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Radiation Power and Transfer

Power ≡ Radiant Flux:

$$\Phi = \frac{d}{dt}W = |\frac{1}{\mu_0}(\mathcal{E} \times \mathcal{B})| = |\mathcal{S}| = \oint\limits_A \mathcal{S}\, d\vec{A} \tag{1}$$

$dW \equiv$ Radiant Energy[1], $W \equiv$ Work

$\mathcal{S} \equiv$ Poynting-Vector, $A \equiv$ radiant surface area, $d\vec{A} \perp dA$

Flux Density ≡ Radiant Intensity (ray beam angular from source at distance g):

$\mathcal{J} = \frac{d\Phi}{d\Omega_g}$

$\mathcal{J}_\lambda = \frac{c}{\lambda^2}\mathcal{J}_\nu$

$$d\mathcal{J} = \frac{d^2\Phi}{d\Omega_g} = \frac{d^2\Phi}{\frac{dA_b \cos(\varepsilon_b)}{R^2}} = \mathcal{L} dA_g \cos(\varepsilon_g) \tag{2}$$

where Radiance[2] $\mathcal{L} =$ const.

Irradiance ≡ Impact Intensity (ray beam straight at receiver in distance b):

$\mathcal{I} = \frac{d\Phi}{dA_b} = \mathcal{J}\frac{\cos(\varepsilon_b)}{R^2} = \frac{d\mathcal{H}}{dt}$

Radiant Exposure ≡ Action:

$\mathcal{H} = \int\limits_{t_1}^{t_2} \mathcal{I}(t)\, dt$

Radiant Exitance ≡ Radiant Emittance:

$\mathcal{M} = \frac{d\Phi}{dA_g}$

Radiance ≡ Radiant Density (Apparency, Brightness):

Emissity ≡ $\mathcal{L}_g$

Appearence Areas: $dA_g \cos(\varepsilon_g)$ and $dA_b \cos(\varepsilon_b)$

[1] Strahlungsenergie
[2] experimentally measured

$$\mathcal{L} = \frac{d\mathcal{J}}{dA_g \cdot \cos(\varepsilon_g)} = \frac{1}{dA_g \cos(\varepsilon_g)} \frac{d^2\Phi}{d\Omega_g} = \frac{1}{dA_b \cos(\varepsilon_b)} \frac{d^2\Phi}{d\Omega_b} = \frac{c}{4\pi} w_{EM} \tag{3}$$

$\mathcal{L} = const.$: diffused emission, reflection, brightness, rough no mirroring surface …

$\mathcal{L} \neq$ const.: radiation transfer, no diffusion, apparent, smooth surface mirroring …