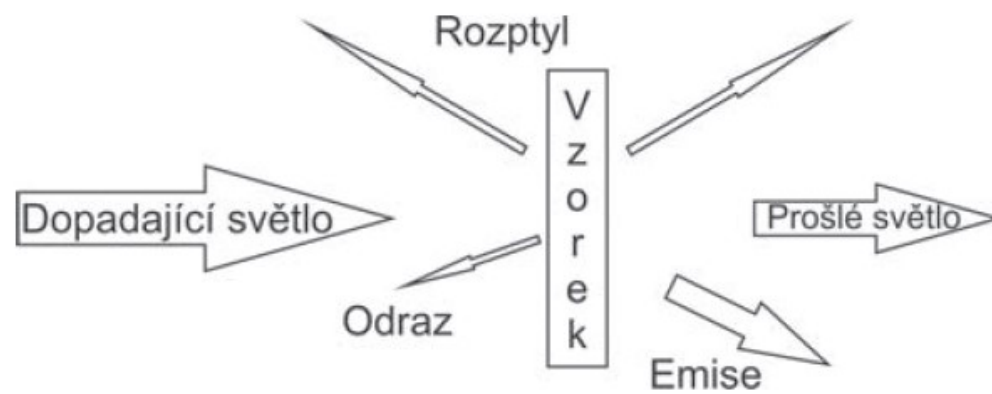
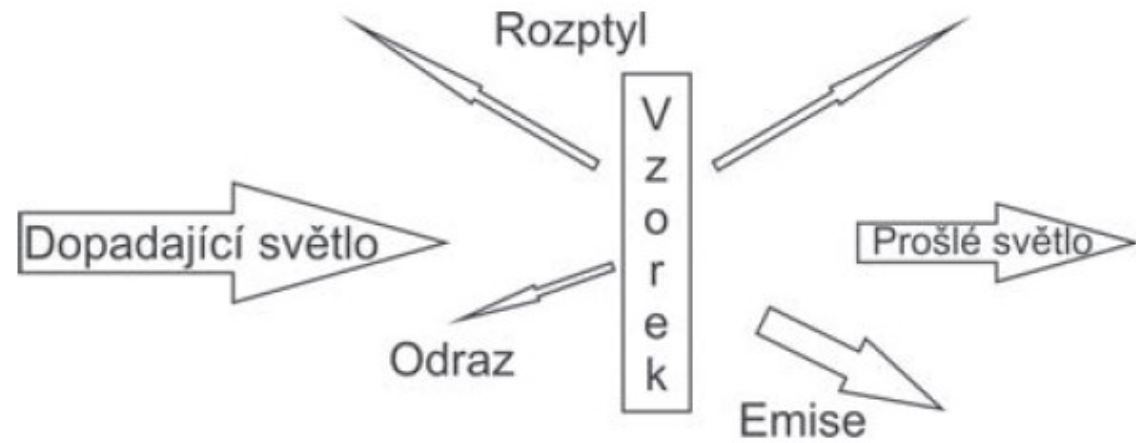


Spektroskopie



Obr. 11.1 Interakce světla s látkou

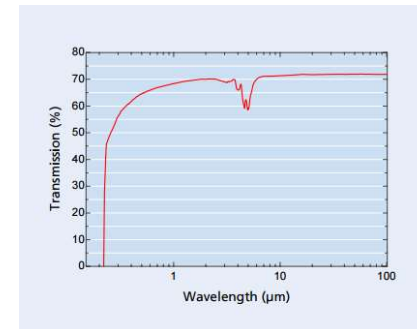
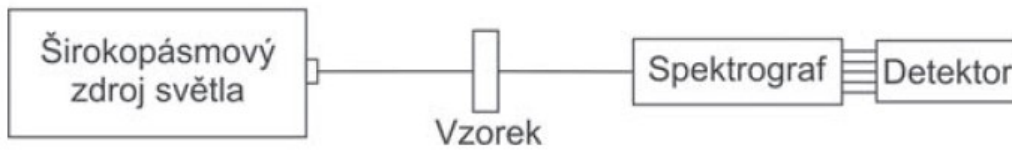
Interakce světla s látkou



Co se dá měřit?

$$T(\nu) = I_t(\nu) / I_0(\nu)$$

transmise



Obr. 11.2 Uspořádání pro transmisní měření

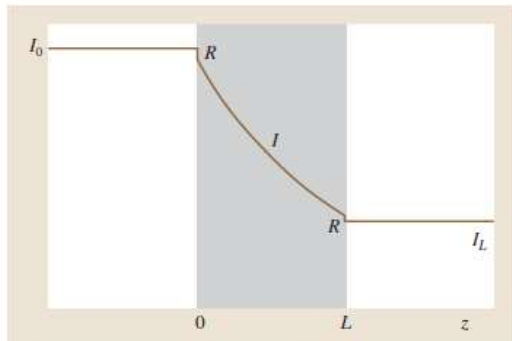


Fig. 5.10 Illustration of the Lambert–Beer law, displaying the bulk absorption inside the optical material and reflective Fresnel losses R at both surfaces

