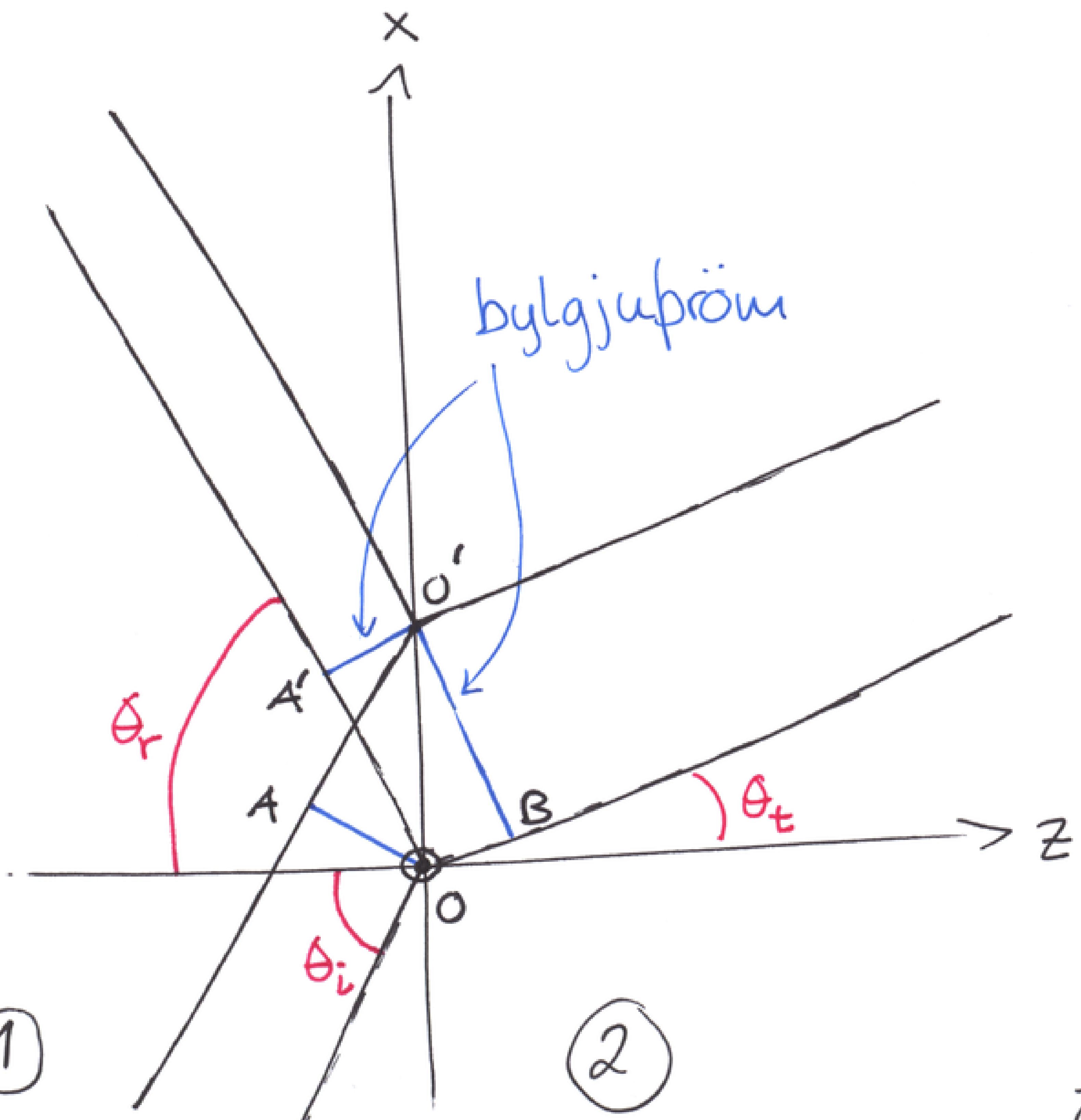
Innfall undir horni á skilfleti rafsvara



