

---

## References

1. L. Landau and E. Lifshitz: *The Classical Theory of Fields*. (Pergamon Press, Oxford, 1968)
2. A. Einstein: Verhandl Dtsch.Ph.Ges. B.**18**(1916) 318
3. W. Heitler: *The Quantum Theory of Radiation*. (Clarendon Press, Oxford, 1936)
4. W.M. Fine, Ya.I. Khanin: *Quantum Electronics*. (MIT Press, Cambridge, MA, 1968)
5. V.L. Ginzburg: *Theoretical Physics and Astrophysics*. (Pergamon Press, Oxford, 1979)
6. E. Fermi: Phys. Rev. **57**(1940)485
7. G.N. Watson: *Bessel Functions and Their Applications*. (Cambridge University Press, Cambridge, 1922)
8. H. Bateman: *Higher Transcendental Functions, 2nd edn.* (McGraw–Hill, New York, 1953)
9. M. Born, E. Wolf: *Principles of Optics* . (Pergamon Press, London, 1959)
10. L. Landau and E. Lifshitz: *Electrodynamics of Continuous Media*. (Pergamon Press, Oxford, 1982)
11. V.L. Ginzburg: Sov. Phys. Doklady. **56**(1947)145
12. Ya. Fainberg and A. Yegorov: Plasma Phys. Rep. **12**(1999)123
13. M.V. Kuzelev, A.A. Rukhadze, P.S. Strelkov: *Relyativistskaya plazmennaya elektronika (Plasma Relativistic Electronics)*. (Moscow, 2002)
14. W.P. Allis, S.J. Buchsbaum, and A. Bers: *Waves in Anisotropic Plasma*. (MIT Press, Cambridge, 1963)
15. N.A. Kroll and A.W. Trivelpiece: *Principles of Plasma Physics*. (McGraw–Hill, New York, 1973)
16. J.V. Jelley: *Cherenkov Radiation and Its Applications*. (Pergamon Press, London, 1958)
17. B.M. Bolotovskiy: *Oliver Heavyside* (Nauka, Moscow, 1985)
18. I. Frank and V. Ginzburg: Sov. Phys. JETP **16**(1946)15
19. V.L. Ginzburg and V.N. Tsytovich: *Transition Radiation and Transition Scattering*. (Gordon & Breach, London, 1990)
20. B.M. Bolotovskiy and G.V. Voskresenskiy: Sov. Phys. Uspekhi **9**(1966) 73
21. L.A. Vainshtein: *Teoria difrakcii i metod faktorizacii (Diffraction Theory and Factorization Method)*. (Sov. Radio, Moscow, 1966)

22. B. Noble: *Methods Based on Wiener–Hopf Technique for the Solution of Partial Differential Equations*. (London, 1958)
23. S. Smith, E. Purcell: *Phys.Rev.* **92**(1953)1069
24. P. Morse and H. Feshbach: *Methods of Theoretical Physics*. (McGraw–Hill, New York, 1953)
25. Ya. Fainberg and N. Khizhnyak: *Sov. Phys. JETP* **32**(1957)32
26. M.V. Kuzelev, A.A. Rukhadze: *Electrodinamika plotnykh puchkov v plazme (Electrodynamics of Dense Beams in Plasma)*. (Nauka, Moscow, 1990)
27. I.S. Gradshteyn, I.M. Ryzhik: *Tables of Integrals, Sums, and Products*. (Academic Press, New York, 1980)
28. A.A. Kolomensky, A.N. Lebedev: *Sov. Phys. Doklady* **7** (1962) 492
29. V.Ya. Davydovsky: *Sov. Phys. JETP*, **16** (1963) 629
30. H. Motz: *JAP* **22**(1951)527
31. G. Goldstein: *Classical Mechanics* (Addison–Wesley Press, Cambridge, 1974)
32. G.I. Budker in: *Proc. Int. Conf. on Storage*. (Orsay, 1966)
33. A.A. Kolomensky and A.N. Lebedev: *Theory of Cyclic Accelerators*. (N.-H., Amsterdam, 1966)
34. V.I. Kurilko and Yu.V. Tkach: *Physics – Uspekhi*. **38** (1995) 231
35. R.H. Dicke: *Phys. Rev.* **93** (1954) 99
36. A.N. Kolmogorov: *Sov. Phys. Doklady* **59** (1954) 527; V.I. Arnold: *Russ. Math. Surv. Sov. Math.* **18** (1963) 9,85; J. Moser: *Machr. Acad. Wiss. Gottingen. Math. Phys. Kl.* **IIa** (1962) 1
37. A.J. Lichtenberg, M.A. Lieberman: *Regular and Stochastic Motion*. (Springer–Verlag, New York, 1983)
38. B. Chirikov: *Phys. Reports* **52** (1979) 265
39. V. Arnold: *Matematicheskie metody v klassicheskoy mekhanike (Mathematical Methods of the Classical Mechanics)*. (Nauka, Moscow 1977)
40. *Basic Plasma Physics*. Edit. A. Galeev, R. Sudan *et al.* (N.-H. Co, Amsterdam, 1984)
41. E. Lifshitz, L. Pitayevsky: *Physical Kinetics*. (Pergamon Press, Oxford, 1981)
42. L. Landau, E. Lifshitz: *Fluid Mechanics*. (Pergamon Press, Oxford, 1987)
43. A.I. Akhiezer, Ya.B. Fainberg: *Sov. Phys. Doklady* **69** (1949) 525
44. L.D. Landau: *J. Phys. USSR* **10** (1946) 26
45. D.D. Ryutov: *Plasma Phys. Control. Fusion* **41** (1999) A1–A12
46. M.A. Evgrafov. *Asimptoticheskie ocenki (Asymptotic estimations)*. (GITTL, Moscow 1957); N.McLachlan: *Complex Variable and Operational Calculus with Technical Applications* (University Press, Cambridge, 1946)
47. A.V. Gaponov, A.L Goldenberg, D.P. Grigoryev, M.I. Petelin: *JETP Lett.* **2**(1965)430; V. A. Flyagin, A.V. Gaponov, M.I. Petelin, V.K. Yulpatov: *IEEE Trans. MTT-25* (1977)514
48. V.A. Balakirev *et al.*: *Sov.Phys.JETP* **84** (1983) 507
49. M.J. Clauser, M.A. Sweeney: *Proc. 1st Inter. Topical Confer. Electron Beam Research and Technol.* (Albuquerque 1976) **1** 135
50. R.B. Miller: *Intense Charged Particle Beams*. (Plenum Press, New York, 1983)
51. C. Nielsen, A. Sessler: *Rev. Scient. Instrum.* **30** (1959) 80
52. A.A. Kolomensky, A.N. Lebedev: *Atomnaya energiya (Atomic Energy)* **7** (1959) 549
53. Ya.B. Zeldovich: *Sov. Phys. Uspekhi* **18** (1975) 79
54. V.L. Bratman, N.S. Ginzburg, G.S. Nusinovich: *Journ Techn. Phys. Lett.* **3** (1977) 395

