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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 Energy<sup>1</sup>,  $W \equiv$  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 Radiance<sup>2</sup>  $\mathcal{L} = \text{const.}$

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  $dA_b \cos(\varepsilon_b)$

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<sup>1</sup>Strahlungsenergie

<sup>2</sup>experimentally measured

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

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

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