

□ Index

A

Absorption, *see also* Loss

in atmosphere, 204, 684–687

with aerosol, 684

depth, 481

in ground, 204, 684–687

by particle, 18, 574–576

along path, 574–576

in tau interval, 205–206

Absorption line, 36, 573

in diffuse reflection, 592–598

depth of formation, 640

homogeneous slab, 593–597

inhomogeneous atmosphere, 637, 640

square root law, 635

well-mixed atmosphere, 636

by omnidirectional probe, 640–642

profile, 592–597

Absorption band, 575, 683

structure, 598

Absorption coefficient, 592–595

Accuracy, 519, 523

check, 203, 362

Added layer, 70–71, 101, 174

Adding ground surface, 625–629

Adding method, 43, 54, 56–62, 625, 703

convergence, 57

with polarization, 62, 505

Aerosol, 317, 661–675 *see also* Turbidity

altitude, 662

causing aureole, 651, 657–659

collection, 662

composition, 662

continental, 662

maritime, 662

natural, 661–675

origin, 662

refractive index, 664

size distribution, 657, 662

from aureole, 668–670

from extinction curve, 671–675

by inversion, 668, 670

by model fit, 668–670

wide angle scattering, 664,

666–668

Air

phase function, 310–311

phase matrix, 532

polarization, 311, 532

Air–sea interface, 627, 708

Albedo, *see also* Plane albedo; Spherical

albedo

critical, 225

effective, 516, 518, 524

geometric, 600–601

in reactor physics, 4

for single scattering, 3, 35, 303, 312

notation, 3

power expansion, 381, 383

transformation, 481

Altostratus, 661

A matrix, 58–61
 Henyey–Greenstein phase function, 462–464
 Ambartsumian function, 44, 99–102, 108, 119
 as matrix, 102
 Ambartsumian method, 43, 50–54, 174
 Amplitude
 complex, 21
 transformation by scattering, 18–20
 Angle with normal, sign, 4
 Ångström's law, 673
 Anisotropy, *see* Asymmetry parameter
 A.N.S., *see* Astronomical Netherlands
 Satellite
 Antisymmetric solution, 508
 Approximation, *see* specific methods
 Arago point, 555
 Astronomical Netherlands Satellite, 715
 Asymmetry parameter, 35, 68, 70, 79,
 303–309, 312–314, 316–324, 372–373,
 384–388
 transformation, 481
 water drop, 312–313
 Asymptotic expression, thick layer, 68–87
 conservative, 81
 isotropic scattering, 202
 Asymptotic fitting, 45, 82, 85–87, 93, 202–203,
 335, 339, 362, 367
 Asymptotic radiance, 708–711
 attenuation, 708–709
 pattern, 710–711
 Atmosphere, with ground surface,
 inhomogeneous, 64
 internal radiation, 631–633
 reflection function, 626–632
 Attenuation length, 707
 Aureole, 311, 651, 655, 657–661
 measurement, 657–660, 670
 multiple scattering, 659–661
 radiance, 669–670
 in ultraviolet, 657
 Auxiliary equation, 48, 49
 for Rayleigh scattering, 562
 Azimuth-dependent terms, 90, 493–494,
 498–505
 effective albedo, 516–518

B

Babinet point, 555
 Backlayer, diffusely reflecting, 702
 Backscatter, 305–307, 314
 predominant, 403–404
 Backward peak, 307, 309, 368, 489–492

Beam

attenuation coefficient, 708–710
 extinction coefficient, 705
 scattering coefficient, 708, 710
 Bessel function, 388
 modified, 594
 Binomial expansion, 109, *see also*
 Characteristic binomial
 Blackbody, 25, 204, 497
 Blackbody radiation, 25
 Blue sky, 310–311, 531, 555–557, 651, 661
 Bond albedo, 600, 603, *see also* Spherical
 albedo
 Born approximation, 670
 Bottom boundary, *see* Ground surface
 Brewster point, 555
 Brightness, 651, 652, *see also* Radiance
 Busbridge polynomial, 43, 91–92, 105,
 108–113, 120

C

Case method, 84, 118, 121–122, 335, 405
 Chapman function, 667
 Characteristic binomial, 94–95, 112
 Characteristic equation, 516
 alternate form, 98
 methods of solution, 96–99
 multiple roots, 381, 383–388
 roots, 96–98, 107
 Characteristic function, 43, 91, 94, 112,
 119–120, 518
 determination, 94
 for four-term phase function, 356–357
 integral check, 95
 for small *N*, 96
 Characteristic root, 377–378
 Circular polarization, symmetry relations, 616
 Cirrostratus, 661
 Cirrus, 661, 680–682
 polarization, 668
 Clearing, 706
 Climate, 682–683
 Closely packed particles, 699–703
 Cloud
 atmospheric, 317
 broken, 653, 683, 694–695
 cooling, 687
 cuboid, 694–698, 705
 asymptotic case, 695–698
 corner domain, 695–698
 Henyey–Greenstein scattering, 698
 isotropic scattering, 695–698