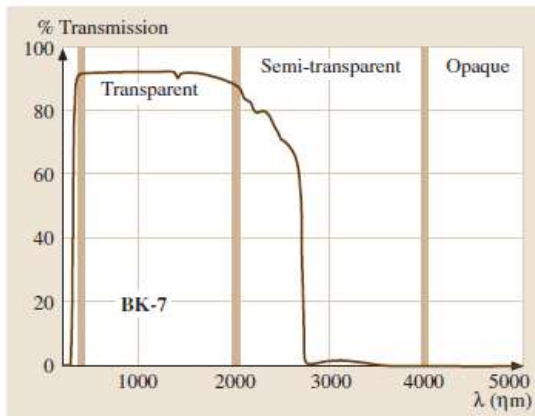
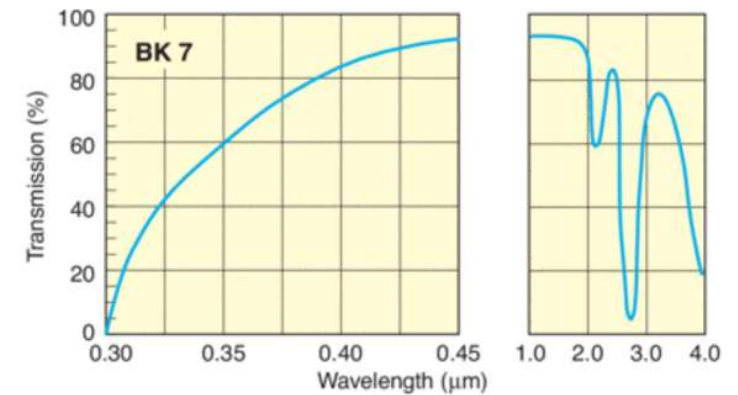
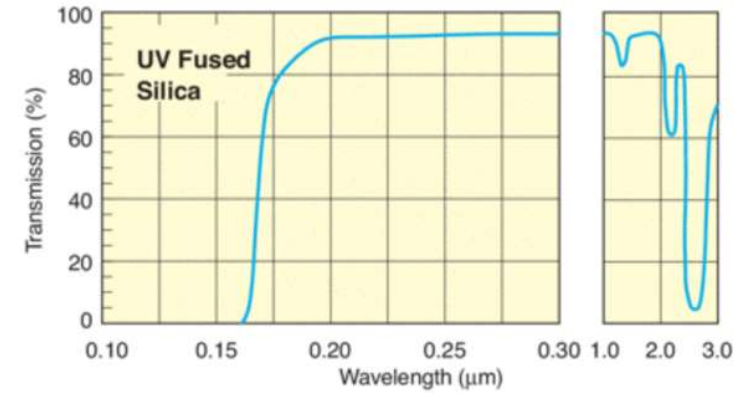
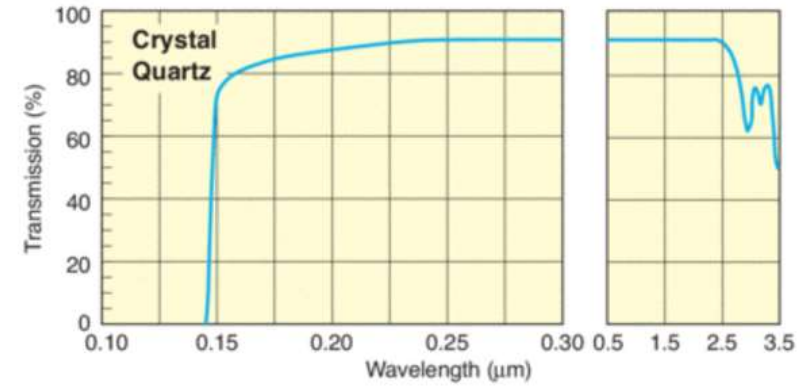
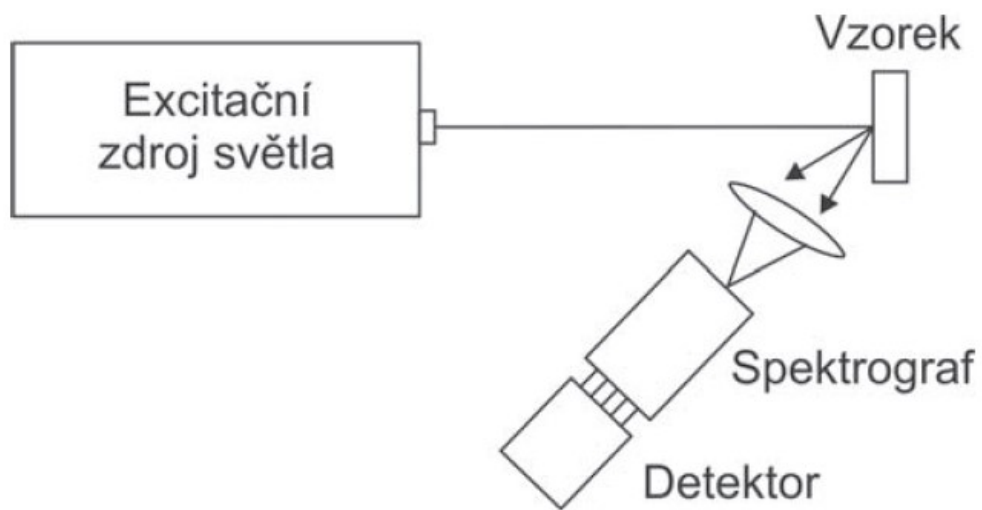


