Ch. 8 EM Wellen in Materie

- **Wellengleichung in Materie**
- **Grenzflächen zwischen Medien**
- **Reflexion, total Reflexion**
- **Brechung, Doppelbrechung**
- **Brewster Winkel**

Ebene Welle durch Medium

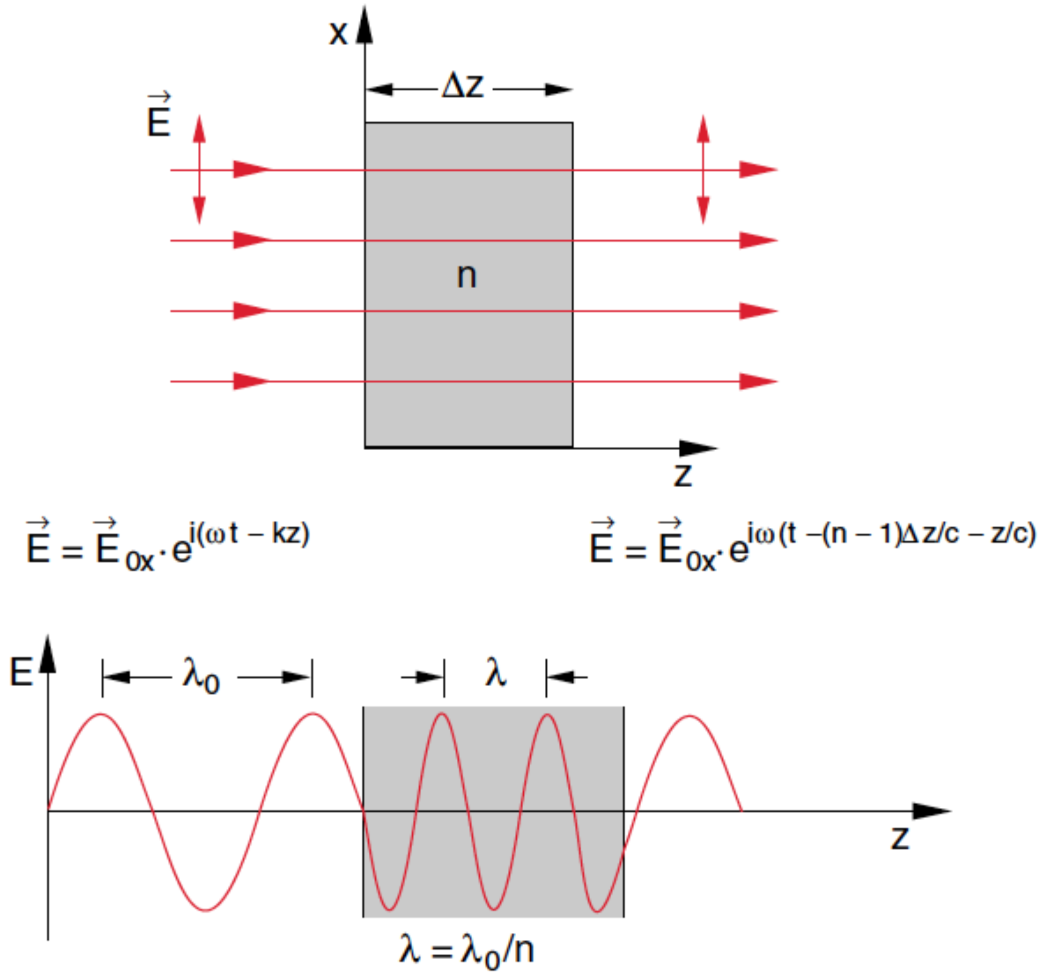
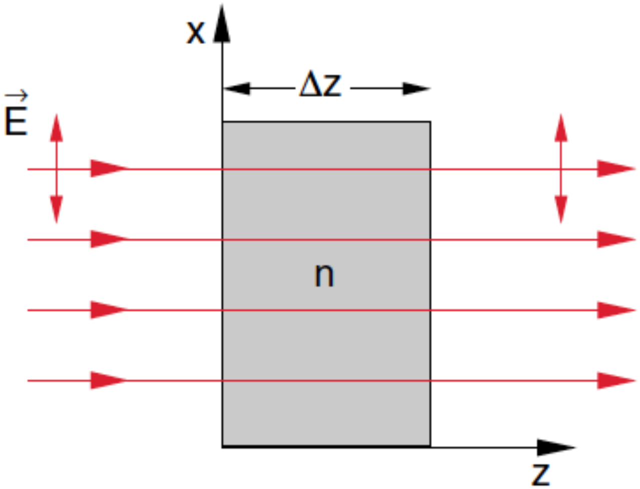
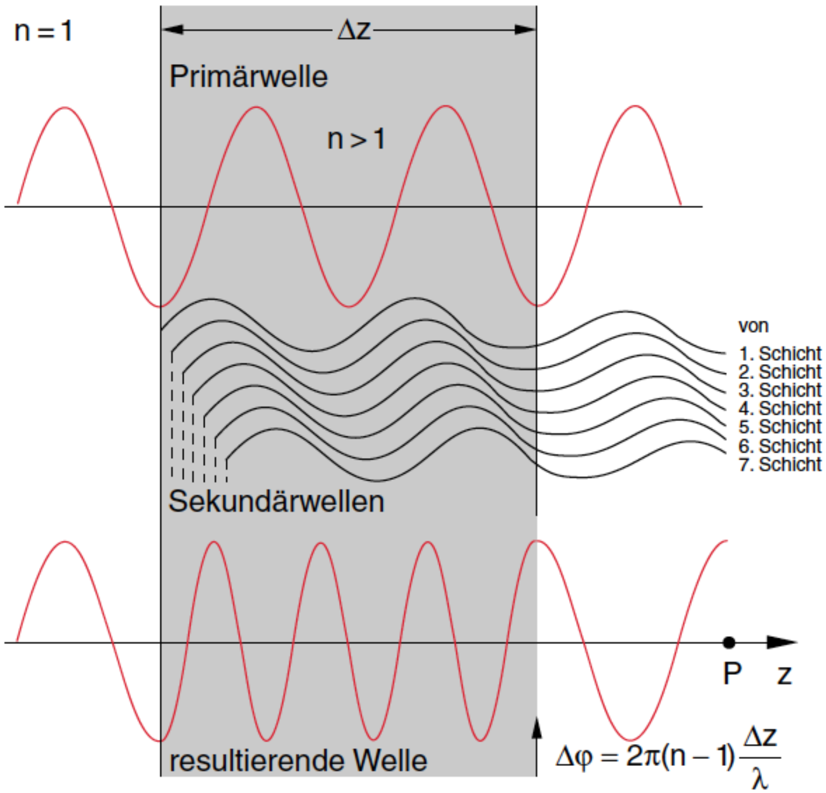