- heating, 687
 - heterodisperse, 521
 - isolated, 694–698
 - liquid water content, 687
 - model, 320, 322–324
 - monodisperse, 521
 - particle, remote sensing, 667
 - phase function, 315–317
 - polarization, 667
 - reflected energy, 682
 - terrestrial, 388
 - Cloudbow, 668
 - Cloud cover, fractional, 683, 695
 - Cloud deck, 651–652
 - opaque, 653–654
 - with overlying atmosphere, 627–630
 - radiance, 651–652, 668
 - reduction of illumination, 654–655
 - Cloud layer,
 - internal radiation field, 206
 - reflection function, weak loss, 80
 - Coastal water, 707
 - Coherency matrix, 23, 534
 - Computer time, 86
 - Condensed notation, *see* Shorthand notation
 - Conservative atmosphere, 188, 190
 - Conservative scattering, 38
 - Constraint, 103–104, 11, 663
 - Continued fraction, 380, 383
 - Continuum
 - absorption, 592, 595
 - albedo, 595–596
 - of eigenvalues, 159
 - extinction, 595
 - optical path, 594
 - scattering, 572
 - Contour integral, 159
 - Contrast ratio, 629–632, 703
 - Convergence, *see* specific methods
 - CP representation of polarized light, 497, 508, 533, 614
 - Critical albedo, 140, 233
 - Critical limit, 233
 - Critical size of reactor, 692
 - Cross section
 - for absorption, 25
 - for emission, 25
 - Cuboid, *see* Cloud, cuboid
 - Cumulus, 680–681
 - Curve of growth, 593–598, 634
 - slab with ground surface, 597
 - square root law, 594–598
 - Cylinder, randomly oriented, 661
- D**
- Damping profile, 593–596
 - Daylight sky, *see* Sky, daylight
 - Delta-Eddington approximation, 41
 - δ function, 309
 - Depolarization
 - of lidar echo, 680–682
 - of molecular scattering, 311, 533
 - Depression in absorption line, 592–596
 - Detailed balance, 16–17, 23, 27
 - in astrophysics, 17
 - inverse use, 17–18, 20
 - Detector
 - as four-vector, 496
 - reading, 133–135
 - reciprocity to source, 615
 - sensitivity, 130
 - Diffraction, 657, 660–661
 - anomalous, 315
 - Fraunhofer, 314
 - pattern, with size distribution, 669–670
 - peak, 312, 314, 322–323
 - omission, 481
 - Diffusion, *see also* specific phase function
 - approximation, 75–76, 159
 - improved, 76
 - coefficient, 75, 159
 - constant, 144
 - depth, 481
 - domain, 68, 70, 75–76, 82, 90, 92–93, 178–180, 183, 187–188, 198, 201, 209–213, 224, 478, 708–711
 - with polarization, 507–508, 512
 - equation, 159
 - exponent, 70, 78, 93, 708–709, 711
 - asymptotic expression, 152
 - check, 87
 - error by neglect of polarization, 511
 - higher root, 383
 - with polarization, 508–513
 - as variable, 78–80, 380–384, 386
 - inward, 394
 - length, 70, 93, 152, 377
 - mode, 70
 - nonconservative, 93
 - outward, 394
 - pattern, 109, 111, 478, 710
 - expansion, 384
 - forward/back ratio, 511
 - with polarization, 507–512
 - moments, 513
 - as vector, 69

- Diffusion (*cont.*)
 solution, 121
 azimuth-dependent terms, 515–517
 conservative, 92
 nonconservative, 93
 stream, 70–77, 224, 339, 477
 internal reflection, 71–72, 374–375
 negative, 72, 80, 212, 374
 from source layer, 83
- Direct experiment, 207
- Disk, *see* Planet; Sun
- Dispersion function, 97, 105–106
- D* matrix, 58–61
 Henyey–Greenstein phase function, 462–464
- Double peak phase function
 asymmetry factor, 489
 flux, 490–491
 reflection function, 483, 486, 490–491
 bimoment, 491
 semi-infinite medium, 490–491
 transmission, 490–491
- Doubling method, 43, 45, 54–56, 209, 222, 396, 612, 691, 716
 azimuth-dependent terms, 507
 basis for asymptotic fitting, 85
 convergence, 43, 63
 Henyey–Greenstein phase function, 408–411
 improved, 146
 isotropic scattering, 232–234, 408–410
 critical limit, 233–234
 eigenvalue, 232–234, 408–411
 from Milne equation, 146–148
 with polarization, 505–507
- Dust, 496
 from forest fire, 662
 interplanetary, 659, 713
 interstellar, 713
 scattering pattern, 606
 slab, 714

E

- Earth
 atmosphere
 albedo, 559
 optical depth, 310
 scattered light, 650–661, 664–668
 radiation budget, 682–683
- Echo delay time, 573
- Eddington approximation, 76, 143, 370, 644, 717
- Eddington method, modified, 697
- E* function, *see* Exponential integral
- Eigenfunction
 of diffusion equation, 74
 Henyey–Greenstein phase function, 335, 337–338
 expansion, 121, 132, 405
 of Milne operator, 144
 singular, 74, 159
 as expansion term, 43, 121, 159, 222
 with polarization, 122
- Eigenvalue, *see also* Doubling method, convergence
 of anisotropic transfer equation, spectrum, 376–388
 of diffusion equation, 74, 93
 Henyey–Greenstein phase function, 333–336
 discrete, 43, 93
 in successive order method
 Henyey–Greenstein phase function, 407–408
 isotropic scattering, 233
- Electron as scatterer, 531
- Electron capture, 18
- Elliptical integral, 333
- Elongation, 601
- Embedding, *see* Invariant embedding
- Emergence, *see* Escape function;
 Reflection; Transmission
- Emission, thermal, 18, 24
 disk, 26
 isothermal body, 642
 nonisothermal body, 643–644
 nontransparent sphere, 26
 slab, 221
 zero-order, 220–221
- Energy, *see also* Flux; Loss
 deposition in cloud, 687
 fate
 asymptotic, 684–687
 Henyey–Greenstein phase function, 400–402
 isotropic scattering, 205–206
 sink, 180
- Equator of planet, 602
- Equivalence, 480
 theorem, 574–577
- Equivalent width, 573, 592–598
- Error
 function, 160
 integral, 393

- propagation, 63
 - round-off, 86
 - Escape function, 72, 111–114, 116–117, 151, 339, 357–363, 486, 513, 668, *see also* specific phase function
 - moment, 116–117
 - expansion, 80, 360–362
 - nearly conservative,
 - expansion, 79
 - reduction to H function, 91
 - conservative, 117
 - nonconservative, 115–116
 - similarity, 374, 479
 - as vector, 69
 - Escape probability, 181–182, 208, 213–217
 - isotropic scattering, 213–217, 220
 - one-sided, 213–217
 - two-sided, 213–214
 - slab, Henyey–Greenstein phase function, 405–406
 - Escape region, isotropic scattering, 179, 211–213
 - Euler's constant, 9, 672
 - Expansion, *see* Successive order
 - Exponential
 - integral, 8–10, 196, 597
 - asymptotic form, 9
 - differentiation, 9
 - expansion, 9
 - generalized, 10–11
 - sum fitting, 683
 - Extinction, *see also* Interstellar extinction
 - coefficient, 316
 - curve, 317
 - inversion, 670–675
 - maximum, 670–674
 - model fit, 671–674
 - polydisperse medium, 672–675
 - depth, 481
 - Extrapolated endpoint, 73
 - Extrapolation length, 72, 117, 174, 234, 409, 513, 685, *see also* Escape function
 - finite layer, 218
 - Hopf, 218
 - nearly conservative,
 - expansion, 79
 - nonconservative,
 - similarity, 374–376
 - reduced, 115, 357–363
 - similarity, 357–362
 - Extrapolation to large thickness, 201–203
- F**
- Far-field scattering pattern, 18–20, 699
 - F function, 8, 11–13, 136, 187, 196
 - differentiation, 11
 - expansion, 13
 - numerical values, 12–13
 - recurrence, 11, 13
 - reduction, 11
 - Fluid motion with radiation, 707
 - Fluorescent scattering, 231
 - Flux
 - absorbed
 - Henyey–Greenstein phase function, 400–402, 456–461
 - isotropic scattering, 203–206, 218, 228, 282–290
 - from bottom of atmosphere, 64
 - directional, 693
 - divergence, 684
 - emerging, 81–82, 188, 190, 497
 - extinction coefficient, 705
 - in column of finite width, 705
 - net, 5, 75, 693, 712
 - in diffusion domain, 184
 - in slab, 488
 - conservative, 209, 282–290, 292–299
 - Henyey–Greenstein phase function, 405, 465–476
 - isotropic scattering, 205–206, 208, 292, 299
 - operator, 69
 - reflected, 81, 486–487
 - Henyey–Greenstein phase function, 400–405, 456–461
 - isotropic scattering, 174, 203–205, 228–230, 282–290
 - transmitted, 486–487
 - Henyey–Greenstein phase function, 400–401, 456–461
 - isotropic scattering, 201–205, 228, 282–290
 - zero order, 203, 282–290, 456–461
- F** matrix, 21
- Fog, 317, 661
 - Forward and backward peak, 700
 - Forward peak, 307, 309, 358–360, 489–492
 - addition, 362, 368–369, 479–481, 491–492
 - influencing lidar echo, 677
 - Forward scattering, 305–307, 403–405, 480
 - Four by four matrix, 496, 500, 503

