

References

- [1] Abraham, R., Marsden, J.E.: Foundations of Mechanics. Reading: Benjamin 1978
- [2] Anosov, D.: Geodesic flows on closed Riemannian manifolds with negative curvature. Proc. Steklov Inst., Vol. 90 (Amer. Math. Soc. translation) 1969
- [3] Behnke, H., Sommer, F.: Theorie der analytischen Funktionen einer komplexen Veränderlichen. Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, Vol. 77. Berlin, Heidelberg, New York: Springer 1962
- [4] Birman, J.S.: Braids, Links, and Mapping Class Group. Annals of Mathematics Studies. Princeton: Princeton University Press 1974
- [5] Bolotin, S.V.: Nonintegrability of the n -centre problem for $n > 2$. Vestnik Mosk. Gos. Univers., ser. math. mekh. **46** (1982), No. 4
- [6] Bowen, R.: Periodic Orbits for Hyperbolic Flows. Amer. J. Math. **94**, 1–30 (1972)
- [7] Combes, J.M., Duclos, P., Klein, M., Seiler, R.: The Shape Resonance. Commun. Math. Phys. **110**, 215–236 (1987)
- [8] Eckhardt, B.: Irregular Scattering. Physica D **33**, 89–98 (1988)
- [9] Eckhardt, B., Jung, Ch.: Regular and irregular potential scattering. J. Phys. A: Math. Gen. **19** L829–L833 (1986)
- [10] Falconer, K.J.: The geometry of fractal sets. Cambridge: Cambridge University Press 1986
- [11] Farkas, H.M., Kra, I.: Riemann surfaces. Graduate Texts in Mathematics, Vol. 71. Berlin, Heidelberg, New York: Springer 1977
- [12] Fomenko, A.T.: Integrability and Nonintegrability in Geometry and Mechanics. Dordrecht, Boston, London: Kluwer 1988
- [13] Franz, W.: Topologie I. Berlin, New York: Walter de Gruyter 1973
- [14] Gutzwiller, M.: Mild Chaos. In: Chaotic Behavior in Quantum Systems. Ed.: G. Casati. New York and London: Plenum Press 1985
- [15] Hadamard, J.: Sur les lignes géodésiques des surfaces à courbures opposées. Procès-Verbaux Soc. Sci. Phys. Natur. Bordeaux, 4. mars 1897.
- [16] Hadamard, J.: Les surfaces à courbures opposées et leur lignes géodesiques. Journ. Math. 5^e série, t. 4, 27–73 (1898); Œuvres, Tome II
- [17] Helffer, B., Sjöstrand, J.: Resonances en limite semi-classique. Bulletin de la S.M.F., memoire No. 24/25, **114** (1986)
- [18] Hirsch, M.W.: Differential Topology. Graduate Texts in Mathematics, Vol. 33. Berlin, Heidelberg, New York: Springer 1988
- [19] Hunziker, W.: Scattering in Classical Mechanics. In: Scattering Theory in Mathematical Physics. J.A. La Vita and J.-P. Marchand, Eds., Dordrecht: Reidel 1974
- [20] Jung, Ch., Tél, T.: Dimension and escape rate of chaotic scattering from classical and semiclassical cross section data. *preprint* (1991)

