Contents

1 Radiation from Relativistic Particles ........................................ 1
   1.1 General Properties of Radiation from Relativistic Particles ......... 1
   1.2 Radiation Formation Length ...................................... 6
   1.3 Radiation from a Heavy Charged Particle Colliding With an Atom ... 9
   1.4 Transition Radiation and Diffraction Radiation .................. 13
   1.5 Wakefield in Linear Accelerators ................................ 19
   References ........................................................................ 26

2 General Properties of Diffraction Radiation .............................. 29
   2.1 Diffraction Radiation as Radiation from Polarization Currents ...... 29
   2.2 Formation Length of Diffraction Radiation .......................... 32
   2.3 Radiation from Relativistic Particle Near a Screen ............... 35
   2.4 Diffraction Radiation from Ultrarelativistic Particles .............. 38
   2.5 Effect of the Excitation of the Medium on Diffraction Radiation ... 43
   2.6 Diffraction Radiation from a Charged Particle Reflected from a Single Crystal ...................................................... 49
   References ........................................................................ 53

3 Diffraction Radiation at Optical and Lower Frequencies ............. 55
   3.1 Diffraction Radiation from a Circular Hole in an Opaque Screen ... 55
   3.2 Diffraction Radiation from an Inclined, Perfectly Conducting Half-Plane ............................................................. 64
   3.3 Radiation Generated by a Charge Passing Through a Slit in a Perfectly Conducting Screen ....................................... 81
   3.4 Polarization Characteristics of Diffraction Radiation ............... 92
   References ........................................................................ 101

4 Diffraction Radiation in the Ultraviolet and Soft X-Ray Regions .... 105
   4.1 Polarization Current and the Radiation Field ....................... 105
   4.2 Forward Diffraction Radiation ...................................... 109
   4.3 Backward Diffraction Radiation .................................... 115
4.4 X-ray Diffraction Radiation Under Conditions of the Cherenkov Effect ..................................... 119
4.5 Diffraction Radiation from a Crystal Target ................................................................. 123
References .................................................................................................................. 134

5 Diffraction Radiation at the Resonant Frequency ........................................ 137
5.1 Diffraction Radiation at the Resonant Frequency from a Nonplanar Surface ......................................................... 137
5.2 Diffraction Radiation at the Resonant Frequency from a Wedge ........ 142
References .................................................................................................................. 147

6 Diffraction Radiation from Media with Periodic Surfaces ................ 149
6.1 Smith—Purcell Radiation .............................................................................. 149
6.2 Scalar Theory of the Diffraction of the Self Field of an Electron from a Plane Semit transparent Grating ................................. 153
6.3 Smith—Purcell Effect As Radiation Generated by Induced Surface Currents ................................................................. 156
6.4 Smith—Purcell Effect As Resonant Diffraction Radiation ............. 162
6.5 Resonant Diffraction Radiation Generated by Electrons Moving Near a Tilted Planar Grating .................................................. 177
6.6 Smith—Purcell Radiation from a Thin Dielectric Layer on a Conducting Substrate ........................................... 186
References .................................................................................................................. 194

7 Coherent Radiation Generated by Bunches of Charged Particles .... 197
7.1 Coherent Radiation Generated by Short Electron Bunches ........ 197
7.2 Coherent Synchrotron Radiation in the Millimeter and Submillimeter Wavelength Ranges ....................................... 207
7.3 Coherent Diffraction Radiation ................................................................... 211
7.4 Coherent Smith—Purcell Radiation .............................................................. 216
References .................................................................................................................. 219

8 Diffraction Radiation in the Pre-wave (Fresnel) Zone .................. 221
8.1 Transition Radiation in the Pre-wave (Fresnel) Zone .................. 221
8.2 Diffraction Radiation in the Pre-wave (Fresnel) Zone as a Tool for Beam Diagnostics ............................................................. 231
References .................................................................................................................. 249

9 Experimental Investigations of Diffraction Radiation Generated by Relativistic Electrons ............................................................. 251
9.1 Experimental Results on Diffraction Radiation and Comparison with Theoretical Calculations ........................................................ 251
9.2 Optical Diffraction Radiation from a Slit Target and the Possibility of the Measurement of the Transverse Size of an Electron Beam 260
9.3  Experimental Investigations of the Generation of Smith—Purcell Radiation by Ultrarelativistic Electron Beams .......................... 265
9.4  Some Prospects of Application of Diffraction Radiation .............. 271
References ................................................................. 275
Diffraction Radiation from Relativistic Particles
Potylitsyn, A.; Ryazanov, M.I.; Strikhanov, M.N.;
Tishchenko, A.A.
2011, XIV, 278 p. 127 illus., Hardcover
ISBN: 978-3-642-12512-6