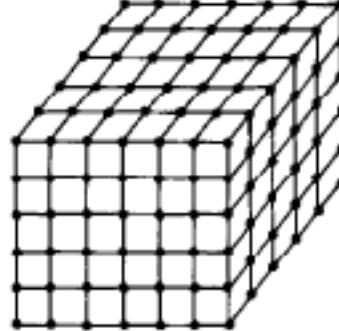


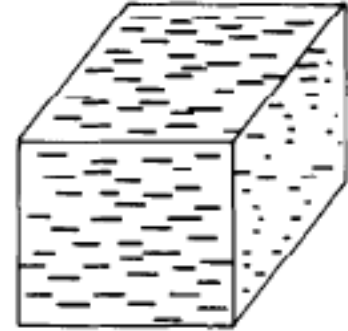
Gas, liquid,
amorphous solid



Polycrystalline

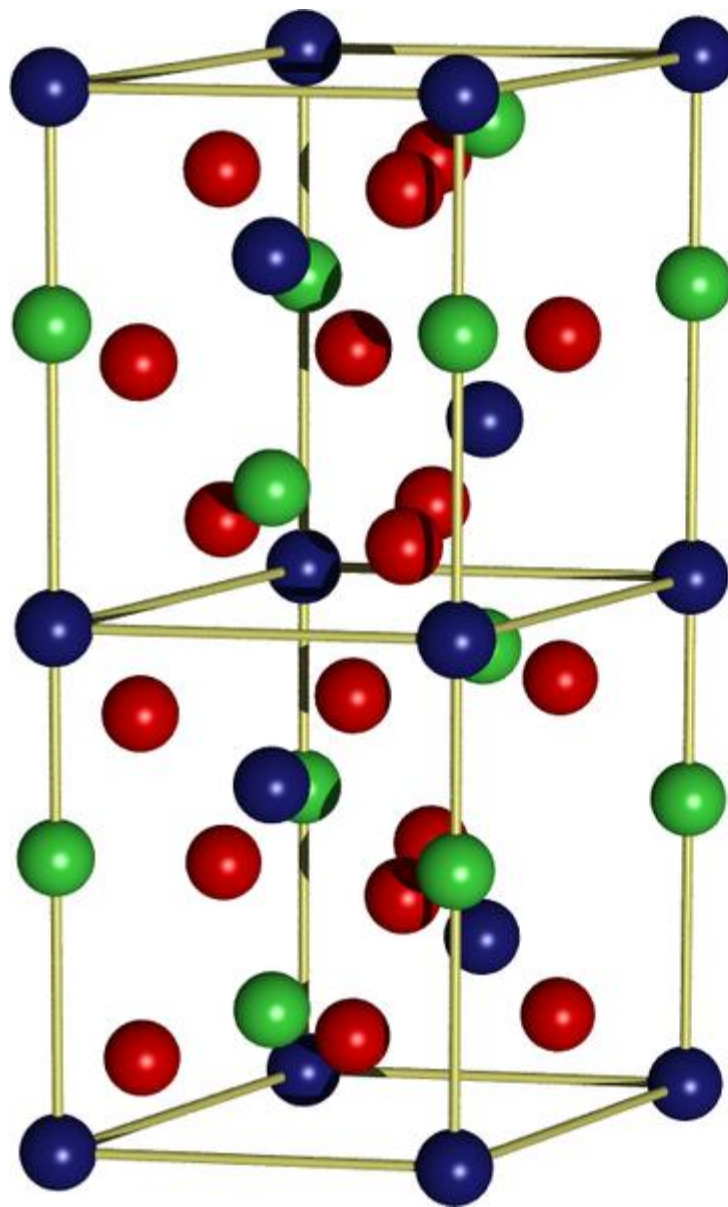


Crystalline



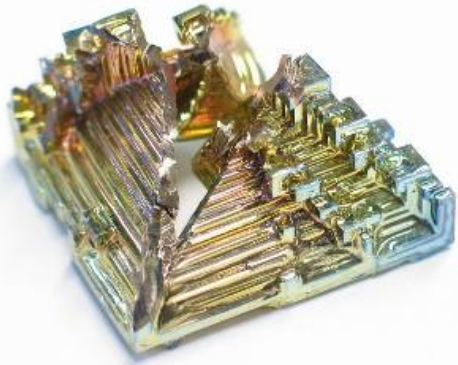
Liquid crystal

Kristaloptika



