbolic dynamics, 252  
 graph  
   irreducible, 311  
   root, 312  
   rooted tree, 312  
   strongly connected, 311  
   transition, 308  
   tree, 312  
 Gray codes, 253  
 Green's function, 663  
 analogue of, 902  
 density of states, 662  
 diffraction, 766  
 energy dependent, 662  
 regularized, 700  
 scattering, 713  
 semiclassical, 690, 692, 693  
 short distance, 689, 690  
 trace, 662  
   long orbits, 689  
 Greene's residue criterion, 142  
 group, 852  
   compact, 182  
   cyclic, 853  
   dihedral, 853  
   dynamical, 43  
   evolution, 58  
   finite, 161, 853  
   general linear, 854  
   integral, 485–487  
   integration, 488  
   Lie, 139, 192, 194  
   matrix, 163  
   not a, 877  
   orbit, 167, 182, 193, 197  
   orbit, marginal eigenvalue, 201  
   orbit, slice, 215, 217, 223  
   orbit, velocity, 837  
   order of, 162, 853  
   representation, 162, 488, 856  
   semi-, 349, 898  
   symmetric, 853  
   symmetry, reduction, 214  
   tangent field, 195, 196  
 Gutzwiller

path integral, 692  
 trace formula, 655, 698  
 Gutzwiller, M., 795  
 Haar measure, 488  
 Hadamard determinant, 397  
 Hadamard product, 700  
 Hamilton  
   -Cayley theorem, 830, 834  
   -Jacobi equation, 625, 675, 690, 919  
   equations, 675  
   principal function, 625, 678  
 Hamiltonian, 676  
   dynamics, 135–145  
   equations, 136  
   flow, 136, 876  
   spectral determinant, 408  
   stability, 139, 840  
   flows, stability, 838  
   Hénon map, 142  
   matrix, 139, 146  
   repeller, periodic orbits, 133  
   separable, 660  
 Hankel function, 690, 723, 739  
 Hankel singular values, 116  
 Hannay-Ozorio de Almeida sum rule, 508  
 harmonic oscillator, 824  
 Harter, W. G., 492  
 heat  
   equation, 615, 616  
 Heaviside function, 662  
 Heisenberg, 804  
   picture, 962  
 Heisenberg, W., 804  
 helium, 741, 804  
   collinear, 59, 78, 137, 657, 759  
   cycles, 303, 760  
   eigenenergies, 760  
   fundamental domain, 744  
   Poincaré section, 759  
   stabilities, 760  
   stability, 133  
 Helmholtz equation, 723  
 Helmholtz free energy, 371  
 Hénon map  
   fixed points, 78  
 Hénon map, 74, 76, 142  
   attractor, 123, 361  
   cycles, 133, 637  
   fixed points, 284  
   Hamiltonian, 142  
   horseshoe, 284  
   inverse, 284  
   Lyapunov exponent, 123  
   natural measure, 352