Fig. 5.11 Transmission through 10 mm thick BK-7 optical glass showing regions of transparency (visible), semi-transparency (near IR) and opacity (far IR)





Obr. 11.3 Uspořádání pro luminiscenční měření

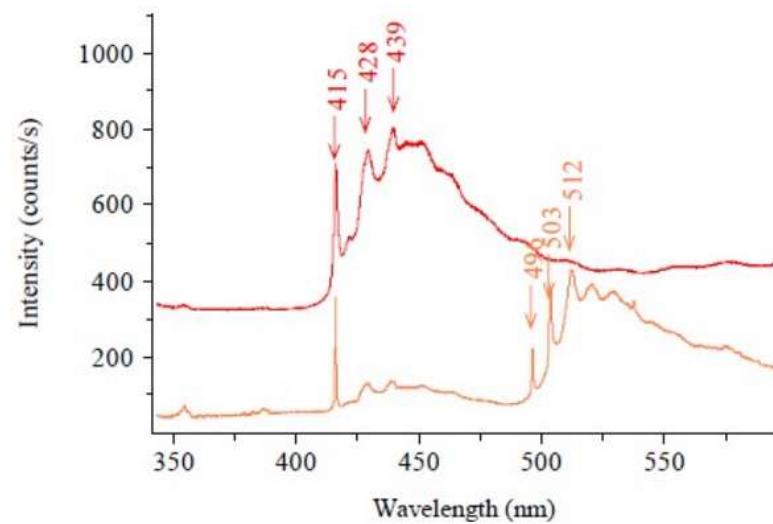
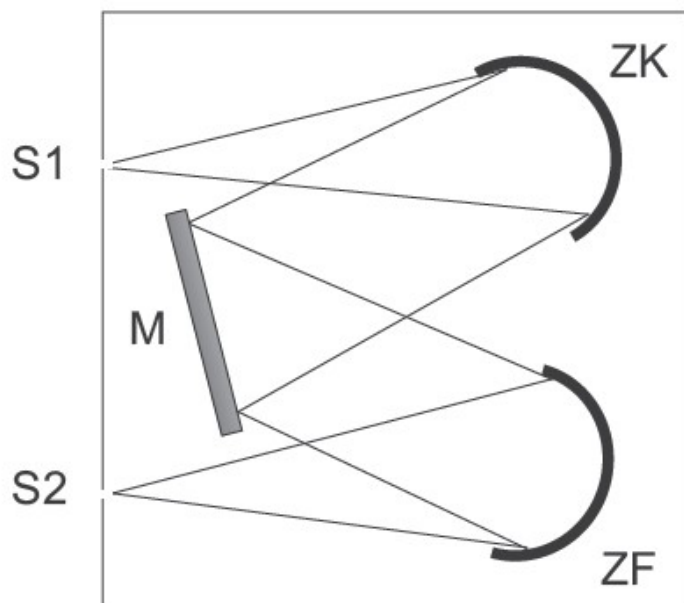


