

Index

- aberrations, 104, 199, 553
- absorption, 597, 611, 644
- absorption and thin-film approximation (table), 217
- absorption correction, 43, 216
 - flat specimen, 43
 - granularity, 47
 - validity, 47
- absorption edge, 171
- accidental degeneracy, 17
- Ag-Cu interface, 571
- Al₁₂Mn, 78
- Al-4wt.% Cu alloy, 257
- Al-Cu, 575, 725
- Al-Cu θ' phase, 270
- Al-Ge interface, 571
- Al-Li alloy, 75
- α boundary, 407
- amateur mistake, 263, 269, 380, 728
- amorphous material, 498
 - 1-D model, 498
 - HRTEM, 87
- analytical TEM, 64, 168, 653
- anisotropic crystal, 430
 - elastic, 378, 413
- anomalous scattering, 134, 472
 - partial pair correlations, 507
- antibonding orbitals, 172
- antiphase boundary, 405
 - superlattice diffraction, 406
- aperture angle, 69, 92, 116
 - optimum, 114
- apertureless image, 73
- Appendices – tables and charts, 675
- artificial rays, 70
- Ashby-Brown contrast, 410
- astigmatism, 106
 - correction procedure, 109
 - salt and pepper contrast, 109
- atom, 1
 - as a point, 468
 - atomic displacement disorder, 478
 - atomic form factor, 227
 - dependence on $\Delta\mathbf{k}$, 153
 - destructive interference at angles, 145
 - effective Bohr radius, 149
 - electron, table of, 682, 683
 - electrons and x-rays, 152
 - high energy x-rays, 152
 - model potentials, 146
 - Mott formula, 152
 - physical picture, 143
 - Rutherford, 149
 - screened Coulomb potential, 147
 - sensitivity to bonding electrons, 154
 - shape of atom, 143, 153
 - Thomas-Fermi, 149
 - x-ray, table of, 677
 - atomic periodicities
 - resolution of, 85
 - atomic size effect, 480
 - Auger effect, 13, 223
 - autocorrelation function, 2, 55, 469
 - average column length, 453
 - average potential of solid, 597
 - axial dark-field imaging, 75, 263, 264, 380, 576
 - axial divergence, 26, 430
 - B2 structure, 246, 570
 - back focal plane, 69, 73
 - background, 59
 - subtraction and integration, 49
 - backscatter Laue of Si, 11
 - backscattered electrons, 204
 - bar, 732
 - barn, 732
 - basis vectors, 237
 - beam propagation, 607
 - beam representation, 596
 - beam tilt
 - dislocation position, 592

- in HRTEM, 579
- tilt coils, 579
- beams and Bloch waves, 613
 - normalization, 615
- beats
 - acoustic, 612
 - mathematical analysis, 617
 - pattern, 617
 - physical picture, 612
- becquerel, 731
- Beer's law, 210
- backscattered electron image (BEI), 204
- bend contour, 354, 416, 636
 - Cu-Co, 358
 - diffraction patterns, 357
- bending magnets, 21
- Bethe asymptotic cross section, 193
- Bethe ridge, 183
- Bethe surface, 190, 191
- biology, 73
- black cross, 328
- Bloch wave representation, 596
- Bloch waves, 612
 - amplitudes and dispersion surface, 639
 - beats at defect, 642
 - change across defect, 642
 - characteristics, 622
 - energies, 621
 - orthogonality, 620
 - weighting coefficients, 615
- Bloch-wave propagator, 645
- block diagram of a TEM, 64
- Blue Boy, 137
- blue sky, 132
- Boersch effect, 106
- Bohr magneton, 731
- Bohr radius
 - dependence on Z , 149
 - effective, 149
- Born approximation, 226, 604
 - first, 141
 - higher order, 141
 - second, 141
- Bose–Einstein statistics, 487
- boundary conditions, 629
- Bragg's law, 3
- Bragg–Brentano geometry, 26
- bremsstrahlung
 - coherent, 60
 - intensity, 16, 24
- bright-field (BF) imaging, 69, 72, 73
- brightness, 22, 110
 - conservation of, 111
 - electron gun, 115
- brilliance, 22
- broadening of x-ray peaks
 - analytical comparison to TEM, 461
 - asymmetric, 453
 - asymmetry from strain range, 454
 - complement of TEM, 461
 - crystalline defects, 455
 - dislocation, 461
 - meaning of size and strain, 461
 - stacking faults, 446
- buckled specimen, 354, 421
- Burger's circuit, 708
 - in HRTEM image, 87
- Burger's vector, 363, 569, 708
 - conservation of, 712
 - fcc, 366
- calorie, 732
- camera constant, 79
 - calibration, 79
 - determination of, 721
- camera equation, 78
- camera length, 78, 92
- carrier, 86
- Cauchy function, 433
- CCD cameras, 586
- center of gravity, 511
- center of the goniometer, 49
- characteristic radiation, 13, 16, 24
- chemical bonding, 172
- chemical disorder, 478, 487
- chemical map, 64
- chemical short-range order, 487, 492
- children's jacks, 267
- chromatic aberration, 105
 - importance of thin specimens, 106
- classical electron radius, 731
- Cliff–Lorimer factor, 212
 - calculation, 215
 - experimental determination, 215
- coherent bremsstrahlung, 60
- coherent elastic scattering, 125
- coherent imaging, 586
- coherent inelastic scattering, 125
- coherent scattering, 123
 - delicate, spectacular and confusing, 129
 - forward direction, 144, 510
 - length, 127
 - phases, 130
- column lengths, 455