55. G.R. Smith, A.N. Kaufman: *Phys. Fluids*. **21** (1978) 2230–2241
56. Y. Gell, R. Nansch: *Phys. Fluids*. **23** (1980) 1646–1655
57. D.R. Shklyar: *Sov. Phys. JETP* **53** (1981) 1187
58. A.N. Antonov, V.A. Buts, O.F. Kovpik, *et al.*: *JETP Lett.* **69** (1999) 851
59. V.A. Buts, O.V. Manuilenko, Yu.A. Turkin: *Plasma Physics Reports* **25** (1999) 737
60. A. Oraevsky: *Gaussian Beams and Optical Resonators* (Nova Science, New York, 1996)
61. E.L. Saldin, E.A. Schneidmiller and M.V. Yurkov: *The Physics of Free Electron Lasers*. (Springer-Verlag, 2000)
62. C.W. Roberson and P. Sprangle: *A Review of Free Electron Lasers*. *Physics of Fluids* **B 1** (1989) 3–42
63. N.M. Krall, P.L. Morton, and M.N. Rosenbluth in: *Free Electron Generators of Coherent Radiation, Physics of Quantum Electronics*. (Addison-Wesley, Reading, MA, 1980)113; M.N. Rosenbluth, B.N. Moore, and H.W. Wong: *IEEE J. Quantum Electron.* **QE-21**, 1026 (1985).
64. P. Sprangle, C.M. Tang, and W.M. Manheimer: *Phys. Rev. Lett.* **43** (1979) 1932; *Phys. Rev.* **A 21** (1980) 302
65. G.T. Moore: *Opt. Commun.* **52** (1984) 46; E.T. Sharlemann, A.M. Sessler, and J.S. Wurtele: *Phys. Rev. Lett.* **54** (1985) 1925; *NIM A* **239** (1985) 29
66. A.M. Kondratenko and E.L. Saldin: *Part. Acc.* **10** (1980) 207
67. N.S. Ginzburg: *J. Techn. Phys. Lett.* **14** (1988) 197; N. Ginzburg and Ju. Novozhilova: *J. Techn. Phys. Lett.* **15** (1989) 771
68. Zhirong Huang and Kwan-Je Kim: *NIM A* **445** (2000) 105 (2000)
69. N. Vinokurov and A. Skrinsky in: *Proc. 10th Int. Conf. on High Energy Accelerators*. **2** (Serpukhov, 1977) 454