$\epsilon_1 \mu_1$ $\epsilon_2 \mu_2$

Sami fasahraði í 1

$\hookrightarrow \overline{OA'} = \overline{AO'}$

$$\overline{OO'} \sin\theta_r = \overline{OO'} \sin\theta_i$$

$$\rightarrow \boxed{\theta_r = \theta_i}$$

speglunarlögmál

snells

Eins verður að gilda

$$\frac{\overline{OB}}{u_{p2}} = \frac{\overline{AO'}}{u_{p1}}$$

$$\frac{\overline{OB}}{\overline{AO'}} = \frac{u_{p2}}{u_{p1}} = \frac{\overline{OO'} \sin\theta_t}{\overline{OO'} \sin\theta_i}$$

því fæst

$$\boxed{\frac{\sin\theta_t}{\sin\theta_i} = \frac{u_{p2}}{u_{p1}} = \frac{\beta_1}{\beta_2} = \frac{n_1}{n_2}}$$

þar sem brotstuðlarnir hafa verið skilgreindir sem

$$n_i = c/u_{pi}$$

Lögmál Snells fyrir bylgjubrot

Nú var $u_{pi} = \frac{1}{\sqrt{\mu_i \epsilon_i}}$

því fæst

$$\boxed{\frac{\sin\theta_t}{\sin\theta_i} = \sqrt{\frac{\epsilon_1}{\epsilon_2}} = \sqrt{\frac{\epsilon_{r1}}{\epsilon_{r2}}} = \frac{n_1}{n_2} = \frac{\eta_2}{\eta_1}}$$

fyrir efni með $\mu_1 = \mu_2 = \mu_0$

Ef í viðbót $\epsilon_{r1} = 1$, $n_1 = 1$

fæst

$$\boxed{\frac{\sin\theta_t}{\sin\theta_i} = \frac{1}{\sqrt{\epsilon_{r2}}} = \frac{1}{n_2}}$$