Fourier expansion in azimuth, 493–494, 498,
501–505, 514–515
number of terms, 520–523
ratio between orders, 525
Rayleigh scattering, 519, 543–544
Fourier spectroscopy, 634
Fourier transform, 158
Four-vector, 496–497, 503
Fraunhofer diffraction, *see* Diffraction
Fredholm integral equation, 110, 122, 162

G

GAARS field test, 673
Gain, *see also* Point-direction gain
in antenna theory, 26
arbitrary configuration, 26
extended definition, 27
upon scattering, 152
Galactic light
diffuse, 714, 716–717
illuminating globule, 715
Gamma size distribution, 664–665
GARP, *see* Global Atmospheric Research
Program
Gaussian distribution, 159–161, 316
Gaussian division, 43
Gaussian quadrature, 226
Generalized spherical function, 497, 508
Geometric albedo
for model atmosphere, 621
of planet, 600–601, 618, 620–621
Geometric factor, 609, 621
Geometric series, 141, 591, 614
Geometry different from slab, 486
Gershun equation, 712
 G function, 8, 13–15, 136, 196
expansion, 14, 228
numerical values, 14–15
recurrence, 14
symmetry, 13
Glass bead, 313
Global Atmospheric Research Program, 687
Globule, 715–716
Glory, 312, 315–316, 322–324
Glossy surface, 702
Grafting of theories, 692
Grazing reflection, 525
on sphere, 313
Greenhouse effect, 644

Green's function
asymptotic expansion, 393
factorization, 393
Grey absorption, 644
Ground surface below atmosphere, 35, 63–65,
204, 507, 625–629

H

Hailstone, 314, 316
Half-space, 90, 691
Halo, 314
Haze, 666
absorbing, 375
model, 316–317, 320–322
phase function, 311, 315–317
size distribution, 664–665
Heating rate, 684
Heat transfer, 706–707
through insulating layer, 706
between walls, 706
Henyey–Greenstein phase function, 307–309,
320–322, 331–332, *see also* Flux
azimuth-dependent terms, 522–529
characteristic equation, roots, 384–388
in diffuse galactic light, 716–717
diffusion
exponent, 333–336, 367, 511, 709–710
expansion, 335
length, 333–336
pattern, 335, 337–338
escape function, 339–342, 367
conservative, 358–361
expansion coefficients, 308, 331
extrapolation length,
conservative, 340–341, 359–361, 376
nonconservative, 340–341, 367, 376
in globule, 715
internal reflection coefficient, 374–375
Kuščer polynomials, 378–379
Legendre coefficients, 308, 331
Minnaert plot, exponent, 619–620
plane albedo, 367–369, 400–403
point-direction gain, 405–406, 465–476
moment, 405, 467–468, 471–472, 475–476
rapid-guess formulas, 363–364
reflection function, 367–368, 396–399,
412–453, 486–487
azimuth-dependent terms, 523–529
asymptotic, 525–529
ratio of total to first order, 524–525

- bimoment, 339, 343–354, 398, 401, 403–405, 412–453, 701–702
 - first order, 399–400, 412–443
 - low order, 412–443
 - moment, 339, 345–354, 398, 412–453
 - nearly conservative, 391–392
 - in opposition, 617–618
 - ratio of total to first order, 397–399, 454–455, 678
 - semi-infinite atmosphere, 339, 342–354
 - slab with varying ground, 629–632
 - semi-infinite atmosphere, 339–354
 - similarity parameter, 478
 - slab, 396–476
 - spherical albedo,
 - semi-infinite atmosphere, 344, 367, 370–371
 - slab, 403–405
 - successive orders, convergence, 522–523
 - transmission function, 396–399, 412–453, 486–487, 652
 - azimuth-dependent terms, 523–529
 - asymptotic, 525–529
 - ratio of total to first order, 524–525
 - bimoment, 398, 412–453
 - low order, 412–443
 - moment, 398, 412–453, 487
 - truncation, 488
 - unbounded medium, 331–338
 - H* function, 43, 91, 104–108, *see also* specific
 - phase function
 - expansion, 108
 - explicit expression, 106–107
 - integral relation, 106–107
 - isotropic scattering, 162–169, 187, 203, 225, 584, 597, 621
 - in corner domains, 166
 - definition, 162
 - derivative, 165
 - near divergence, 167–168
 - expansion, 163–166
 - integral, 168
 - integral equation, 162
 - moments, 169–171
 - asymptotic form, 170–171
 - expansion, 169–171
 - numerical values, 163–164
 - representation
 - integral, 162
 - rational, 163
 - virtual angles, 166–169
 - moment, 108, 112
 - Hiding power, 703
 - Historical note, 54, 201
 - Hopf function, 163, 176, 183, 188, 190
 - for Rayleigh scattering, 541
 - Hopf solution, 140, 394
 - Hybrid formulation, 576
 - Hydrodynamics, 706–707
 - Hydrologic optics, 707–713
 - asymptotic domain, 708–711, 713
 - Hyperbolic function, 77, 699
 - Hypergeometric function, 669–670
- I
- IAMAP, *see* International Association of Meteorology and Atmospheric Physics
 - Ice, 179
 - absorption coefficient, 705
 - cloud, 668
 - crystal, 314, 661
 - Importance, 28
 - Inferior conjunction, 608
 - Inhomogeneous atmosphere
 - by adding method, 58–61
 - reflection function, isotropic scattering, 52–53
 - Injection function, *see* Escape function
 - Injection region, isotropic scattering, 209, 211–212
 - Instability
 - in inversion procedure, 663
 - in recurrence, 377–380
 - Insulation by foam, 706
 - Integral check, 693, 715
 - Integral equation, *see also* Milne equation
 - for Ambartsumian functions
 - linear, 103–104, 109
 - nonlinear, 103–104
 - for diffusion, 72–73, 93, 376
 - eigenvalue, 377–378
 - Fredholm, 110, 122, 162
 - for *H* function, 91
 - linear, 105–107, 162
 - nonlinear, 105–106, 109, 162
 - for reflection and transmission, 99
 - for size distribution
 - inversion, 663
 - model fitting, 663
 - for Sobolev Φ function, 118, 120, 138–139
 - for *X* and *Y* function
 - linear, 119
 - nonlinear, 52, 119, 224

