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Refraction for identifying matter (property of matter):

$$\eta \stackrel{opt.}{=} \frac{\sin(\alpha)}{\sin(\beta)} = \frac{\eta_\beta}{\eta_\alpha} \stackrel{prism}{=} \frac{\sin[\frac{1}{2}(\varpi + \varsigma_{min})]}{\sin[\frac{1}{2}\varpi]} \stackrel{phys.}{=} \sqrt{\epsilon_r \mu_r} = \frac{\lambda_\alpha}{\lambda_\beta} = \frac{v_{ph,\alpha}}{v_{ph,\beta}} = \frac{1}{2} \frac{\lambda}{d} \frac{n}{\cos(\beta)} = \sqrt{\left(\frac{n}{2} \frac{\lambda}{d}\right)^2 + \sin(\alpha)^2} \stackrel{dispers}{=} \quad (1)$$

$$\text{Vacuum} \iff \eta = 1 \quad f = \text{FocalLength} \quad D = \text{RefractivePower}(\text{Dioptri})$$

$$n \equiv \text{order ("Quantum")}: n = \frac{\nu}{c} \Delta s = \frac{\Delta \varphi}{2\pi} = 2\eta \frac{d}{\lambda} \sqrt{\eta^2 - \sin(\alpha)^2} = 2\eta \frac{d}{\lambda} \cos(\beta) = \frac{q}{e_0} \in \mathbb{N}$$

$$v^2 = \left(\frac{\nu \lambda}{\eta}\right)^2 = \left(\frac{\omega}{k \eta}\right)^2$$

$$\left(\frac{\eta}{c}\right)^2 = \epsilon \mu \quad \epsilon = \epsilon_0 \epsilon_r \quad \mu = \mu_0 \mu_r$$

where:

$\alpha :=$  irradiation angle, incoming radiation direction, from source/sender (Einstrahlungswinkel zur Normalen auf Grenzfläche des Mediums)

$\beta :=$  refraction angle for bented transmitted radiation  $A_t$  orientation in matter (Durchstrahlungswinkel zur Normalen aus Grenzfläche ins Medium)

Orientation of Radiation:



Figure 1: Radiation

$\vartheta$  = reflection angle for redirected radiation  $A_{r\parallel}$  parallel to  $\alpha$  from matter <sup>1</sup>

$\theta$  = diffraction angle for redirected radiation  $A_{r\perp}$  orthogonal to  $\alpha$  from matter <sup>2</sup>

$\varpi = \beta_1 + \beta_2$  = angle of converging body surfaces (point tip of prismic medium), spread angle of prism

$\varsigma$  = deviation angle of redirected ray beam after refraction (transmission) and diffraction

<sup>1</sup>Abstrahlwinkel zur Grenzfläche des Mediums

<sup>2</sup>Beugungswinkel durch Objekt ins Vakuum

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$u_g$  = aperture angle (acceptance) from sender source (at distance  $g$ )

$w_b$  = inclination angle at observer receiver (at distance  $b$ )

$\varepsilon$  = visual angle from observer/receiver (of eye)