Alspeglun

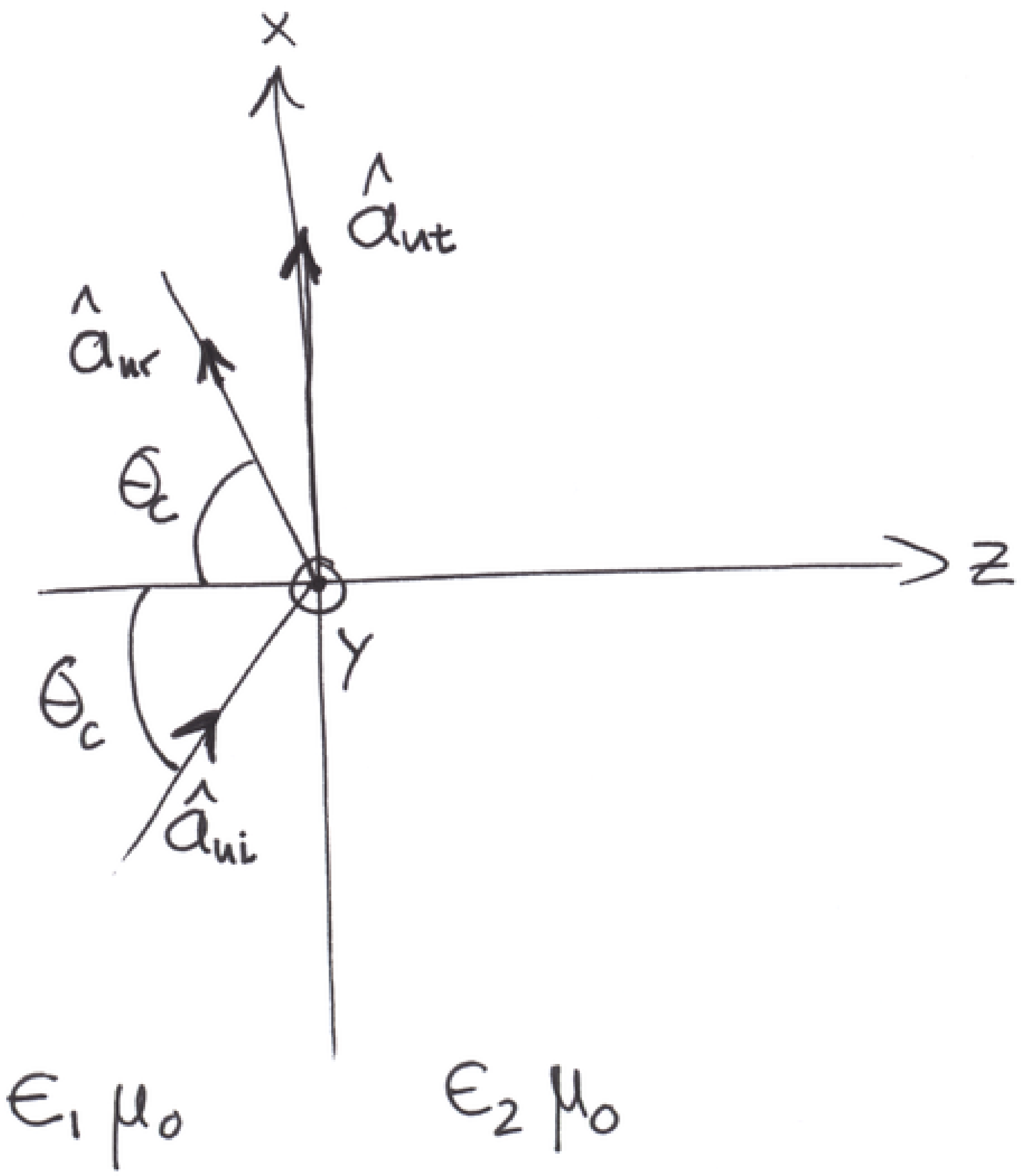
Setjum $\epsilon_1 > \epsilon_2$

$$\frac{\sin\theta_t}{\sin\theta_i} = \sqrt{\frac{\epsilon_1}{\epsilon_2}}$$

þá kemur ~~oe~~ því fyrir stórt $\theta_i = \theta_c$ að $\theta_t = \frac{\pi}{2}$

$$\sin\theta_c = \sqrt{\frac{\epsilon_2}{\epsilon_1}}$$

fyrir enn stærri θ_i fer enginn geisli inn í 2 lengur



$$\boxed{\theta_c = \arcsin\left(\frac{n_2}{n_1}\right)}$$

Í ② gildir

$$\hat{a}_{nt} = \hat{a}_x \sin\theta_t + \hat{a}_z \cos\theta_t$$

$$\frac{\sin\theta_t}{\sin\theta_i} = \sqrt{\frac{\epsilon_1}{\epsilon_2}} > 1$$

$\sin\theta_i > \sin\theta_c = \sqrt{\frac{\epsilon_2}{\epsilon_1}}$

$$\rightarrow \underbrace{\sin\theta_t}_{\text{rauntala}} = \underbrace{\sqrt{\frac{\epsilon_1}{\epsilon_2}}\sin\theta_i}_{\text{rauntala}} > 1$$

En engin rauntölulausn fyrir θ_t

$$\cos\theta_t = \sqrt{1-\sin^2\theta_t} = \pm i\sqrt{\frac{\epsilon_1}{\epsilon_2}\sin^2\theta_i - 1}$$

Bæði $\bar{E}_t$ og $\bar{H}_t$ hafa liðinn

$$e^{-i\beta_2 \hat{a}_{nt}\cdot\bar{R}} = e^{-i\beta_2(x\sin\theta_t + z\cos\theta_t)}$$

þegar $\theta_i > \theta_c$ fæst

$$e^{-\alpha_2 z} e^{-i\beta_{2x} x}$$

með

$$\alpha_2 = \beta_2\sqrt{\left(\frac{\epsilon_1}{\epsilon_2}\right)\sin^2\theta_i - 1}$$