- distribution, 455, 457
- neighbor pairs in column, 457
- random termination, 456
- complementarity of BF and DF, 75
- Compton scattering, 134
 - incoherence, 136
- condenser lens
 - aperture, 91
 - convergence (C2), 90
 - spot size (C1), 90
- condenser/objective STEM mode, 65
- constants, 731
- constructive interference, 3
- contrast transfer function, 86, 557
 - damping of, 561
- conventional modes, 72
- conventional TEM, 80
- convergence angle control, 211
- convergent-beam electron diffraction (CBED), 82, 306
 - α -Ti, 323–331
 - BF disk symmetry, 318
 - black cross, 328
 - DF disk symmetry, 318
 - diffraction group, 317, 318
 - disk and crystal symmetry, 319
 - intensity nonuniformity, 83
 - Ewald sphere, 307
 - FeS₂, 330
 - Friedel's law, 317
 - G disk symmetry, 318
 - Gjonnes-Moodie lines, 327
 - glide plane, 327
 - HOLZ lines and lattice parameter, 313
 - HOLZ radius G_n , 311
 - HOLZ spacing, 312
 - illumination, 82
 - intensity oscillations in disk, 309
 - point group, 317
 - positions of disks, 313
 - orthorhombic examples, 314
 - projection diffraction group, 318
 - sample thickness determination, 309
 - screw axis, 327
 - semi-angle of convergence, 307
 - special positions, 327
 - symmetric many-beam, 327
 - unit cell, 310
 - whole pattern symmetry, 318
- conversion factors, 732
- convolution, 705
 - defined, 432
 - example, 432
 - Gaussians, 432
 - Lorentzians, 432
 - of potential and beams, 602
 - theorem, 435
 - Voigt function, 434
- core excitations energy variables, 180
- core hole decay, 168
- Cornu spiral, 535, 592
- correlations, 492
 - short-range, 492
- Coulombic interaction, 184
- coupled oscillators, 610, 659
- Cowley-Moodie method, 657
- crystal potential
 - inversion symmetry, 603
 - real, 603
- crystal symmetry elements, 318
- crystal system notation, 243
- crystalline defects, 455
- crystallite sizes
 - distribution and TEM, 461
 - TEM and x-ray, 461
- Cu₂O, 155
- Cu-Co, 413
- Curie, 731
- d -orbitals (shapes), 155
- damping function, 566
- dark-field (DF) imaging, 69, 72, 73
- dead time, 30
- Debye model, 486
- Debye-Scherrer, 10
- Debye-Waller factor, 173, 482, 520, 706
 - calculation of, 486, 706
 - concept, 485
 - conventions, 486
- deconvolution, 434
 - effect of noise, 437
 - Fourier transform procedure, 434
 - frequency filter, 440
 - procedure with noise, 439
- defects, 340
- δ boundary, 407
- density, 44
- density heterogeneity, 504
- density of unoccupied states, 172
- density-density correlations, 517
- depth of field, 81, 117
- depth of focus, 81, 117
- detective quantum efficiency, 30
- detector
 - analytic TEM, 33
 - beryllium window, 32

- calorimetric, 33
- charge sensitive preamplifier, 35
- count rates, 30
- dead layer, 32
- energy resolution, 30
- escape peak, 32
- gas-filled proportional counter, 30
- intrinsic semiconductor, 31
- position-sensitive, 34
- scintillation counter, 31
- Si[Li], 33
- solid state, 31
- table of characteristics, 31
- x-ray, 29
- deviation parameter, s , 258, 341, 344
 - effective, 631
 - Kikuchi lines, 301
 - sign of, 341
- deviation vector
 - in dynamical theory, 601
- differential scattering cross section, 128, 190
 - inelastic, 186
- diffracted beams
 - across defect, 644
- diffracted power, 449
- diffraction
 - and apertures, 106
 - coherence, 231
 - Δk and θ , 231
 - electron, 226
 - fine structure, 267
 - Fourier transform of potential, 230
 - frequency and time, 229
 - incident wave, 228
 - line broadening, 423
 - translational invariance in plane, 9
 - vectors and coordinates, 228
 - wave, 228
 - wavevectors, 230
- diffraction contrast, 64, 73, 339
 - dynamical
 - dislocation, 640
 - interface, 641
 - stacking fault, 641
 - dynamical without absorption, 640
 - null contrast, 360
 - strain fields, 358
- diffraction coupling, 170
- diffraction lens, 92
- diffraction mode, 70
- diffraction pattern
 - background, 59
 - bcc, 689, 690
 - chemical composition, 7
 - crystallite sizes, 8
 - dc, 691, 692
 - fcc, 687, 688
 - hcp, 693–696
 - indexed powder, 675
 - internal strains, 6
 - peak broadening, 6
 - silicon, 4
 - size effect broadening, 7
- diffraction vector, 84
- diffuse scattering, 467
 - chemical disorder, 490
 - displacement disorder, 481
 - SRO, 494
 - thermal, 485
- digital data
 - interpolation of peak centers, 705
- dilatation, 427
- dipole approximation, 195
- dipole oscillator, 130
- Dirac δ -function, 221, 469
- Dirac equation, 17
- Dirac notation, 183
- dirty dark-field technique, 75
- disk of least confusion, 104
 - resolution, 113
- dislocation, 339, 708
 - Burger's vector, 708, 730
 - charge sinks, 708
 - core, 710
 - contrast tables, 730
 - dipole, 369
 - double image, 375
 - dynamical contrast, 378, 643
 - edge, 363, 708
 - fcc and hcp, 711
 - $\mathbf{g} \cdot \mathbf{b}$ analysis, 730
 - groups of, 714
 - image width, 375
 - interactions, 713
 - loop, 709
 - mixed, 708
 - partial, 712
 - phase-amplitude diagram, 363
 - plastic deformation, 708
 - position of image, 363, 374
 - reactions, 711
 - screw, 365, 708
 - self energy, 709
 - strain field, 713
 - superdislocation, 369

