

Refraction for identifying matter (property of matter):

$$\begin{aligned}
\eta &\stackrel{opt.}{=} \frac{\sin(\alpha)}{\sin(\beta)} = \frac{\eta_{\beta} \text{ prism}}{\eta_{\alpha}} \stackrel{=}{=} \frac{\sin[\frac{1}{2}(\varpi + \varsigma_{min})]}{\sin[\frac{1}{2}\varpi]} \\
&\stackrel{phys.}{=} \sqrt{\epsilon_r \mu_r} = \frac{\lambda_{\alpha}}{\lambda_{\beta}} = \frac{v_{ph,\alpha}}{v_{ph,\beta}} = \frac{1}{2} \frac{\lambda}{d_l} \frac{n}{\cos(\beta)} = \sqrt{\left(\frac{n}{2} \frac{\lambda}{d_l}\right)^2 + \sin(\alpha)^2} \\
&\stackrel{dispersion}{=} \eta(\lambda) = \eta(\omega) \stackrel{anisotropy}{=} \eta(r)
\end{aligned} \tag{1}$$

Vacuum  $\Leftrightarrow \eta = 1$ : <sup>1</sup>

$$f = FocalLength \quad D = RefractivePower(dioptry) \tag{2}$$

$n \equiv$  order (“quantum”):

$$n = \frac{\nu}{c} \Delta s = \frac{\Delta \varphi}{2\pi} = 2\eta \frac{d_l}{\lambda} \sqrt{\eta^2 - \sin(\alpha)^2} = 2\eta \frac{d_l}{\lambda} \cos(\beta) = \frac{q}{e_0} \in \mathbb{N} \tag{3}$$

$$v^2 = \left(\frac{\nu \lambda}{\eta}\right)^2 = \left(\frac{\omega}{k\eta}\right)^2 \tag{4}$$

$$\left(\frac{\eta}{c}\right)^2 = \epsilon \mu \quad \epsilon = \epsilon_0 \epsilon_r \quad \mu = \mu_0 \mu_r \tag{5}$$

where:

$d_l :=$  distance length

$\alpha :=$  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)

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<sup>1</sup>Brechkraft