---

## Index

- Amplification
  - Compton regime 227
  - Raman regime 227
  - spatial 112, 113, 209, 222
  - temporal 217, 236
- Autophasing 105
- Autoresonance 67, 175, 189, 195, 200
- Beam
  - emittance 81, 220
  - Gauss-Laguerre 212, 213, 234
  - guiding 232
  - instability in plasma 159
- Bounce oscillations 107
- Boundary Conditions 42, 53, 180
- Bremsstrahlung 4
- Causality Principle 45
- Chaos 114, 118
- Chaotic Dynamics 114, 119, 175, 201, 204
- Chirikov Criterion 120
- Coherence 3, 87, 89
  - conditions 89
  - factor 91
  - in a train of particles 3, 6, 12, 14–16, 18, 36, 93
  - lattices 92
  - spatial 95
- Cold System 5
- Continuity Equation 131, 161, 223
- Coulomb Fields 15, 17, 18, 20, 21, 24, 26, 33, 76, 98, 201, 204
- Current 240, 242, 244
  - density 13, 22, 39, 76, 160, 177
- Cyclotron
  - autoresonance maser 67, 175, 205
  - resonance 67, 174, 175
  - waves 132, 134, 137–139, 143, 145, 149, 155, 174, 180
- Deceleration by Radiation 4
- Detuning 113, 163, 164, 166, 169, 224, 226, 227
  - optimal 113, 164, 166, 219, 220
- Diffraction 231
  - parameter 235
- Dispersion
  - equation 48, 63, 64, 114, 173, 174, 188, 210
  - periodic structures 28, 29
  - plasma 163
  - relations 47, 61, 125, 134, 136–139, 147, 151, 152, 154, 225, 240
  - ribbon beam 178
  - waveguide 46
- Distribution Function 82, 169, 176, 201
- Doppler Effect 7, 9
- Efficiency 195, 215, 220, 229, 230
- Eigenvalues 41
- Elementary Emitter 3
- Emission
  - classical 102, 103
  - quantum 98, 100
  - spectral line 91, 99, 101
  - spontaneous 4, 5

- stimulated 5, 98
- zone 58, 59
- Field Zone
  - far 4
  - near 38, 47, 50, 53
- Filamentation 110
- Free Electron Laser 87, 208
- Gain 209, 241
- Group Velocity 55, 110, 122, 163
- Gyrotion 53, 175, 182, 195, 205
- Harmonic Numbers 52, 56, 57
- Helmholtz Equation 41, 42
- Homocline Points 119
- Impedance 35
  - coupling 35
- Increment 182, 183, 228, 235, 243
- Instability
  - absolute 162
  - convective 167
  - increment 113, 217, 226, 227
  - local 9, 119, 120
  - radiative 176
- KAM Theorem 119
- Landau Damping 171, 176
  - negative 170
- Langmuir Frequency 162
- Lasing 102, 104
- Lethargy 249
- Lienard-Wichert Potentials 4, 38
- Liouville Theorem 81, 82, 115, 221
- Local Dispersion Relations 137
- Lorentz Force 73, 76
- Lyapunov Criterion 119
- Multipoles 47
- Negative Energy 140
- Negative Mass Instability 183
- Non-Linear
  - parameter 227, 229
  - resonance 115, 199
  - saturation 218
- Optical
  - cavity 211
  - klystron 215
- Optimal Detuning 235
- Parabolic Approximation 211, 234
- Phase
  - bunching 108, 109, 183
  - dynamics 107, 111
  - slippage 104, 106, 107, 121, 194, 196
  - trajectory 80, 107
- Polarization 52, 56, 214
  - losses 16, 18
  - oscillations 16
- Potential
  - ponderomotive 223, 224
  - retarded 37, 38, 76, 79
- Poynting Vector 44, 47, 54, 72, 79, 90
- Radiation
  - cyclotron 37, 53, 55, 68, 197
  - friction 67
  - instability 176
  - length 112
  - parametric transition 27
  - reaction force 72, 76, 78, 79
  - secondary 116
  - spectral line 105
  - synchrotron 37, 55, 65, 167
  - transition 12, 22, 36, 48
  - under uniform motion 8
- Resonance 114
  - cyclotron 83
  - independent 189
  - lines 67, 189, 192, 193
  - overlapping 15
  - secondary 116
  - separation 114, 122
  - width 114, 121, 122
- SASE Regime 113
- Saturation 114, 218, 219
- Scattering
  - by bound particles 65
  - coherent 66, 80, 94
  - Compton 60, 61
  - cross section 80, 95
  - Thomson 64
- Spectral-Angular Distribution 57, 65, 113, 114, 218, 219

- Stimulated Radiation 5
- Superradiance 239, 240
- Synchronism 10, 11, 27, 34, 54, 55, 93,  
104, 159, 213
  - for periodic motion 40
- Synchrotron Oscillations 83, 107, 218,  
229
- Undulator 50, 69
  - coefficient 51, 57, 214, 223, 226
  - helical 55, 212, 214, 229
- plane 212, 233, 240
- radiation 37, 87, 209
- tempered 230
- Vlasov Equation 160, 176
- Waves
  - in free space 38, 48
  - plasma 162, 163
  - proper 38, 53
  - space charge 132, 143