Radiometric Terms and Units

Radiometry

Vacuum UV	< 185 nm
Ultraviolet	~ 185 to ~ 380 nm
Visible	~ 350 to ~ 830 nm
NIR	~ 800 to ~ 1800 nm
SWIR	~ 1600 to ~ 2500 nm
MIR	~ 2 to 5 μm
LWIR	~ 5 to 12 μm
IR	> 12 μm

Radiance & Luminance

Sun	2×10^7	W/m^2-sr
Sun	2×10^9	cd/m^2
Frosted bulb	10,000	cd/m^2
Fluorescent	5,000	cd/m^2
Computer screen	100	cd/m^2

Planck's Blackbody Equation

$$L_\lambda = \frac{2c^2h}{\lambda^5(e^{hc/\lambda kT}-1)} = W/(m^2\text{-sr-}\mu m)T=k$$

Useful Constants

h	6.63E-34 Planck Constant (J*s)
c	3.00E+08 Speed of Light (m/s)
k	1.38E-23 Boltzman Constant (J/K)
σ	5.67E-8 Stefan-Boltzman Constant

$$\sigma = \frac{2\pi^5 k^4}{15c^2h^3} = W/(m^{\wedge 2} {}^{*} L^{\wedge 4}) \text{ - "Sigma"}$$

Radiance of Sphere

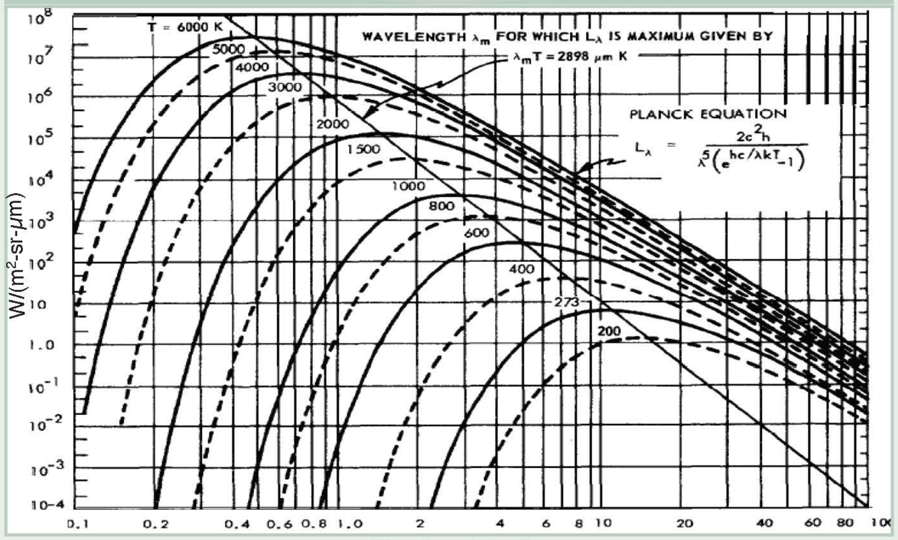
$$\text{Radiance of Sphere} = \frac{\Phi_i}{\pi A_S} * \frac{\rho}{1-\rho(1-f)}$$

Φ = Flux W/(m^2-sr-μm)
ρ = Reflectance
A_S = Area of Sphere
f = Fractional port area

Approx. Calculation of Solid Angle

$\Omega = \pi \sin^2\text{-}\theta$	(sr) FOV (θ= half angle)
$\Omega = \pi(NA)^2$	(sr) NA of Fiber
$\Omega = \dfrac{\pi}{2f\,(/\#)^2}$	(sr) F-Number

Blackbody Absolute Spectral Radiance Curves



Wavelength (μm)

Conversion Factors

ILLUMINATION

Multiply # > To obtain #	Footcandles	Lux
Footcandles	1	0.0929
Lux	10.76	1

1 footlambert = 1 footcandle at sphere exit port

LUMINANCE

Multiply # > To obtain#	Footlamberts	cd/m^2
Footlamberts	1	0.2919
cd/m^2	3.426	1

Sky Illumination Conditions

Condition	Approx. Lux
Clear, Peak Irradiance	1000W/m2
Clear, Peak Lux	100,000
Clear, in Shade	10,000
Overcast, Light	1,000
Overcast, Heavy	100
Overcast, Sunset	10
Clear, 0.25hr after Sunset	1
Clear, 0.5hr after Sunset	0.1000
Clear, Full Moon	0.0100
Clear, No Moon	0.0010
Overcast, No Moon	0.0001