prime cycles, 639, 649  
 pruning, 907  
 pruning front, 282  
 stability, 99, 113  
 structural stability, 287  
 symmetries, 876  
 time delay map, 302  
 transient, 639  
 Hénon, M., 74  
 Hénon-Heiles  
   symbolic dynamics, 183  
 hermitian  
   conjugation, 855  
   matrix, 855  
 heroes  
   unsung, xiv, xix  
 Hessian matrix, 140  
 heteroclinic  
   connection, 243, 251, 255, 800  
   intersection, 282  
   orbit, 54, 97, 149, 183, 243, 254,  
   280  
 high-dimensional  
   state space, 47  
 Hilbert  
   basis, *see* invariant polynomial basis  
   space, 660  
 Hilbert-Schmidt  
   operators, 964  
   condition, 520  
 Hilbert-Weyl theorem, 182  
 Holmes, P., 583  
 homoclinic  
   orbit, 56, 243  
   point, 789  
   tangency, 263, 274  
   tangle, 282, 604  
 Hopf bifurcation, 591  
 Hopf's last hope, 801  
 Hopf, Eberhardt, 591, 800, 801  
 Hopf, Heinz, 758  
 horseshoe, 268  
   complete, 269  
 hydrodynamical  
   interpretation of QM, 691  
 hyperbolic  
   flow, 106, 142, 404  
   non-, 25  
   orbit, partially, 106  
   systems, 367, 409, 421, 425, 439,  
   448, 503, 526, 533, 550, 656,  
   704, 797, 806, 923, 930, 934  
 hyperbolicity assumption, 17, 387  
 image space, 214, 223  
 in  
   node, 95, 103  
   spiral, 95, 103  
 in-degree, 312  
 in/out nodes, 94  
 inadmissible symbol sequence, 251  
 incommensurate, 41  
 incompressible flow, 91  
 indecomposability, 309  
   metric, 238  
 index  
   Maslov, *see* topological index  
 index summation, repeated, 90, 140, 853  
 indifferent stability, 84  
 induced map, 553  
 inertial manifold, 576, 583  
 infinite-dimensional state space, 47  
 infinite-dimensional flows, 49, 566–586  
 inflection point, 592  
 information dimension, 932, 933  
 initial  
   conditions, sensitivity to, 8  
   point  $x_0$ , 16, 40, 82  
   state  $x_0$ , 16, 40  
 injective, 77  
 integrable system, 137, 815  
 integrated observable, 366, 367, 372, 380,  
   387, 401, 415, 905  
 integration  
   by parts, lattice, 863  
   group, 488  
   Runge-Kutta, 58  
 intermittency, 157, 362, 427, 428, 433,  
   449, 455, 525, 539, 656, 755,  
   934, 943  
   anomalous diffusion, 449  
   escape rate, 549  
   piecewise linear model, 542  
   resummation, 555  
   stability ordering, 557  
 internal node, 312  
 invariance  
   cyclic, 127, 293  
   Galilean, 567, 587  
   local Galilean, 588  
   of flows, 108  
   symplectic, 136, 146, 838  
 invariant, 856  
   density, *see* natural measure  
   matrix, 855  
   measure, 352  
   measure, Gauss map, 362  
   metric, 104, 109

points, 168, 193, 463  
 polynomial basis, 173, 182, 183, 187, 214, 222–225  
 set, compact, 167  
 subgroup, 166  
 subspace, 168  
 topological, 104  
 tori, 202  
 vector, 855  
 inverse  
   hyperbolic, 105, 142  
   iteration, 127  
     iteration, Hamiltonian repeller, 133  
 inversion, 171  
 involution, 853  
 inward/outward spirals, 94  
 irreducible  
   decomposition, 861  
   graph, 311  
   matrix, 309  
   representation, 462, 486  
   segment, 179  
 irrep, 462, 861  
   cyclic group, 475  
 irep basis  
   dihedral group, 477  
 irreversibility, 24, 43  
 Ising model, 285, 469, 481, 940, 942, 952, 953, 958  
 isotropy  
   subgroup, 170, 173, 176, 177, 182  
 isotropic decomposition, 170  
 iteration, 39  
   inverse, 127  
     Hamiltonian repeller, 133  
   map, 71  
 itinerary, 12, 14, 238, 286, 301  
   bi-infinite, 240, 250  
   future, 244, 250  
   past, 250  
 Jacobi, C.G.J., 92  
 Jacobian  
   matrix, 16, 83, 93, 831  
 jacobian, 90, 348  
   Hénon map, 99  
 Jonqui re function, 450, 452, 455, 543, 563  
 Jordan normal form, 834  
 KAM, 147  
   tori, 539  
 Kamiltonian, 140  
 Kaplan-Yorke criterion, 106  
 Karhunen-Lo e, 266

Keller diffraction, 773  
 Keller, J.B., 794  
 Keplerian orbit, 655  
 kernel  
   resolving, 521  
 kneading  
   determinant, 254  
   sequence, 247, 259  
   theory, 247  
   value, 247, 258, 259  
 Kolmogorov entropy, 157, 337, 927, 929, 934  
 Koopman operator, 897, 901  
 Kraichnan, Robert H., 801  
 Kramers, 804  
 Krein-Friedel-Lloyd formula, 715  
 Kronecker delta, 828, 854  
 KS, *see* Kustaanheimo-Stiefel  
 Kuramoto, Y., 583  
 Kuramoto-Sivashinsky  
   equilibria, 586  
   system, 582–586  
 kurtosis, 371, 381, 446  
 Kustaanheimo-Stiefel transformation, 742, 819  
 $L^2$  function space, 531  
 Lagrangian, 677  
   coordinates, 45, 65, 83, 490  
   frame, 107  
   manifold, 679  
 laminar states, 539  
 Langevin equation, 618, 627  
 Laplace  
   transform, 23, 329, 375, 389, 390, 395, 662, 690, 899  
   transform, discrete, 325, 388, 560  
 Laplace, Pierre-Simon de, 6  
 Laplacian  
   diagonalization, 878  
   diagonalized, lattice, 869  
   inverse, lattice, 864  
   lattice, 863, 864  
   non-local, 878  
 last hope, Hopf's, 801  
 lattice  
   derivative, 862  
   Fourier transform, 866  
   integration by parts, 863  
   Laplacian, 863, 864  
   Laplacian, diagonalized, 869  
   Laplacian, inverse, 864  
 leaf, *see* external node  
 least action principle, 301, 644  
 Legendre transform, 678

