

Contents

1. Introduction. By A.W. Sænæz and H. Oberall (With 1 Figure)	1
References	4
2. Theory of Coherent Bremsstrahlung. By A.W. Sænæz and H. Oberall (With 7 Figures)	5
2.1 Overview	5
2.2 General Remarks on CB and CR; Kinematics	9
2.3 Born-Approximation Theory of Coherent Bremsstrahlung	15
2.4 Numerical Results	20
2.5 Kinematics of CB and CR. Theory of fb Transition Intensities	23
2.6 Summary	28
References	29
3. Coherent Bremsstrahlung - Experiment. By G.D. Kovalenko, L.Ya. Kolesnikov, and A.L. Rubashkin (With 21 Figures)	33
3.1 History	33
3.2 General Formulas for Coherent Bremsstrahlung	35
3.2.1 Kinematics	35
3.2.2 Intensity and Polarization	36
3.3 Experimental Equipment for Coherent Bremsstrahlung Studies	39
3.3.1 Experimental Layouts and Photon-Beam Formation Technique ...	39
3.3.2 Crystal Targets	41
3.3.3 Goniometers	42
3.4 Experimental Results and Discussion	43
3.4.1 Spectral Characteristics of Bremsstrahlung in Crystals	43
3.4.2 Orientation Dependence of Total Energy Flux and Photon Intensity	47
3.4.3 Measurements of CB Polarization	50
3.4.4 Effect of Secondary Collimation on CB Parameters	54
3.4.5 Particular Properties of CB at Low Initial Electron Energies	56
3.5 Conclusion	58
References	58

4. Bent Crystal Channeling. By R.A. Carrigan, Jr. and W.M. Gibson (With 18 Figures)	61
4.1 Channeling at High Energy	61
4.2 Bending	69
4.3 Bending Theory	71
4.4 Bending Experiments	77
4.5 Factors Affecting Charged-Particle Bending with Single Crystals ...	83
4.5.1 Materials	83
4.5.2 Radiation Damage	84
4.5.3 Angular Acceptance	84
4.5.4 Spatial Acceptance	85
4.5.5 Deflection	85
4.6 Possible Applications	85
4.6.1 Extraction	85
4.6.2 Secondary Beam Bending	86
4.6.3 Beam Focusing	86
4.6.4 "Separated" Beam for Short-Lived Particles	86
4.6.5 Charm-Particle Magnetic Moment Measurement	87
4.6.6 Interstitial Site Information	87
References	88
5. Classical Theory of the Radiation from Relativistic Channeled Particles By V.V. Beloshitsky and M.A. Kumakhov (With 11 Figures)	91
5.1 Historical Introduction	91
5.2 Classical Theory of Channeling	92
5.3 Multiple Scattering Effects	94
5.4 Classical Theory of Radiation	98
5.4.1 Semiquantitative Treatment of Radiation	98
5.4.2 General Relations	100
5.4.3 Planar Channeling	102
5.4.4 Axial Channeling of Electrons	111
5.4.5 Quasi-Channeling in the Axial Case	116
5.5 Comparison of Spectral Intensity with That of Bremsstrahlung	119
5.6 Concluding Remarks	123
References	124
6. Channeling Radiation - Quantum Theory By J.U. Andersen, E. Bonderup, and E. Laegsgaard (With 16 Figures)	127
6.1 Channeling and Channeling Radiation	127
6.2 Transverse Wave Equation	131
6.3 Emission of Radiation	134

6.4 Corrections to the Wave Equation	135
6.5 Axial-Channeling Radiation	136
6.6 Planar-Channeling Radiation	140
6.7 Coherent Bremsstrahlung	145
6.8 Damping and Linewidth	146
6.9 Scattering Potential	150
6.10 Thermal Scattering	151
6.11 Nonsystematic Reflections	153
6.12 Electronic Scattering	154
6.13 Multiple Scattering and Line Intensity	157
6.14 Applications	162
References	163
 7. Channeling-Radiation Experiments. By B.L. Berman and S. Datz (With 19 Figures)	165
7.1 Historical Background	165
7.2 Experimental Apparatus and Techniques	170
7.3 Experimental Results	177
7.3.1 Perspective	177
7.3.2 Electron Channeling Radiation	178
a) Electron Planar-Channeling Radiation	178
b) Electron Axial-Channeling Radiation	181
c) Two-Dimensional "Molecular" Bound States for Channeled Electrons	183
7.3.3 Positron Channeling Radiation	185
a) Positron Axial-Channeling Radiation	185
b) Positron Planar-Channeling Radiation	185
c) High-Energy ($\gtrsim 1$ GeV/c) Planar-Channeling Radiation	188
7.3.4 Binary Crystals	189
7.3.5 Crystal Defects	189
References	191
Additional References	194
 8. Transition Radiation. By G.B. Yodh (With 25 Figures)	195
8.1 Scope of the Review	195
8.2 Characteristics of Transition Radiation	196
8.2.1 General Theoretical Formula for the Differential Yield	196
a) Two Semi-Infinite Media	196
b) Multilayered Medium	197
c) Single-Foil Yield (SF)	198
d) N-Foil Yield (NF)	198

8.2.2	Interference Effects	199
8.3	Yield Integrated Over Angle	200
8.3.1	General Remarks	200
8.3.2	Single-Surface Yield (SS)	200
8.3.3	Single-Foil Yield (SF)	201
a)	Formation-Zone Effect	201
b)	Single-Gap Yield	203
8.3.4	N-Foil Yield	204
8.4	Experimental Tests of Transition-Radiation Theory	207
8.4.1	General Remarks	207
8.4.2	Discussion of Experimental Tests of Multifoil Theory	211
8.5	Current Applications of TR of High-Energy Particles, and New Developments	216
8.5.1	Particle Identification	217
a)	Optimization of TR Particle Identifiers	217
b)	Experimental Results	218
8.5.2	Energy Measurement Using TR	224
8.5.3	Transition Radiation Detectors as Accelerator Monitors	225
8.5.4	TR as a Tunable X-Ray Source	225
8.5.5	Other Developments	225
References	227
Subject Index	231