- tilt boundary, 714
- weak-beam dark-field method, 378
- dispersion corrections, 681, 702, 703
- dispersion surface, 618, 638
- displacement disorder
 - dynamic, 478
 - static, 478
- DO₁₉ structure, 569
- double diffraction
 - forbidden diffractions, 304
 - tilting experiment, 304
- double exposures, 722
- double-differential cross section, 188
- double-tilt holder, 276
- drift of sample, 379
- Duane-Hunt Rule, 13
- dynamical absences
 - space group, 329
- dynamical theory
 - boundary conditions, 629
 - eigenvalue problem, 656
 - extinction distances, 657
 - intuitive approach, 595
 - multibeam, 602, 655
 - multibeam and HRTEM, 655
 - multislice method, 657
 - phase grating, 657
 - propagator, 657
 - vs. kinematical theory, 604, 607
- effective deviation parameter, 344
- effective extinction distance, 344
- eigenfunctions
 - constant potential, 596
 - periodic crystal, 596
- elastic anisotropy, 446
- elastic scattering, 125
 - Rutherford, 150
- electric dipole radiation, 130
- electric dipole selection rule, 19, 61
- electron coherence length, 92
- electron energy-loss near-edge structure (ELNES), 172
- electron energy-loss spectrometry (EELS), 64
 - $M_{4,5}$ edge, 202
 - Al, 190
 - background in spectrum, 171
 - chemical analysis, 196
 - energy filter, 585
 - experimental intensities, 188
 - extended fine structure, 168
 - fine structure, 168, 172
 - magnetic prism, 198
 - Ni spectrum, 171
 - nomenclature for edges, 172
 - partial cross section, 193
 - plasmon peak, 171
 - spectrometer, 169
 - aperture, 192
 - diffraction-coupled, 170
 - entrance aperture, 170, 190
 - image-coupled, 170
 - parallel, 170
 - serial, 169
 - spectrum
 - background, 196
 - edge jump, 222
 - multiple scattering, 197
 - thickness gradients, 585
 - typical spectrum, 170
 - white lines, 171, 174
 - zero loss peak, 170
- electron form factors
 - table of, 682, 683
- electron gun
 - brightness, 110
 - filament saturation, 90
 - self-bias design, 89
 - thermionic triode, 89
- electron interaction parameter, 564
- electron mass, 731
- electron microprobe, 205, 209
- electron probe size, 211, 212
- electron scattering
 - Born approximation, 138
 - coherent elastic, 138
 - Green's functions, 140
- electron wave
 - probability interpretation, 138
- electron wavelengths, 732
- electron-matter interactions, 13
- electronic transition nomenclature, 172
- electropolishing, 726
- elegant collar, 137, 155
- elemental mapping, 36
- energy, 123
- energy-dispersive spectrometry (EDS), 30, 64
 - background, 212
 - compositional accuracy, 218
 - confidence level, 219
 - detector take-off angle, 210
 - electron trajectories in materials, 202
 - escape path, 210
 - k -factor determination, 728