Leibniz, Gottfried Wilhelm, 6  
 Letellier, C., 183  
 level set, 136  
 Liapunov, *see* Lyapunov  
 libration orbit, 746, *see* self-retracing  
 Lie  
   algebra, 139, 194, 195, 829  
   bracket, 196  
   derivative, 196  
   group, 139, 192, 194  
   product, 829  
 lifetime, 15  
   matrix, 718  
 limit cycle, 42, 105, 112, 115  
 linear  
   cocycle, 93  
   flow, 85, 92  
   space, 827  
   stability, 81, 102, 580  
 linearized  
   flow, 93  
 link, 311  
 Liouville  
   equation, 358  
   operator, 358  
   theorem, 138, 140, 142, 144, 357  
 Liouville's formula, 90  
 little group, 176  
 Littlewood, J.E., 791  
 local  
   divergence rate, 381  
   stability, 81, 102, 580  
 localization, quantum dynamical, 148  
 logistic map, *see* unimodal  
 longitudinal  
   coordinate, 688  
 loop  
   intersecting, 327  
 Lorentz gas, 433, 439, 453, 454, 456, 539  
 Lorentzian, 663  
 Lorenz flow, 56, 76, 96–98, 185, 186, 188, 255  
   complex, *see* complex Lorenz flow  
   polar coordinates, 188, 877  
   proto-Lorenz, 188  
   symmetry, 172, 188  
 Lorenz, E.N., 74, 183  
 loxodromic, 840  
   quartet, 142, 147  
 Lozi map, 74, 77  
 Lyapunov  
   characteristic numbers, 121  
   covariant vector, 120–122

matrix, 309, 360, 426  
partition, 446, 793  
  finite, 239, 316  
  infinite, 315  
  not unique, 263  
Maslov index, *see* topological index  
material invariant, 614  
Mather, *see* Aubry-Mather theory  
matrix  
  diagonalizing, 859  
  exponential, 86, 900  
  group, 163  
  hermitian, 855  
  invariant, 855  
  irreducible, 309  
  negative definite, 116  
  of variations, *see* stability matrix  
  positive definite, 116, 629  
  product, 829  
  representation, 163, 829  
  stability, 82, 625  
matrix rep  
  cyclic group, 474  
Maupertuis, P.L.M. de, 147, 301, 644  
mean, 370  
measure, 347  
  continuous, 824  
  invariant, 352  
  natural, 74, 353, 359, 368, 438, 505,  
  508, 800, 806  
mechanics  
  quantum, 660  
  statistical, 24  
mediocre  
  convergence, 907  
memory  
   $m$ -step, 238  
  finite, 317  
method of connections, 226  
metric  
  entropy, 102  
  entropy, Gauss map, 607  
  indecomposability, 238, 908  
  invariant, 104, 109  
    Floquet multiplier, 109  
  transitivity, 908  
microcanonical ensemble, 381  
Mira, C., 74  
Misiurewicz, M., 74  
mixing, 8, 9, 17, 54, 75, 354, 368, 369,  
  505, 529, 798, 908  
mode, normal, 877  
modulated traveling wave, 203  
Moebius inversion, 334

