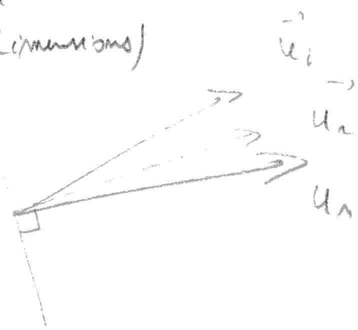
Valable

loi de Descartes vectorielle (à 3 dimensions)



$\vec{u}_i \cdot \vec{u}_n > 0$ sinon le rayon n'est pas incident

$\vec{u}_r \cdot \vec{u}_n = \cos r \geq 0$ sauf si réflexion totale

$= \sqrt{1 - \left(\frac{n_1}{n_2}\right)^2 \sin^2 i}$

$= \alpha$

$\vec{u}_r = \lambda \vec{u}_n + \mu \vec{u}_i$

$n_1 \sin i = n_2 \sin r$

$\vec{u}_r \cdot \vec{u}_n = \lambda + \mu \, \vec{u}_i \cdot \vec{u}_n = \lambda + \mu \cos i = \alpha$

$u_r^2 = \lambda^2 + 2\lambda\mu \cos i + \mu^2 = 1$

$(\alpha - \mu \cos i)^2 + 2(\alpha - \mu\cos i)\mu \cos i + \mu^2 = 1$

$\alpha^2 - 2\alpha\mu \cos i + \mu^2 \cos^2 i + 2\alpha\mu\cos i - 2\mu^2\cos^2 i + \mu^2 = 1$

$\mu^2 (1 - \cos^2 i) = 1 - \alpha^2$ $\quad \mu^2 = \left[1 - 1 + \left(\frac{n_1}{n_2}\right)^2 \sin^2 i\right] / \sin^2 i$

$= \left(\frac{n_1}{n_2}\right)^2$

μ est ≥ 0

$\mu = \frac{n_1}{n_2} \quad \lambda = \alpha - \frac{n_1}{n_2} \cos i$

$$\vec{u}_r = \left(\sqrt{1 - \left(\frac{n_1}{n_2}\right)^2 \sin^2 i} - \frac{n_1}{n_2}\cos i\right) \vec{u}_n + \frac{n_1}{n_2} \vec{u}_i$$