

- absolutely continuous
measure, 375
AC property, 381
AC property, 381
albedo, 216
algebra
of reflectance and transmittance operators, 230
normed, 243
Banach, 244
altitude (in a reference frame), 19
Ambarzumian's principle, 228
angle, polar, azimuthal, 24
apparent radiance, 362
apparent-radiance equation, 361
- Banach algebra, 244
Beam Transmittance function, 344
various properties, 348
blondel, 179
boundary
reflecting, 340
- candela, 163, 179
Clairaut's equation (for inverse n^{th} power irradiance law), 126
complete (Planckian) radiator, 162
constitutive definitions, 8
contraction property (of beam transmittance), 348
convexification
white, black, 316
coordinate systems, terrestrial, 19
cosine collector, 7
cosine law, for irradiance, 26
- definitions: constitutive, operational, 8
depth (in a reference frame), 19
dichroic material (and polarized light), 84
diffraction, limits on radiometry, 16
direction, defined, 19
upward, downward, 21
unit inward, 25
for reflectance and transmittance, 212
- directly transmitted radiance, 347
- electromagnetic, view of light (vs phenomenological), 13
energy conservation principle (for radiometry), 199
equation of transfer for radiance, 368
time dependent and polarized form, 371
- flux (see 'radiant flux' or 'luminous flux')
- frames (of reference, e.g. terrestrial), 24
- group structure
of natural light fields, 307
- Haidinger's brush (in polarized light), 84
hemisphere (\mathbb{E}_{\pm}), 24
herschel, 172
- illuminance, 166
inherent radiance, 363
integrating sphere, 262
intensity
radiant, 70
luminous, 166
interaction method
a first synthesis, 222
in other fields, 223 (footnote)
summary, 388
and quantum theory, 390
interaction operators
integral structure, 372
kernel, 380
see also 'operators'
interaction principle
physical basis, 189
basic statement, 205
place in radiative transfer theory, 208
levels of interpretation, 208
Ambarzumian's principle, 228
applications to plane surfaces, 217
applications to curved surfaces, 258
applications to plane-parallel media, 285
applications to general spaces, 322
on one-parameter media with sources, 330

- as basis for beam transmittance and volume attenuation function, 344
- as basis for path function, path radiance, 351
- as basis for volume scattering function, 364
- as basis for equation of transfer, 368
- as a means and as an end, 391
- interfaces
 - reflecting, 340
- interreflection calculations
 - terminable and non-terminable, 248
- invariant imbedding relation
 - on plane-parallel media, 297
 - historical notes, 299
 - generalized form, 301
 - for one-parameter media, 327
 - in general media, 339
- irradiance
 - defined, 14, 171
 - meaning, 16
 - typical orders of magnitude, 17
 - in terrestrial frames, 24
 - upward, downward, 24
 - net, 26
 - cosine law for, 26, 66 (from radiance), 35, 131, 138
 - radiance from, 41
 - scalar, 54
 - spherical, 56
 - hemispherical, 58
 - vector, and mechanical analogy, 62
 - janus plate (for net), 68
 - distance law (for spheres), 103
 - distance law (for circular disks), 105
 - distance law (for general surfaces), 106
 - via line integrals, 109
 - via surface integrals, 115
 - laws of the form $1/r^n$, 120
 - distributions, equivalence of with radiance distributions, 143
 - computation for parallel planes, 217
 - on plane-parallel media, 286
- iterated operators, 236
- Janus plate, 68
- joule, 172
- kernal, interaction, 380
- lambert
 - transmitter or reflector, 262
- linear functional, 373
 - positive, 375
- line of flux, 8
- lumen, 161, 179
- luminance
 - distribution, relative, 156
 - distribution, general, 163, 166
 - typical magnitudes, 164
 - path, 179
- luminosity
 - of a wavelength, 153
- luminosity function
 - standard, 151, 157, 159, 160
 - for individuals, 153
 - photopic, 155, 158
 - scotopic, 155
 - relative (of radiance), 157
 - generalized, 184
- luminous emittance, 166, 179
 - scalar, 168, 179
 - vector, 179
- luminous energy, 167
- luminous energy density, 167
- luminous flux, 166
- luminous intensity, 166
- luxoid (via inverse n th power for irradiance), 130
- μ (millimicron), 192
- measure
 - Riemann, Lebesgue, Stieltjes, 12
 - illustration of, 373
 - basic theorems, 375
 - interaction, 380
- media
 - plane-parallel, cylindrical, etc., see Table of Contents
- meter
 - radiance, 30
 - for polarized radiance, 85
- millimicron (μ), 192
- Möbius strip, 271
- moon
 - radiance of, 98
 - radiant intensity of, 99
 - luminance of, 164