moment, 370  
moment-generating function, 370, 550  
monodromy matrix, 88, 110, 386, 839  
Morse index, *see* topological index  
moving frame, 213, 214  
  SO(2), 229  
multi-scattering matrix, 725  
multifractals, 948  
multiplicative cocycle, 93  
multiplicative ergodic theorem, 121  
multiplicative noise, 618, 621, 624, 627  
multiplier, Floquet, 105, 262  
multipoint shooting method, 297  
*N*-disk, transition matrix, 316  
natural density, *see* natural measure  
natural invariant, *see* natural measure  
natural measure, 74, 300, 353, 359, 368,  
  381, 438, 505, 508, 528, 800,  
  806  
nature, geometry of, 11  
Navier-Stokes equation, 566  
Navier-Stokes flow  
  stability, 106  
negative definite matrix, 116  
neighborhood, 81, 111  
Nero, G., 463  
neutral, *see* marginal  
New York subway map, 263  
Newton method, 128  
  convergence, 128  
  damped, 128  
  flows, 129  
  optimal section, 894  
Newtonian dynamics, 135  
node, 311  
  external, 312  
  in-degree, 312  
  internal, 312  
  out-degree, 312  
noise  
  Brownian, 617  
  Gaussian, 624, 626, 912  
  multiplicative, 618, 621, 624, 627  
  white, 624  
non-hyperbolic  
  systems, 508, 561, 563  
non-wandering set, 41, 269  
nonequilibrium, 438  
nonhyperbolic  
  flow, 106, 108  
norm, 963  
normal  
  divisor, 166  
  form, 822

mode, 877  
washing machine, 161  
obscure  
  foundations, 804  
  jargon, 203, 237  
  topology, 581, 586  
observable, 353, 359, 366, 386, 438, 448,  
  505, 550, 559, 794, 897, 937,  
  942, 958  
  integrated, 366, 367, 372, 380, 387,  
  401, 415, 905  
  simultaneous, 861  
  vector, 381  
ODEs, 47  
  almost, 58  
1-disk  
  creeping, 733  
  scattering, 724  
  semiclassical scattering, 730  
Onsager-Machlup, 627  
open system, 14, 376, 377, 379, 404,  
  504, 656, 661, 695, 722, 753,  
  768  
operator  
  evolution, 372  
  Hilbert-Schmidt, 964  
  just a matrix, 863  
  Koopman, 897, 901  
  Liouville, 358  
  norm, 963  
  Perron-Frobenius, 349, 379  
  positive, 964  
  regularization, 970  
  resolvent, 325, 375, 899  
  semigroup  
    bounded, 375, 899  
    shift, 248, 250, 862  
  stepping, 862  
  trace-class, 963  
orbit, 40, 71, 167  
  closed, 112  
  group, 197  
  inadmissible, 247  
  Keplerian, 655  
  periodic, 41, 250, 415, 696, 697  
  relative, 201  
  returning, 695  
  space, 214  
order preserving map, 246  
ordering  
  spatial, 245, 270  
ordinary differential equations, *see* ODEs  
orientation  
  preserving map, 876  
reversing map, 876  
orthogonality relation, 283, 830, 834, 860  
Oseledec ergodic theorem, 121  
out  
  node, 95, 103  
  spiral, 95, 103  
out-degree, 312  
Palais slice, 226  
palpitations, chicken heart, 8  
paradise  
  this side of, 501  
partial differential equations, *see* PDEs  
partially hyperbolic  
  invariant tori, 202  
  orbit, 106  
partition, 238, 251  
  state space, 347  
  function, 371, 379  
  generating, 251  
  infinite, 258, 330, 337  
  Markov, 239  
passive scalar, 614  
past topological coordinate, 271  
path integral  
  stochastic, *see* Wiener integral  
PDEs, 39, 47  
period  
  relation to action, 750  
  relative, 199  
periodic  
  orbit, 13, 41, 106, 112, 198, 250,  
  415, 696, 697  
  condition, 126, 130, 293, 636  
  extraction, 126–130, 293–300, 636–  
  646  
  Hamiltonian repeller, 133  
  inverse iteration, 127  
  multipoint shooting, 297  
  Newton method, 128  
  relative, 199, 483, 491  
  relaxation algorithm, 637  
  short, 170, 179  
point, 13, 16, 20, 22, 41, 257, 887  
  admissible, 325  
  count, 333  
  symbolic label, 250  
  unstable, 14  
Perron-Frobenius  
  matrix, 309  
  operator, 349, 379, 513  
  theorem, 528, 534, 951  
Peter-Weyl theorem, 192  
phase space, 38, 138, *see* state space  
3-disk, 908