Snaigės





Bismutas



Ledas



Kvarcas

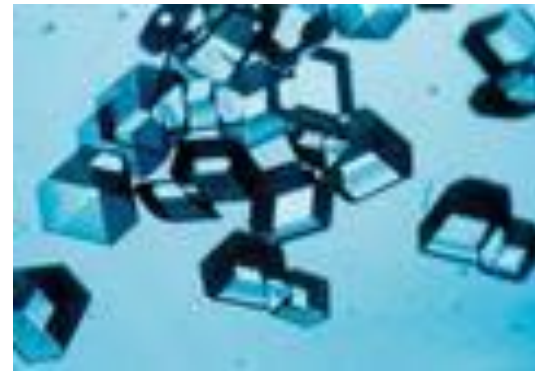




Druska

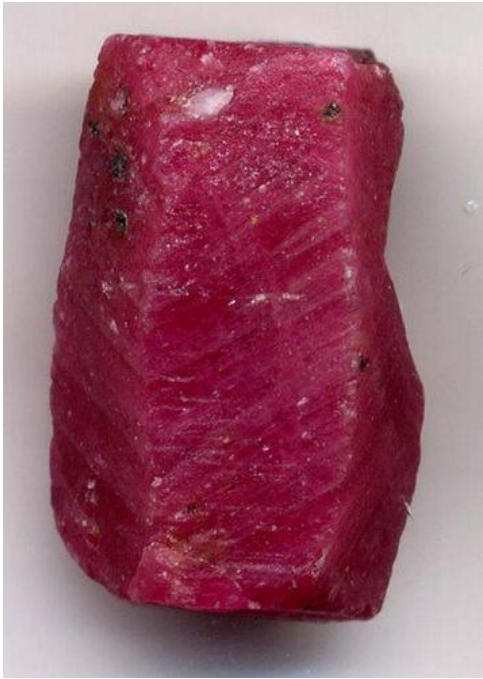


Proteinai



Insulinas





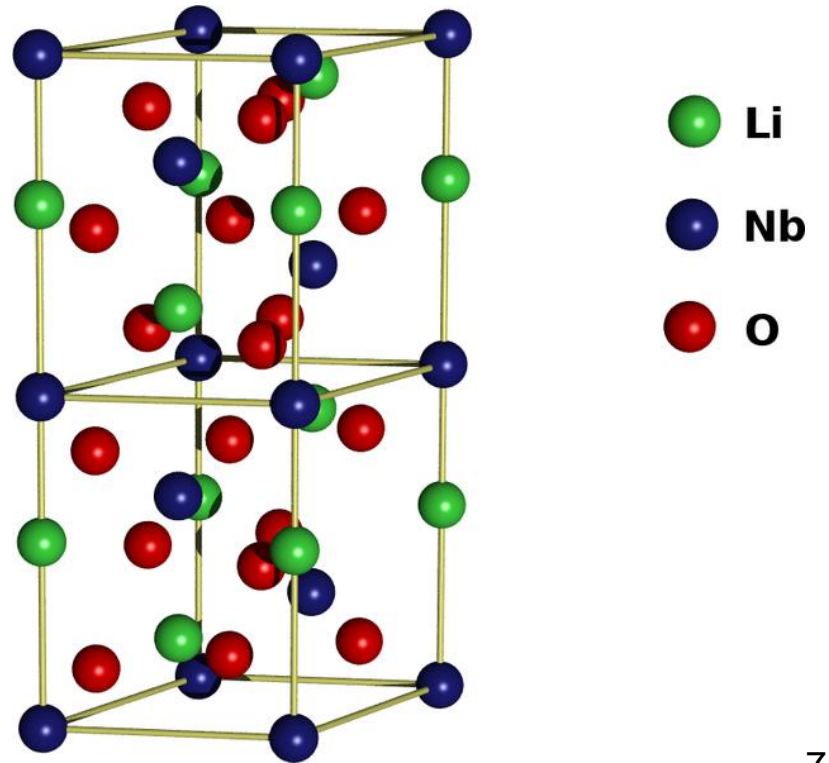
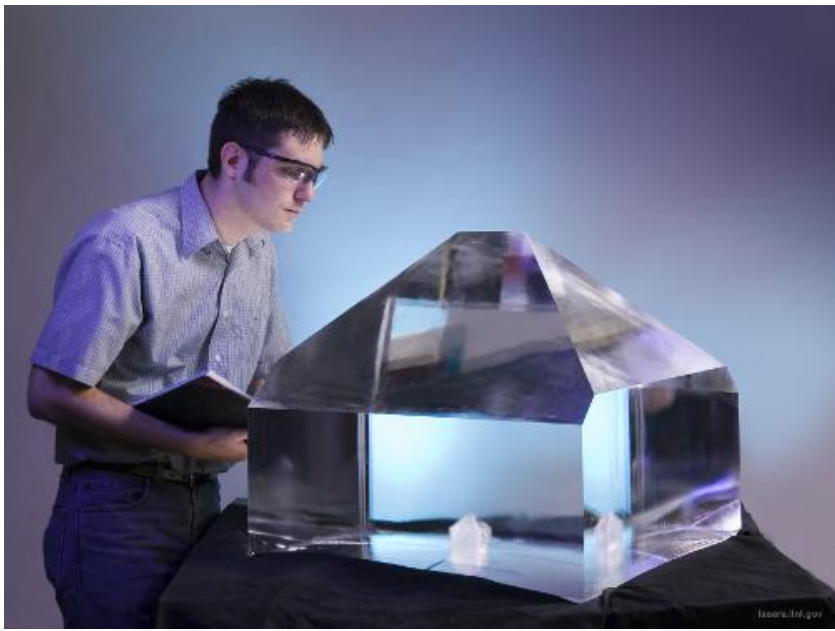
Rubinas