Figure 4. PL bands of the natural and irradiated yellow diamonds at -100°C



Obr. 11.5 Možné uspořádání monochromátoru (tzv.uspořádání Czerny-Turner) s rovinnou mřížkou. Světlo vstupuje do monochromátoru vstupní štěrbinou S1, je kolimováno zrcadlem ZK, dopadá na mřížku M a je fokusováno zrcadlem ZF do výstupní roviny

$$R_s = \left| \frac{\lambda}{\Delta\lambda} \right|$$

Spektrální rozlišení

$$\Delta\lambda = \lambda_2 - \lambda_1$$

$$\Delta\theta = \frac{d\theta}{d\lambda} \Delta\lambda$$

Úhlová disperze

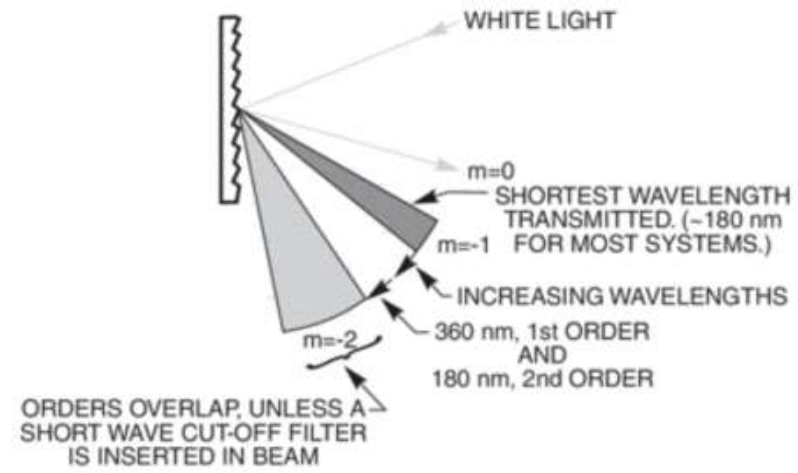
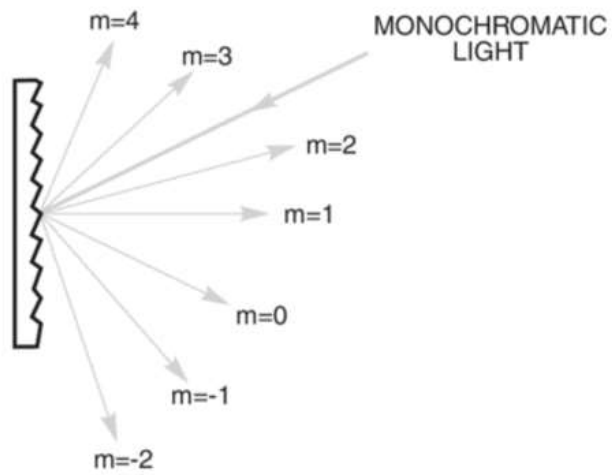
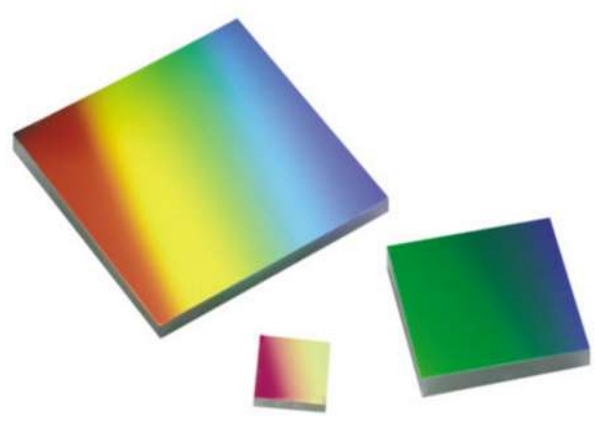
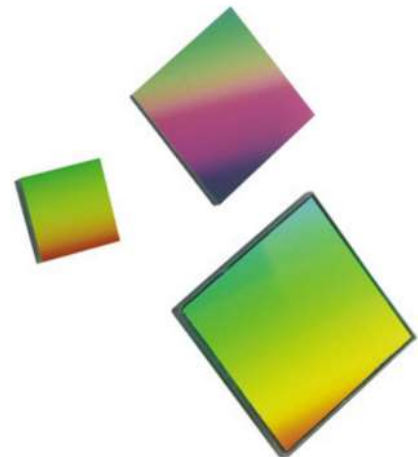


Figure 2: The "Grating Equation" satisfied for a parallel beam of monochromatic light.



