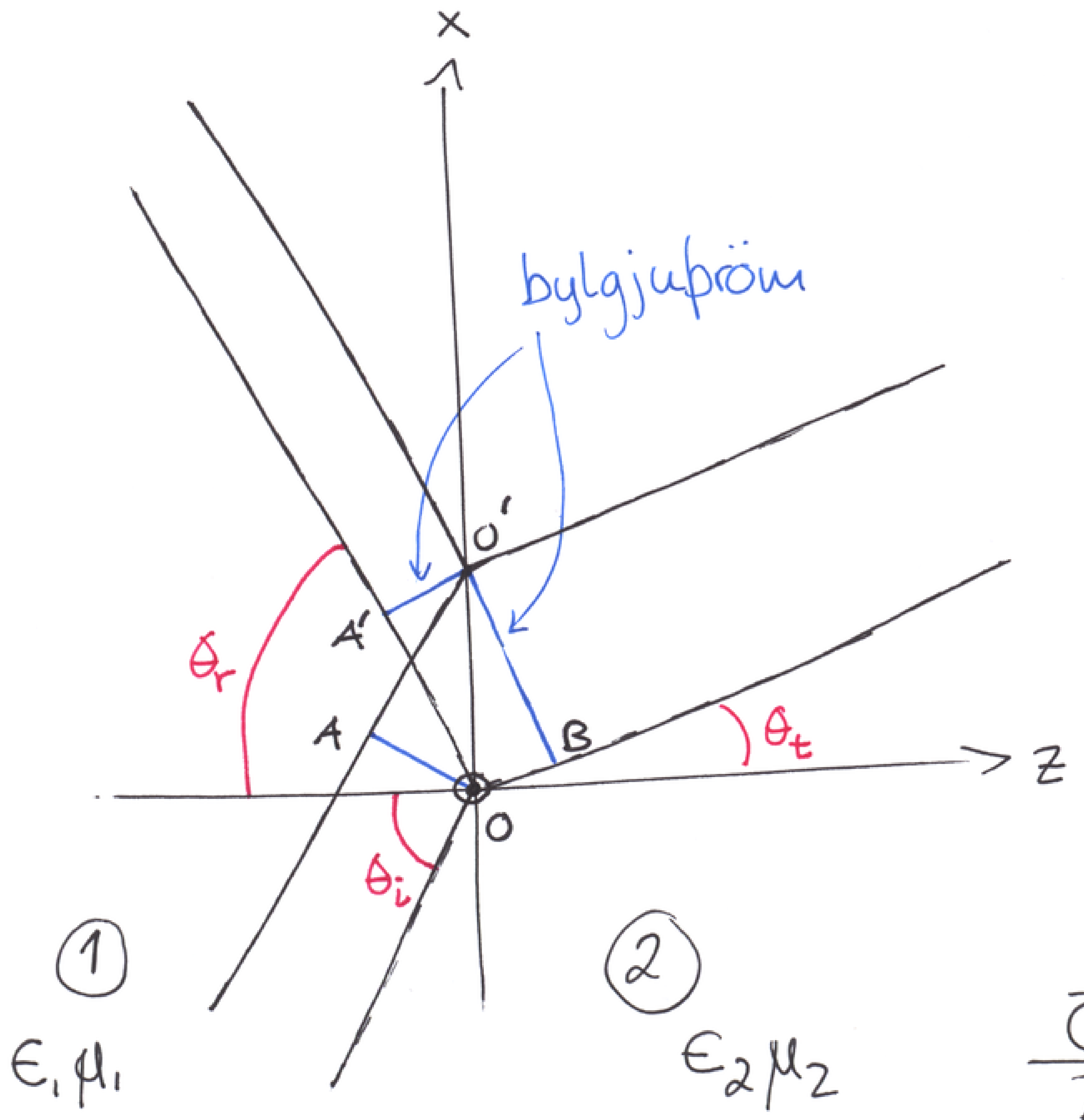
Innfall undir horni á stilfleti vefsvara



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

Einsverður að gilda

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

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

②

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 $\epsilon_{r1} = 1$, $n_1 = 1$

