Dispersion of light

$$v = \lambda f$$

v – velocity of wave (m s^{-1})

λ – wavelength (m) – distance between two maximum

f – frequency (Hz = s^{-1}) – number of complete cycles per a time

Colour

Magnitude of velocity of light depends on frequency – this phenomenon is called dispersion of light.

index of refraction: n = c / v =>is also frequency depending

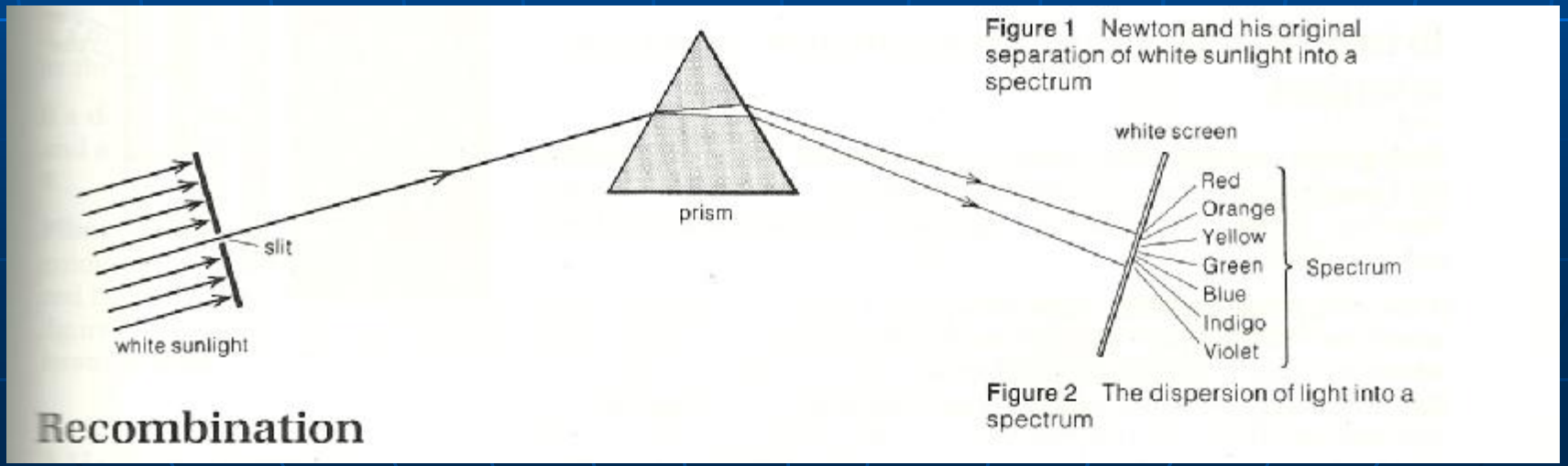


Figure 1 Newton and his original separation of white sunlight into a spectrum

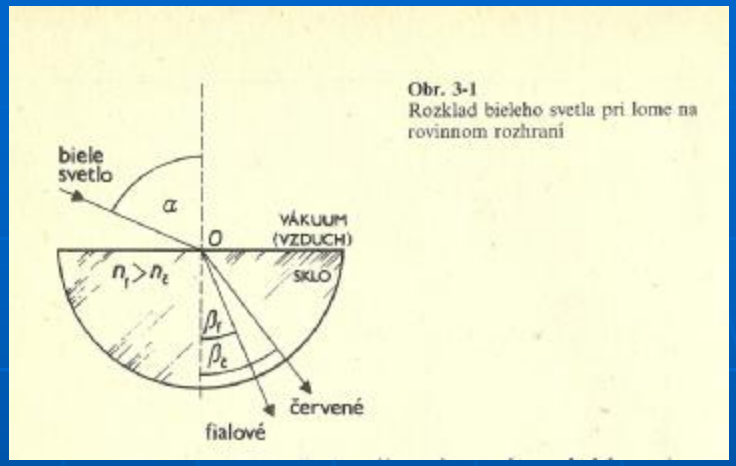
Figure 2 The dispersion of light into a spectrum

Recombination

Using Snell´s law:

$\sin\alpha / \sin\beta_r = n_r / n_a$

$\sin\beta_r = (n_a \sin\alpha) / n_r$



$\sin\alpha$ - **incidence angle of white sunlight**

$\sin\beta_r$ - **angle of refraction for the red component of the white light**

n_r – **index of refraction of the red component in the glass**

n_a - **index of refraction of the light in air** ($n_a = 1$)