- microchemical analysis, 208
- minimum detectable mass (MDM), 219
- minimum mass fraction (MMF), 218
- practice, 728
- quantification, 210
- sensitivity versus Z , 169
- spectrometer, 210
- statistical analyses, 219
- Student- t distribution, 219
- typical spectrum, 209, 222
- energy-filtered TEM (EFTEM)
 - chemical mapping, 199
 - diffraction contrast, 200
 - energy-filtered TEM imaging, 197
 - instrumentation, 198, 585
 - spatial resolution, 202
- equatorial divergence, 26
- eucentric tilt, 104
- Everhart-Thornley detector, 207
- Ewald sphere
 - and Bragg’s Law, 261
 - axial dark-field imaging, 263
 - construction, 260
 - curvature, 260
 - dynamical theory, 634
 - Laue condition, 260
 - manipulations, 262
- excitation error, s_g , 600
 - in dynamical theory, 601
- experimental high-resolution imaging, 545
- extended electron energy-loss fine structure, (EXELFS), 172
 - phase shifts, 173
 - typical data, 174
- extended x-ray absorption fine structure (EXAFS), 175
- extinction distance, 344, 596
 - effective, 344
 - table of, 345
 - $\xi_{g-g'}$, 600
- extinction distance and structure factor, 604
- extracted particle, 78

- factors of 2π , 631
- Faraday cage, 210
- fast Fourier transform, 567
 - deconvolution, 464
- Fe₃Al, 407
- Fe-Cu
 - grain boundaries, 514
- FeCo, 246
- field effect transistor, 35
- field emission gun, 90
 - cold, 90
 - Schottky, 91
- filament lifetime, 89
- fingerprinting, 5
- first-order Laue zone, FOLZ, 264
- fission, 156
- fluorescence correction, 216
- fluorescence filter, 29
- fluorescence yield, 207
- flux (in scattering), 127
- focusing circle, 27
- focusing strength, 67
- FOLZ, 312
- forbidden diffractions, 241, 244
 - double diffraction, 304
- forbidden transition, 19
- form factors
 - electron, table of, 682
 - x-ray, table of, 677
- forward scattering
 - coherence, 510
- Fourier methods with multiple orders, 447
- Fourier transform, 84
 - bare Coulomb, 149
 - complex, 437
 - cutoff oscillations, 439
 - decaying exponential, 148
 - deconvolution, 434
 - Gaussian, 439
 - Lorentzian, 148, 439
 - low-pass filter, 439
 - pairs, table of, 701
 - scattered wave, 143
- Frank interstitial loop
 - HRTEM image of, 87
- Fraunhofer region, 526
- Fresnel fringes, 592
 - at edge, 536
 - defocus, 109, 592
 - focus, 537
 - spacing, 537
- Fresnel integrals, 535
- Fresnel propagator, 539
- Fresnel region, 526
- Fresnel ring
 - and astigmatism, 109
 - and focus, 109, 592
- Fresnel zones, 530
- Friedel’s law, 471

- CBED, 317
- $g \cdot b$ rule, 363
 - Burger's vector, 363
- GaAs, 85
- Gallipoli, 18
- gas gain, 31
- Gaussian damping function, 566
- Gaussian focus, 553, 576
- Gaussian function, 458
- Gaussian image plane, 104
- Gaussian thermal displacements, 707
- Geiger, 150
- generalized oscillator strength, 188, 190
- geometrical optics, 67
- Gjonnes-Moodie (GM) lines, 327
- glass lens, 93
 - concave, 97
 - Fermat's principle, 99
 - phase shifts, 97
 - shape of surface, 97
 - spherical surface, 97
- goniometer, 25
 - θ - θ , θ - 2θ , 276
 - Bragg-Brentano, 26
- grain boundaries, 408, 568
- Gray, 731
- Green's function, 140
 - spherical wavelet, 525
 - wave equation, 539
- growth ledges, 416
- Guinier approximation, 511, 513
- Guinier radius, 513
- Guinier-Preston zones, 257

- half-width-at-half-maximum, 424
- hexagonal close packed
 - interplanar spacings, 57
 - structure factor rule, 57
- HgCdTe, 12
- high-resolution TEM (HRTEM), 83, 523
 - compensate aberration with defocus, 547
 - effect of defocus, 545
 - effect of spherical aberration, 546
 - image matching, 560
 - image simulation procedure, 562
 - lens characteristics, 553
 - microscope parameters, 565
 - simple interpretations, 571
 - solute effects at $1 \xi_{000}$, 573
 - specimen parameters, 562
 - total error in phase, 548
- HRTEM practice, 545
 - anomalous spot intensities, 584
 - beam tilt effects, 579
 - defocus, 576
 - doubling of spot periodicities, 580
 - FFTs from local regions, 584
 - minimum contrast condition, 576
 - sample thickness, 582
 - surface layers, 584
 - use of EELS, 582
- HRTEM simulations
 - beam convergence, 566
 - diffuse scattering, 567
 - microscope instabilities, 566
 - misfitting atoms, 575
 - other helpful programs, 583
 - quantifying parameters, 567
 - scattering factor differences, 573
 - size of array and unit cell, 567
 - solute misfit, 573
 - spot intensities, 575
 - specimen and microscope, 576
 - vertical features, 575
- high-angle annular dark-field (HAADF) imaging, 586
 - source of incoherence, 587
- higher-order Laue zone, HOLZ, 264, 312
 - dynamical absences, 329
 - excess and deficit lines, 315
 - lines and lattice parameter, 313
- hole count spectrum, 209
- homogeneous medium
 - plane wave in, 525
- Howie-Whelan-Darwin equations, 602
- Huygen's principle, 529
 - spherical wave analysis, 529
- hydrogenic atom, 190
- Hönl dispersion corrections, 134