Abb. 8.1. Durchgang einer ebenen Welle durch ein Medium mit Brechungsindex n. Die Reflexion an den Grenzflächen ist hier nicht berücksichtigt

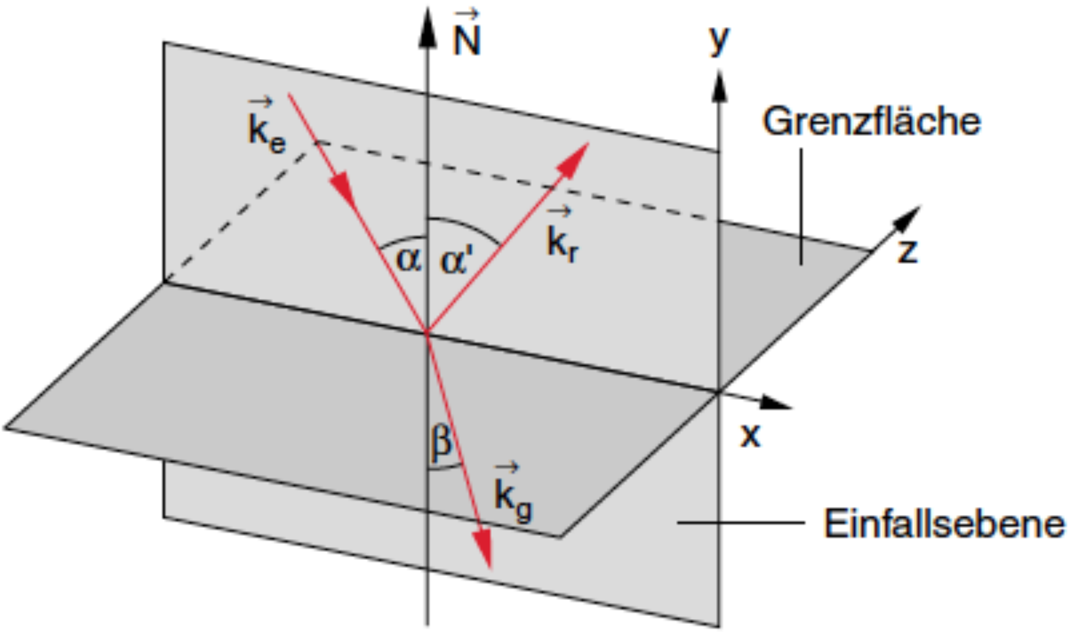
Ebene Welle durch Medium

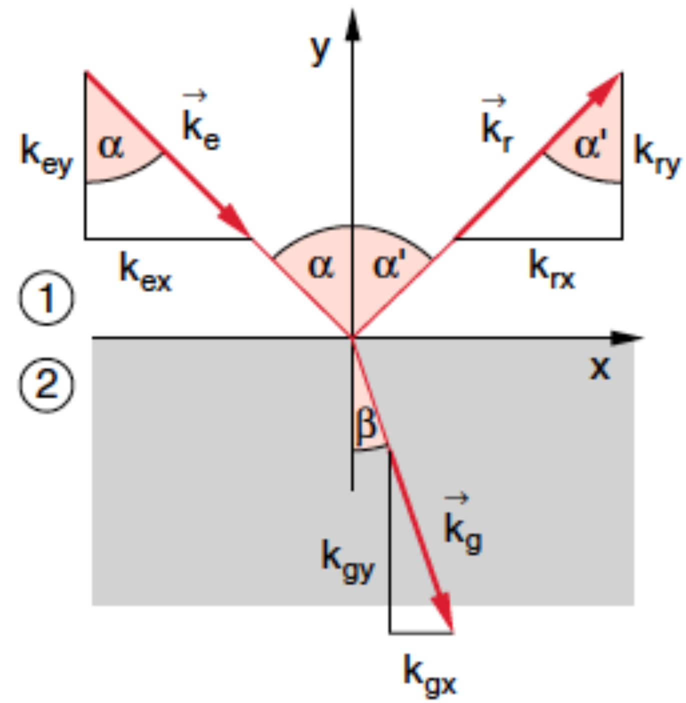




Reflexion und Brechung

Geometrie und Koordinatensystem





Totale interne Reflexion: Wellenleiter aus “heisser Luft”

PHYSICAL REVIEW X **4,** 011027 (2014)

