Photometry.
Light sources.

Blackbody radiation – light bulbs, Sun spectrum. Discharge lamps, LED.

Fluorescence.

Photometry

Deals with energy/power transmitted by radiation

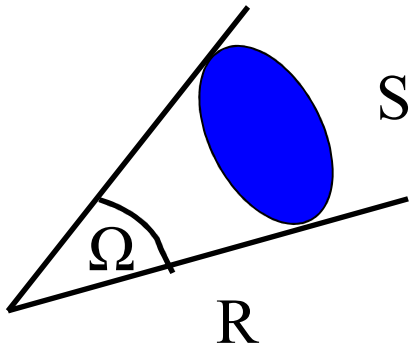
- Radiation quantities – full electromagnetic spectrum
- Luminous quantities – visible radiation/light only (400-800nm)

Not simple conversion between radiation and light quantities!

Radiant flux – Luminous flux

- Radiant flux Φ_e[W]

$S=R^2\Omega$, $[\Omega]=sr$



- Luminous flux Φ[W], [lumen=lm]

1/683 Watt of 555 nm green light provides one lumen

Radiant intensity – Luminous intensity

- Radiant intensity = radiant flux per 1sr

$$I_e = \frac{\Delta\Phi_e}{\Delta\Omega}, \quad [Wsr^{-1}]$$

- Luminous intensity = luminous flux per 1sr

$$I = \frac{\Delta\Phi}{\Delta\Omega}, \quad [Wsr^{-1}] = [candle = cd]$$

Radiance – Luminance

- Radiance = radiant flux per 1sr and 1m^2 perpendicular to the radiation direction

$$L_e = \frac{\Delta I_e}{\Delta S}\cos\alpha, \quad [Wsr^{-1}m^{-2}]$$

- Luminance = luminous flux per 1sr and 1m^2 perpendicular to the light direction

$$L = \frac{\Delta I}{\Delta S}\cos\alpha, \quad [Wsr^{-1}m^{-2}]$$

Irradiance - Illuminance

- Irradiance = radiant flux per $1\mathrm{m}^2$

$$E_e = \frac{\Delta\Phi_e}{\Delta S}, \quad [Wm^{-2}]$$

- Illuminance = luminous flux per $1\mathrm{m}^2$

$$E = \frac{\Delta\Phi}{\Delta S} = \frac{I}{r^2}\cos\alpha, \quad [Wm^{-2}][lux = lx]$$

Light sources

- Thermal radiation - Blackbody radiation

Transfer of heat energy into radiation
lightbulbs

- Electric discharge in gasses – excitation of electrons in orbitals and jumps back

(discharge) lamps

- Anihilation of electron-vacancy pair

Light emitting diodes (LED)

Lightbulbs

Radiation from tungsten wire (W melting point is high 3653K)

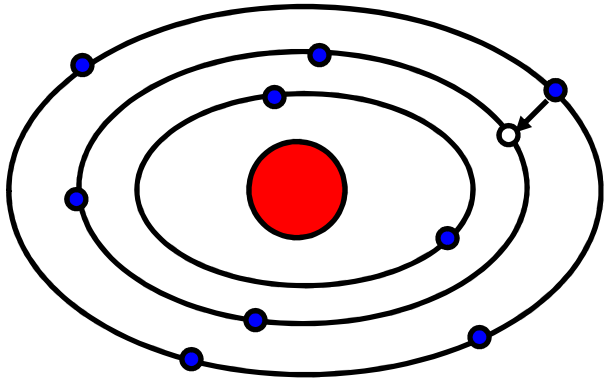
Bulb filled by inert gas – reversible reaction