- ideal gas, 511
- illumination angle, 90
- illumination system
 - convergence (C2), 90
 - lenses, 88
 - point source, 90
 - spot size (C1), 90
- image coupling, 170
- image inversions, 92
- imaging lens system, 92
 - cross-overs, 102
- imaging mode, 70
- imaging plates, 34, 586

- in-situ studies, 66
- incident plane wave, 139
- incoherence, 123
- incoherent elastic scattering, 125
- incoherent imaging, 586
- incoherent inelastic scattering, 125
- incoherent scattering, 124
- index of refraction, 94
- indexed diffraction patterns, 675
- indexing diffraction patterns, 4
 - concept, 276
 - easy way, 278
 - row and column checks, 281
 - start with diffraction spots, 282
 - start with zone axis, 278
- inelastic electron scattering, 167
- inelastic form factor, 186
- inelastic scattering, 125
- information limit, 557
- insertion device, 21
- instrument function, 436
- instrumental broadening, 430
- integral cross section, 194
- integral inelastic cross section, 222
- interface
 - coherent, 569
 - crystal-liquid, 583
 - incoherent, 571
 - semicoherent, 570
- interference patterns, 86
- intermediate aperture, 77
- intermediate lens, 71, 92
- internal interfaces
 - displacement vector, 387
 - phase shifts, 385
 - phase-amplitude diagram, 389
- internal stress, 428
- International Centre for Diffraction Data, 5
- interphase boundaries, 568
- interstitial loop, 409
- ionization, 13
- ionization cross section, 208
- isomorphous substitutions, 472
- isotopic substitutions, 472
- isotropic averages, 495
- isotropic scattering, 127

- JEOL 200CX, 577
- JEOL 2000FX, 715
- JEOL 2010F, 63
- JEOL 4000EX, 560, 577
- Johansson crystals, 27

- jump-ratio image, 200

- Kikuchi lines
 - deviation parameter, 301
 - indexing, 296
 - Kikuchi maps, 301
 - Kossel cones, 295
 - measure of s , 341, 380
 - origin, 293
 - sign of s , 301
 - specimen orientation, 298
 - visibility, 295
- kinematical theory
 - disorder, 467
 - validity, 226, 341, 348
 - vs. dynamical theory, 604, 607, 659
- kinematics of inelastic scattering, 182
- Kossel cones, 295

- $L1_0$ structure, 569
- LaB₆ thermionic electron source, 89
- laboratory exercises, 715
- lattice dynamics, 487
- lattice fringe imaging, 550
- lattice parameter measurement, 49
- lattice translation vectors
 - primitive, 232
- Laue condition, 235
 - and Bragg's law, 235
 - Ewald sphere, 260
- Laue method, 10
- Laue monotonic scattering, 490, 495
- Laue zones, 263, 312
 - symmetry and specimen tilt, 265
- ledges, 569
- len design
 - phase shifts, 97
 - ray tracing, 94
- lens, 198, 540
 - aberrations, 104
 - as phase shifter, 540
 - curvature of glass, 94, 95
 - ideal phase function, 540
 - magnetic
 - symmetry, 549
 - performance criteria, 104
 - phase transfer function, 549
- lens and propagator rules, 540
- lensmaker's formula, 68, 118, 541
- l'Hôpital's rule, 251
- light in transparent medium, 527
- line of no contrast, 410, 411
- Lorentz factor, 39, 42
- Lorentz microscopy, 66

- Lorentzian function, 458
 - second moment divergence, 465
- magnetic lens
 - electron trajectory, 100
 - focusing action, 101
 - image rotation, 101
 - Lorentz forces, 100
 - pole pieces, 100
 - rotation calibration with MoO₃, 102, 723
 - short solenoid, 99
 - spiraling electron motion, 101
- magnon scattering, 158
- main amplifier, 35
- manufacturers, 67
- Marsden, 150
- mass attenuation coefficients, 136
 - x-ray, table of, 676
- mass thickness contrast, 340
- mass-thickness contrast, 73
- materials, 1
 - chemical compositions, 1
 - crystal structure, 1
 - diffraction pattern, 2
 - microstructures, 1
- matrix \underline{C} , 616
- matrix \underline{C}^{-1} , 616
- mean inner potential, 155
- measured intensities, 45
- metallic glass, 6, 501
- metals
 - cold-worked, 460
- microchemical analysis, 168
 - relevant energies, 168
- microstructure, 1, 63, 339
- Miller index, 4
- minimum contrast condition, 576
- modulation, 86
- moiré fringes, 390, 418
 - parallel, 391
 - rotational, 391
- monochromatic radiation, 10
- monochromator, 27
 - asymmetrically-cut crystal, 28
 - diffracted beam, 28
 - incident beam, 29
- Monte Carlo, 204
- Moseley's laws, 18, 220
- Mott formula, 152
- multi-body spatial correlations, 506
- multi-lens systems, 70
- multichannel analyzer, 36
- multiplicity, 44
- multislice method
 - accuracy, 592
 - defocus, 565
 - deviation parameter, 592
 - in k -space, 564
 - incident beam, 565
 - microscope parameters, 565
 - phase shifts in, 544
 - projected potential, 564
 - slice thickness, 562
- Mössbauer diffraction, 161
 - chemical sensitivity, 164
 - form factors, 162
 - interference with x-ray scattering, 164
 - resonance and phase, 163
- Mössbauer spectroscopy, 164
- nanocrystal
 - Ni₃Fe, 463
 - TiN, 453
- nanodiffraction, 78
- nearest-neighbor shells, 496
- Nelson–Riley lattice parameter
 - determination, 51
- neutron
 - chopper, 156
 - coherent inelastic scattering, 160
 - coherent scattering length, 157
 - dynamical structure factor, 158
 - graphite monochromator, 156
 - incoherent inelastic scattering, 159
 - inelastic scattering, 158
 - magnetic scattering, 157
 - mass, 731
 - Maxwellian distribution, 156
 - moderation, 156
 - multiphonon scattering, 160
 - negative scattering length, 157
 - phonon dispersion curve, 161
 - phonons and magnons, 158
 - polarized, 157
 - reactor source, 156
 - spallation source, 156
 - time-of-flight monochromator, 156
 - transmutation of samples, 157
 - wavelength, 731
- NIST SRM, 45
- Nobel prizes, 2
- nomenclature
 - EELS edges, 172
 - electronic transitions, 172
 - x-ray 19, 20