- multiplicative property (of beam transmittance), 348
 - nanometer ($= 10^{-9}$ m) = millimicron ($m\mu$), 192
 - natural (mode of) solution, 203, 247
 - norm-contracting property
 - of C operator, 147
 - of R, T operators, 236
 - of \mathcal{V} operators, 322
 - normed operator algebra, 243
 - north-based reference frame, 19
- operational definitions, 8
- operators
 - algebra, 230
 - iterated, 236
 - algebra and radiative transfer, 241
 - algebra, normed, 243
 - \mathcal{U} , \mathcal{S} , 319
 - interaction, structure of, 372
 - volume transpectral, 386
 - path function, 383
 - path radiance, 384
 - interaction for general spaces, 314, 378
 - interaction for surfaces, 377
 - miscellaneous examples, 387
- optical properties
 - inherent and apparent, 349
- path function
 - radiant, 172
 - luminous, 179
 - derivation 351
 - connection with path radiance, 354
 - integral representation, 367
 - operator, 383
- path luminance, 179
- path radiance, 172
 - derivation, 351
 - connection with path function, 354
 - operator, 384
- phase space density, 9
- phenomenological, view of light (vs electromagnetic), 13
- photoelectric effects (photoelectric cells, photoemissive, photoconductive, photovoltaic), 3
- photometry
 - geometrical, 2, 165
 - generalized, 183
 - non linear, 185
- photon
 - as an aid to visualization, 10
 - entering an eye from a star, 18
- Planckian (complete) radiator, 162
- Planck's quantum of action, 9
- plane of scattering, 91
- plane-parallel media, see Table of Contents
- point source
 - operational definition, 75
 - criterion for, 105
- polarization convention, 194 (footnote)
- polarized equation of transfer, 371
- Poynting vector field, 9
- Principles of Invariance
 - on plane-parallel media, 294
 - on spherical, cylindrical, toroidal media, 325
 - on general media, 336
- quantum-terminabel calculations, 254
- quantum theory and interaction method, 370
- radiance
 - empirical definition, 30, 171
 - meter, 30, 85
 - theoretical, 32
 - via photon density, 33
 - typical values, 33, 34, 97
 - distributions (on E), 34
 - function (on $X \times E$), 34
 - irradiance from, 35 (from irradiance), 41
 - field vs surface, 44
 - invariance property, 46
 - radiance-invariance law, 46
 - operational meaning of surface radiance, 49
 - n^2 -law, 51
 - polarized, 83
 - std. Stokes vector, 88

- std. observable vector, 88
 polarization composition theorem, 89
 local observable vector, 91
 radiant flux content of polarized, 94
 distributions, elliptical, 131
 distributions, polynomial, 139
 distributions, equivalence of with irradiance distributions, 143
 path, 172
 D'-additivity (surfaces), 195
 D'-continuity (surfaces), 195
 of parallel planes, 244
 D'-additivity (slabs), 282
 D'-continuity (slabs), 282
 on plane-parallel media, 290
 directly transmitted, 347
 residual, 347
 unattenuated, 347
 radiant density, 54, 172
 radiant emittance, 28, 171
 empirical, 29
 scalar, 61
 vector, 171
 radiant energy, 54, 172
 over space, 60,
 over time, 61
 radiant flux
 operational definition, 2, 7, 171
 calculations, 117
 meaning, 8
 F-additivity, 10
 F-continuity, 11
 monochromatic (or spectral), 11
 finite vs countable additivity, 11
 S-additivity, 12
 S-continuity, 12
 D-additivity, 13
 D-continuity, 13
 radiant intensity
 empirical definition, 70, 171
 field vs specific, 72
 theoretical, 73
 point sources and, 74
 cosine laws for, 77, 80
 vector, 81
 area-law for general surfaces, 119
 radiative process
 defined, 190
 radiative transfer theory
 as based on the interaction principle and operator algebra, 188
 radiator
 Planckian or complete, 162
 radiometrically adequate collector, 151
 radiometric norm, 146, 232
 radiometric-photometric transition operator, 166, 169
 radiometry
 geometrical, 2
 transition to photometry, 166
 mathematical basis of, 169
 Radon-Nikodym theorem, 185
 derivative, 376
 reference frame
 terrestrial, 20
 stratified, 24
 local vs standard (in polarized context), 91
 reflectance
 empirical, for surfaces, 194
 operators, for surfaces, 210
 theoretical, for surfaces, 213
 lambert, 215
 algebra of operators, 230
 operators for plane-parallel media, 279
 semigroup properties, 300
 residual radiance, 347
 phenomenological interpretation, 349

 scalar illuminance, 167
 scalar irradiance, 54
 scalar luminous emittance, 168
 scattering
 plane of, 91
 standard function, 318
 scatter processes (Rayleigh, Compton, etc.), 191
 semigroup properties
 of reflected and transmitted radiant flux, 300
 of $\Gamma_2(a,b)$, 309
 of $\Gamma_3(a,b)$, 298, 301
 of $\Gamma_4(a,b)$, 303, 312

- connections among Γ_3, Γ_4 , 313
- of beam transmittance, 348
- solid angle, 37
- subtense of surfaces, 112
- S-additivity property, 114
- S-continuity property, 114
- and the foundations of Euclid's optics, 115
- sources
 - in one-parameter media, 330
- space light (= path radiance), 363
- specific intensity (see radiance, surface), 44
- specific radiance, 44
- spherical irradiance, 56
- steradian, 38
- Stokes vector (for radiance), 88
- sun
 - radiance of, 97
 - radiant intensity of, 98
 - luminance of, 164
- sun-based reference frame, 19
- surfaces
 - solid angle subtense of, 112
 - general two-sided, 267
 - general one-sided, 271
- talbot, 179
- time dependent equation of transfer, 371
- transmittance
 - empirical, for surfaces, 194
 - operators, for surfaces, 210
 - theoretical, for surfaces, 213
 - lambert, 262
 - algebra of operators, 230
 - operators for plane-parallel media, 279
 - semigroup properties, 300
- truncation error estimates, 250
- unattenuated radiance, 347
- unified atmosphere-hydro-sphere problem, 343
- views of light (phenomenological vs electromagnetic), 13
- volume attenuation function, 349
- volume scattering function, 364
- volume transpectral scattering operator, 386
- watt, 171