Useful Conversion Calculations

Conversion Calculation of Spectral Radiance (W/m^2-sr-μm) to Photons/Second

W/m^2-sr-μm * (wavelength/(h*c)) = (photons/s)/m^2-sr-μm

Conversion of Photons to Rayleighs

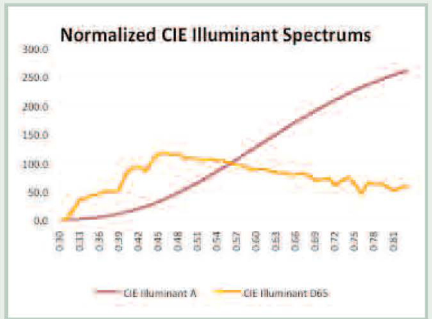
1 Rayleigh = 7.96E-08 photons/s*m^2*sr

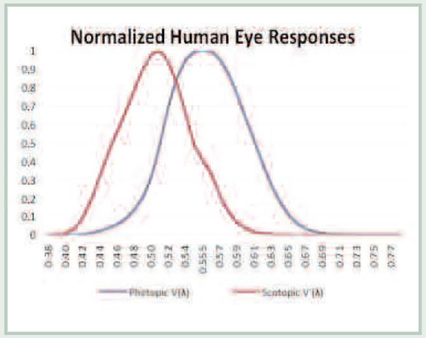
Plane Angle Conversions

Plane Angle Conversions (°/rad)	1 Degree (°)	1 Minute (')	1 Second ('')	1 Radian (rad)	1 mRadian (mrad)
1 Degree (°)	1	60	3600	1.745E-02	17.453
1 Minute (')	1.667E-02	1	60	2.909E-04	0.29089
1 Second ('')	2.778E-04	1.667E-02	1	4.848E-06	4.85E-03
1 Radian (rad)	57.2958	3437.75	2.06E+05	1	1000
1 mRadian (mrad)	5.730E-02	3.43775	206.265	1.00E-03	1

Radiometric Terms and Units

	Radiometric	Spectroradiometric	Photopic
Flux	Power Watts	Power/wavelength interval Watts/nm	Luminous Flux Lumens
Flux/area	Irradiance Watts/m^2	Spectral Irradiance Watts/m^2 nm	Illuminance Lumens/m^2 = Lux
Flux/solid angle	(Radiant) Intensity Watts/sr	Spectral Intensity Watts/sr nm	(Luminous) Intensity Lumens/sr = candela
Flux/area solid angle	Radiance Watts/m^2 sr	Spectral Radiance Watts/m^2 sr nm	Luminance Candela/m^2 = nit Lumens/m^2 sr = nit





Conversion Factors Chart

Number of → multiplied by table factor equals number of ↓	W/m^2·sr·µm	W/m2-sr-nm	mW/m^2·sr·µm	mW/m^2·sr·nm	µW/m^2·sr·µm	µW/m^2·sr·nm	W/cm^2·sr·µm	W/cm^2·sr·nm	mW/cm^2·sr·µm	mW/cm^2·sr·nm	µW/cm^2·sr·µm	µW/cm^2·sr·nm
W/m^{2}sr·µm	1	10^{3}	10^{-3}	1	10^{-6}	10^{-3}	10^{4}	10^{7}	10	10^{4}	10^{-2}	10
W/m^{2}sr·nm	10^{-3}	1	10^{-6}	10^{-3}	10^{-9}	10^{-6}	10	10^{4}	10^{-2}	10	10^{-5}	10^{-2}
mW/m^2·sr·µm	10^{3}	10^{6}	1	10^{3}	10^{-3}	1	10^{7}	10^{10}	10^{4}	10^{7}	10	10^{4}
mW/m^2·sr·nm	1	10^{3}	10^{-3}	1	10^{-6}	10^{-3}	10^{4}	10^{7}	10	10^{4}	10^{-2}	10
µW/m^2·sr·µm	10^{6}	10^{9}	10^{3}	10^{6}	1	10^{3}	10^{10}	10^{13}	10^{7}	10^{10}	10^{4}	10^{7}
µW/m^{2}sr·nm	10^{3}	10^{6}	1	10^{3}	10^{-3}	1	10^{7}	10^{10}	10^{4}	10^{7}	10	10^{4}
W/cm^2·sr·µm	10^{-4}	0.1	10^{-7}	10^{-4}	10^{-10}	10^{-7}	1	10^{3}	10^{-3}	1	10^{-6}	10^{-3}
W/cm^2·sr·nm	10^{-7}	10^{-4}	10^{-10}	10^{-7}	10^{-13}	10^{-10}	10^{-3}	1	10^{-6}	10^{-3}	10^{-9}	10^{-6}
mW/cm^{2}sr·µm	0.1	10^{2}	10^{-4}	0.1	10^{-7}	10^{-4}	10^{3}	10^{6}	1	10^{3}	10^{-3}	1
mW/cm^2·sr·nm	10^{-4}	0.1	10^{-7}	10^{-4}	10^{-10}	10^{-7}	1	10^{3}	10^{-3}	1	10^{-6}	10^{-3}
µW/cm^2·sr·µm	10^{2}	10^{5}	0.1	10^{2}	10^{-4}	0.1	10^{6}	10^{9}	10^{3}	10^{6}	1	10^{3}
µW/cm^2·sr·nm	0.1	10^{2}	10^{-4}	0.1	10^{-7}	10^{-4}	10^{3}	10^{6}	1	10^{3}	10^{-3}	1

COURTESY OF

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