Kalcitas

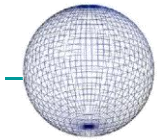


Galis

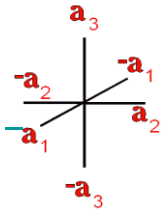


Kristalografines klasēs

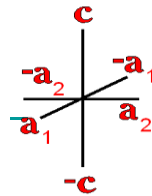
Amorfinē



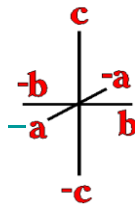
Izometrinē



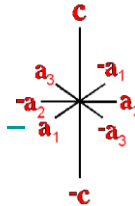
Tetragonalinē



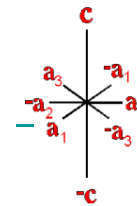
Ortorombinē



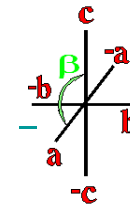
Heksagonalinē



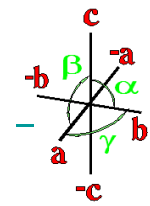
Trigonalinē



Monoklininē



Triklininē



Tetartoidal
Diploidal
Hextetrahedral
Gyroidal
Hexoctahedral

Disphenoidal
Pyramidal
Dipyramidal
Scalenoledral
Ditetragonal pyramidal
Trapezohedral
Ditetragonal-Dipyramidal

Pyramidal
Disphenoidal
Dipyramidal

Trigonal Dipyramidal
Pyramidal
Dipyramidal
Ditrigonal Dipyramidal
Dihexagonal Pyramidal
Trapezohedral
Dihexagonal Dipyramidal

Pyramidal
Rhombohedral
Ditrigonal Pyramidal
Trapezohedral
Hexagonal Scalenoledral

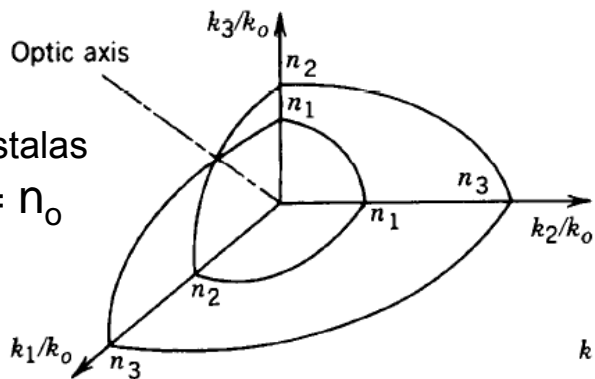
Domatic
Sphenoidal
Prismatic

Pedial
Pinacoidal

Dviašis kristalas

$$n_1 = n_2 = n_o$$

$$n_3 = n_e$$

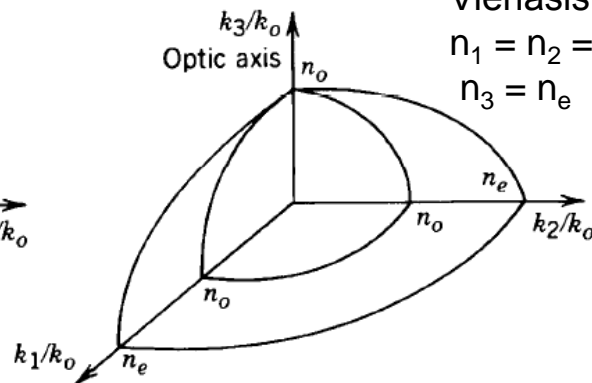


(a)

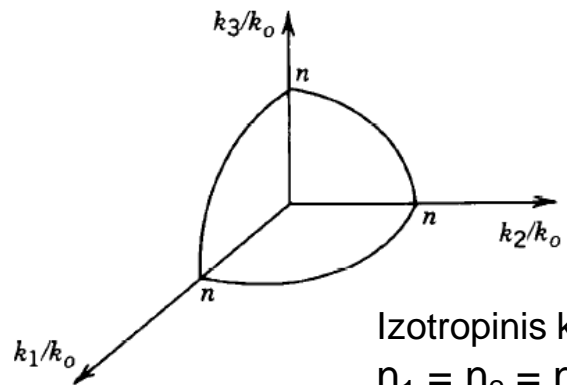
Vienašis kristalas

$$n_1 = n_2 = n_o$$

$$n_3 = n_e$$



(b)