- Integration
 - of H function, 607
 - over τ , 135, 209
- Intensity, 5, 134, *see also* Radiance
 - at arbitrary depth, 69, 117–122
 - average
 - hemispherical, 69
 - at midlayer, 77
 - in diffusion domain, 97
 - as four-vector, 498
 - internal, 221–224
 - similarity, 480
 - local, 494
 - with polarization, 20, 493–495
 - specific, 5, 27
 - at surface, 82
 - transformation
 - by rotation, 22–23
 - by scattering, 20–22
- Interaction principle, 62
- Interference, 20
- Intermediate results, use, 40
- International Association of Meteorology and Atmospheric Physics, 683, 694
- Interpolation between small b and ∞
 - isotropic scattering, 201–203
 - Rayleigh scattering, 559
- Interstellar dust, 713
- Interstellar extinction, 713, 718, 720
- Interstellar grain, 716, 719
- Interstellar polarization, 713
- Interstellar radio scintillation, 717, 719
- Invariance principle, 53, 73, 102, 162, 185
- Invariant embedding, 42, 53, 99, 102, 691
 - Rayleigh scattering, 536
- Inverse problem, 34, 36
- Inversion from radiance to phase function
 - asymptotic, 710–711
 - moderate depth, 712
- Irradiance, 5
 - downward, 712
 - scalar, 5, 712
 - upward, 712
 - vector, 5
- Isotropic scattering, *see also* specific functions
 - diffusion, 152
 - constant, 150, 152
 - exponent, 150, 152
 - emerging radiation, 183–190
 - escape function, 151, 358–362
 - with forward peak, 307
 - with homogeneous sources, 220–221
 - internal intensity, 221–224
 - Kučšer polynomials, 378–379
 - Minnaert plot, exponent, 619
 - plane albedo, 198–199, 483–486
 - phase matrix, factorization, 535
 - point-direction gain, 136, 138–139, 206–213, 216–218, 292–299
 - differential equation, 174
 - in diffusion domain, 175, 209–213
 - expansion, 175–176
 - integral, 186, 218–220
 - as matrix, 130, 136
 - moment, 136, 138–139, 174–182, 206–221, 292–299
 - differential equation, 227
 - integral, 220
 - zero order, 208
 - nearly conservative, 178–180
 - numerical values, 176–178, 207, 292–299
 - in semi-infinite atmosphere, 174–182
 - at surface, 175, 224
 - thick layer, 209–213
 - rapid-guess formulas, 362–364
 - reflection function, 151, 192–203, 222, 236–281, 398, 617–618
 - bimoment, 136, 172–174, 193–194, 202, 236–281
 - nearly conservative, 390–392
 - eigenfunction expansion, 145
 - first order, 194, 236–281
 - with ground, 631–632
 - as matrix, 130, 133–135
 - moment, 136, 172, 193–194, 200–202, 236–281
 - for $\mu \rightarrow \infty$, 219–220
 - numerical values, 236–281, 482–486, 543–544
 - ratio total to first order, 196–198
 - second order, 236–281
 - thick slab, 201–203, 482–486
 - third order, 236–281
 - specifications, 149–151, 185, 201, 209
 - spherical albedo, 198–199, 370, 483–486
 - successive orders, eigenvalue, 141–144, 586
 - thick layer, 198–203
 - transmission function, 192–203, 222–223, 651–652
 - bimoment, 136, 193, 195, 237–279
 - diagonal value, 195
 - diffuse, 130, 193, 195
 - eigenfunction expansion, 145
 - first order, 195, 237–279
 - as matrix, 130, 133–135
 - moment, 136, 193, 195, 200–202, 237–279

- numerical values, 237–279
 - second order, 237–279
 - thick slab, 200–203
 - third order, 237–279
 - zero-order, 193–196, 237–279
 - as matrix, 130
 - Isotropic sector phase function, 307, 308
 - escape function, 358–361
 - extrapolation length, 376
 - internal reflection coefficient, 374–375
- J**
- Junge size distribution, 655, 664, 669, 672
 - Jupiter
 - cloud level, 622, 624
 - geometric albedo, 620–621, 624
 - infrared limb darkening, 643
 - Minnaert plot, 616, 619
 - polarization, 559, 561, 622–624
- K**
- Kirchoff's law, 18
 - for blackbody, 25
 - for finite body, 24
 - for polarized light, 25–26
 - for surface, 32
 - for thin disk, 25
 - KM *see* Kubelka–Munk formula
 - K matrix, 57, 59
 - Knudsen number, 706
 - Kubelka–Munk formula, 491, 698–703
 - accuracy test, 700–702
 - conservative scattering, 700
 - finite layer, 699–702
 - Kuščer polynomial, 91, 94–98, 120, 376
 - asymptotic expression, 377
 - convergence, 377–379
 - ratio of orders, 377–380
 - recurrence, 94–95, 377
- L**
- Ladenburg–Reiche function, 595, 597
 - Λ operator, 130
 - Lambert law, 204, 497, 605, 608
 - Lambert surface, 6, 468, 472, 476
 - below atmosphere, 623, 626
 - Laplace transform, 574, 577, 585
 - inverse, 574, 577–579, 582, 584, 589, 676, 719
 - Laser, 314
 - Laser radar, 675
 - Latex suspension, 709–710
 - Legendre coefficient, 308, 317–324
 - high order, 703
 - Legendre expansion, 482, 614, 710
 - example, 523
 - number of terms, 519–520
 - Legendre function, 79, 528, 605
 - associated, 47, 94–95, 324, 498, 509–510, 516, 520
 - related function, 311, 325
 - of second kind, 98, 366, 379
 - Legendre polynomial, 43, 89, 94–95, 109, 304, 317
 - associated, 325–328, 597
 - Lidar, 573, 662–663, 693–694, 717
 - attenuation factor, 677
 - bistatic, 663
 - clouds, 573, 675–682
 - depolarization, 680–682
 - echo time, 663, 676
 - multiple scattering, 676–680
 - reception cone, 676–677, 679–680
 - return signal
 - function of reception column, 678–680
 - orders, 677
 - ratio of total to single scattering, 678–679
 - Life on planet, 616
 - Lighthouse, 719
 - Limb, *see* Globule; Planet; Sun
 - Line absorption, *see* Absorption
 - Linearly anisotropic phase function, 89, 96–97, 121, 305–306
 - Busbridge polynomials, 364
 - characteristic equation, root, 365–367, 381–382
 - in diffuse galactic light, 717
 - diffusion exponent, 365–367
 - dispersion function, 366
 - escape function, 339, 358–359, 367
 - extrapolation length, 366–367
 - H function, 364–366
 - derivative, 365–366
 - moment, 364–365
 - Kuščer polynomial, 378–379
 - Minnaert plot, exponent, 619–620
 - plane albedo, 368–369
 - reflection function, 486–487, 617–618
 - bimoment, 367, 701
 - moment, 367–368
 - spherical albedo, 367
 - transmission function, 486–487