$$\beta_{2x} = \beta_2\sqrt{\frac{\epsilon_1}{\epsilon_2}}\sin\theta_i$$

Yfirborðsbylgja
(fæst í x-y fleti/yfirborði)
og dofnandi í
z-átt

$\boxed{\text{Evanescent}}$

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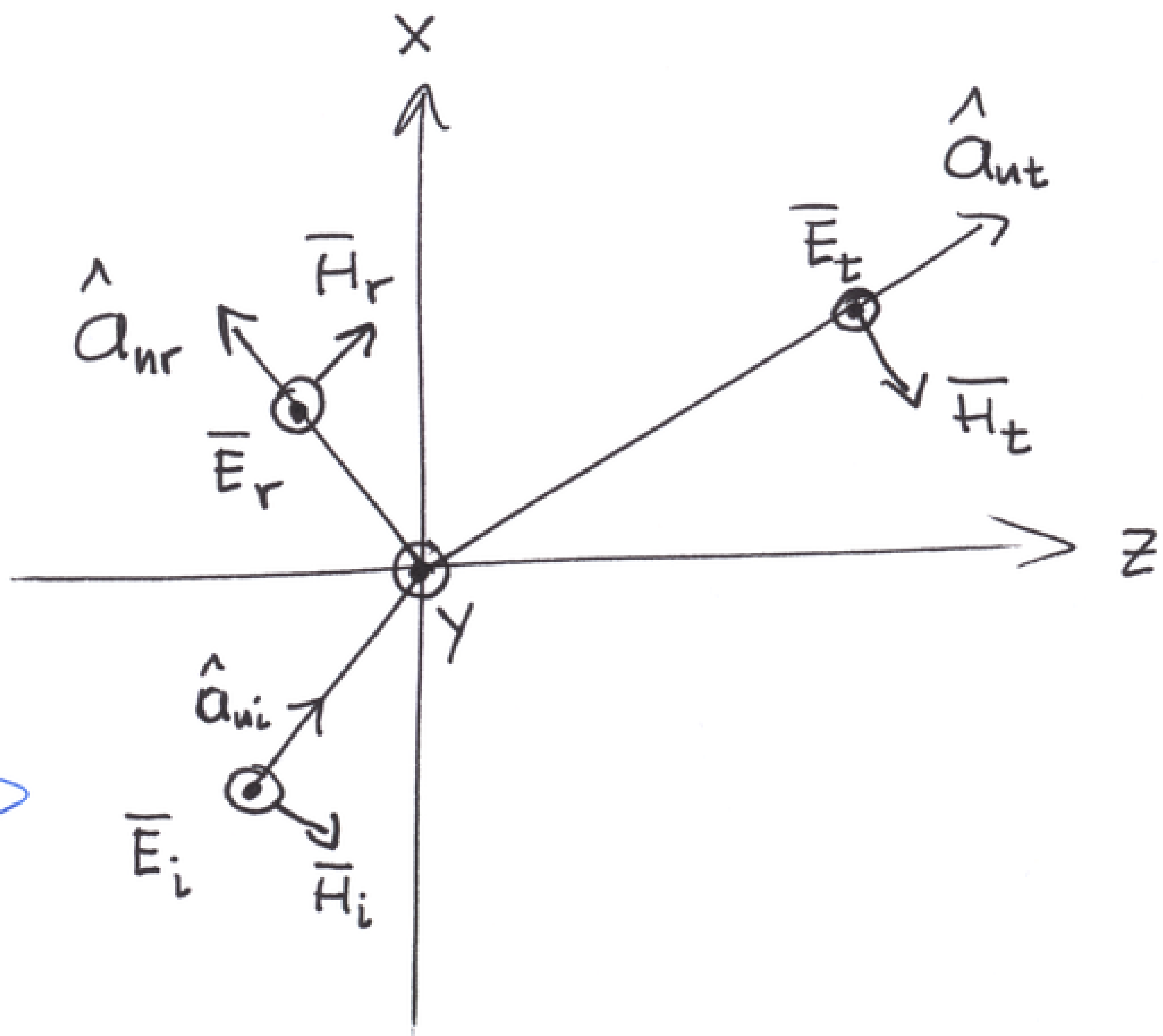
Þverskautun

Þvert á innfallssléttu



Inn

$$\overline{E}_i(x,z) = \hat{a}_y E_{i0} e^{-i\beta_1(x\sin\theta_i + z\cos\theta_i)}$$

$$\overline{H}_i(x,z) = \frac{E_{i0}}{\eta_1}(-\hat{a}_x\cos\theta_i + \hat{a}_z\sin\theta_i) \cdot e^{-i\beta_1(x\sin\theta_i + z\cos\theta_i)}$$

