Medical Biophysics

Why do we learn it?

Reasons:

1. The structure and function of human body,

2. the methods, techniques, equipment of medical diagnosis and therapy have bases of natural science.

$$\varphi\upsilon\sigma\iota\zeta = \text{nature}$$
$$\text{physics} = \text{natural science}$$

   It is interesting that the meaning of „physic" = „art of healing, medical science"

3. Medical mentality
   logical, analyzing, systematic,
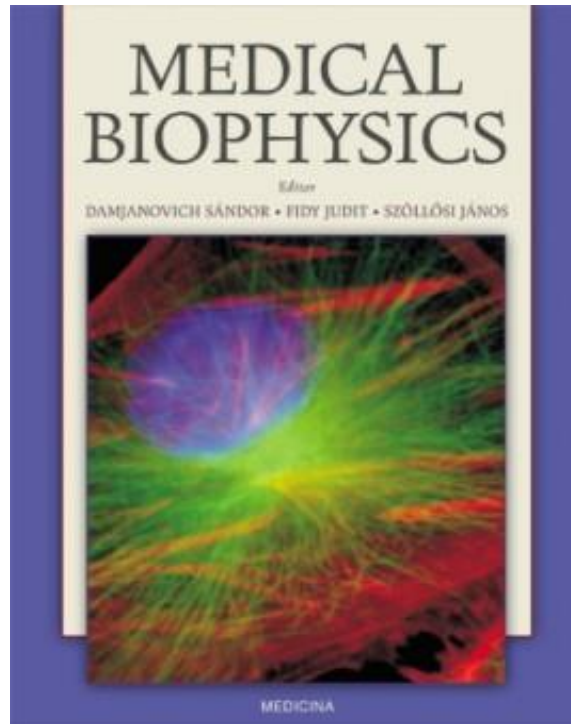   an important peculiarity is the continual skepticism.

Purposes:

   I. To get knowledge

   II. **Solving problems**, methods

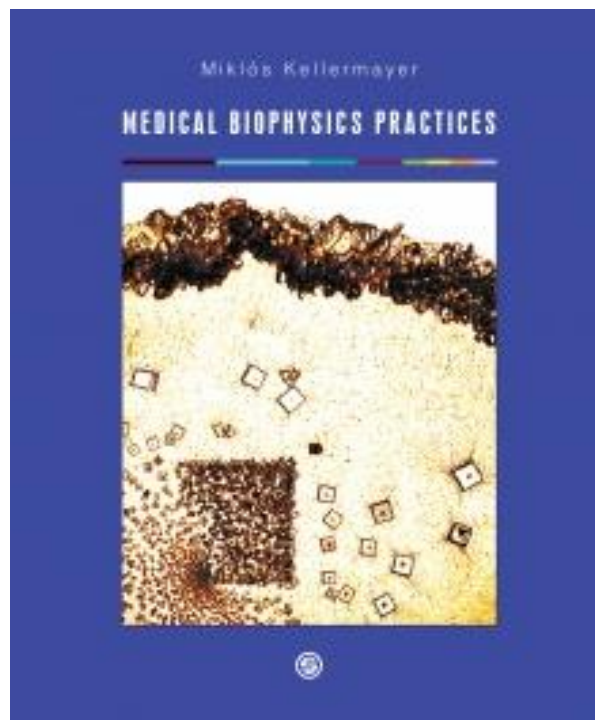   III. Approach, attitude of mind

Suggested textbook and manual:

Medical Biophysics
Editors: Damjanovich Sándor, Fidy Judit, Szöllősi János
Medicina

Medical Biophysics Practices
Authors: staff of the Institute of Biophysics and Radiation Biology

Radiations

Sunshine, x-ray, sound, radio-waves, radioactive radiation

Sensation, detection

Basics of radiometry

a	b	c
source	radiation	irradiated target

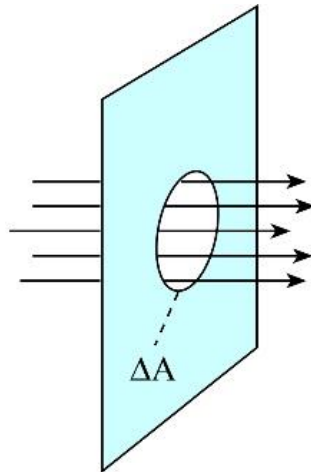# Energy propagation

Emitted power

$$P = \frac{\Delta E}{\Delta t}$$

(Energy current intensity)