Local scattering, 498–503, 506–516
 Log-normal size distribution, 664–665, 675
 Lommel-Seeliger law, 196, 606–610
 Lorentz profile, 593–595
 Loss, *see also* Absorption
 in atmosphere, 77, 80, 685–687
 weak absorption, 78, 80, 180
 by finite depth, 80
 in ground, 685–687
 at large depth, 80
 total, 685–687
 Luminance, 652

M

Magneto-optic activity, 616
 Magnitude of planet, 600–601
 Manufacturing control, 699
 Marine optics, *see* Hydrologic optics
 Mars
 clearing, 630
 haze, 630
 isophotes, 620
 Minnaert plot, 616, 619–620
 surface changes, 631
 Matching of cloud deck and atmosphere,
 628–630, 646
 Matrix, 128
 dot product, 76, 145
 inversion, 111, 146
 $\mu\mu$, 46, 68–69, 128, 130
 $\mu\tau$, 128, 130
 operator theory, 62
 partitioning, 146–148
 product, 68–69, 128, 131, 172
 singular, 69, 129–131
 $\tau\mu$, 128, 130
 $\tau\tau$, 128, 130
 transfer method, 43, 62–63, 74
 unit, 69, 535
 Mellin transform, 674
 Meropé, reflection nebula, 714, 715
 Metallic optical properties, 314
 Method, *see also* specific methods
 advantages, 42–44
 of computation, 40
 criteria, 39–44
 of derivation, 39
 discretization, 41, 43–44
 drawbacks, 42–44
 hybrid, 41, 45, 50
 multistream, 44

 preferred, 45
 probabilistic, 41
 traditional, 90
 Microwave, analog measurement, 314
 Midlayer intensity, 43
 in galaxy, 716
 Heney–Greenstein phase function, 223,
 405, 462–464
 isotropic scattering, 209, 223, 292–299, 405
 Mie theory, 303, 304, 311–314, 317–320,
 324–325, 509, 511, 519, 671, 703
 absorbing sphere, 313–314
 nonabsorbing sphere, 312–313
 polarization, 312, 315
 scattering pattern, 304, 311–312, 356, 638
 amplitude, 324
 asymmetry, 312–314, 316
 lobe shift, 520
 Milk, 698, 709–710
 blackened, 709–710
 Milky Way, 713
 Millimeter wave, 317
 Milne equation, 127–128, 131–132, 146
 eigenfunctions, 140–144
 eigenvalues, 140–144
 generalized, 48, 49
 homogeneous, 150, 152–153, 185
 inhomogeneous, 153, 185
 in matrix form, 131
 solution, 131–132
 Milne matrix, expansion, 145
 Milne operator, 127–130, 134
 eigenvalues, 140–144
 Milne problem, 85, 90, 111–114, 169, 393
 Minnaert–Barkstrom plot, 620
 Minnaert plot, 616, 619–620
 Mirror
 angle, 545–546, 549
 matrix, 505
 Mist, 698–699
 Mixing ratio, 592
 Mode of propagation, 121, 333
 Mode radius, 316, 322, 664–665
 Model, use, 34–36, 713, 717
 Molecule, 496
 free path, 706
 Moment, *see* specific function
 Monte Carlo method, 44, 575, 610, 676, 691
 cuboid cloud, 695–698
 reflection nebula, 713–715
 Multiple scattering, 34–35
 μ vector, 64, 68–69, 128, 130, 172

N

- Nasty corner of (a , b) domain, 81, 591, 684–687
 Natural light, 23, 28, 496, 508
 Nearly conservative scattering, 78–81, 388–389, *see also specific phase functions*
 Neptune, geometric albedo, 620–621
 Net current, 488, 693
 Net flux, *see* Flux
 Neumann series, 42, 132, 146–147, 676
 Neutron scattering, 79
 Nonasymptotic part, 159
 Nonspherical particle, 314–315
 lidar echo, 680
 Nonstationary problem, 574
 Nonuniqueness, 381
 N operator, 69, 497
 Normalization
 of eigenfunction in diffusion, 74–75
 of incident flux, 193
 of μ vector, 172
 by other authors, 78, 85
 of specular reflection function, 626
 Nuclear reactor, *see* Reactor

O

- Ocean, *see also* Hydrologic optics
 under atmosphere, 507
 Omnidirectional probe, 640–641
 Onsager relation, 17
 Opacity, 143
 Opal glass, 698–699
 Opaque atmosphere, 625
 Operator
 defining moment, 69
 on μ , 130
 on τ , 128, 130
 Opposition, 608, 610
 effect, 606
 in circular polarization, 616
 line, 545–546
 Optical depth, 68, 128
 reduced, 396
 transformation, 481
 Optical path, *see* Photon, path
 Optical thickness, 76, 575
 reduced, 479
 Order, *see also* Successive order
 in Fourier expansion, 505, 514–515, 522–529
 of successive scattering, 505, 514–515, 522–523

- Orthogonality, 121, 326
 half-range, 43, 121
 Overcast sky, 507
 Ozone, 567, 641, 657