Plane Ruled Reflection Gratings

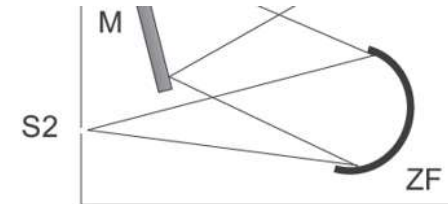


Plane Holographic Reflection Gratings

Rozlišení spektrálních přístrojů

$$\Delta\theta = \frac{d\theta}{d\lambda} \Delta\lambda$$

Úhlová disperze



$$\Delta x_2 = f_2' \Delta\theta$$

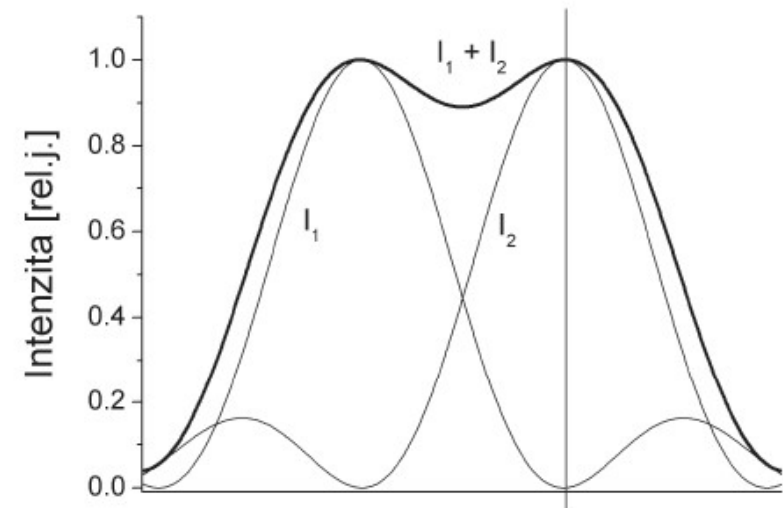
Rayleighovo kritérium

$$\theta_{\min} \approx \frac{\lambda}{d}$$

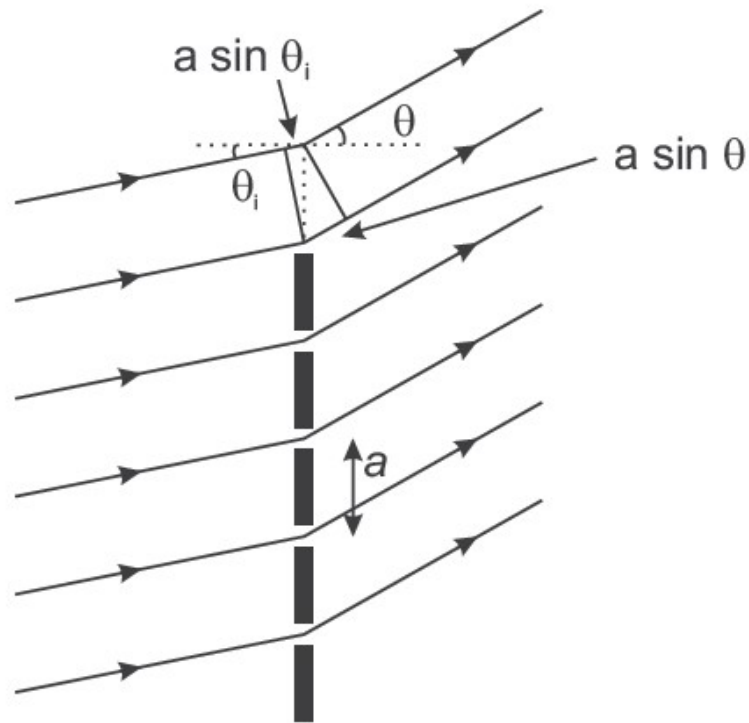
$$\Delta \hat{x}_2 \approx f_2' \frac{\lambda}{d}$$

$$\Delta x_2 = \Delta \hat{x}_2$$

$$R_s = \left| \frac{\lambda}{\Delta\lambda} \right| \approx d \left| \frac{d\theta}{d\lambda} \right|$$



Optická ohybová mřížka



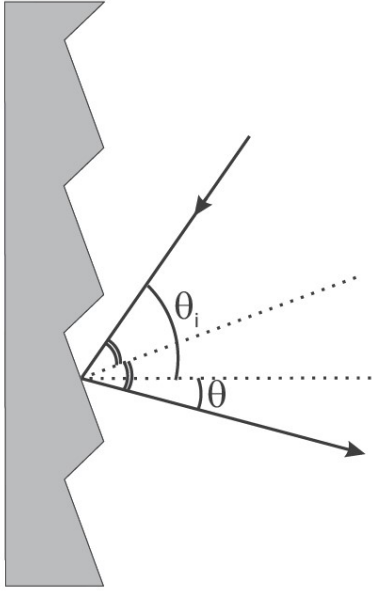
$$a(\sin \theta_i - \sin \theta_m) = m \lambda$$

$$\frac{d\theta_m}{d\lambda} = -\frac{m}{a \cos \theta_m}$$

$$l = \frac{d}{\cos \theta_m}$$

$$R_S = d \frac{|m|}{a \cos \theta_m} = \frac{l}{a} |m| = N |m|$$

pů, „čar“) na milimetr. Například pro mřížku s 1200 čarami/mm, která má velikost $l = 5$ cm, dostáváme v prvním řádu rozlišení $R_S = 60\,000$.