- non-dipole transitions, 195
- normal stress, 428
- normalization of vectors, 280
- nuclear exciton, 162
- null contrast condition, 360

- objective aperture, 69
- objective lens, 67
 - construction, 92
 - pole pieces, 92
- ordering, 493
- orientation for diffraction, 38
- orientation relationship
 - image and diffraction pattern, 92
- orthogonality condition, 435
- orthogonality relationships, 600
- osmium, 73

- pair distribution function, 55, 503
 - synchrotron source, 506
- pair probability
 - conditional, 492
- partial cross section, 193
- partial dislocation, 392, 712
 - Frank, 393
 - Shockley, 392
- partial pair correlations, 507
- Patterson function, 467
 - atomic displacement disorder, 478
 - average crystal, 477
 - chemical disorder, 490
 - definition of, 469
 - deviation crystal, 477
 - graphical construction, 472
 - homogeneous disorder, 476
 - perfect crystal, 473
 - random displacements, 479
 - SRO, 494
 - thermal spread, 483
- Pauli principle, 186
- Pd-Si alloy, 87
- peak width vs. Δk method, 442
- Pearson VII function, 53
- pendellösung, 608
- periodic boundary conditions, 567
- perturbation theory, 621
- phase, 123
 - and materials, 542
 - of electron wavefront, 523
- phase contrast, 64, 340
- phase errors, 86
 - constructive interference, 555
 - lens accuracy, 97
- phase fraction determination, 45
 - integrated areas, 49
 - internal standard method, 48
 - retained austenite, 48
- phase grating, 564, 605
 - approximation, 660
- phase problem, 472
 - anomalous scattering, 472
- phase relationships, 86
- phase transfer function, 542
- phase-amplitude diagram, 340, 346, 347, 659
 - dislocation, 363
 - Fresnel zones, 532
 - in dynamical theory, 607
 - of white noise, 438
 - screw dislocation, 370, 374
 - stacking fault, 396
- phase-space transform chopper, 274
- Philips EM400T, 212, 719
- Philips EM430, 554
- phonon, 159, 482
 - density of states, 160
 - scattering, 125, 158
- photoelectric scattering, 133
- π boundary, 407
- Planck's constant, 118, 731
- plasmon, 176
 - lifetime, 177
 - mean free path, 178, 220
 - specimen thickness, 178, 220, 582
 - table of plasmon data, 180
- plasmon peak, 171
- point resolution, 555
- Poisson ratio, 429
- polar net, 287
- polarization correction, 43
- polarized incident radiation, 47
- pole-zero cancellation, 36
- poly-DCH polymer, 79
- polychromatic radiation, 10
- polycrystalline Au, 721
- Porod law, 515, 522
- Porod plot, 516
 - fractal particles, 517
 - surface area, 517
- position-sensitive detector, 27
 - area detector, 34
 - charge-coupled-device, 34
 - delay line, 34
 - imaging plates, 34
 - measured intensities, 45
 - resistive wire, 34

- powder average for x-ray diffractometry, 46
- powder method, 11
- precipitate
 - coherency, 410
 - fringe contrast, 405
 - image of coherent, 413
 - incoherent, 414
 - orientation relationship, 728
 - semi-coherent, 414
 - variants, 725
- principal quantum number, 17
- principal strains, 428
- projected potential, 564
- projector lens, 71, 92
 - distortion, 278
- propagator, 539, 564
- pseudo-Voigt function, 53, 434

- quadrupole lens, 108
- quantum efficiency, 29
- quantum electrodynamics, 13
- quantum numbers, 17
- quasi-elastic, 430