P

- Padé approximation, 580, 582
 Paetzold probe, 641
 Paint layer, 491, 698–703
 covered spot, 703
 reflecting power, 700
 Parametrization, 683
 Particulate material, 699
 Peak, *see also* Diffraction; Forward peak;
 Transmission function, zero-order
 downward, 711
 Pencil beam in inverse problem, 714
 Penetration depth, 637–640
 statistics, 639–640
 Phase angle, 601
 Phase function, 5, 35, 70, 303–317, 496–497,
 see also specific phase functions
 asymmetry, 70, 304
 change of sign, 305
 asymptotic radiance, 710–711
 azimuth average, 70, 497
 characteristics, 303
 choice, 303, 310
 elliptical, 308
 expansion
 Fourier, 520–521
 in Legendre functions, 80–123, 304, 317–324, 481, 519–520
 finite, 305–306, 356–357
 family, 305, 308
 integral, 70
 forward part, 305–307, 309
 inverse linear, 307, 308
 of large body, 308
 normalization, 5, 70, 304
 singular, 308–309
 of sphere, 303, 304
 sum
 of exponentials, 320–322
 of Gauss functions, 676
 Phase integral of planet, 600–601
 Phase matrix, 494–498, 500–503, 513
 azimuth-independent part, 324, 513
 effective albedo, 518
 expansion, 317, 324–329, 509
 symmetry, 504

- Phase shift, 312, 317
 - Photoionization, 18
 - Photon
 - exit angle, 695
 - path
 - geometrical, 575
 - mean, 388, 577–579, 583–587, 589–591
 - near-conservative scattering, 583–584
 - in separate order, 578
 - in transmission, 586–587
 - optical, 575
 - probability distribution, 577–582
 - asymptotic, 579–582, 588–590
 - dispersion, 585–588
 - exact, 585, 587–588
 - moment, 577
 - nonconservative, 582–584
 - semi-infinite atmosphere, 579–584, 589
 - in separate order, 578–580, 585, 587–588
 - slab, 584–585, 588
 - standard curve, 585–586, 588–589
 - root-mean-square, 388
 - square mean root, 594–595
 - statistics, 573–591, 634, 636–640
 - for fixed penetration depth, 638–639
 - inhomogeneous slab, 575
 - Physical definition, 70–73
 - Physical derivation, 54, 101, 179–180, 603–604
 - Physical meaning
 - of matrix and vector, 130
 - of matrix product, 68–69, 129, 174, 193
 - of Neumann series, 132
 - Physical system, linear, 16
 - Pillar scattering, 697–698
 - Pioneer, 624
 - Plane albedo, 4
 - Eddington approximation, 370
 - similarity, 482–486
 - thick layer, 486
 - Plane of reference, 20, 495–497, 499–500
 - choice, 20, 555, 564, 566
 - rotation, 22–23, 495–497, 500
 - Plane-parallel layer, *see* Slab
 - Planet, 599–649, *see also* specific planets;
 - Geometric albedo; Spherical albedo
 - absorption spectrum, 370, 372–374, 593, 634–640
 - brightness distribution, 615–618
 - flux, reflected, 600
 - full phase, 606, 608, 610
 - integration over disk, 35, 599–614
 - limb, 602, 615
 - darkening, 132
 - infrared, 221
 - model computation, 34–36, 599, 606–610, 621
 - with ground, 35, 198
 - with thick atmosphere, 607–609
 - nearly black, 606
 - in opposition, 132, 522, 543–544, 617–624
 - as particle, 600–601, 610
 - phase function, 599–610
 - asymmetry factor, 606–611
 - integral, 604–605
 - Legendre expansion, 605, 607, 609
 - in opposition, 607
 - polarization, 549, 557–563, 599, 610–614, 623–624
 - near-symmetry, 546–547, 616
 - with Rayleigh scattering,
 - diffuse reflection, 537, 557–561
 - finite depth, 623–624
 - polarization, 549, 557–563
 - surface reflection, 196
 - symmetry about equator, 615–616
 - thermal emission, 642–646
 - white, 605–606, 608–609
 - Plant canopy, 705–706
 - Plate scattering, 697–698
 - Poincaré sphere, 495
 - Point-direction gain, 4, 29, 37, 693, *see also*
 - specific phase function
 - by adding method, 56–60
 - in Ambartsumian's method, 50
 - in arbitrary configuration, 4, 29
 - asymptotic, 84
 - with ground surface, 64
 - inhomogeneous slab, 32, 58–60
 - reciprocal definition, 29, 32, 56
 - at separation layer, 60, 488
 - at surface, 37, 488
- Poisson distribution, 580
- Polarizability, 531
 - tensor, 314, 532
- Polarization, 5, 39, 493–513, *see also* Stokes
 - parameter
 - circular, 495–496, 503
 - degree, 495
 - ellipse, 495
 - elliptical, 501
 - linear, 495–496, 501
 - partial, 496
 - reciprocity, 17–26, 30–31

representation, 495–498, 533
 CP, 324, 533
 transformation, 497, 533
 signature, 315
 state, 494–496
 Polluted water, 710
 Polynomial, 151, *see also* Busbridge
 polynomial; Kuščer polynomial;
 Legendre polynomial; Sobolev
 polynomial
 Polyvinyl acetate, 710
 Power law size distribution, 664–665, 672–673
 Propagation, *see* Diffusion; Random medium
 propagation
 Ψ -norm, 539–540
 Pulse delay, 718–720
 spread in time, 718–720

Q

Quasi-single scattering approximation, 41, 713

R

Radar, 675
 Radiance, 5, 615, 652, *see also* Intensity
 attenuation coefficient, 712
 unit, 658–659
 Radiation
 density, 73, 84, 138
 dose, 657
 hydrodynamics, 706–707
 pressure on sphere, 313–314
 slip, 706
 Radiative equilibrium, 152
 Radiative transfer, historical note, 54
 Radio wave scattering, 719–720
 Rain, model, 316
 Rainbow, 312, 315–316, 322–324
 Random medium propagation, 720
 Random orientation, 23, 500, 532, 605, 661
 Random walk, 718
 Rapid-guess formula, 83, 362–364
 Rayleigh–Gans pattern, 670
 Rayleigh phase function, 305–306, 311, 356,
 494, 531–532
 escape function, 362
 exact solution, 537–538
 H function, 538
 internal radiation field, 538
 plane albedo, 483–486
 reflection function, 482–486, 543–544, 618