Demonstration of Long-Lived High-Power Optical Waveguides in Air

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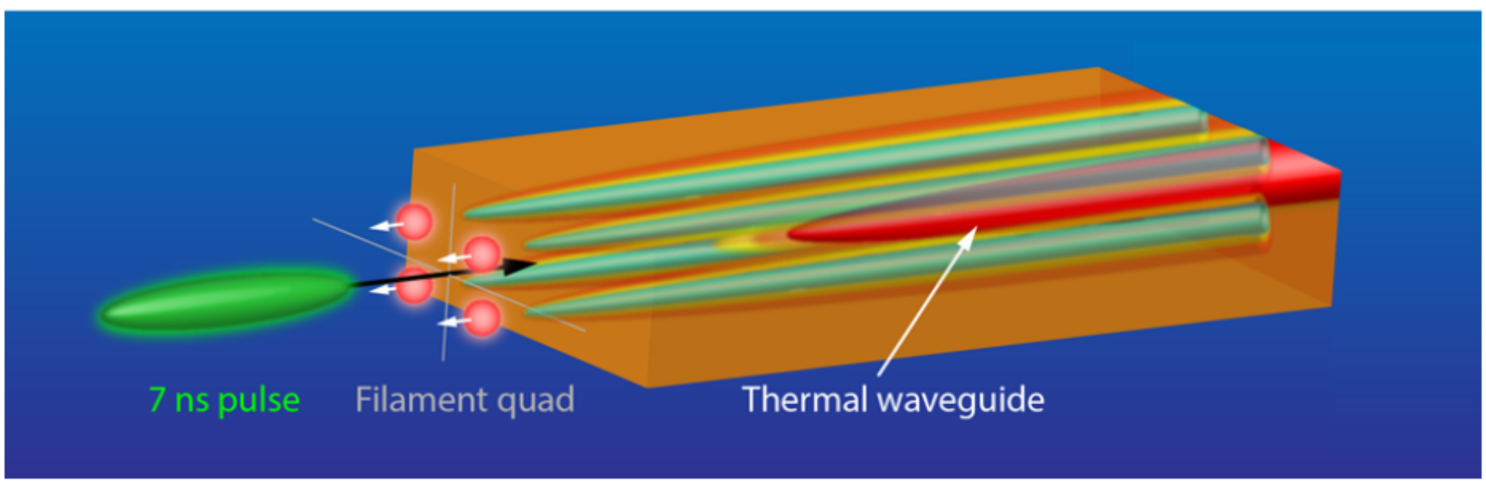
We demonstrate that femtosecond filaments can set up an extended and robust thermal waveguide structure in air with a lifetime of several milliseconds, making possible the very-long-range guiding and



Fresnel-Gleichungen

Reflexions- und Transmissions- Koeffizienten des elektrischen Feldes einer ebenen, elektromagnetische Welle

<u>s-Polarisation</u>

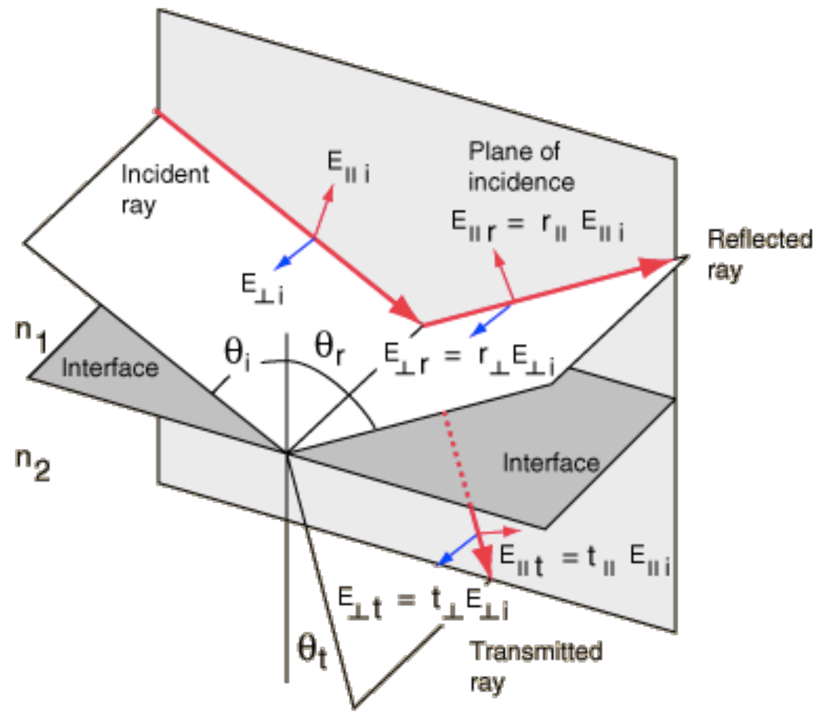
$$\varrho_s = \frac{A_{rs}}{A_{es}} = \frac{n_1 \cos\alpha - n_2 \cos\beta}{n_1 \cos\alpha + n_2 \cos\beta} = -\frac{\sin(\alpha-\beta)}{\sin(\alpha+\beta)}$$

$$\tau_s = \frac{A_{gs}}{A_{es}} = \frac{2 n_1 \cos\alpha}{n_1 \cos\alpha + n_2 \cos\beta} = \frac{2 \sin\beta \cos\alpha}{\sin(\alpha+\beta)}$$

<u>p-Polarisation</u>

$$\varrho_p = \frac{A_{rp}}{A_{ep}} = \frac{n_2 \cos\alpha - n_1 \cos\beta}{n_2 \cos\alpha + n_1 \cos\beta} = \frac{\tan(\alpha-\beta)}{\tan(\alpha+\beta)}$$

$$\tau_p = \frac{A_{gp}}{A_{ep}} = \frac{2 n_1 \cos\alpha}{n_2 \cos\alpha + n_1 \cos\beta} = \frac{2 \sin\beta \cos\alpha}{\sin(\alpha+\beta)\cos(\alpha-\beta)}$$



Fresnel-Gleichungen

Reflexions- und Transmissions- Koeffizienten für Energie einer elektromagnetische Welle

$$R = \frac{\bar{I}_r}{\bar{I}_e} = \frac{A_r^2}{A_e^2} \qquad T = \frac{n_2 \cos\beta}{n_1 \cos\alpha} \frac{A_g^2}{A_e^2} \qquad T + R = 1$$

<u>s-Polarisation</u>

$$R_s = \frac{A_{rs}^2}{A_{es}^2} = \left(\frac{n_1 \cos\alpha - n_2 \cos\beta}{n_1 \cos\alpha + n_2 \cos\beta}\right)^2 = \left(\frac{\sin(\alpha - \beta)}{\sin(\alpha + \beta)}\right)^2$$

<u>p-Polarisation</u>

$$R_p = \frac{A_{rp}^2}{A_{ep}^2} = \left(\frac{n_2 \cos\alpha - n_1 \cos\beta}{n_2 \cos\alpha + n_1 \cos\beta}\right)^2 = \left(\frac{\tan(\alpha - \beta)}{\tan(\alpha + \beta)}\right)^2$$