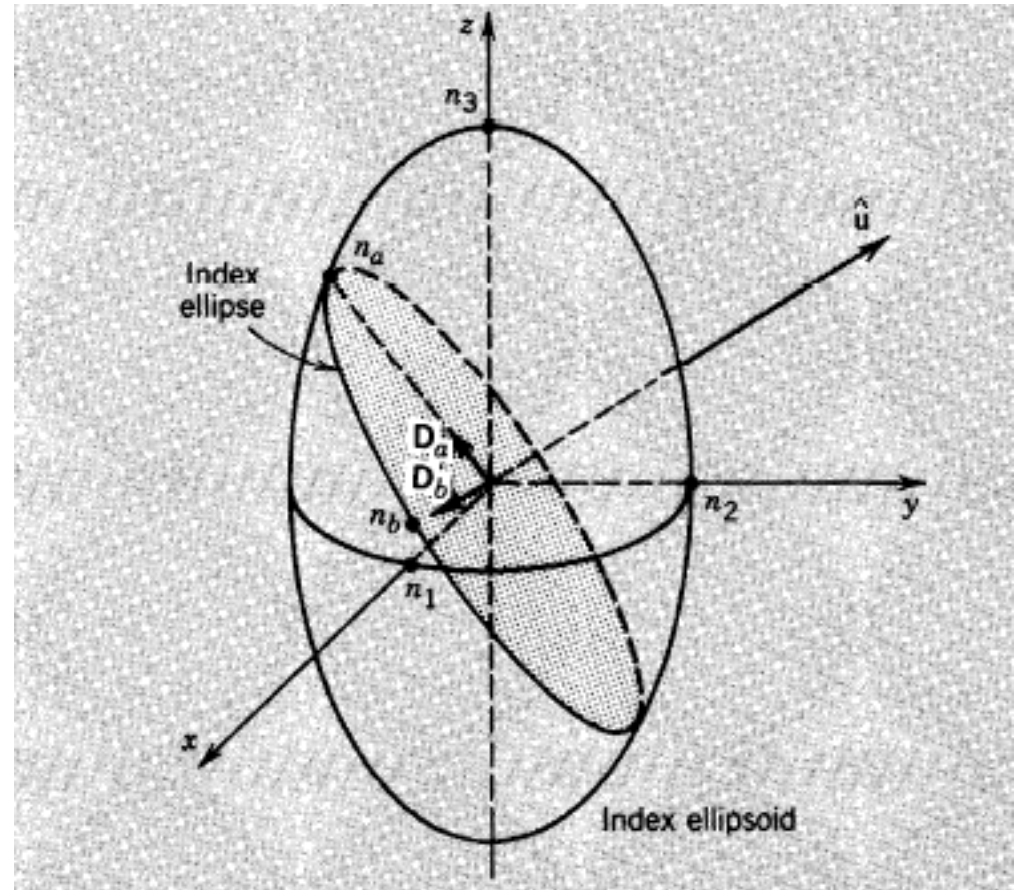
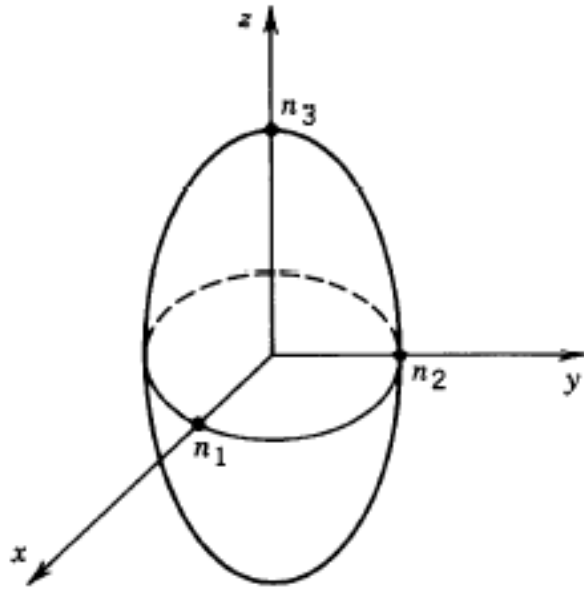


Izotropinis kristalas

$$n_1 = n_2 = n_3 = n$$

(c)