spherical albedo, 370, 483–486
 transmitted flux, 539
 Rayleigh scattering, 305, 494, 503, 531–569
 characteristic function, 539
 diffusion domain, 566
 exponent, 539–540, 554, 566
 escape function, 358–359, 362, 540–541, 567
 nonconservative, 554
 exact solution, 536–538
 with ground surface, 557–563
 reflection function, 557–561
 with isotropic scattering, 532, 537–538, 554
 escape function, 358–359
 phase matrix, 532, 534–536
 H function, 537, 539–540, 547
 Milne problem, 356, 538, 540–541
 of natural light, 531, 543, 561
 nonconservative, 532, 537, 550–554
 pattern, 531–532
 phase matrix, 531–536
 azimuth-independent part, 534
 factorization, 534–536
 plane albedo, 483–486, 538
 on planet, 543–544, 557–563, 607, 610
 polarization, 311, 531–533
 near-symmetry, 543, 546–547, 567, 616
 in principal plane, 541–549
 orders, 546, 622
 sign, 542, 546, 561
 in zenith, 563–567
 pure, 311, 531–533
 reflection function, 482–486, 536–538,
 541–543
 Fourier terms, 519, 543–544
 orders, 552–553, 561–563
 in principal plane, 541–544
 representation, 533
 semi-infinite atmosphere, 540–550
 slab, 555–567
 asymptotic, 559–561
 eigenvalues, 562–563
 spherical albedo, 483–486
 tables, 537–538
 transmission function, 536–538, 564–567
 Reactor, 28, 692–693
 Reciprocity, 16–33, 59, 393
 arbitrary configuration, 24–27
 of detector and source, 135, 615
 of escape and injection, 72
 in F matrix, 21–22
 in physical meaning, 17, 100, 135, 213
 with polarization, 27, 546, 567, 616

Reciprocity (*cont.*)

- principle, 16–17, 85, 129
- reflection function, 193, 614–616
- slab, 30–31
- surface, 30
- transmission function, 193
- use in photometry, 614–616

Redistribution

- equation, 503
- over frequencies, 94
- function, 49, 69, 497
 - Heney–Greenstein phase function, 332–333, 397, 652
 - integral, 70
 - isotropic scattering, 150
- matrix, 130, 131–134

Reduction to H functions, 362

Redundant parameter, 86

Reference, *see* Plane of reference

Reference band, 641

Reflectance in hydrologic optics, 712

Reflection, *see also* specific phase functions;

- Plane albedo; Spherical albedo
- coefficient, 202
- of diffusion stream, 72
- function, 5–6, 36–38, 51, 72, 102–103, 498
 - by atmosphere
 - over cloud, 627–629
 - over ground, 63, 64, 625–626, 628–629
 - over sea, 63, 626–627
- bimoment, 80–81, 701
 - first order, 519
- computation, 91, 118–120
- first order, 367–368, 397, 484, 487, 518–519
- Fourier expansion, 504–505, 521–523
- high order terms, 388–393
- inhomogeneous slab, 31, 58–59, 61
 - as matrix, 69
- moment, 116–117, 519
- nearly conservative, 79–80, 389–392
- ratio of total to first order, 454–455, 521
- reduced to H function, 91–92, 109, 115–117
- similarity, 372–374, 480
- thick layer, 82

matrix, 498, 503–506, 513

thin slab, 503–504

nebula, 693, 714–715

multiplicity, 715

ratio of total to first order, 714–715

Remote sensing

- active, 675–676
- passive, 675

Resolvent, 120

Restraint, *see* Constraint

Reverse experiment, 28–29, 32, 207

Roadmap, 118–119

Rotation matrix, 496, 500, 533

S

Saturn

- geometric albedo, 620–621
- Minnaert plot, 616, 619

Scalar, 68

Scalar density, 488, 693

Scattering

- angle, 499, 601
- backward, 305, 307, 384, 489–491
- coherent, 18–20
- conservative, 78, 81–83
- depth, 481
- far-field, 18–20, 22
- incoherent, 20, 27
- local, 494, 499–503
- matrix, 496, 500, 519

Schwarzschild–Milne integral equation, 127

Searchlight, 693–694

Seasonal change, 616

Sea water, 709–710

Seeing, 720

Semi-infinite atmosphere, 90, 355–376, 388–394

Shell, scattering, 692

Shorthand notation, 69–70, 128–130, 512

Similarity, 303, 317

- in diffusion pattern, 375
- in escape function, 357–359
- in extrapolation length, 374–376
- not in azimuth-dependent terms, 618
- parameter, 75, 369, 372, 479
- in reflection function, 397–399
- relation, 223–224, 477–481, 646, 683
 - accuracy, 482
 - alternatives, 478–479
 - conservative scattering, 355–362, 403–405, 408, 479
 - degenerated, 355
 - nonconservative, 364, 372–374, 477–479
 - for slab, 403–405, 477–481
- in spherical albedo, 370–371
- test, 370, 372–376
 - clouds, 487–489
 - by truncation, 366–369

