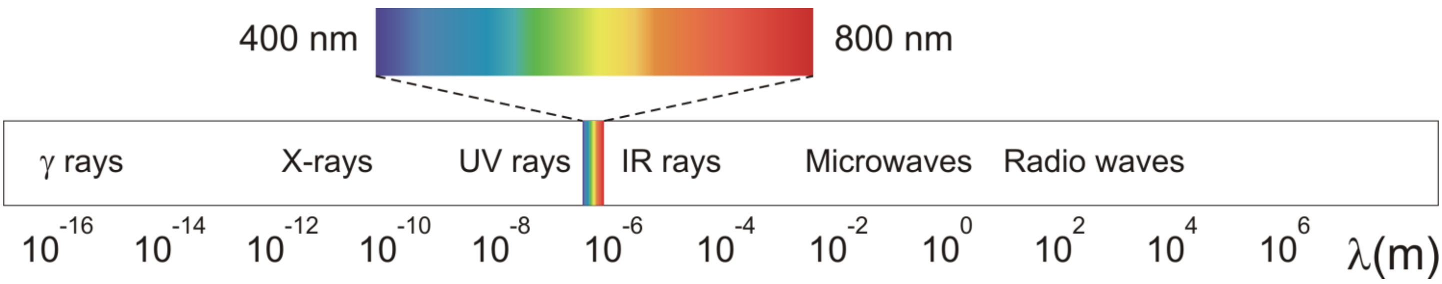
Optics

What is light? Visible electromagnetic radiation

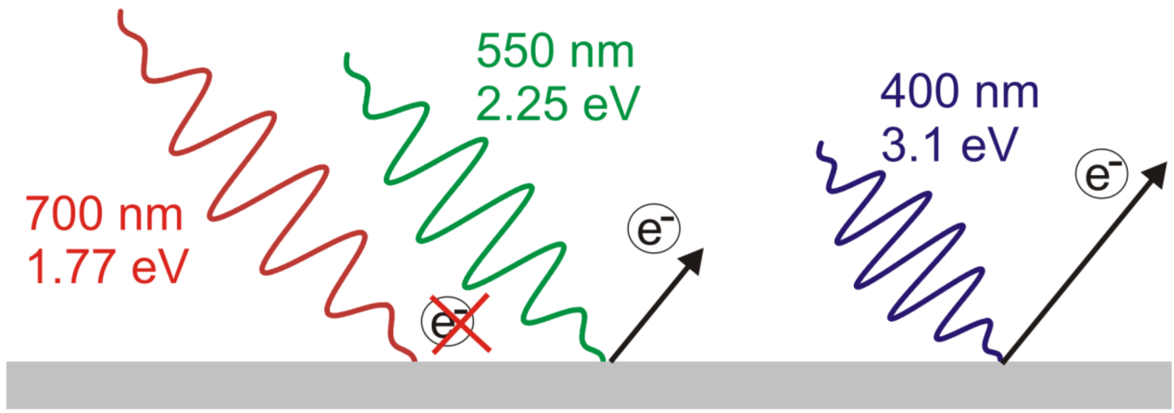
Wave



Particle Properties

The photon is the elementary particle which carries the energy of electromagnetic radiation.

Photoelectric effect: An incident photon removes an electron from the bound electrons of an atom or molecule, while the photon is absorbed.



Wave–particle duality is the concept that all matter and energy exhibits both wave-like and particlelike properties

Phenomenon

Can be explained in terms of waves.

Can be explained in terms of particles.

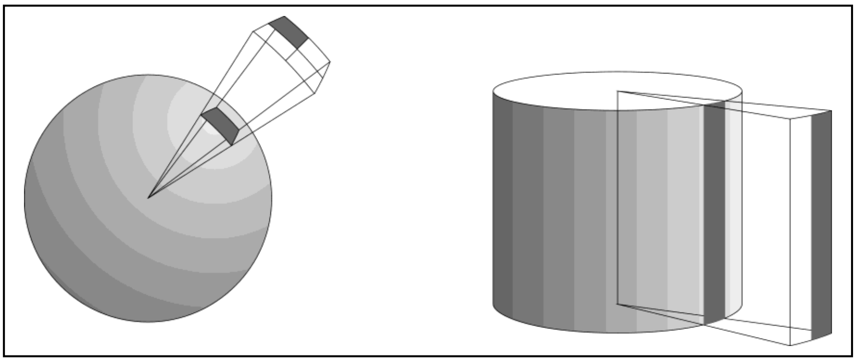
	waves	particles
Reflection	+	+
Refraction	+	+
Interference	+	-
Diffraction	+	-
Polarization	+	-
Photoelectric effect	-	+

Basics of radiometry
Source, radiation, irradiated target
Emitted power (P), intensity (J_E), (Flux density)

$$J_E = \frac{\Delta E}{\Delta t \Delta A} \qquad\qquad M = \frac{\Delta P}{\Delta A}$$

Point-like isotropic radiator
Radiation is independent of the direction in the whole solid angle.
Total emitted power per unit surface area

Simple laws: the roles of symmetry, distances and angles



1. Spherical symmetry

$$P = M_1 A_1 = M_2 A_2$$

$$\frac{M_1}{M_2} = \frac{r_2^2}{r_1^2} \qquad\qquad M \sim 1/r^2$$

2. Cylindrical symmetry

$$M \sim 1/r$$

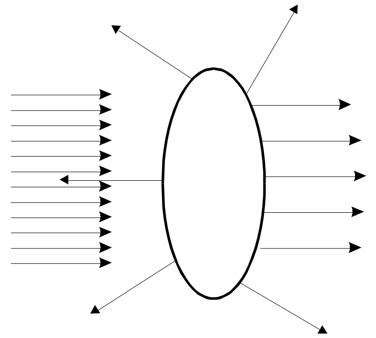
(Planar symmetry)

3. Out of perpendicular incidence

$$M = J\cos\alpha$$

4.)

radiation



matter

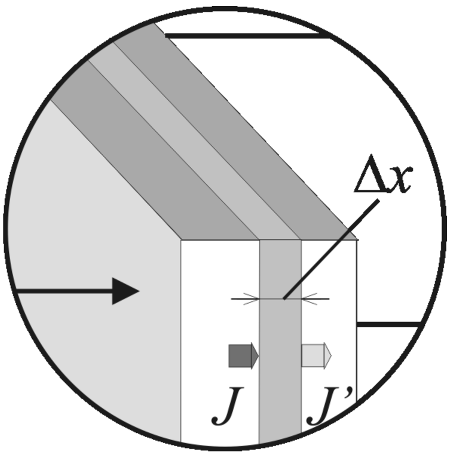
interaction: J decreases, but how? (experiment)

$\Delta J = J_{out} - J_{in}$ depends on

— incident intensity	J_{in}
— layer thickness; (number of layers)	$x = k\Delta x$
— quality of matter	μ

Initial essumptions:

- for „small" Δx $\quad \Delta J \sim \Delta x$ and $\Delta J \sim J$ *(proportional)*
- if $\Delta x = 0$ $\quad J_{out} = J_{in} = J_0$



$\Delta J = J' - J$

x characteristic for the **quantity** of matter,
μ for the **quality** of matter
For layers with "extreme" small Δx $\quad \Delta J = J' - J = -J\mu\Delta x$

$$\color{red}{J(x) = J_0\, e^{-\mu x}}$$