$$W + 2I \rightarrow WI_2$$

Synthesis <1400^{o}C, decomposition >1400^{o}C

(Discharge) lamps

Light generated during jumps of electron from one to another orbital



$$E_f - E_c = \frac{hc}{\lambda}, \quad h = 6{,}626 \cdot 10^{-34}\, Js$$

Lamps

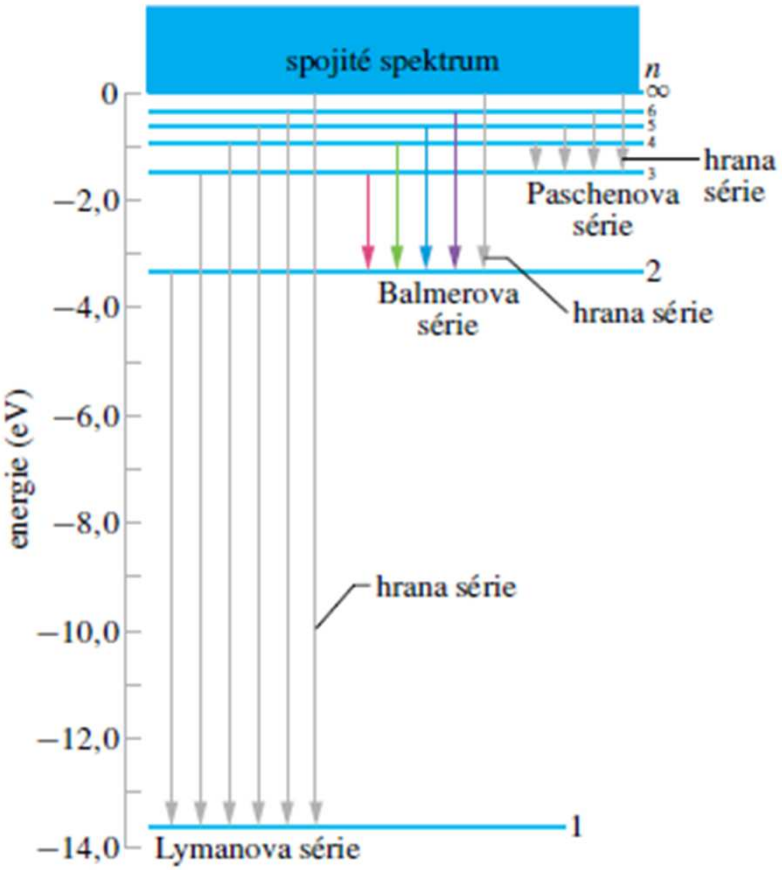
Tubes with electrodes filled by gasses – neon, xenon, sodium, mercury, etc.

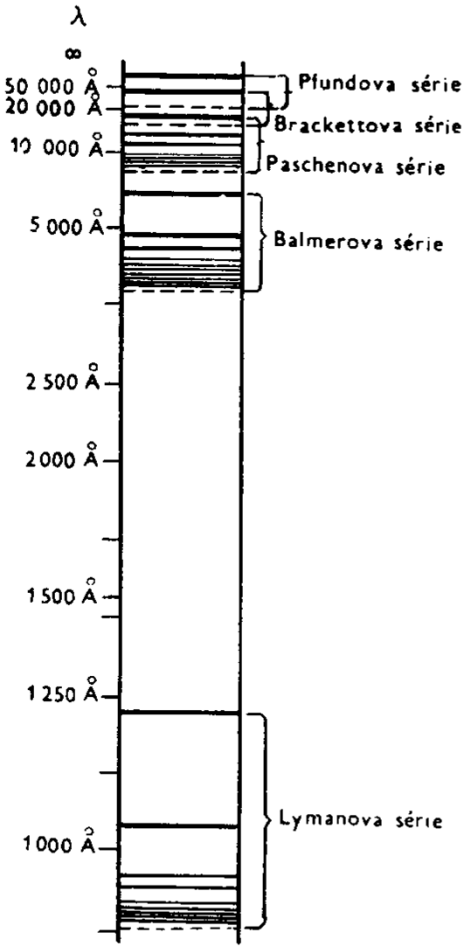
Xenon lamp – continuous and isoenergetic light spectrum, photography, xerox, movie projection etc.

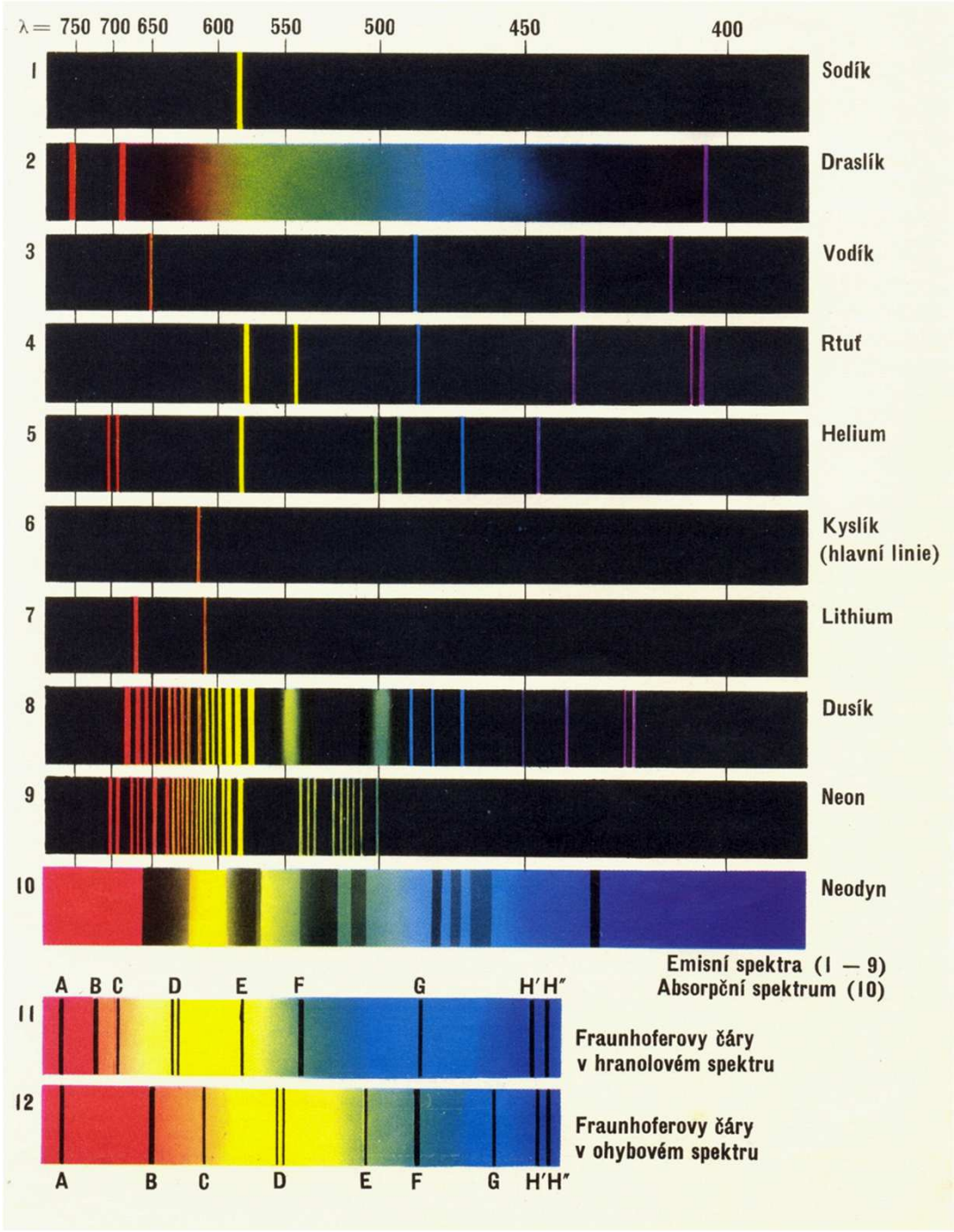
Light tube walls (e.g. mercury) covered by luminophore for fluorescence UV light transformation to visible light