Single scattering albedo, *see* Albedo

Singular eigenfunction expansion, 43, 67, 74, 90, 222

- with polarization, 508
- Rayleigh scattering, 536
- Size distribution, 664–665
 - of aerosol,
 - of drops, 315–316, 318, 320, 323
- Size parameter, 318–322
- Sky, *see also* Blue sky
 - clear fraction, 683
 - daylight, 310–311, 651–661
 - multiple scattering, 655–657
 - polarization, 557, 664, 666–668
 - elliptical, 667
 - with ground reflection, 555
 - neutral point, 555–557, 666
 - at zenith, 563–567
 - radiance, 664, 666–668
 - near horizon, 667
 - Rayleigh scattering, 564–565
 - single scattering fraction, 655–657
 - zenith–horizon ratio, 651–654
 - below clouds, 507, 651–652
 - with snow cover, 653–654
 - red, 651
 - white, 651
- Slab, *see also* specific phase function
 - inhomogeneous, reciprocity, 30–31
 - thick, asymptotic expression, 76–78
- Small-angle scattering, multiple, 660–661, 717–720
- Smog, 666
- Snow, 179
 - albedo, 653
 - cover, 653–654
 - flake, 314
 - pack, 703–705
 - reflectance, 703–704
- Sobolev method, 118–120
- Sobolev Φ function, 138–139, 209, 220
- Sobolev polynomial, 43
- Sobouti function, 226–227, 230–231
- Soft particle, 670–673
- Solar radiation to ground, 654–655
- Source
 - homogeneous distribution, 218–221
 - layer
 - internal, 68, 83–84, 137–138, 213
 - isotropic scattering, 153–161, 206
 - unidirectional, 85
 - at surface, 32, 50, 129
 - in unbounded medium, 153–161
 - zero order, 48, 193
- Source function, 494, 499
 - asymptotic, 160–161
 - in diffusion domain, 97
 - expansion, 130
 - first order, 138
 - as four-vector, 498–499, 501
 - isotropic scattering, 133–137, 150, 179, 188, 190, 206, 209, 211–213, 222
 - orders, 137, 160–161
 - at surface, 193, 213
 - starting term, 48, 130, 134
 - total, 130, 138
- Source matrix, 502
- Spectral line, *see* Absorption line
- Specular reflection, 626–627
- Sphere, as scatterer, 311–314, 511
- Spherical albedo, 4, 26, *see also* specific phase function; Reflection, function, bimoment
 - approximation, 369–371
 - expansion, 369–370
 - first order term, 370
 - of planet, 600–601, 603–611
 - ratio total to first order, 370, 454–455
 - similarity, 369–371, 482–486
 - of snow, 704
- Spherical geometry, 602, 692
 - approximation, 667
- Square mean root path length, 594–595
- Standard haze, size distribution, 665–666, 669
- Standard problem, 38–39
 - with polarization, 39
- Stellar atmosphere, 692
 - emission, 643
- Stokes parameter, 20–22, 316, 324, 493–498, 500, 503, 505, 533–535
- Stratoscope, 622
- Stratosphere, heating, 682
- Struve function, 672
- Subcritical domain, 198, 234
- Successive order
 - azimuth-dependent terms, 514–518, 522–530
 - Fourier components, 49
 - from invariance, 50
 - method, 42, 45–46, 67
 - convergence, 141, 393, 514–515
 - Henyey–Greenstein phase function, 406–408
 - isotropic scattering, 135–137, 141–142
 - semi-infinite atmosphere, 388–393
 - half-step, 47–49, 494
 - starting function, 48
- Sulfuric acid, 612
- Sun
 - corona, 658–659
 - disk, 129, 658
 - visibility through cloud, 654–655, 660–661

- Sun (*cont.*)
 hazy, 660–661
 limb, 658
 Superior conjunction, 608
 Surface
 brightness, 615
 correction function, 183–187
 detail, visibility, 625, 629–632
 reflection, 6, 491, 606
 Symbolic equation, 506
 Symmetry, *see also* Reciprocity
 assumption, 498, 501
 in azimuth, 499
 check, 17
 meridan, 615
 relation, 17
 rotational, 493
 Synthetic spectrum, 634
- T**
- τ vector, 128, 130
 Taylor expansion, 577
 Terminator, 602, 615
 Thermodynamics
 equilibrium, 17
 nonequilibrium, 17
 Thickness, reduced, 405
 Thomson scattering, 531
 Thought experiment, 17, 99, 693
 Three by three matrix, 503
 Time delay
 along path, 573, 574
 upon scattering, 574
 Time dependent problem, 153
 Time-reversal, invariance, 17
 Titan, geometric albedo, 620–621
 Transfer equation, 41, 47–48, 75, 92–93,
 127–128, 712
 anisotropic, 376–388
 boundary condition, 111
 formal solution, 48
 homogeneous, 508
 Transfer function, 2-point, 27–28, 33
 Transition region, 178–179, 209
 Translation
 of Kubelka–Munk formulas, 700
 of normalization, 78
 of symbolic formulas, 506, 512
 of terminology, 6
 nuclear scattering, 693
 Translucent atmosphere, 625–626, 628–629
 over identical atmosphere, 629
 over Lambert surface, 628–629
- Transmission, 36–38, *see also* specific phase
 function
 by adding method, 61
 diffuse, 61, 503
 first order, 397, 487, 518–519
 moment, 519
 Transmission function, 6, 37, 102–103
 Fourier expansion, 504, 521–522
 inhomogeneous slab, 31, 58–59, 61
 as matrix, 69
 thick layer, 82, 654
 zero order, 37, 52, 55, 61
 Transmission matrix, 513
 zero order, 504
 Transparent atmosphere, 625–626
 Trial function, 410
 Truncation, 366–369, 481–487
 Turbidity, 315, 662
 affecting sky brightness, 655–658
 spectrum, 316
 Turbulent spectrum, 707
 Twilight, 692
 Two by two matrix, 508–509, 513, 533–536
 Two-stream approximation, 41, 309, 491, 699,
 706
 Two-vector, 508–513, 540
- U**
- U matrix, 497
 Underwater atmosphere, 627
 Uniform incidence, 399, 401, 468, 472, 476
 Uniqueness, 74, 103, 105, 162, 224, 610
 Unpolarized light, *see* Natural light
 U operator, 497
 Uranus
 geometric albedo, 620–621
 limb darkening, 622
 model atmosphere, 622
 polarization, 559
 U vector, 69
- V**
- Variation principle, 132
 Vector, *see* μ vector; τ vector; Shorthand
 notation
 Vector product, 68, 128
 Venera eight, 645–646
 Venus
 absorption line, 598, 634–636
 phase effect, 635–636
 atmosphere energy balance, 644–646
 carbon dioxide bands, 635

cloud
 multiple layer, 645–646
 particle, 611–613
 refractive index, 612–613
 size distribution, 611–613
 pressure at top, 613
 ground albedo, 645
 infrared limb darkening, 642–643
 phase function, 610–612
 polarization, 196, 315, 507, 610–614
 measurement, 611
 Rayleigh scattering contribution, 613
 in second order, 614
 theory, 611–614
 spherical albedo, 610–611
 temperature, 642–646
 thermal emission, 642–646
 ultraviolet marking, 613
 Virtual angle, 166, 181, 230–231
 Visibility of object in water, 707
 Volcanic eruption, 662, 666, 682

W

Wallis formula, 390, 528
 Water
 cloud, 487–488, 500
 drop,
 asymmetry factor, 313
 phase function, 315–321, 496
 Wave propagation in turbulent medium,
 707
W vector, 69

X

X function, 43–44, 91
 isotropic scattering, 136, 139, 193, 208–210,
 224–227
 moment, 219, 225–230
 expansion, 228
 nonlinear relation, 232
 numerical value, 225–227, 292–299
 Rayleigh phase function, 538
 Rayleigh scattering, 555, 566
X ray
 extinction, 718
 halo, 718–719
 pulsar, 719
 scattering, 717

Y

Y function, 43–44, 91
 isotropic scattering, 136, 139, 193, 208–210,
 224–227
 contour diagram, 225–226
 moment, 219, 225–230
 expansion, 228
 nonlinear relation, 232
 numerical value, 225–227, 292–299
 virtual angles, 225–226
 Rayleigh phase function, 538
 Rayleigh scattering, 555, 566

Z

Zenith, *see* Sky
 Zodiacal light, 668, 713