Speglað

$$\overline{E}_r(x,z) = \hat{a}_y E_{r0} e^{-i\beta_1(x\sin\theta_r - z\cos\theta_r)}$$

$$\overline{H}_r(x,z) = \frac{E_{r0}}{\eta_1}(\hat{a}_x\cos\theta_r + \hat{a}_z\sin\theta_r) \cdot e^{-i\beta_1(x\sin\theta_r - z\cos\theta_r)}$$

Áfram

$$\overline{E}_t(x,z) = \hat{a}_y E_{t0} e^{-i\beta_2(x\sin\theta_t + z\cos\theta_t)}$$

$$\overline{H}_t(x,z) = \frac{E_{t0}}{\eta_2}(-\hat{a}_x\cos\theta_t + \hat{a}_z\sin\theta_t) e^{-i\beta_2(x\sin\theta_t + z\cos\theta_t)}$$

fjórar óþekktar stærðir

E_{r0}, E_{t0}, θ_r, θ_t

þættir $\bar{E}$ og $\bar{H}$ samsíða skilfletinum í $z=0$ eru samfelldir

$$E_{iy}(x,0) + E_{ry}(x,0) = E_{ty}(x,0)$$

$$\downarrow$$

$$E_{i0}e^{-i\beta_1 x\sin\theta_i} + E_{r0}e^{-i\beta_1 x\sin\theta_r} = E_{t0}e^{-i\beta_2 x\sin\theta_t}$$

verður að halda fyrir öll x

→ fasar verða að passa saman

$$\beta_1 x\sin\theta_i = \beta_1 x\sin\theta_r = \beta_2 x\sin\theta_t$$

↳ Lögmál Snells

$$\theta_r = \theta_i$$

$$\frac{\sin\theta_t}{\sin\theta_i} = \frac{\beta_1}{\beta_2} = \frac{n_1}{n_2}$$

$$H_{ix}(x,0) + H_{rx}(x,0) = H_{tx}(x,0)$$

$$\frac{1}{\eta_1}\left(-E_{i0}\cos\theta_i e^{-i\beta_1 x\sin\theta_i} + E_{r0}\cos\theta_r e^{-i\beta_1 x\sin\theta_r}\right) = -\frac{E_{t0}}{\eta_2}\cos\theta_t e^{-i\beta_2 x\sin\theta_t}$$

þá verða jöfnurnar

$$E_{i0} + E_{r0} = E_{t0}$$

$$\frac{1}{\eta_1}(E_{i0} - E_{r0})\cos\theta_i = \frac{E_{t0}}{\eta_2}\cos\theta_t$$

sem gefa

$$\Gamma_\perp = \frac{E_{r0}}{E_{i0}} = \frac{\frac{\eta_2}{\cos\theta_t} - \frac{\eta_1}{\cos\theta_i}}{\frac{\eta_2}{\cos\theta_t} + \frac{\eta_1}{\cos\theta_i}}$$

$$\tau_\perp = \frac{E_{t0}}{E_{i0}} = \frac{2\frac{\eta_2}{\cos\theta_t}}{\frac{\eta_2}{\cos\theta_t} + \frac{\eta_1}{\cos\theta_i}}$$

Og eins og áður mátti við

$$\boxed{1 + \Gamma_\perp = \tau_\perp}$$

Héðan má sjá fyrri jöfnur með hornrétt-innfall þ. $\theta_t = 0$, $\theta_i = 0$

Ef ② er kjörleiðari verður $\eta_2 = 0$

$\Gamma_\perp = -1$, $\tau_\perp = 0$

engin framferð

þegar

$$\Gamma_\perp = \frac{\frac{\eta_2}{\cos\theta_t} - \frac{\eta_1}{\cos\theta_i}}{\frac{\eta_2}{\cos\theta_t} + \frac{\eta_1}{\cos\theta_i}}$$

er skoðað má spyrja hvort til sé $\theta_i = \theta_{B\perp}$ (með η_1 og η_2) þ.a. $\Gamma_\perp = 0$