$\sin\beta_r = \sin\alpha / n_r$

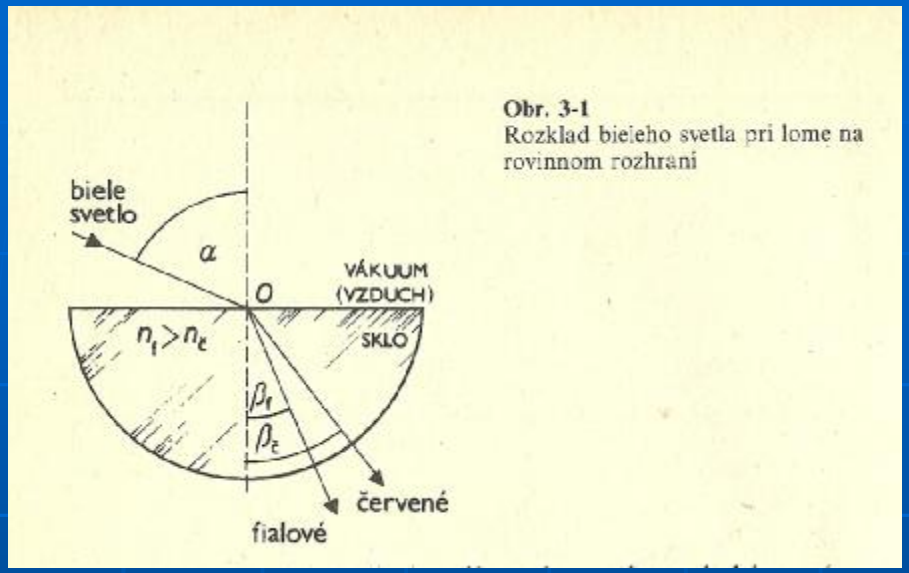
For the violet component of white sunlight:

$\sin\beta_v = (n_a \sin\alpha) / n_v$

$\sin\beta_v = \sin\alpha / n_v$

$=> \beta_r > \beta_v$ **and** $n_r < n_v$ **and** $v_r > v_v$

Dispersion of white sunlight into spectrum



Obr. 3-1
Rozklad bieleho svetla pri lome na rovinnom rozhraní

- $f_v = 7.8 \times 10^{14}$ Hz
- $f_r = 3.8 \times 10^{14}$ Hz
- Frequency of a light stays constant as it passes through different mediums, wavelength changes:

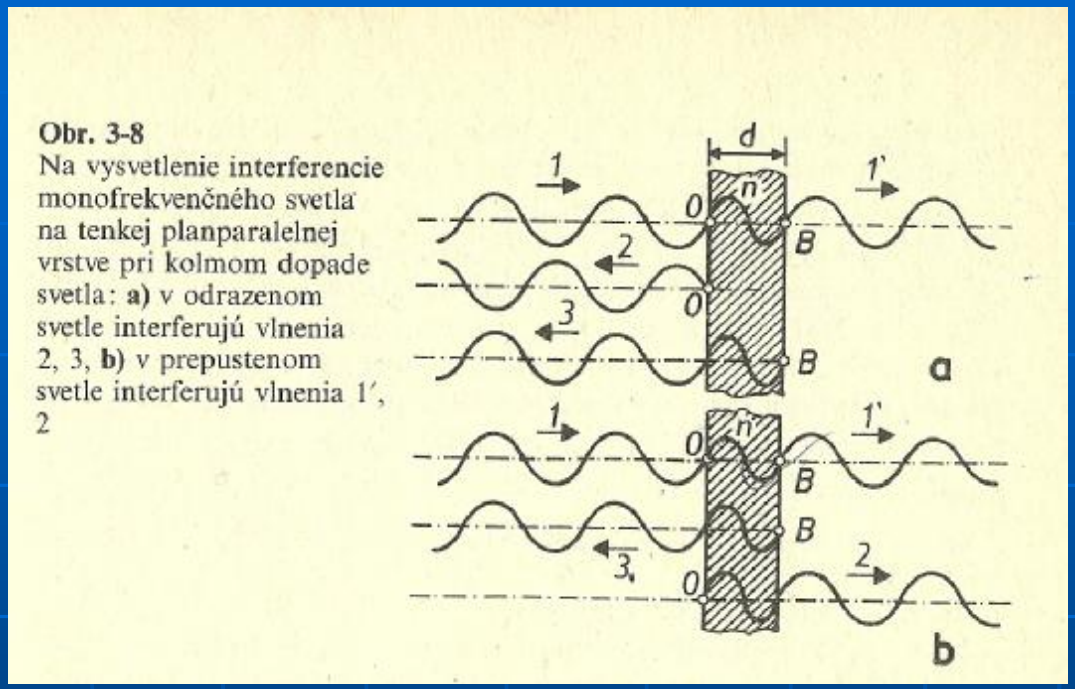
$v = \lambda f \Rightarrow f = v / \lambda = c / \lambda_0$ (wavelength of light in vacuum)

$$\lambda = \lambda_0 / n$$

- wavelength is n-times smaller as light passes the medium from vacuum.

A wavelength of yellow sodium light in air is λ = 589.593 nm, refractive index of carbon disulphide is n = 1.626. Calculate frequency , wavelength and speed of the yellow sodium light in carbon disulphide. Is the colour of the light changed as it passes the Carbon disulphide?

Interference:



1. **the waves have the same frequency and wavelength and are exactly in phase.**
2. **$\Delta l = 2\ n\ d$** (n – index of refraction of given medium, d – thickness of planparallel plane)
3. **maximum:** $2\ n\ d = (\ 2\ k - 1\ )\ \lambda / 2$

   minimum: $2\ n\ d = 2\ k\ \lambda / 2$

- Calculate thickness of soap bubble with $n = 1.350$ and wavelength $\lambda = 589.3$ nm.