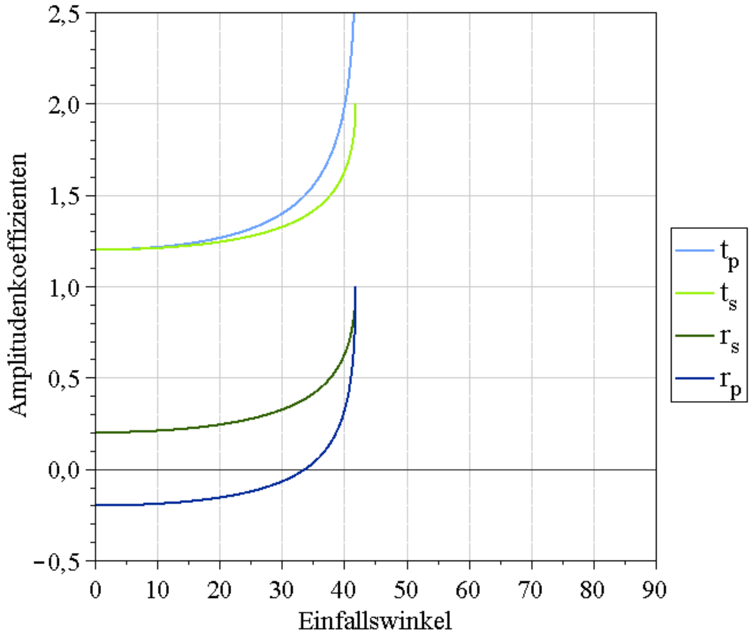
Fresnel-Gleichungen

Reflexions- und Transmissions-Koeffizienten für elektromagnetische Welle

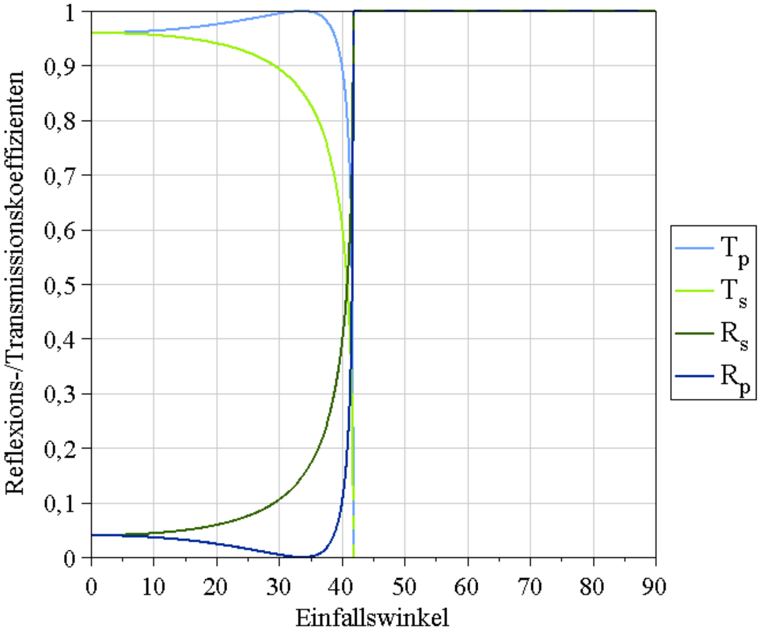
<u>$n_1>n_2$</u>

<u>($n_1=1.5$, $n_2=1$)</u>

Amplitude



Intensität

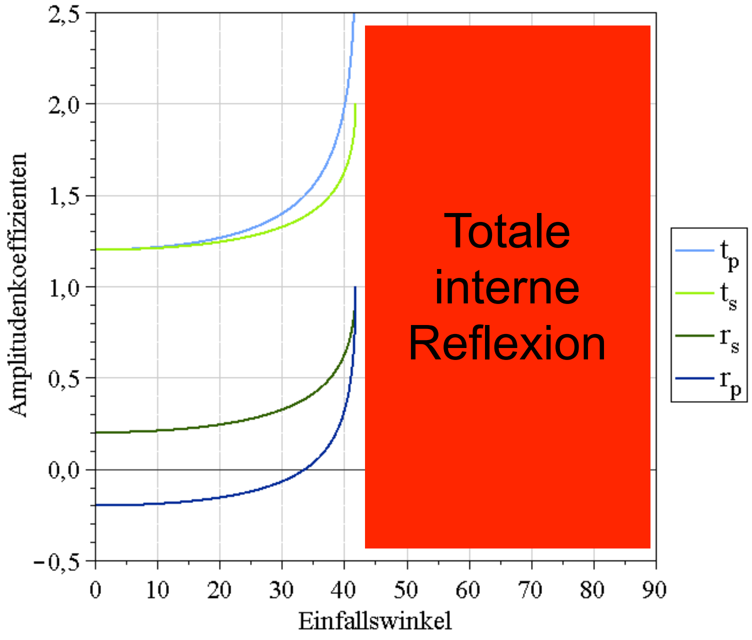


Fresnel-Gleichungen

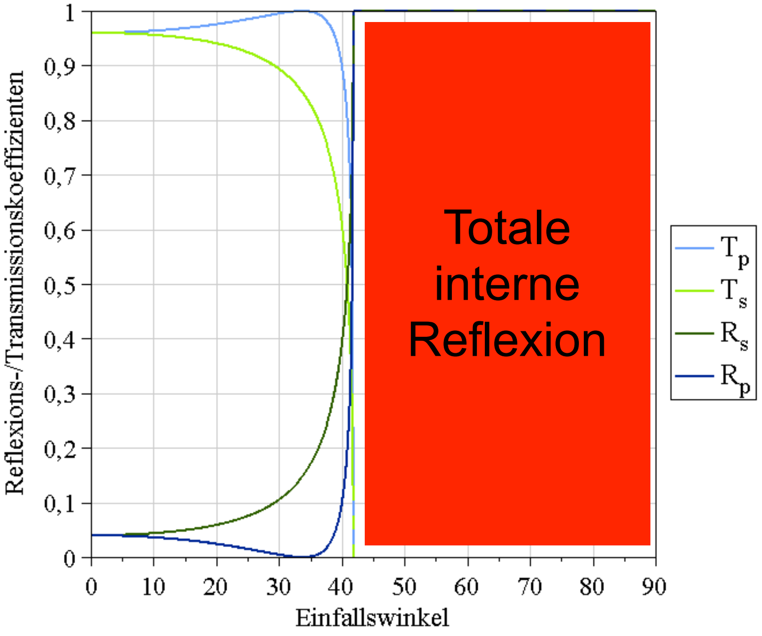
Reflexions- und Transmissions-Koeffizienten für elektromagnetische Welle

