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Radiation Power and Transfer

Power \equiv Radiant Flux:

$$\Phi = \frac{d}{dt} W = \left| \frac{1}{\mu_0} (\mathcal{E} \times \mathcal{B}) \right| = |\mathcal{S}| = \oint_A \mathcal{S} d\vec{A} \quad (1)$$

$dW \equiv$ Radiant Energy¹, $W \equiv$ Work

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

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

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

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

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

where Radiance² $\mathcal{L} = \text{const.}$

Irradiance \equiv 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 \equiv Action:

$$\mathcal{H} = \int_{t_1}^{t_2} \mathcal{I}(t) dt$$

Radiant Exitance \equiv Radiant Emittance:

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

Radiance \equiv Radiant Density (Apparency, Brightness):

$$\text{Emissivity} \equiv \mathcal{L}_g$$

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

¹Strahlungsenergie

²experimentally measured

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

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

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