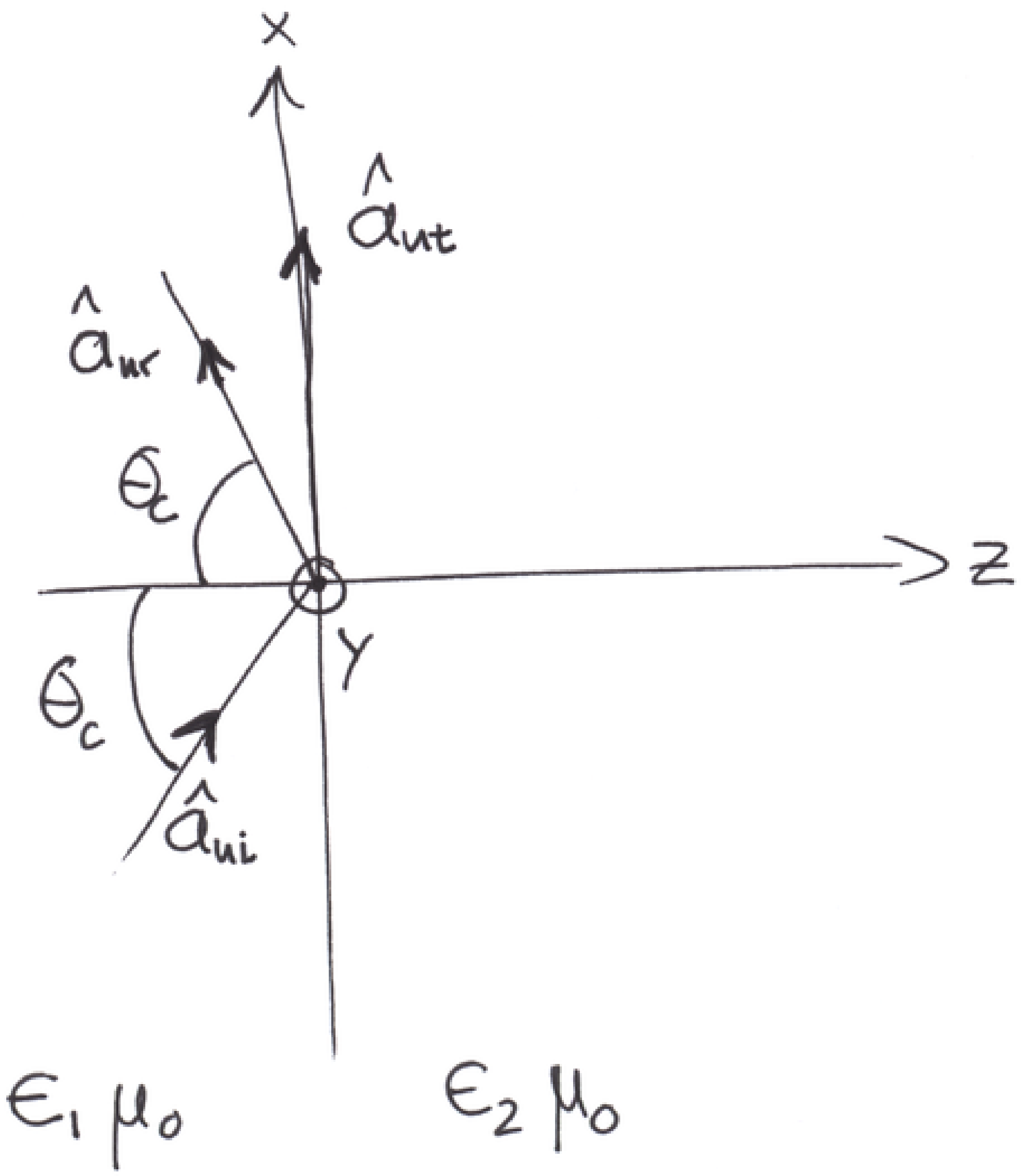
fæst

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

Alspeglun

Setjum $\epsilon_1 > \epsilon_2$

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



þá kemur að 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

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

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

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

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

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

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

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

<u>Yfirborðsbylgja</u>

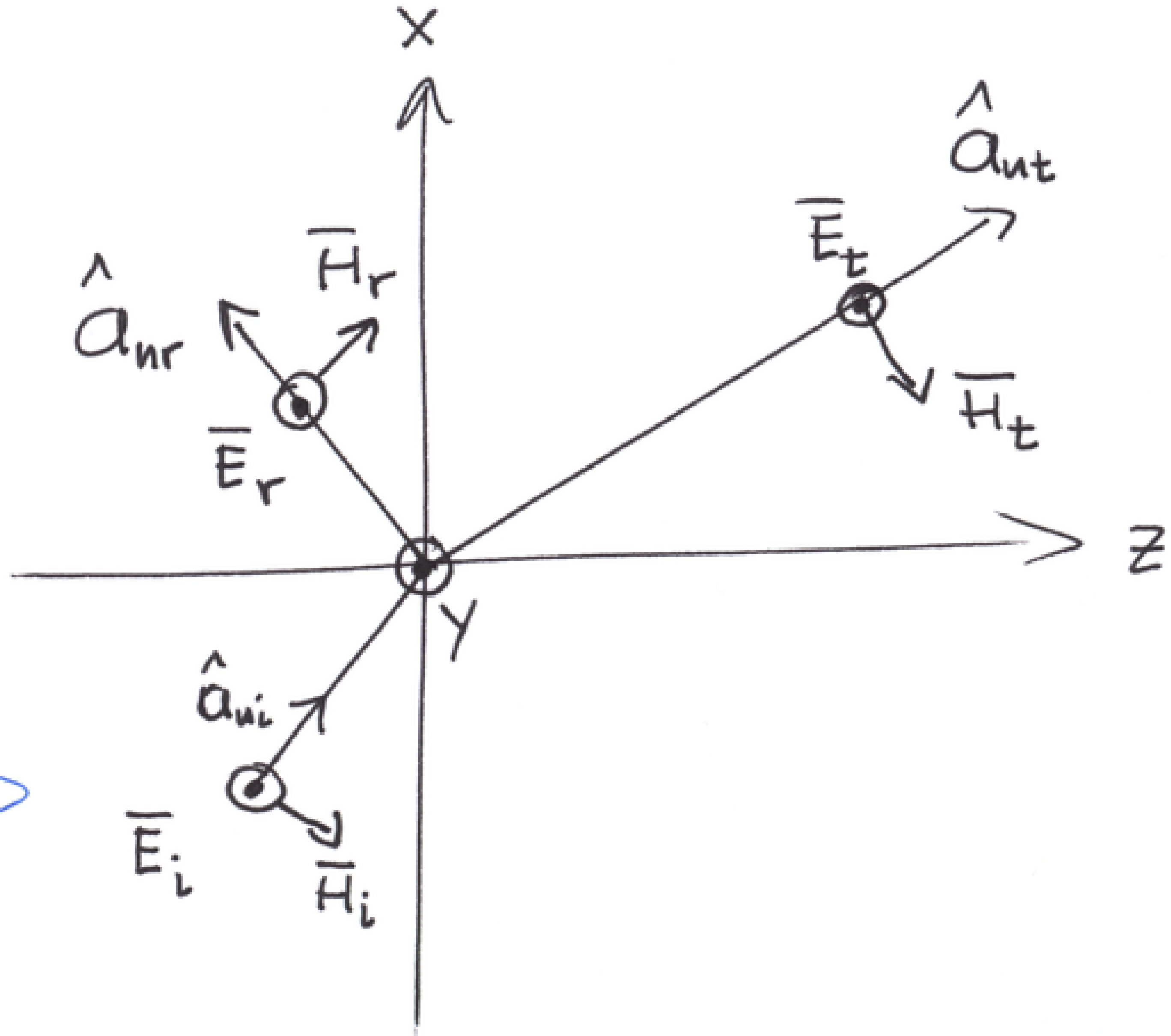
(föst í x-yfirborði)

og <u>dofnandi</u> í z-átt

$\boxed{\text{Evanescent}}$

pver skantum

pvert ā inn fallssletta



Inn

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

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

Spegla

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

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

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

$$E_{r0},\ E_{t0},\ \theta_r,\ \theta_t$$

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

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

$$\downarrow$$

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

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

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

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

$$\boxed{\begin{gathered}\theta_r=\theta_i\\ \frac{\sin\theta_t}{\sin\theta_i}=\frac{\beta_1}{\beta_2}=\frac{n_1}{n_2}\end{gathered}}$$

þá verða jöfnurnar

$$E_{io} + E_{ro} = E_{to}$$

$$\frac{1}{\eta_1}(E_{io} - E_{ro})\cos\theta_i = \frac{E_{to}}{\eta_2}\cos\theta_t$$

sem gefa

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

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

Og eins og báðast 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

fyrir efni með $\mu_1 = \mu_2 = \mu_0$
(engin segulvirkni)
er komið ekki til

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

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

* Almennt er $|\Gamma_{\perp}|^2 > |\Gamma_{\parallel}|^2$ sem fall af θ_i, nema fyrir $\theta_i = 0$

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

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

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

sem gefur núna

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

samanborið við

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

$\rightarrow$ 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.

Það er oft talað

um skautunarhorn