- [21]Katok, A., Knieper, G., Pollicott, M., Weiss, H.: Differentiability and Analyticity of Topological Entropy for Anosov and Geodesic Flows. *Inventiones mathematicae* **98**, 581–597 (1989)
- [22]Klein, M.: On the Absence of Resonances for Schrödinger Operators with Non-Trapping Potentials in the Classical Limit. *Commun. Math. Phys.* **106**, 485–494 (1986)
- [23]Klein, M.: On the Mathematical Theory of Predissociation. *Annals of Physics* **178** 48–73 (1987)
- [24]Klein, M., Knauf, A.: *In preparation*
- [25]Klingenberg, W.: Eine Vorlesung über Differentialgeometrie. Berlin, Heidelberg, New York: Springer 1977
- [26]Klingenberg, W.: Riemannian Geometry. *Studies in Mathematics 1*; Berlin, New York: De Gruyter 1982
- [27]Knauf, A.: Ergodic and Topological Properties of Coulombic Periodic Potentials. *Commun. Math. Phys.* **110**, 89–112 (1987)
- [28]Knauf, A.: Coulombic Periodic Potentials: The Quantum Case. *Annals of Physics* **191**, 205–240 (1989)
- [29]Knauf, A.: Closed orbits and converse *KAM* theory. *Nonlinearity* **3**, 961–973 (1990)
- [30]Landau, L.D., Lifschitz, E.M.: *Lehrbuch der theoretischen Physik*, Vol. I. Berlin: Akademie-Verlag 1966
- [31]Loomis, L.H., Sternberg, S.: *Advanced Calculus*. Reading: Addison-Wesley 1968
- [32]Milnor, J.: *Morse Theory*. *Annals of Mathematics Studies*. Princeton: Princeton University Press 1973
- [33]Moser, J.: Regularization of Kepler's Problem and the Averaging Method on a Manifold. *Comm. Pure Appl. Math.* **23**, 609–636 (1970)
- [34]Narnhofer, H.: Another Definition for Time Delay. *Phys. Rev. D* **22**, 2387–2390 (1980)
- [35]Narnhofer, H., Thirring, W.: Canonical Scattering Transformation in Classical Mechanics. *Phys. Rev. A* **23**, 1688–1697 (1981)
- [36]Schwartz, J.T.: *Nonlinear Functional Analysis*. New York: Gordon and Breach 1969
- [37]Parry, W., Pollicott, M.: An analogue of the prime number theorem for closed orbits of Axiom A flows. *Ann. Math.* **118**, 573–591 (1983)
- [38]Poincaré, H.: *Œuvres*, Vol. 6, Paris, Gauthier-Villars 1953
- [39]Simon, B.: Wave Operators for Classical Particle Scattering. *Commun. Math. Phys.* **23**, 37–49 (1971)
- [40]Sinai, Ya. G., Ed.: *Dynamical Systems II*. *Encyclopaedia of Mathematical Sciences*, Vol. 2. Berlin, Heidelberg, New York: Springer 1989
- [41]Smilansky, U.: *The Classical and Quantum Theory of Chaotic Scattering*. *Lecture Notes Summer School on 'Quantum Chaos'*. Les Houches 1989.
- [42]Stiefel, E.L., Scheifele, G.: *Linear and regular celestial mechanics*. *Grundlehren der mathematischen Wissenschaften*, Vol. 174. Berlin, Heidelberg, New York: Springer 1971
- [43]Tél, T.: *Transient Chaos*. In: *Directions in Chaos*, Vol. 4 Ed. Hao Bai-lin. Singapore: World Scientific 1990
- [44]Thirring, W.: *Lehrbuch der Mathematischen Physik 1*. 2nd Ed.; Wien, New York: Springer 1988

- [45]Tricot, C., Jr: Two definitions of fractional dimension. *Math. Proc. Camb. Phil. Soc.* **92**, 57–74 (1982)
- [46]Troll, G.: How to escape a sawtooth. The Weizmann Institute of Science. Preprint
- [47]Walters, P.: *An Introduction to Ergodic Theory*. Graduate Texts in Mathematics, Vol. 79. Berlin, Heidelberg, New York: Springer 1982
- [48]Wojtkowski, M.: Invariant families of cones and Lyapunov exponents. *Ergod. Th. & Dyn. Systems* **5**, 145–161 (1985)

Index of Symbols

| | | | |
|-----------------------|-----|-------------------------------------|-----|
| A^\pm | 115 | \hat{H}_∞ | 16 |
| b, b^\pm | 17 | $H^1(I, M)$ | 35 |
| b_+ | 105 | \mathcal{H} | 66 |
| \mathbf{b}_E | 67 | \mathcal{H}_E | 70 |
| \mathbf{b}_E^\pm | 75 | \mathcal{H}_E | 68 |
| C_k | 60 | I | 35 |
| \mathbf{c}_l | 55 | I_l, I_u | 49 |
| d | 63 | i | 37 |
| d_1 | 36 | J | 43 |
| \dim_H | 89 | $k_g(\gamma)$ | 29 |
| \dim_K | 90 | K_E | 28 |
| dist | 16 | $\kappa_E(T)$ | 99 |
| d_{\min} | 12 | $\kappa_E(T)$ | 100 |
| D | 21 | λ | 21 |
| D_k | 59 | A, A^\pm | 66 |
| \mathbf{d}_l | 56 | L^\pm | 18 |
| ΔT | 83 | AM | 36 |
| exp | 36 | \mathcal{L} | 35 |
| E_{th} | 105 | \mathcal{L}_1 | 36 |
| \mathcal{E} | 35 | $\mathcal{L}^E, \mathcal{L}^\infty$ | 38 |
| ϵ | 11 | \hat{M} | 11 |
| η | 16 | \mathbf{M} | 23 |
| η_E | 23 | $\hat{\mathbf{M}}$ | 24 |
| $\boldsymbol{\eta}_E$ | 24 | \mathcal{M} | 63 |
| F_E^\pm | 102 | n | 11 |
| \mathbf{F}_E^\pm | 100 | ω | 13 |
| g | 70 | ω_E | 84 |
| \hat{g}_E | 23 | $\Omega(\Phi)$ | 74 |
| G | 23 | Ω^\pm | 17 |
| \mathbf{g}_E | 24 | $\Omega_{pq}M$ | 36 |
| $\hat{\mathbf{g}}_E$ | 24 | Ω_*^\pm | 18 |
| \mathbf{G}_E | 41 | \bar{p}^\pm | 18 |
| h_{top} | 73 | P | 13 |
| H | 13 | P_+ | 106 |
| \hat{H} | 1 | P_∞ | 17 |