Kristaloptika

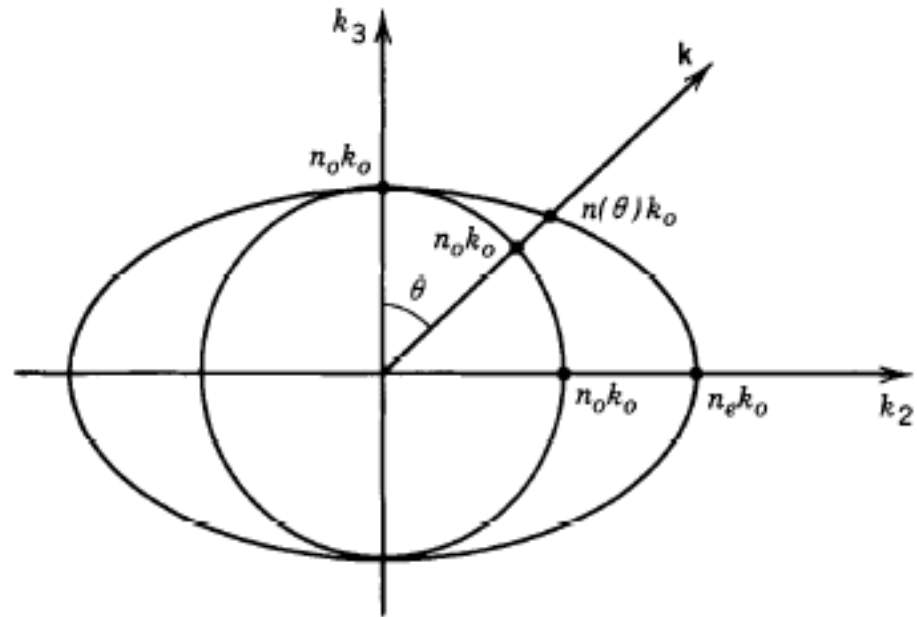


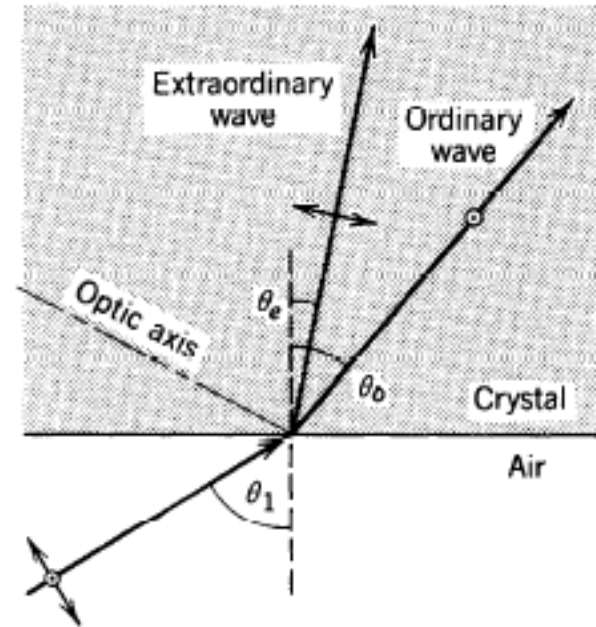
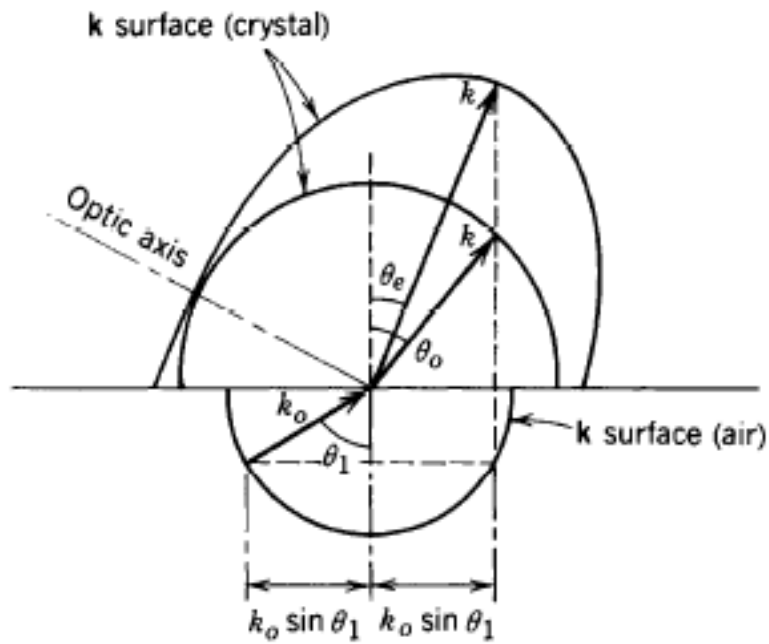
Kristalooptika