density, 357  
 vs. state space, 54  
 physical space, *see* configuration space  
 piecewise  
     constant function, 395  
     linear map, 561  
     linear map, intermittency, 542  
     linear map, repeller, 380  
 pinball, *see* 3-disk  
     simulator, 158  
 plain English, 203, 250  
 plane Couette flow  
     relative solutions, 208  
     stability, 837  
     symmetries, 176, 184, 207, 208  
     unstable manifold, 265  
 Plemelj-Smithies cumulants, 968  
 POD, 266  
 Poincaré invariants, 144  
 Poincaré return map, 65, 66, 279  
     cycle, 110  
     polynomial, 72  
     stability, 88  
 Poincaré section, 13, 65–71, 279, 284, 286  
     3-disk, 153  
     border, 78, *see* chart border  
     Hénon trick, 74  
     hyperplane, 75, 283  
 Poincaré, H., 5, 9, 15  
 point  
     non-wandering, 41  
     periodic, 13  
         symbolic label, 250  
     scatterer, 775  
     wandering, 41  
 point-wise invariant, *see* G-fixed  
 Poisson  
     bracket, 196, 357, 358, 360, 838  
     resummation, 23, 556  
 polar coordinates, 824  
 polar decomposition, 117, 122, 123  
 Pollicott, M., 379, 559  
 polylogarithm, 543  
 polynomial  
     characteristic, 327  
     topological, 329  
 Pomeau, Y., 74  
 positive definite matrix, 116, 629  
 positive operators, 964  
 post-processing, 215, 224  
 potential problems, 58  
 power law  
     correlation decay, 541

pressure  
     thermodynamic, 379  
     topological, 379  
 prime cycle, 127, 250, 293, 342, 387  
     3-disk, 284, 342, 646  
     binary, 275, 284, 338  
     count, 334  
     Hénon map, 639, 649  
     ternary, 285  
 prime periodic orbit, *see* prime cycle  
 primitive cycle, *see* prime cycle  
 principal  
     directions, 117  
     stretches, 117  
 probabilistic zeta function, 559  
 probability  
     density, Gaussian, 624  
     matrix, 309  
 product  
     Lie, 829  
     matrix, 829  
 professor  
     does not know this, 413  
 profile, spatial, 39  
 projection  
     operators, 858  
 projection operator, 834, 859, 860, 866, 867  
     complete, orthonormal, 867  
 propagator, 661  
     semiclassical, 682  
     short time, 683, 689  
     Van Vleck, 684  
 pruned  
     block, 252  
 pruning, 12, 539  
     front, 273  
     3-disk, 240, 288  
     golden mean, 259, 317, 339, 343, 410, 883, 980  
     individual cycles, 341  
     primary interval, 248  
     rules, 316  
     symbolic dynamics, 251  
 pseudo-cycle, 414  
 quadratic map, 77  
 quantization  
     Bohr-Sommerfeld, 655  
     semiclassical, 695  
     WKB, 664, 667  
 quantum  
     chaology, *see* chaos, quantum  
     chaos, 657, 658, 700  
     dynamical localization, 148