- $P_{\infty,+}$ 17
 \mathbf{P} 60
 \mathbf{P}_A 67
 $\mathbf{P}(k_0, k_1)$ 60
 $\mathbf{P}(k_0, \dots, k_m)$ 64
 π_E 26
 $\hat{\pi}_E$ 24
 $\pi_1(\mathbf{M})$ 32
 Π 36
 Φ_E^t 24
 Φ^t 13
 Φ_∞^t 17
 Φ_E^t 13
 R_{\min} 11
 R_{vir} 18
 ρ_E^t 48
 s 17
 σ_E^t 69
 σ_E^t 68
 $s(t, x)$ 25
 \bar{s}_l 11
 s_l 49
 s_{\min} 58
 s_u 49
 s^\pm 17
 \mathbf{s}_l 23
 S 21
 S_l, S_u 48
 $\frac{d\sigma}{d\theta^+}(E, \theta^-, \theta^+)$ 115
 Σ_E 13
 $\hat{\Sigma}_E$ 24
 Σ_E 24
 $\hat{\Sigma}_E$ 24
 \mathcal{S} 63
 σ 63
 t_{\min}, t_{\max} 58
 $T_{X,h}, T_{X,v}$ 47
 T_E 69
 \mathbf{T}_E 60
 \mathbf{T}_E^\pm 48
 \mathbf{T}_{vir} 48
 θ 9
 τ_{Σ_E} 47
 τ 95
 τ^\pm 98
- U_l 28
 U_E 48
 V 11
 V_{\max} 12
 $V(k_0, k_1)$ 60
 $V(k_0, \dots, k_m)$ 63
 φ_{E,θ^-} 115
 W 11
 $W(k_0, k_1)$ 60
 $W(k_0, \dots, k_m)$ 64
 W^s, W^u 82
 $W_\varepsilon^s, W_\varepsilon^u$ 83
 X_E 69
 \mathbf{X} 63
 \mathbf{X}_E 67
 Z_l 11
 Z_∞ 11

Index

- admissible sequences 63
- asymptotically complete 21
- basic sets 85
- braid group 6, 71
- branch points 23
- bound states 17
- branched covering surface 23
- Cantor set 68
- charge 11
 - asymptotic 11
- cone 47
- cone field 5, 48
- configuration space 11
- conjugacy class 39
- covering
 - branched 23
 - transformation 23
 - unbranched 24
- curvature
 - Gaussian 28
 - geodesic 29
- deflection function 99
- desynchronization time 83
- differential cross section 115
- dimension
 - Hausdorff 89
 - metric 89
- distance function 36
- energy functional 35
- energy shell 13
- escape rate 7
- entropy
 - topological 6, 73
 - measure 78
- exit time 48
- exponential map 36
- fundamental group 32
- geodesic 9
 - closed 35
 - equation 43
 - flow 24
 - flow line 9
- gradient flow 39
- hyperbolicity 68
- injectivity radius 37
- instability 46
- integrability 106
- interaction zone 41
- intersection number 6, 56
- irregular scattering 2
- Jacobi
 - equation 62
 - field 58
 - metric 23
- Kepler hyperbola 44
 - eccentricity 49
 - pericenter 14
- length functional 35, 36
- Levi-Civita transformation 25
- Levinson theorem 108
- loop 36
 - non-contractible 38
- Lyapunov exponent 5
- measure
 - cross section 115
 - Hausdorff 89
 - Liouville 21, 70
 - Parry 21, 79
- model curve 116
- Møller transformation 4, 17
- monodromy matrix 62
- non-wandering set 74
- nucleus 11
- Palais-Smale condition 37

phase space 13
Poincaré map 60
Poincaré section 60
potential 11
– molecular 22
– negative Coulombic 11
– purely Coulombic 12
– superharmonic 7, 105
– Yukawa 70, 105
rainbow singularities 113
regularization 4, 12
resonance 6
return time 60
Riccati equation 48
Riemann-Hurwitz formula 31
Runge-Lenz angle 15
Rutherford cross section 113
scattering
– homotopic 117
– states 17
– transformation 21
shift 63
shadowing 130
structural stability 130
suspension flow 68, 69
symbol space 63
symbolic dynamics 5
threshold energy 105
time delay 7, 95
time reparametrization 25
transition matrix 63
topologically transitive 85
unit tangent bundle 24
vertical segment 61
virial identity 18
virial radius 18
zeta function 87