engin speglun

þá þyrfti að gilda

$$\eta_2 \cos\theta_{B\perp} = \eta_1 \cos\theta_t$$

Snell gefur

$$\cos\theta_t = \sqrt{1-\sin^2\theta_t} = \sqrt{1-\frac{n_1^2}{n_2^2}\sin^2\theta_i}$$

$$\eta_2^2 \cos^2\theta_{B\perp} = \eta_1^2\left(1-\frac{n_1^2}{n_2^2}\sin^2\theta_i\right)$$

$$\eta_2^2\left(1-\sin^2\theta_{B\perp}\right) = \eta_1^2\left(1-\frac{n_1^2}{n_2^2}\sin^2\theta_i\right)$$

$$\eta_i = \sqrt{\frac{\mu_i}{\epsilon_i}}$$

Án taps

$$\beta_i = \frac{\omega}{\sqrt{\mu_i\epsilon_i}}, \quad \frac{\beta_1}{\beta_2} = \frac{n_1}{n_2}$$

því fæst

$$\boxed{\sin^2\theta_{B\perp} = \frac{1-\frac{\mu_1\epsilon_2}{\mu_2\epsilon_1}}{1-\left(\frac{\mu_1}{\mu_2}\right)^2}}$$

Brewster hornið fyrir enga speglun fyrir þverskautun

$\boxed{\begin{array}{l}\text{fyrir efni með } \mu_1 = \mu_2 = \mu_0 \\ \text{(engin segulvirkni)} \\ \text{er komið ekki til}\end{array}}$

fyrir samsíða skautun

fást jöfnurnar

$$\Gamma_{\parallel} = \frac{E_{r0}}{E_{i0}} = \frac{\eta_2 \cos\theta_t - \eta_1 \cos\theta_i}{\eta_2 \cos\theta_t + \eta_1 \cos\theta_i}$$

$$\tau_{\parallel} = \frac{2\eta_2 \cos\theta_i}{\eta_2 \cos\theta_t + \eta_1 \cos\theta_i}$$

og

$$\boxed{1 + \Gamma_{\parallel} = \tau_{\parallel}\left(\frac{\cos\theta_t}{\cos\theta_i}\right)}$$

sem er annars form en áður nema fyrir $\theta_i = \theta_t = 0$

* Ef ② er kjörleiðari fæst $\eta_2 = 0$ og aftur

$$\Gamma_{\parallel} = -1, \quad \tau_{\parallel} = 0$$

* $\boxed{\begin{array}{l}\text{Almennt er } |\Gamma_{\perp}|^2 > |\Gamma_{\parallel}|^2 \\ \text{sem fall af } \theta_i \text{, nema} \\ \text{fyrir } \theta_i = 0\end{array}}$

$\boxed{\text{Slembi-skautun bylgja sem falla á flöt undir horni leiðir til meira endurkasts þverskautaðs ljóss. (} \vec{E} \text{ liggur í sama fleti og stilflötunum)}}$

Leitum að $\theta_{B\parallel}$ (Brewster horni fyrir samsíða skautun)

$$\eta_2 \cos\theta_t = \eta_1 \cos\theta_{B\parallel}$$

Sem gefur mér að

$$\boxed{\sin^2\theta_{B\parallel} = \frac{1 - \frac{\mu_2\epsilon_1}{\mu_1\epsilon_2}}{1 - \left(\frac{\epsilon_1}{\epsilon_2}\right)^2}}$$

Samanborið við

$$\boxed{\sin^2\theta_{B\perp} = \frac{1 - \frac{\mu_1\epsilon_2}{\mu_2\epsilon_1}}{1 - \left(\frac{\mu_1}{\mu_2}\right)^2}}$$

→ nú er alltaf til lausn f. $\mu_1 = \mu_2$

$$\sin\theta_{B\parallel} = \frac{1}{\sqrt{1 + \left(\frac{\epsilon_1}{\epsilon_2}\right)}}$$

Vegna munsins á

$\theta_{B\perp}$ og $\theta_{B\parallel}$

er hægt að aðgreina

skautunarstefnur.

Því er oft talað

um skautunarhorn