- Rachinger correction, 430, 704
- radial distribution function, 174, 502, 518
 - small angle scattering, 519
- radio analogy for HRTEM, 86
- radius of gyration, 513
- random variables
 - sum of, 499
- ray diagram, 67
 - for TEM, 117
- ray tracing, 73, 95
- real image, 67
- receiving slits, 26
- reciprocal lattice, 233
 - dimensionality, 275
 - primitive translation vectors, 234
- reciprocal lattice vectors
 - fcc, bcc, sc, 236
 - uniqueness, 234
- reduced diffraction intensity, 505
- reduced x-ray interference function, 507
- refinement methods, 52, 447
 - constraints, 54
 - learned shape function, 54
 - parameters, 53
 - peak shape, 54
- reflected waves, 527
- refractive index, 94

- rel-disk, 268
- rel-rods, 254
- relativistic correction, 118, 682, 732
- relaxation energy, 480
- representations in quantum mechanics, 596, 618
- residual contrast, 365, 370
- resolution, 112
 - limit in HRTEM, 114
 - optimal, 554
 - point, 555
 - point-to-point, 556
 - state-of-the-art in 2000, 87
- Richardson's constant, 115
- Rietveld refinement, 52, 447
- right-hand rule, 277
 - zone-axis convention, 281
- roentgen, 731
- rotating anode source, 24
- Rutherford cross section, 150
- Rutherford scattering, 204
 - in HAADF imaging, 588
- Rydberg, 17, 731

- sample shape for x-ray diffractometry, 46
- scanning electron microscopy (SEM), 204, 205, 209
- scanning transmission electron microscopy (STEM), 64
- scattered wave, 525
- scattering
 - complementarity of different methods, 156
 - differential cross section, 128
 - phase lag, 528
 - total cross section, 128
- scattering factor
 - electron, 563
- scattering law, 130
- scattering potential, 226
- Scherrer equation, 426
- Scherzer defocus, 556, 577, 593
- Scherzer resolution, 554, 557
 - in HAADF imaging, 587
- Schrödinger equation, 16, 524, 598
 - Green's function, 140, 525
- secondary electron imaging (SEI), 206
- secondary electrons, 205, 206
- Seemann–Bohlin diffractometer, 27
- selected area diffraction (SAD), 75
 - spherical aberration, 119
- selection rule, 61
- shape factor, 341, 509

- and s , 259
- definition, 238
- envelope function, 252
- intensity, 342, 475
- rectangular prism, 250
- rel-rods, 254
- sphere, disk, rod, 255
- shear strain, 428
- shielding by core electrons, 19
- Shockley partial dislocation, 712
- short-range order (SRO), 492
 - single crystal, 496
 - Warren-Cowley parameters, 492
- Si, 85
- Si-Ge superlattice, 590
- side-centered orthorhombic lattice, 272
- side-entry stage, 103
- sideband, 86
- Sievert, 731
- SIGMAK, SIGMAL, 194
- sign of s , 301
- signal-to-noise ratio, 30
- simultaneous strain and size broadening, 441
- single channel analyzer, 36
- single crystal methods, 10
- size broadening, 424
- skilled microscopist, 64, 109, 545, 579
- slit width, 38, 430
- small angle scattering, 509
 - concept, 509
 - from continuum, 509
 - Guinier radius, 513
 - neutron, 519
 - Porod plot, 516
 - SANS, 519
 - SAXS, 519
 - x-ray, 519
- solid mechanics, 430
- solid-solid interfaces by HRTEM, 568
- Soller slits, 26, 430
- space group
 - dynamical absences in CBED, 329
- spectral brilliance, 22
- spectrum image, 197
- spherical aberration, 104
 - and defocus in HRTEM, 105
 - and underfocus for SAD, 77
 - effect on SAD, 119
 - phase distortion, 86
- spin, 17
- spin wave scattering, 125
- spin-orbit splitting, 19
- spot size control (C1), 211
- stacking fault, 392, 446
 - analysis example, 401
 - asymmetry of images, 651
 - bounding partials, 398, 401
 - diffraction peak broadening, 446
 - diffraction peak shifts, 447
 - dynamical treatment, 398, 645, 648
 - energy, 713
 - extrinsic/intrinsic rule, 400
 - graphite, 415
 - HRTEM image of, 87
 - kinematical treatment, 394, 397
 - tetrahedra, 409
 - top of specimen, 400, 403
 - visibility, 398
 - widths in images, 404
- staining, 73
- statistical scatter, 437
- stereographic projection, 697-700
 - construction, 284
 - electron diffraction patterns, 285
 - examples, 288
 - Kurdjumov-Sachs relationship, 292
 - polar net, 287
 - poles, 284
 - rules for manipulation, 287
 - twinning, 290
 - Wulf net, 287
- stigmation, 106
 - procedure, 722
- stigmator, 108
- Stokes correction, 434
- storage ring, 20
- strain broadening
 - distribution of strains, 427
 - strain heterogeneity, 453
 - origin, 427
- strain distribution, 442, 454
- strain fields, 358
- strip chart recorder, 464
- structural image, 551
- structure factor, 341
 - and s , 259
 - bcc, 242
 - dc, 4, 243
 - definition, 238
 - fcc, 243
 - hcp, 57
 - lattice, 244
 - phase factor, 233
 - sc, 239
 - simple lattice, 232