evolution, 661  
 interference, 674  
 mechanics, 660  
 potential, 691  
 propagator, 661  
 resonances, 655  
     theory, old, 804  
 quasiperiodic, 41, 493  
 quotient  
     group, 166  
     space, 214  
     state space, 69, 167, 214  
 radius of convergence, 397  
 random  
     walk, 616  
 random matrix theory, 658  
 Rayleigh-Bénard flow, 56  
 recoding, 252, 275, 284  
 rectangle, 270  
 rectification  
     flows, 815  
     maps, 821  
 recurrence, 41, 237  
     time, *see* return time  
 reduced state space, 167, 214, 215  
 reducible representation, 192  
 reflection, 171  
 regular  
     group action, 215  
     representation, 461  
 regular rep  
     cyclic group, 475  
     dihedral group, 475  
 regularization, 700, 819  
     Green's function, 700  
     operator, 970  
 relative  
     equilibrium, 197  
     orbit, 201  
     period, 199  
     periodic orbit, 199, 483, 491  
     solutions, 390  
 relaxation algorithm, 637  
 renormalization, 157  
     golden mean, 597, 605  
 repeated index summation, 90, 140, 853  
 repeller, 14, 42, 376, 657  
     piecewise-linear, 380  
     single fixed point, 513  
 representation, 163  
     character, 487, 856  
     defining, 855  
     dual, 828, 854, 855  
     equivalent, 857  
 faithful, 856  
 irreducible, 462, 486  
 linear, 193  
 matrix, 488, 829, 856  
 reducible, 192  
 regular, 461  
 space, 854  
     standard, 854  
 representative point, 38  
 residue, 144  
     Greene's, 142  
     stability, 142, 148  
 resolvent  
     kernel, 521  
     operator, 325, 375, 899  
 resonances  
     complex, 656  
     quantum, 655  
     Ruelle-Pollicott, 379, 559  
 resumation  
     intermittency, 555  
 return map, 16, 131, 279, 284, 286  
     Rössler flow, 255  
 return time, 559  
     distribution, 560  
 returning orbit, 695  
 reversible  
     dynamics, 43  
 Riemann zeta function, 450, 562, 910  
 right-handed rotation, 204  
 Rolling Stones, 246  
 root, 312  
 rooted tree graph, 312  
 Rössler  
     attractor, 66, 75  
     cycles, 131, 133, 303  
     equilibria, 58, 95, 255  
     flow, 54, 57, 58, 66, 75, 78, 99, 119  
     Lyapunov exponent, 123  
     return map, 255  
     web diagram, 258  
 rotating wave, 197, 208  
 rotation  
     counter-clockwise, 204  
     right-handed, 204  
 Roux, Henriette, 30, 91  
 Ruelle  
     -Pollicott resonances, 379, 559  
     zeta function, *see* dynamical zeta function  
 Ruelle, D., 31, 379, 559  
 Runge-Kutta integration, 58  
 running orbit  
     Lorentz gas, 442

Rutherford, 741  
 Rydberg series, 751  
 $S^1$ , *see* SO(2)  
 saddle, 94, 95, 103, 105  
 saddle point, *see* stationary phase  
 saddle-node bifurcation, 74  
 sample variance, 369  
 sausage,  $(N+1)$ -dimensional, 192  
 sawtooth map, 172, 184, 477  
 scalar multiplication, 828  
 scattering  
     3-dimensional spheres, 157  
     elastic, 708  
     Green's function, 713  
     matrix, 709  
     phase shift, 716  
     point, 775  
 schmactals, *see* fractal  
 Schrödinger  
     equation, 660  
     equation, time-independent, 660  
     picture, 962  
 Schur's Lemma, 486  
 Schwartzian derivative, 824  
 section  
     optimal, 894  
     stroboscopic, 64  
 section, Poincaré, 13, 65, 153, 279, 286  
 secular equation, 833, 834, 859  
 self-retracing cycle, 746  
 self-similar, 22  
     fractal, 312  
 semiclassical  
     approximation, 675  
     Green's function, 690, 693  
     propagator, 682  
     quantization, 695  
     resonances  
         3-disk, 924  
     spectral determinant  
         collinear helium, 753  
     wave function, 680  
     semiclassical zeta function, 701  
 semigroup, 349, 898  
     dynamical, 43, 58, 87, 88, 104, 107,  
         120, 154  
     evolution, 372  
     operator, 375, 899  
 sensitivity to initial conditions, 8, 32, 34,  
     115  
 set, non-wandering, 269  
 shadowing, 19, 331, 434  
     3-disk, 425  
 shift, 250

Bernoulli, 256, 515, 560  
 finite type, 252  
 full, 250, 316  
 map, 592  
 operator, 248, 250, 862  
 sub-, 251  
 short periodic orbit, 170, 179  
 similarity transformation, 109  
 simultaneous observables, 861  
 Sinai, Ya., 31  
 Sinai-Bowen-Ruelle measure, *see* natural measure  
 single fixed point  
     repeller, 513  
     spectral determinant, 514  
 singlet, 494  
 singular value decomposition, 122  
 singular values, 116, 120, 123  
 singularity  
     branch cut, 547  
 sink, 42, 95, 103, 105  
 Sivashinsky, G.I., 583  
 skeleton of chaos, 13, 14  
 skewness, 370  
 slice, 193, 214, 215, 226  
     condition, 215  
     linear, 215  
     Palais, 226  
 Smale, S., 11, 31, 262, 282, 336, 407,  
     792  
     wild idea, 398, 406  
 small divisor problem, 394  
 $S$ -matrix, 709  
 smooth, 194  
     conjugacy, 46, 109, 825  
     dynamical system, 587  
     dynamics, 19, 20, 28, 39, 332, 791,  
         951, 954, 955  
         approximated, 904  
     dynamics, spectral determinant, 533  
     interaction, 957  
     potential, 157  
 SO(2), 194, 204, 216, 229  
 SO(2), 95, 206–209, 229, 824, 832  
     irreducible representation, 204  
 SO(3), 194, 803  
 solution  
     symmetry, 197  
 Sommerfeld  
     diffraction, 773  
 source, 95, 103, 105  
 Sp( $d$ )  
     symplectic group, 139  
 space