$n_1>n_2$
$(n_1=1.5,\ n_2=1)$

Amplitude



Intensität



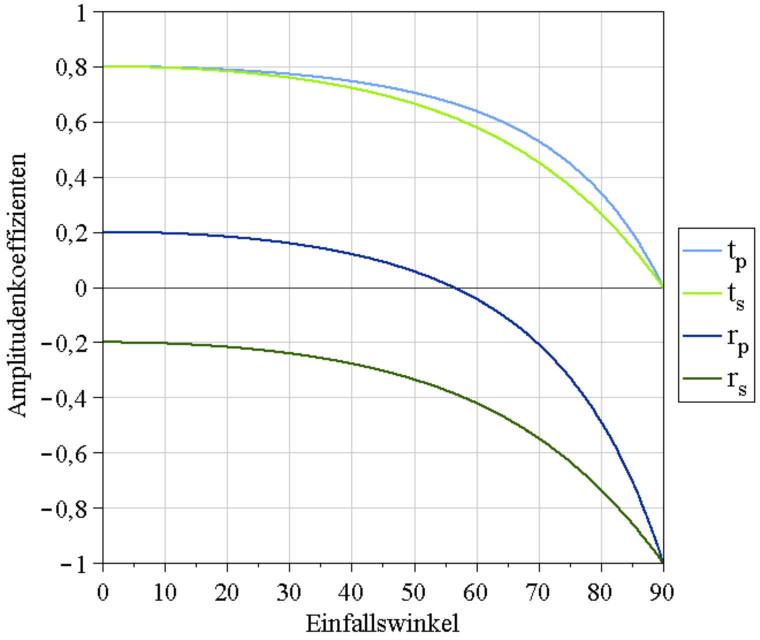
Fresnel-Gleichungen

Reflexions- und Transmissions-Koeffizienten für elektromagnetische Welle

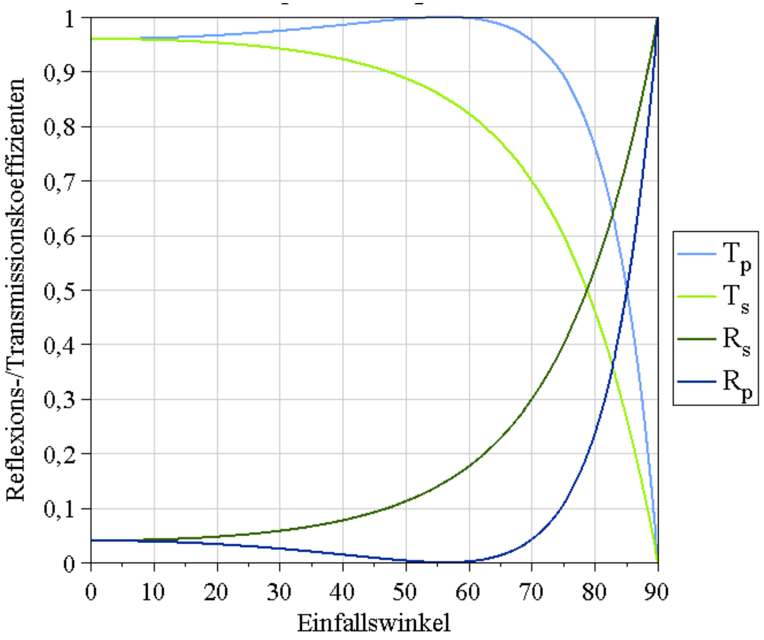
$n_1<n_2$

$(n_1=1,\ n_2=1.5)$

Amplitude



Intensität

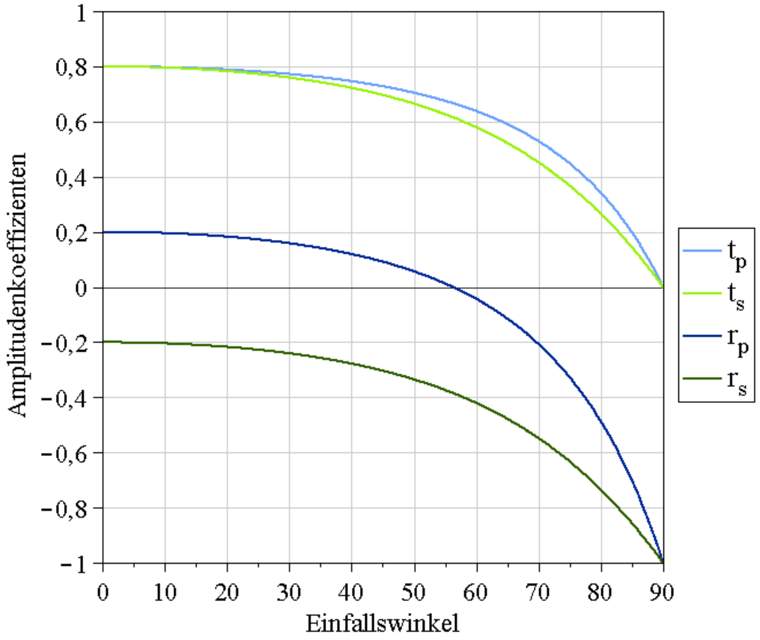


Fresnel-Gleichungen

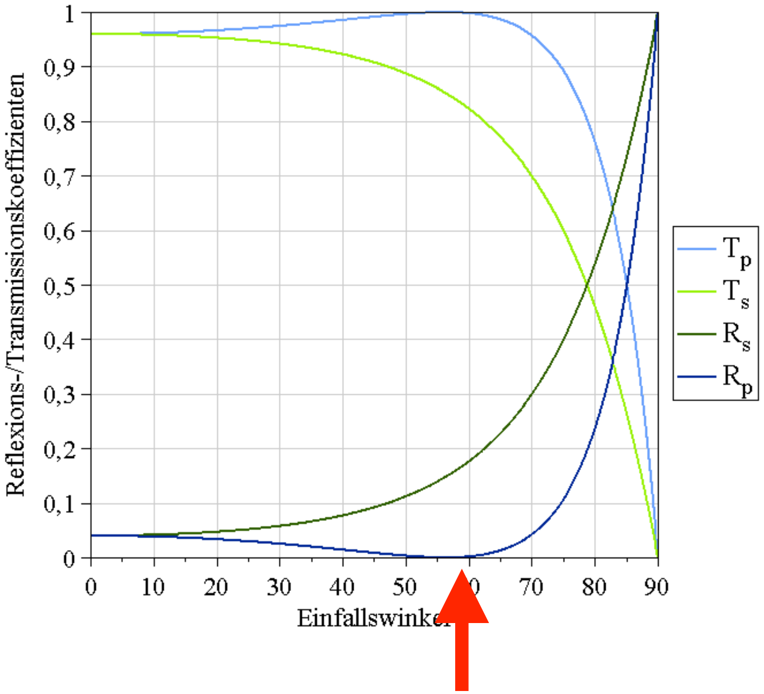
Reflexions- und Transmissions-Koeffizienten für elektromagnetische Welle