Vienaašiai kristalai

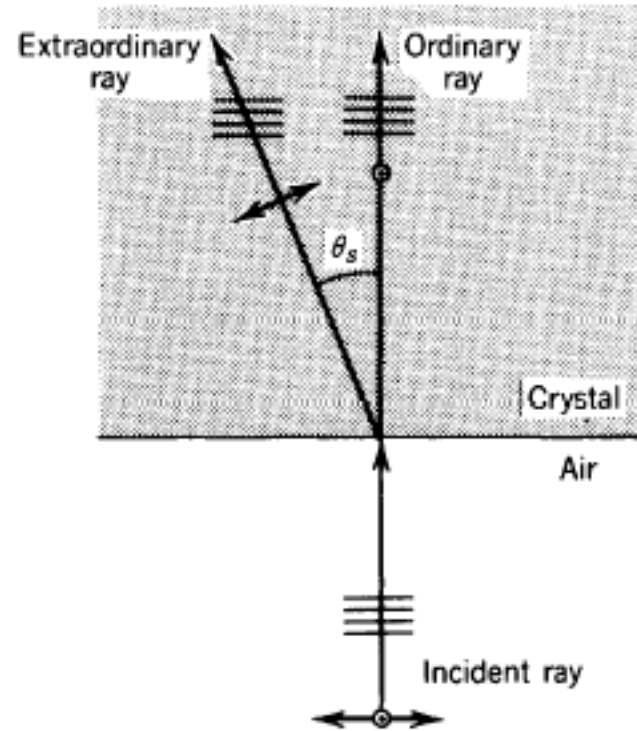
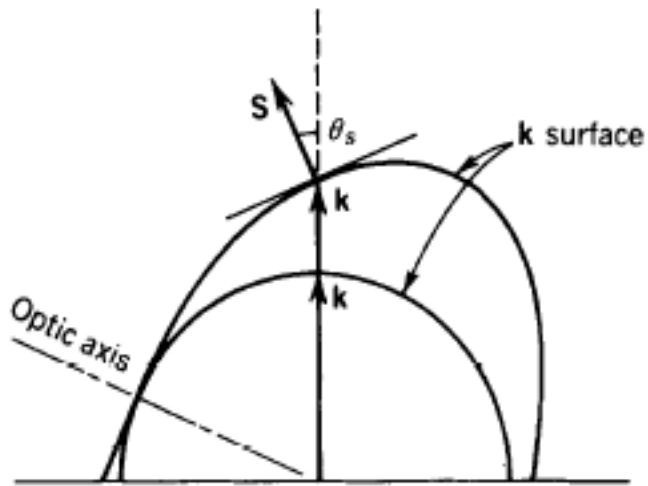
$n_o > n_e$ Optiškai neigiamas krist.

$n_o < n_e$ Optiškai teigiamas krist.





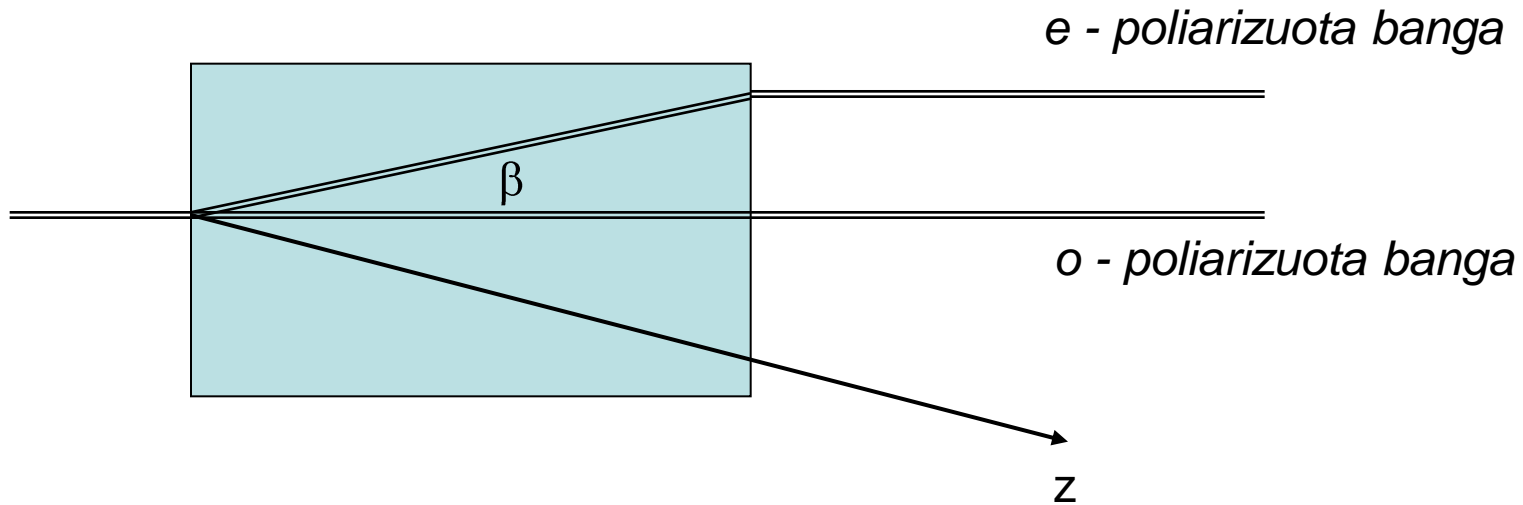
Dvejopas lūžis (bendras atvejis)



Dvejopas lūžis (statmenas kritimas)