analytic functions, 530  
 average, 354, 367  
 configuration, 48, 54  
 defining vector, 855  
 density functions, 395  
 dual, 828, 854, 855  
 linear, 827  
 phase, 54  
 state, 54  
 vector, 827  
 space average, 574  
 span, 828  
 spatial profile, 39  
 spatiotemporal chaos, 48, 567  
 spatiotemporal dynamics, 31  
 spectral  
     decomposition, 830, 835, 852, 860  
     determinant, 23, 326, 397  
         1-dimensional maps, 408  
         2-dimensional hyperbolic Hamiltonian flow, 408  
         1-dof, 702  
         2-dof, 703  
         entire, 408, 519  
         for flows, 398  
         infinite product rep., 399  
         single fixed point, 514  
         weighted, 409  
     radius, 514, 522  
         essential, 531  
     stability, 448  
     staircase, 662  
 spectrum  
     Balmer, 655  
 specular reflection, 152  
 speed, 43  
 Spiegel, Edward A., 801  
 SRB measure, *see* natural measure  
 St. Augustine, 347  
 stability, 81–91  
     billiards, 113, 154  
     continuous symmetry, 201  
     eigenvalue, *see* Floquet multiplier  
     elliptic, 394  
     equations, 93  
     exact, 114  
     exponent, 83, 90, 92, 95, 97, 103,  
         121, *see* Floquet exponent  
     flow, 87  
     Hamiltonian flow, 840  
     Hamiltonian flows, 139, 838  
     indifferent, 84  
     linear, 81, 102, 580  
     maps, 88  
 states space  
     visualization, 48  
 stationary  
     flow, 44  
     phase, 355, 647, 667, 670, 671, 686,  
         693, 722, 736, 765, 767, 918  
 phase approximation, 667, 673, 684,

696, 766, 774  
 point, *see* equilibrium point  
 state, 352  
 stationary Lyapunov basis, 121  
 statistical mechanics, 24  
 steady state, *see* equilibrium point  
 stepping operator, 862  
 Sterling formula, 673  
 stochastic  
   dynamics, 8, 355  
   matrix, 309  
   path integral, *see* Wiener integral  
 Stokes theorem, 145, 679  
 stosszahlansatz, 24, 452  
 strange attractor, 41, 57, 115  
   Rössler flow, 66, 75  
 stratum, 177  
 stretch & fold, 77, 247, 257  
 stretches, 117  
 stroboscopic sections method, 64  
 strongly connected graph, 311  
 structural stability, 27, 269, 281, 332,  
   448, 453, 569, 779, 806  
   Hénon map, 287  
 structure constant, 829  
 subgroup  
   isotropy, 173, 176  
 subshift, 251  
   finite type, 252, 273, 281, 310–312,  
   316  
 super-exponential  
   convergence, 636  
 superstar  
   cycle, 113  
   fixed point, 636  
 surjective, 77  
 survival probability, 15, *see* escape rate  
 SVD, *see* singular value decomposition  
 symbol  
   sequence  
    inadmissible, 251  
    square, 270  
 symbol square, 270  
 symbolic dynamics, 12, 237–252, 881–  
   889  
   3-disk, 34, 240, 288  
   at a bifurcation, 157  
   binary  
    collinear helium, 745  
   coding, 252  
    transition graph, 426  
   complete, 253, 257, 269, 316  
   covering, 250  
   grammar, 252