$n_1 < n_2$
($n_1 = 1$, $n_2 = 1.5$)

Amplitude

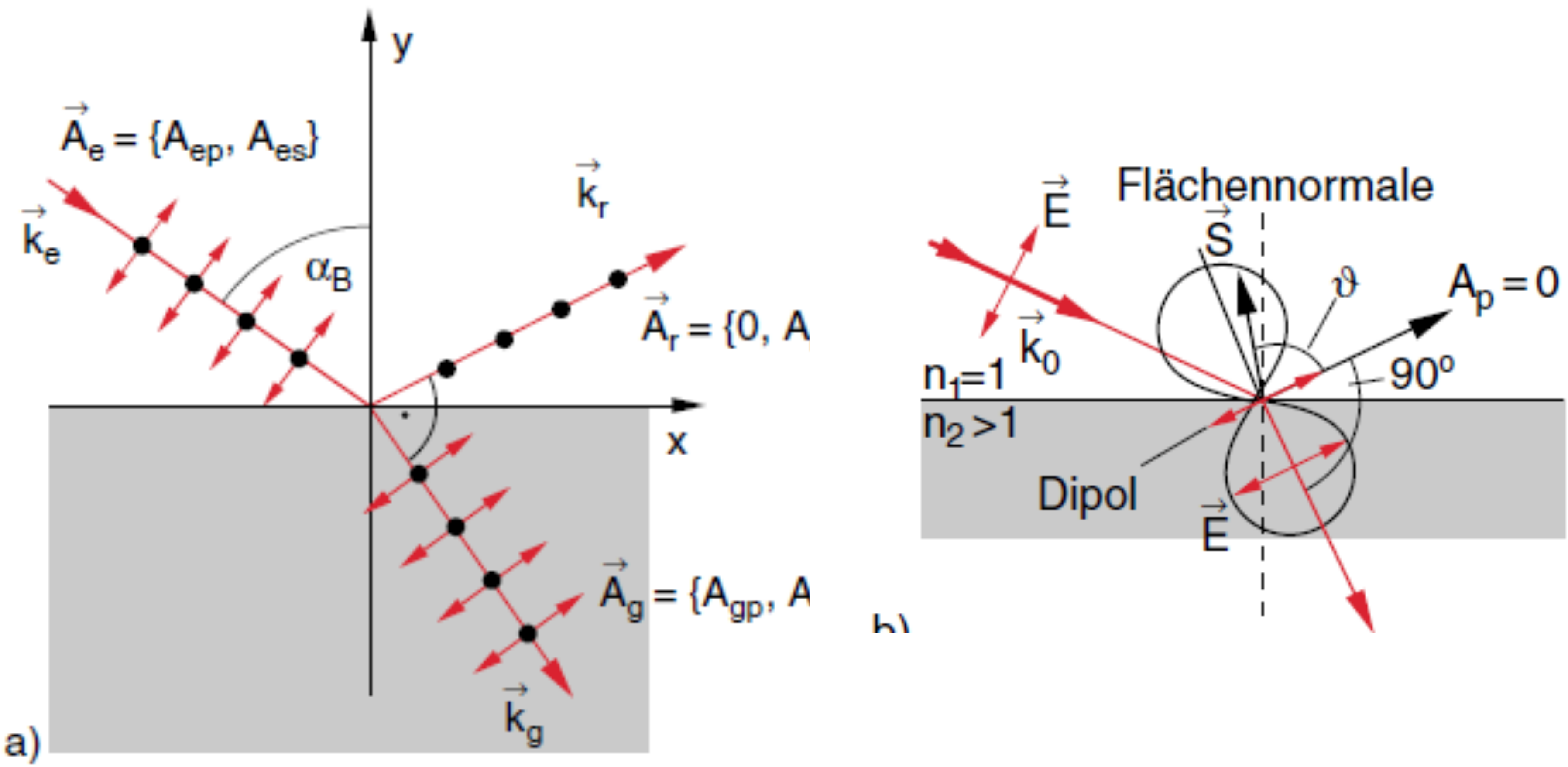


Intensität



Brewster-Winkel ⇨ $R_p=0$

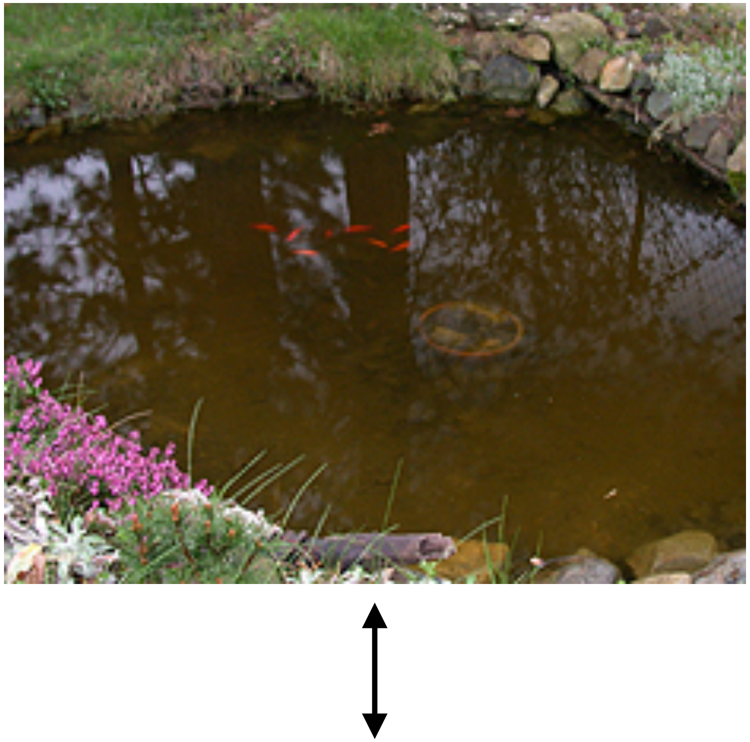
Brewster Winkel



Brewster Winkel

Reflektiertes Licht nahe des Brewster-Winkels ist Polarisiert:

Betrachtet durch
horizontalen Polarisator



Betrachtet durch
vertikalen Polarisator

doi:10.1038/nature10778

Biosignatures as revealed by spectropolarimetry of Earthshine

Michael F. Sterzik[1], Stefano Bagnulo[2] & Enric Palle[3]

Table 1 | Earth observations

	Observing date	
Observations	25 April 2011, 09:00 UT	10 June 2011, 01:00 UT
View of Earth as seen from the Moon		
Sun–Earth–Moon phase (degrees)	87	102
Ocean fraction in Earthshine (%)	18	46
Vegetation fraction in Earthshine (%)	7	3

Doppelbrechung

birefringence
(double refraction)

Figure 1

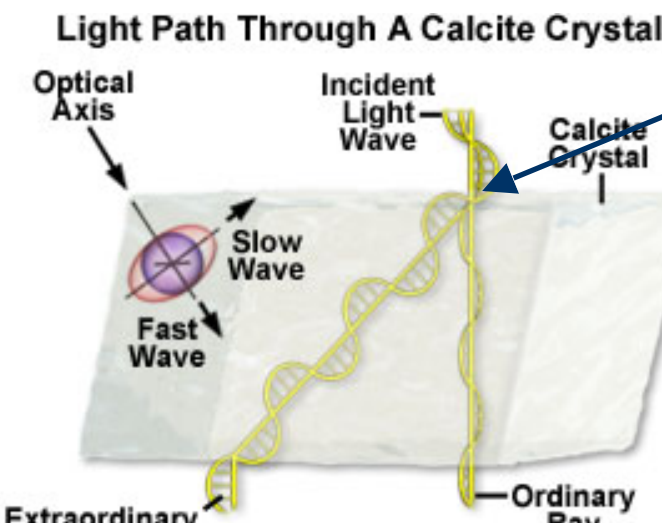


Figure 2

splitting of incident beam in 2 rays

⊥polarisation

normally refracted ray

slow refracted ray
(dep. on cristalline direction)