Spectral lines

Energy radiation in the form of electromagnetic radiation – electron jumps between orbitals, series of lines

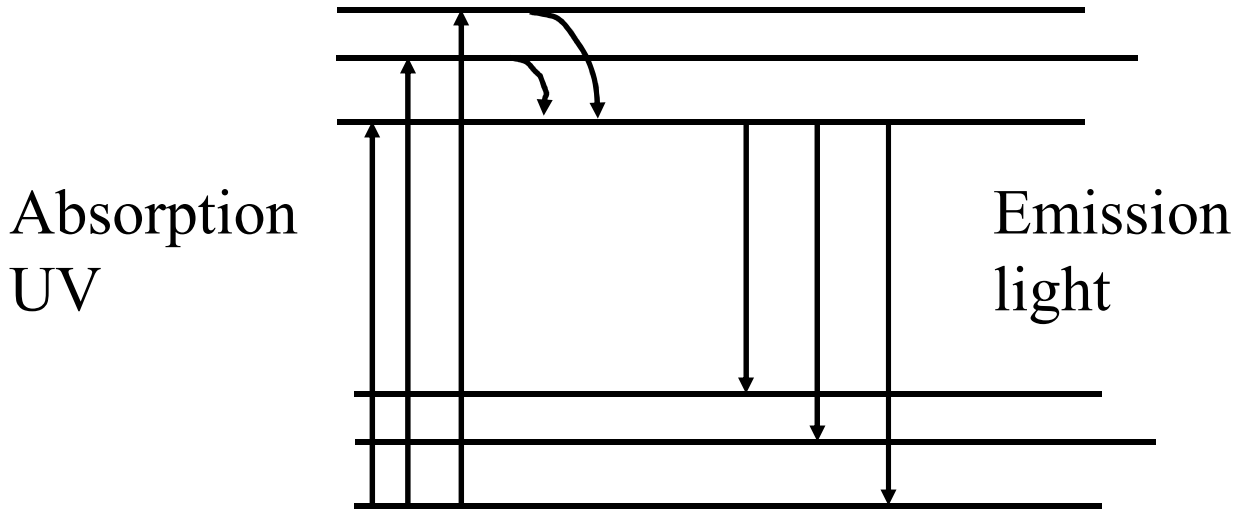





λ = 750 700 650 600 550 500 450 400
1
Sodík
2
Draslík
3
Vodík
4
Rtuť
5
Helium
6
Kyslík
(hlavní linie)
7
Lithium
8
Dusík
9
Neon
10
Neodyn
Emisní spektra (1 — 9)
Absorpční spektrum (10)
A B C D E F G H′H″
11
Fraunhoferovy čáry
v hranolovém spektru
12
Fraunhoferovy čáry
v ohybovém spektru
A B C D E F G H′H″

Fluorescence

Excitation of electron into higher energy orbital and subsequent jumps back to original orbital



Optically active materials for textile, paper etc.

Literature

Pictures used from the books:

HALLIDAY, D., RESNICK, R., WALKER, J.: Fyzika (část 4 – Elektromagnetické vlny – Optika – Relativita, část 5 – Moderní fyzika), Vutium, Brno 2000

A.Beiser: Úvod do moderní fyziky, Academia Praha 1975