Hénon-Heiles, 183  
 pruned, 251  
 recoding, 252, 275, 284  
 unimodal, 244  
 symmetric group, 853  
 symmetry  
    $D_3$ , 286, 470  
   3-disk, 171, 172, 184, 186, 276, 286,  
   470, 480  
   continuous, 191–202, 212–223  
   cyclic, 338  
   discrete, 182, 275, 284  
   dynamical system, 164, 191, 212,  
   488  
   Hénon map, 876  
   of a solution, 170, 176, 177, 182  
   solution, 197  
   under  $G_p$ , 176  
 symmetry-reduced space, 214  
 symplectic, 106  
   2-form, 138  
   dimension, 146  
   group  $Sp(d)$ , 139  
   group  $Sp(2D)$ , 839  
   Hénon map, 142  
   integrator, 900  
   invariance, 136, 146, 838  
   map, 140  
   transformation, 139, 140, 267, 358  
 system  
   open, 376  
 syzygy, 173, 187, 222, 223

tangent  
   bundle, 43, 82  
   field, 195  
   field, group, 196  
   linear equations, 84  
   map, *see* stability matrix  
   space, 82, 195  
 tangent linear propagator, 93  
 tangent map, 93  
 Tauberian theorem, 562  
 teaching  
   combinatorics, 245  
 template, 132, 255  
 tent map, 257, 824, 825  
 ternary  
   prime cycles, 285  
 tessellation  
   smooth dynamics, 904  
 thermodynamical  
   pressure, 379  
 3-body problem, 657, 741, 788, 805, 817  
 3-dimensional sphere

scattering, 157  
 3-disk  
   boundary orbits, 468  
   convergence, 524, 904  
   cycle  
    analytically, 303  
    count, 169, 182, 472, 896  
    expansion, 435  
   escape rate, 382, 425, 435, 501  
   fractal dimension, 930  
   geometry, 153  
   hyperbolicity, 387  
   phase space, 908  
   pinball, 6, 154, 157  
   point scatterer, 775  
   prime cycles, 18, 284, 301, 342, 646  
   pruning front, 240, 288  
   semiclassical resonances, 924  
   shadowing, 425  
   simulator, 158  
   state space, 14, 286, 930  
   symbolic dynamics, 12, 34, 240, 288  
   symmetry, 171, 172, 184, 186, 276,  
   286, 470, 480

time  
   arrow of, 24  
   as parametrization, 47  
   average, 354, 366  
   ceiling function, *see* ceiling function  
   delay, Wigner, 716  
   ordered integration, 87, 91  
   turnover, 95, 97, 832

time average, 574  
 time- $t$  forward map, 54, 73, 197  
 topological  
   conjugacy, 246  
   dynamics, 237, 249, 251, 252, 310  
   entropy, 8, 322, 330  
   future coordinate, 246  
   index, 681  
   topological index, 698, 804  
   invariant, 104  
   Markov chain, 250  
   parameter, 248  
   polynomial, 329  
   trace formula, 325  
   transitivity, 309  
   zeta function, 329, 330

torus, 41  
 totient function, 595  
 $t_p$  cycle weight, 399  
 trace  
   formula

U(1), 204, 229  
 Ulam map, 257, 303, 824, 825  
   skew, 360, 510  
   tent, 362, 410  
 ultraviolet divergence, 699  
 unimodal

kneading value, 258  
 map, 244  
 map, symbolic dynamics, 244  
 well ordered symbols, 258  
 unstable  
     cycle, 113  
     manifold, 16, 263–265, 284  
     periodic orbit), *see* periodic orbit  
     periodic point, 14  
 unstable manifold, 283, 287  
 unsung  
     heroes, xiv, xix  
 UPO (Unstable Periodic Orbit), *see* periodic orbit  
  
 van Kampen, N. G., 627  
 Van Vleck  
     propagator, 684  
 variance, 370  
 variational principle, 626  
 vector  
     basis, 828  
     field, 43  
     field, singularities, 815  
     invariant, 855  
     observable, 381  
     space, 827  
         defining, 855  
         dual, 855  
 velocity, 43  
 velocity gradients matrix, 82, 93  
 vertex, 311  
 visitation frequency, 353  
 visitation sequence, *see* itinerary  
 volume preservation, 156  
 von Neumann  
     ergodicity, 901  
  
 Waleffe, F., 802  
 walk, *see* itinerary  
 wandering point, 41  
 wave function  
     semiclassical, 680  
     WKB, 681  
 wave, standing, 44, 208  
 web diagram  
     Rössler flow, 258  
 weight  
     multiplicative, 29  
 well ordered symbols  
     unimodal, 258  
 Wentzel-Kramers-Brillouin, *see* WKB  
 Weyl  
     Peter-Weyl theorem, 192  
     rule, 698

## Part VI

### Web Appendices