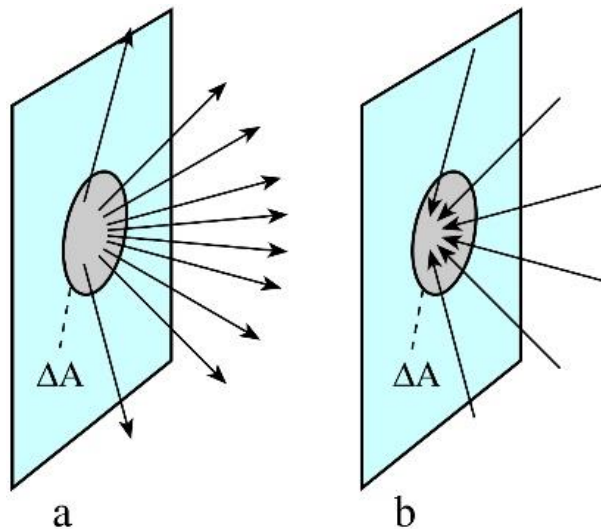$$I_E = \frac{\Delta E}{\Delta t}$$

Radiation intensity (or Intensity, or Flux density)

$$J_E = \frac{\Delta E}{\Delta t \Delta A}$$

Radiance (a), Irradiance (b)

$$M = \frac{\Delta P}{\Delta A}$$

Point-like isotropic radiator

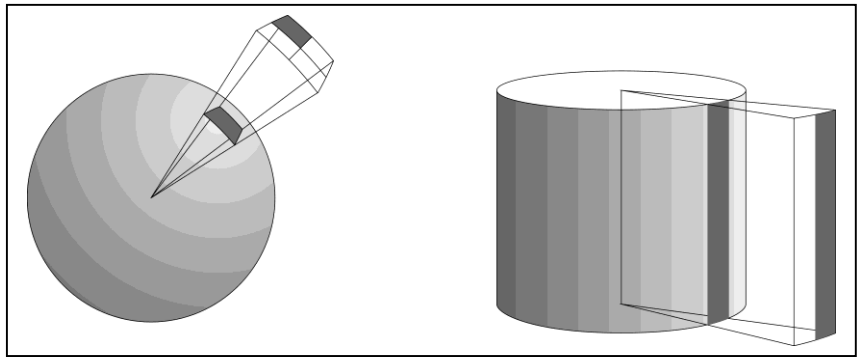Radiation is independent of the direction in the whole solid angle.

Total emitted power per surface area

Simple laws: the roles of symmetry, distances and angles

Spherical symmetry

Cylindrical symmetry

(Planar symmetry)

Decrease in radiation intensity while passing through matter
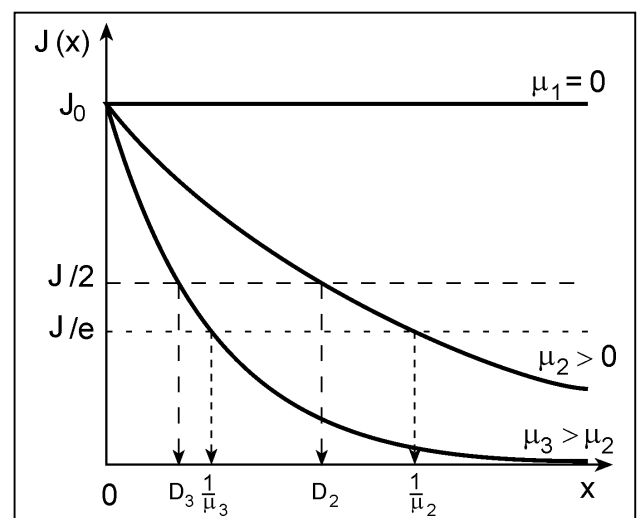
Energy absorption, reflection, dispersion

Outgoing intensity (J) depends on both the type (μ) and depth (x) of the traversed medium, as well as the intensity of the incident radiation (J_0).

Small distances linear proportionality holds.

$$\Delta J = -\mu \Delta x J$$

$$\frac{\Delta J}{\Delta x} = -\mu J$$

Solution ($J = J_0$ when $x = 0$)

$$J = J_0 \mathrm{e}^{-\mu x}$$

The validity of the law depends on the interaction between matter and radiation, but in most cases it provides a very good approximation.

The attenuation coefficient is the inverse of the distance that reduces the intensity by a factor of $1/e$.

D is called the layer thickness for half-intensity.

Types of radiation

electromagnetic radiation (such as light and gamma rays)
mechanical radiation (e.g. sound and ultrasound in particular)
particle radiation (such as alpha or beta rays)

non-ionizing types of radiation
(electromagnetic radiation 1: light; and mechanical radiation: sound, ultrasound)

ionizing radiations
(electromagnetic radiation 2: x-rays, gamma rays; and particle radiations: alpha and beta rays).