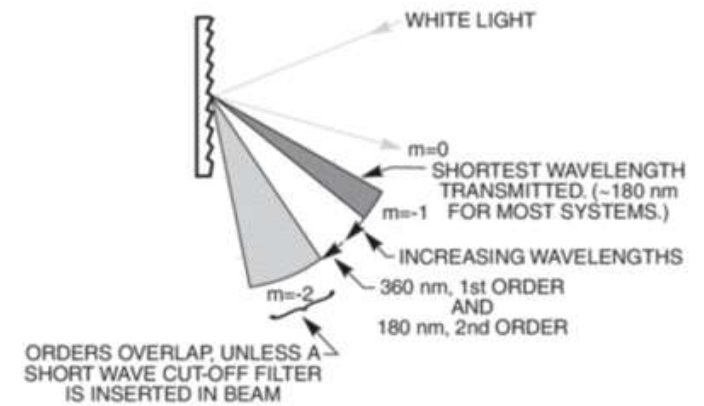
vlnný spektrální interval \bar{F}_S .

$$m \lambda_2 = (m + 1) \lambda_1$$

$$F_{Sm} = \lambda_2 - \lambda_1$$

$$F_{Sm} = \frac{\lambda_1}{m}$$

$$\frac{\lambda}{mN} \leq \Delta\lambda \leq \frac{\lambda}{m}$$

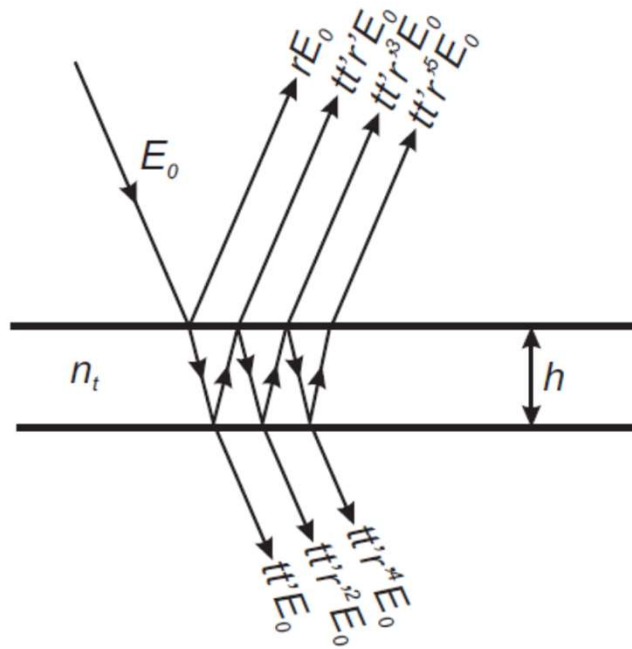




Interferometry

Fabry-Perotův interferometr

MNOHOSVAZKOVÁ INTERFERENCE



$$r = -r'$$

$$r^2 + tt' = 1.$$

Stokesovy vztahy

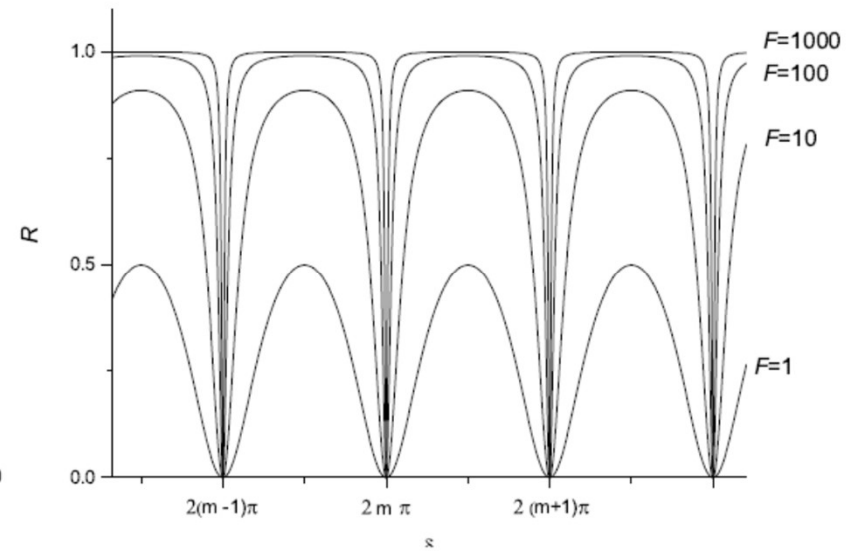
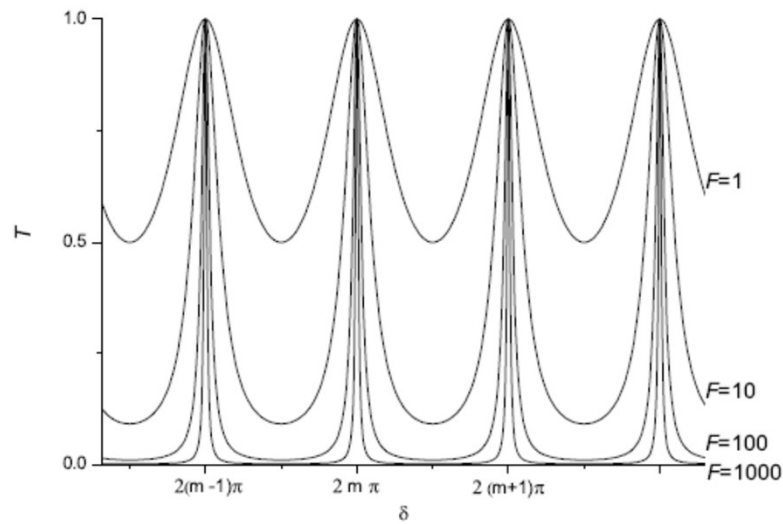
1. $tt'E_0 \exp(i\delta_0)$
2. $tt'r'^2 E_0 \exp(i\delta_0) \exp(i\delta)$
3. $tt'r'^4 E_0 \exp(i\delta_0) \exp(i2\delta)$
4. $tt'r'^6 E_0 \exp(i\delta_0) \exp(i3\delta)$