Kristalooptika

Apertūrinis diafragminis reiškiny (walk-off)



$$\tan \beta = \tan \theta \cdot \left(\frac{\left(1 - \frac{\Delta n}{n_o}\right)^2 - 1}{\left(1 - \frac{\Delta n}{n_o}\right)^2 + \tan^2 \theta} \right),$$

$$\frac{\Delta n}{n_o} \ll 1,$$

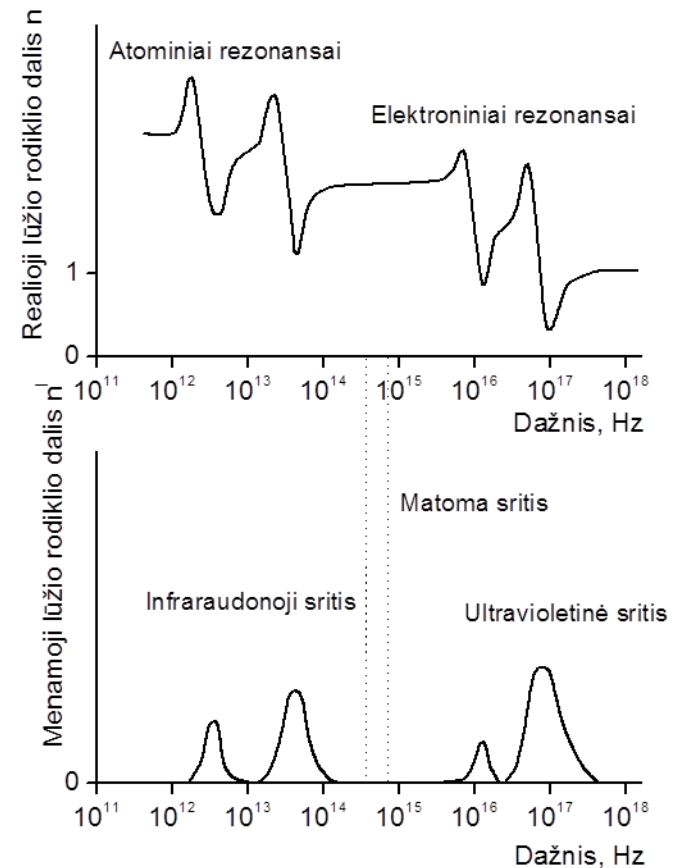
$$\tan \beta \approx \frac{2 \tan \theta \cdot \left(\frac{\Delta n}{n_o}\right)}{1 + \tan^2 \theta} \approx -\sin 2\theta \frac{n_o - n_e}{n_o}.$$

Kristalooptika

$$E(z, t) = E_0 \exp[i(\omega t - kz)] \quad k = 2\pi/\lambda = \omega n/c$$

Kai yra sugertis: $E_x(z, t) = E_0 \exp(-\alpha z) \exp[-i(\omega t - kz)] = -E_0 \exp\{-i[\omega t - (k + i\alpha)z]\}$

$$n^* = n + in' = \frac{c}{\omega}(k + i\alpha) \quad n = ck/\omega \quad n' = c\alpha/\omega$$



Kristalooptika

Elektriniam laukui E_x $p_x = \zeta E_x$ ζ - molekulės poliarizuojamumas.

$$P_x = Np_x = N\zeta E_x$$

$$\epsilon_r = \frac{(\epsilon_0 E_x + P_x)}{\epsilon_0 E_x} = 1 + \frac{P_x}{\epsilon_0 E_x} \quad \text{arba} \quad \epsilon_r = 1 + \frac{N\zeta}{\epsilon_0}$$

Kietame dielektrike (įskaitant tarpmolekulinę sąveiką): $P_x = \frac{N\zeta E_x}{1 - N\zeta/3\epsilon_0}$ ir $\epsilon_r - 1 = \frac{N/\epsilon_0}{1/\zeta - N/3\epsilon_0}$

Harmoninio osciliatoriaus diferencinė lygtis: $\ddot{x} + \gamma_k \dot{x} + \omega_{0k} x = \frac{e}{m} E \exp(-i\omega t)$

Sprendinys: $x = \frac{(eE/m) \exp(-i\omega t)}{\omega_{0k}^2 + \omega^2 - i\gamma_k \omega}$ $\omega_{0k}/2\pi$ - rezonansinis dažnis.

Poliarizuojamumas - $\zeta^* = \frac{P_x}{E_x} = \frac{x e}{E_x} = \frac{(e^2/m)}{\omega_{0k}^2 + \omega^2 - i\gamma_k \omega}$

Lūžio rodiklis: $n^* = n + in'$ $(n^*)^2 = [n^2 - (n')^2] - 2inn' = \epsilon_r^*$

$$n^2 \cong \text{Re}(\epsilon_r^*)$$

$$2nn' = \text{Im}(\epsilon_r^*)$$

Zelmejerio (*Sellmeier*) išraiška:

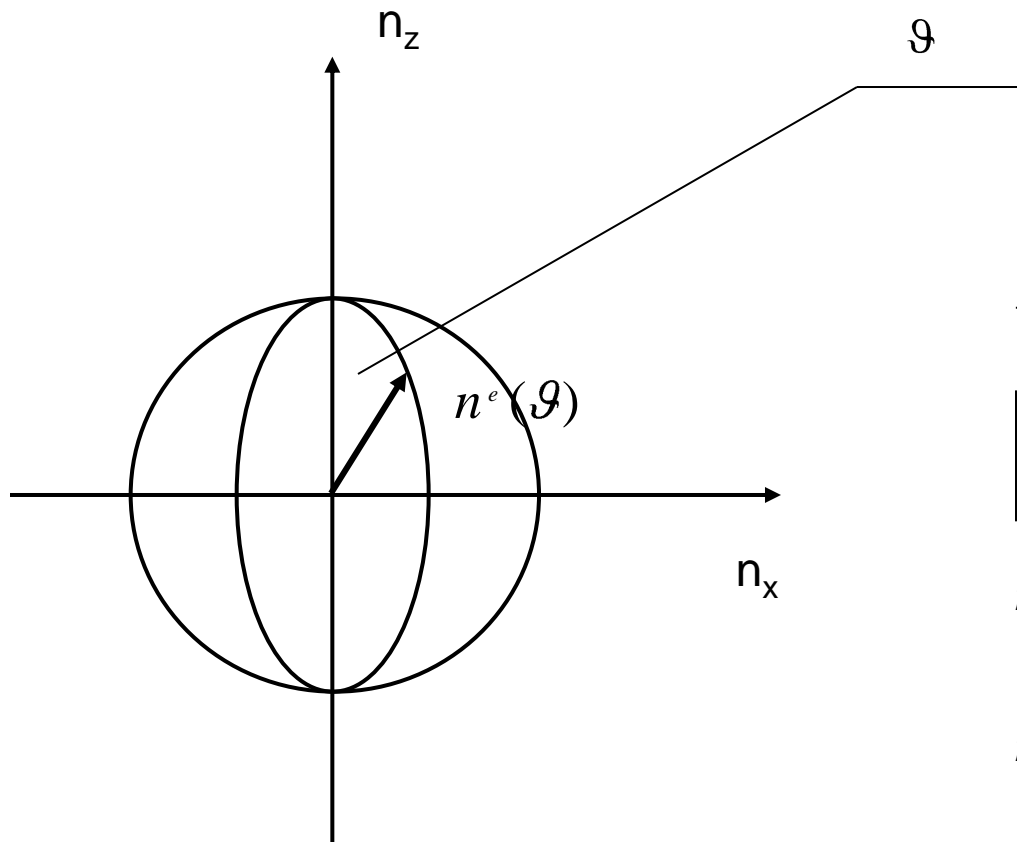
$$n_0^2 - 1 = \sum_k \frac{G_k \lambda^2}{\lambda^2 - \lambda_{1k}^2} = \sum_k \frac{g_k k}{f_{1k}^2 - f^2} \quad \text{arba} \quad n_0^2 - 1 = \frac{b_1 \lambda^2}{\lambda^2 - a_1} + \frac{b_2 \lambda^2}{\lambda^2 - a_2} + \frac{b_3 \lambda^2}{\lambda^2 - a_3}$$

Kvarciniam stiklui:

$$n(\lambda) = 1.4508554 - 0.0031268 \lambda_0^2 - 0.0031268 \lambda_0^4 + \frac{0.0030270}{\lambda_0^2 - 0.035} - \frac{0.0000779}{(\lambda_0^2 - 0.035)^2} + \frac{0.0000018}{(\lambda_0^2 - 0.035)^3}$$

$$n_o^2 = 4.913 + 1.6 \times 10^{-8} (T^2 - 88506.25) \\ + \frac{0.1163 + 0.94 \times 10^{-8} (T^2 - 88506.25)}{\lambda^2 - [0.2201 + 3.98 \times 10^{-8} (T^2 - 88506.25)]^2} - 0.0273 \lambda^2$$

$$n_e^2 = 4.546 + 2.72 \times 10^{-7} (T^2 - 88506.25) \\ + \frac{0.0917 + 1.93 \times 10^{-8} (T^2 - 88506.25)}{\lambda^2 - [0.2148 + 5.3 \times 10^{-8} (T^2 - 88506.25)]^2} - 0.0303 \lambda^2$$



$$\frac{n_z^2}{n_o^2} + \frac{n_x^2}{n_e^2} = 1,$$

$$\left[\frac{(n^e)^2}{n_o^2} \cos^2 \vartheta \right] + \left[\frac{(n^e)^2}{n_e^2} \sin^2 \vartheta \right] = 1,$$

$$n^e(\vartheta) = \frac{n_o n_e}{\sqrt{n_o^2 - (n_o^2 - n_e^2) \cos^2 \vartheta}}.$$

$$n^e(\vartheta) = \frac{n_e}{\sqrt{1 - \varepsilon^2 \cos^2 \vartheta}},$$

$$\varepsilon = \sqrt{1 - \left(\frac{n_e}{n_o} \right)^2}.$$