- structure factor and extinction distance, 604
- sum peak, 36
- supercell, 562
- superlattice diffractions, 245
 - B1 structure, 247
 - B2, table of, 247
 - $L1_0$ -ordered structure, 249
 - $L1_2$ -ordered structure, 249
 - ordered structure, 248
- symmetry elements and diffraction groups, 319
- synchrotron radiation, 20, 196
 - beamlines, 22
 - pair distribution function, 56, 506
 - power density, 22
 - safety training, 23
 - user programs, 22
- systematic absences
 - glide planes, 245
 - screw axes, 246

- take-off angle, 25
- TEM lab practice
 - alignment, 716, 720
 - apertures, 718
 - condenser aperture alignment, 716
 - dust, 721
 - eucentric height, 716
 - film plates and vacuum, 718
 - gun startup, 719
 - JEOL 2000FX, 715
 - Philips 400T, 719
 - preparation, 727
 - sample insertion, 719
 - shutdown, 718, 721
 - startup, 715, 719
 - stigmation correction, 717
 - use of camera, 718
 - voltage center, 717
 - wobbler, 717
- thermal diffuse scattering, 482
- thermal field emission gun, 91
- thermal vibrations, 520
- thermionic electron gun, 89
- thermionic emission, 89
- θ' precipitate, 725
- thickness contours, 350
 - effect of absorption, 353
 - wedge-shaped specimen, 352
- thin-film approximation, 212
- Thomas Gainsborough, 137
- Thompson scattering, 131
- three-window image, 200
- through-focus series, 568, 577, 580
- Ti-Al, 369, 568
- Ti-Al-Mo alloy, 570
- tilt of beam or crystal, 565
- top-entry stage, 103
- torr, 732
- total scattering cross section, 128
- transparency broadening, 430
- truncation (in k -space), 86
- tungsten filament, 88
- twin, 417
 - boundary, 408
- two-beam BF images
 - dislocation, 371, 372
- two-beam condition, 343
- two-beam dynamical theory, 609, 625
- two-lens system, 71

- undulator, 21
- uniform strain, 454
- unmixing, 493

- vacancy, 408
 - loop, 408
- valence electrons, 154, 172
- vector ϕ , 616
- vector ψ , 616
- Vegard's law, 51, 481
- videorecording for kinetics, 67
- void, 409
 - Fresnel effect, 410
- Voigt function, 434, 705
 - second moment divergence, 465
- voltage center alignment, 578

- Warren–Averbach method, 447
 - average column length, 453
 - computer procedures, 460
 - interval in Δk , 459
 - practical problems, 459
 - real space distance, 459
 - sine series, 455
 - size coefficients, 457, 465
 - size factor, 451
 - strain factor, 451
- Warren–Cowley SRO parameters, 492
- wave amplitudes, 124
- wave crests
 - match at interface, 94
- wave equation
 - Green's function, 539
- wavefront modulations, 605
- wavelength

- electron, 732
- x-ray, 732
- wavelength dispersive spectrometer (WDS), 33
- wavelet (defined), 225
- wavevector
 - of electron in solid, 598
- weak phase object, 551
- weak-beam dark-field method, 378
 - g - $3g$, 380
 - analysis of, 381
 - deviation parameter, s , 381
 - dislocations in Si, 385
 - Kikuchi lines, 380
- Wehnelt electrode, 89
- white lines, 171, 174
- white noise, 438
- wiggler, 21
- window discriminator, 36
- wobbling, 578
- Wulff net, 287, 697, 700

- x-ray
 - anomalous scattering, 681
 - bremsstrahlung, 13
 - characteristic, 13
 - coherent bremsstrahlung, 60
 - electric dipole radiation, 130
 - energy distribution, 15, 37
 - energy-wavelength relation, 14
 - notation, 19, 20
 - synchrotron radiation, 20
 - wavelength distribution, 15

- x-ray absorption, 43
- x-ray absorption coefficients
 - table of, 676
- x-ray detector, 29
- x-ray form factors
 - table of, 677
- x-ray mapping, 36
- x-ray scattering, 130
 - anomalous, 134, 165
 - characteristic depth, 136
 - classical electrodynamics, 130
 - Compton, 134
 - dependence on atomic number, 133
 - dispersion corrections, 134
 - electron cross section, 128
 - mass attenuation, 136
 - near resonance, 132
 - photoelectric, 133
- x-ray spectroscopy system, 33–35
- x-ray tube, 23
- x-ray wavelengths, 732

- Young's modulus, 429, 445

- Z -contrast imaging, 340, 586
 - instruments, 589
 - sample drift, 590
- ZAF correction, 215
- zero loss peak, 170
- zero-order Laue zone, ZOLZ, 264
- zero-point vibrations
 - diffuse scattering from, 487
- zone axis, 277