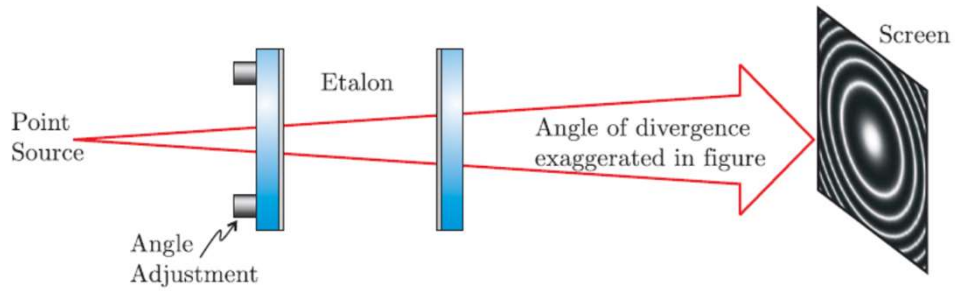
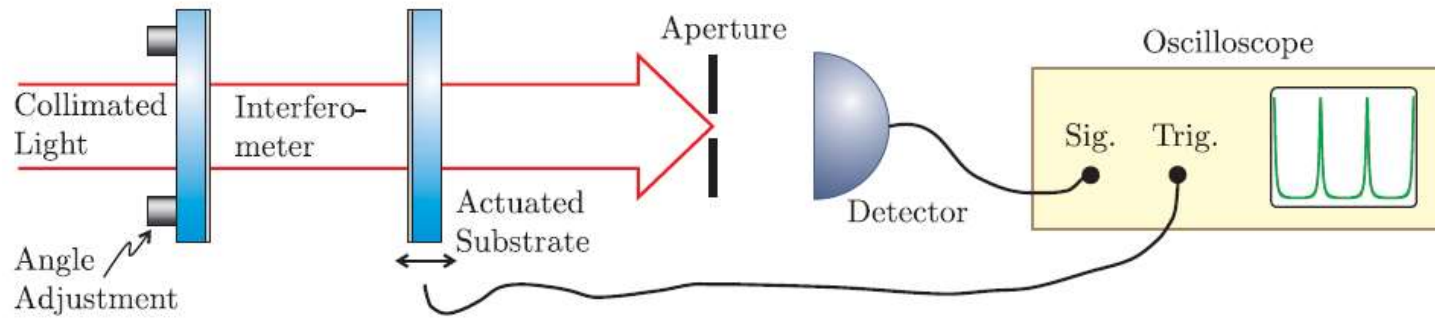
$$I_t = I_0 \frac{1}{1 + F \sin^2 \frac{\delta}{2}}$$