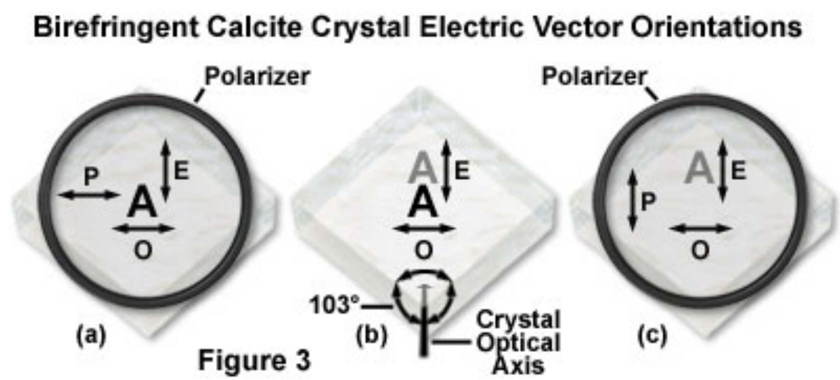
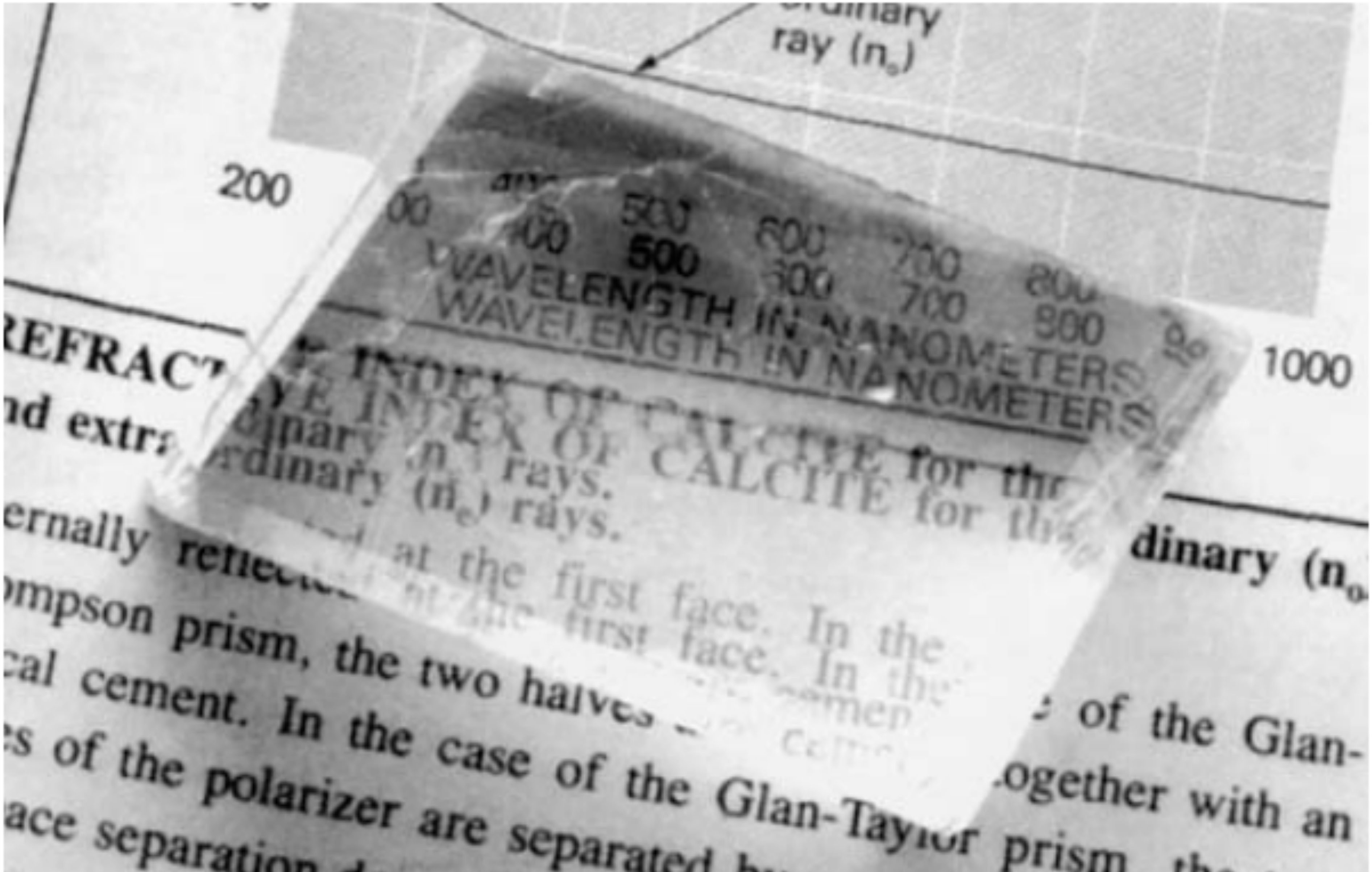
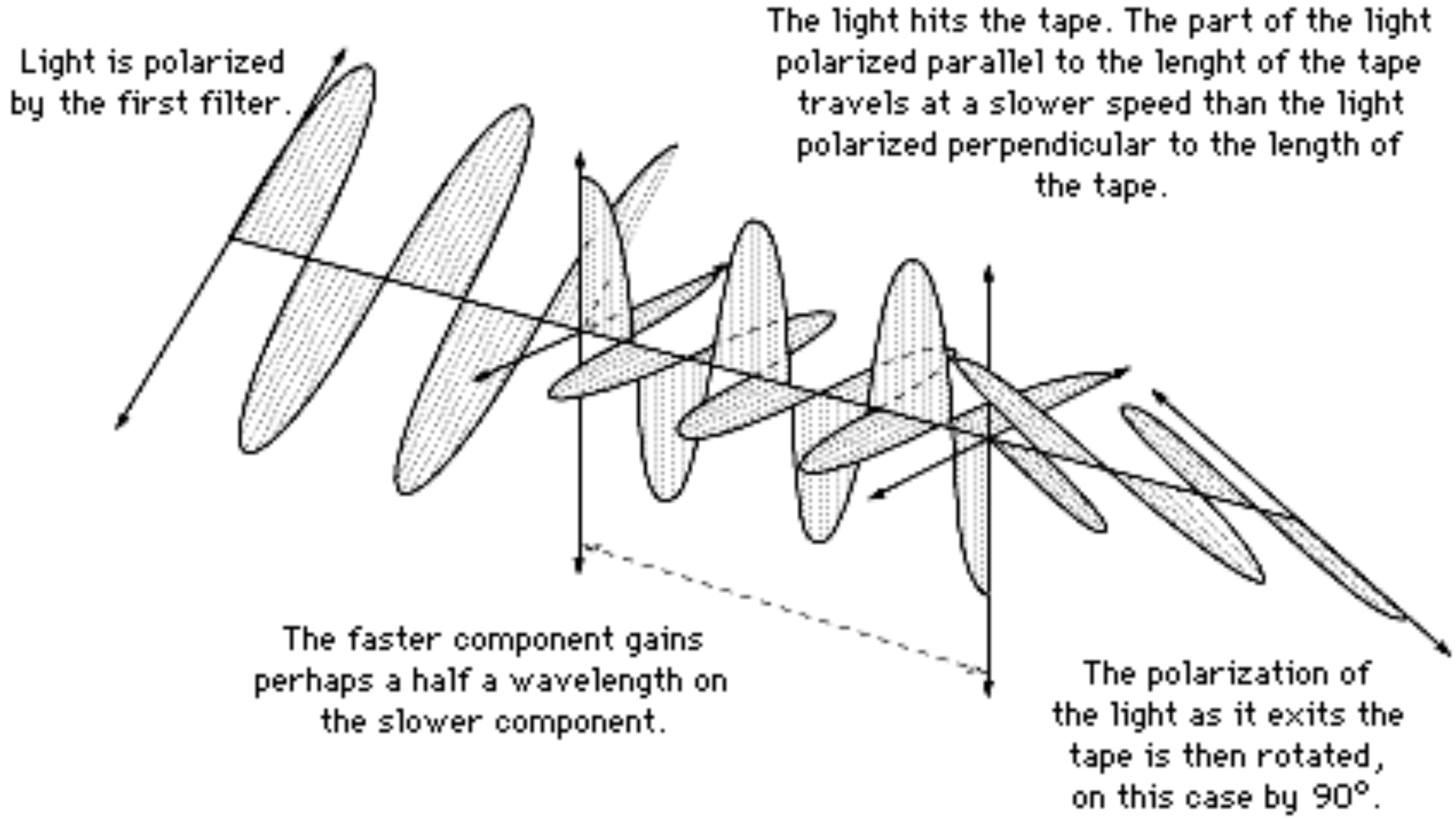


Figure 3

Doppelbrechung



Polarized light mosaic: scotch tape sandwich



A wave diagram of polarized light passing through a birefringent tape.

Polarisation Rotationswinkel $\alpha=\alpha(\lambda,d)$

λ: Wellenlänge

d: Scotch tape Dicke

http://www.exploratorium.edu/snacks/polarized_mosaic/

Synthetische DNA basierte optisch aktive

LETTER

doi:10.1038/nature10889

DNA-based self-assembly of chiral plasmonic nanostructures with tailored optical response

Anton Kuzyk[1]*†, Robert Schreiber[2]*, Zhiyuan Fan[3], Günther Pardatscher[1], Eva-Maria Roller[2], Alexander Högele[2], Friedrich C. Simmel[1], Alexander O. Govorov[3] & Tim Liedl[2]