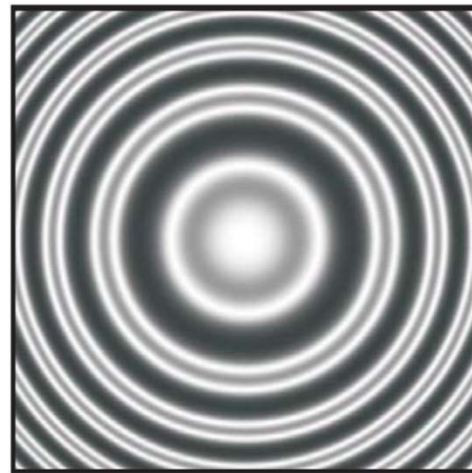
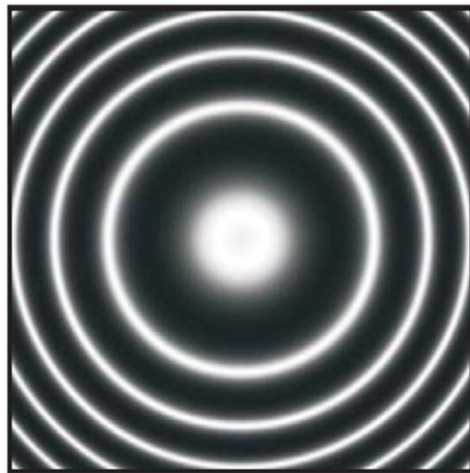
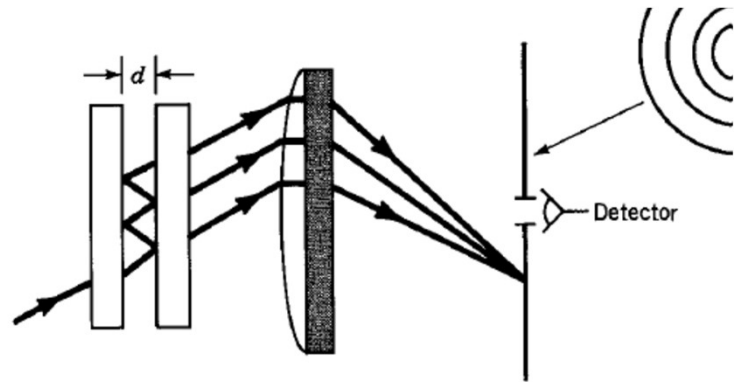
$$F = \frac{4R}{(1-R)^2}$$

$$R_d + T_d = 1$$

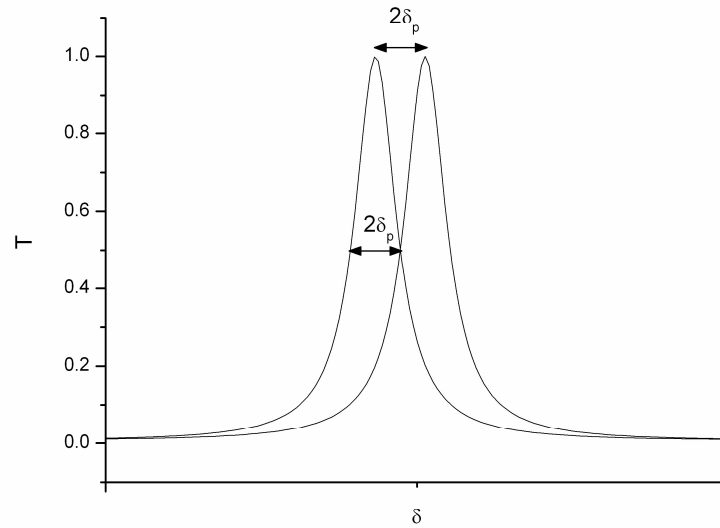
Airyho funkce







Spektrální rozlišení Fabry-Perotova interferometru



$$\left(\sin \frac{\delta_p}{2}\right)^2 = \frac{1}{F}$$

$$\delta = \frac{4\pi}{\lambda} h \cos \theta_t.$$

$$\Delta\delta_{\min} = 2\delta_p \approx \frac{4}{\sqrt{F}}$$

$$|\Delta\delta| = 4\pi h \cos \theta_t \frac{\Delta\lambda}{\lambda^2}$$

$$|\Delta\delta| = 4\pi h \cos\theta_t \frac{\Delta\lambda}{\lambda^2}$$

$$\Delta\lambda_{\min} = \frac{\lambda^2}{\pi h \sqrt{F} \cos\theta_t} = \frac{2\lambda}{m\pi\sqrt{F}}$$

Spektrální rozlišení Fabryho-Perotova interferometru

$$R_S = \frac{\pi}{2} m \sqrt{F}$$

Kolmý dopad

$$m = \frac{2h}{\lambda}$$

Například pro odrazivost zrcadel $R = 0.9$ a $h = 5$ cm, a světlo vlnové délky 500 nm dostáváme: $m = 4 \times 10^5$, $F = 360$ a $R_S = 12 \times 10^6$.

Volný spektrální interval

$$F_S = \frac{\lambda_1}{m} \quad F_S = \frac{\lambda^2}{2h}$$

$$m \lambda_2 = (m + 1) \lambda_1$$

$$\frac{\pi}{2} m \sqrt{F} \leq \Delta\lambda \leq \frac{\lambda^2}{2h}$$