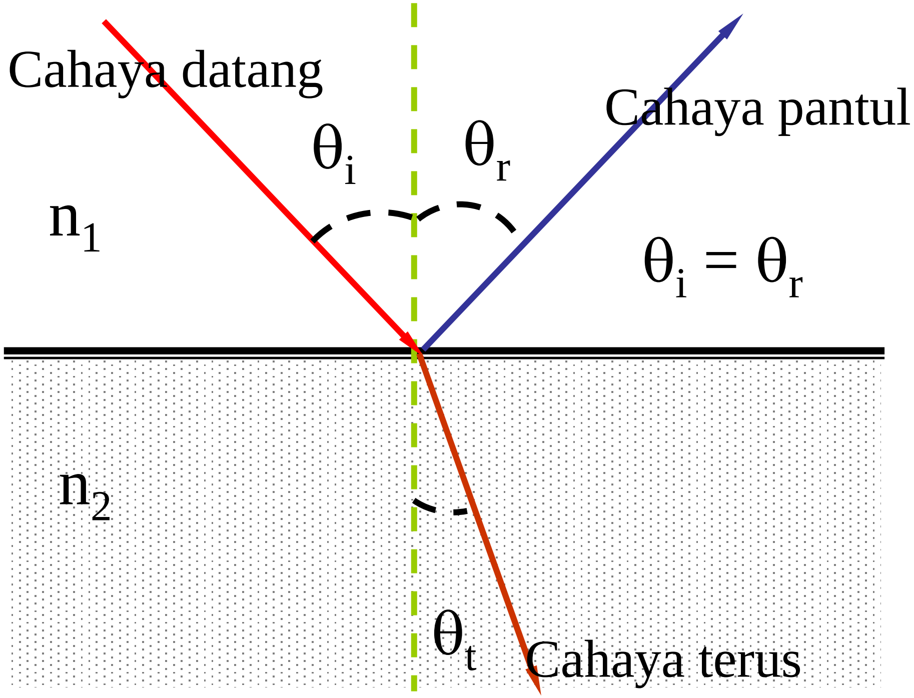
TEORI CAHAYA

Teori Cahaya

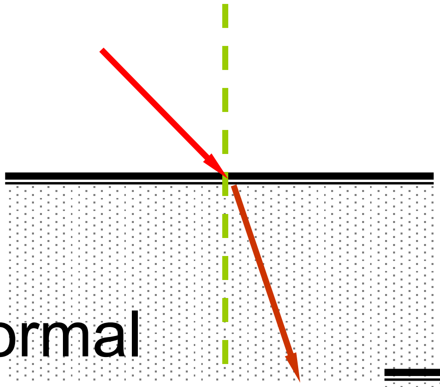
- Pendekatan optika geometris
  - Cahaya merambat lurus
  - Kecepatan di r hampa (c) ~ 3×10^8 m/s
  - Kec di medium lain → v = c/n ; n adalah indeks bias medium
  - Hukum SNELL mengenai pemantulan
    - Cahaya datang, cahaya pantul, dan garis normal terletak pada bidang datar
    - Sudut datang = sudut pantul

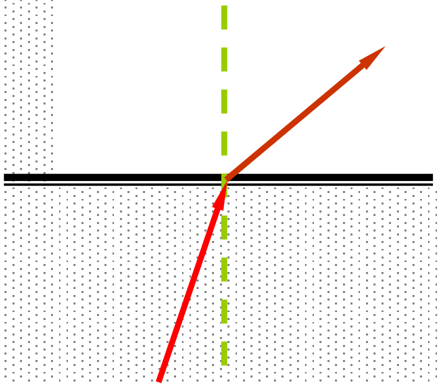
Teori Cahaya

– Hukum SNELL mengenai pembiasan



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

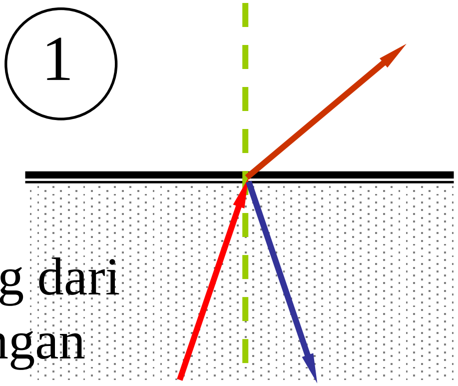




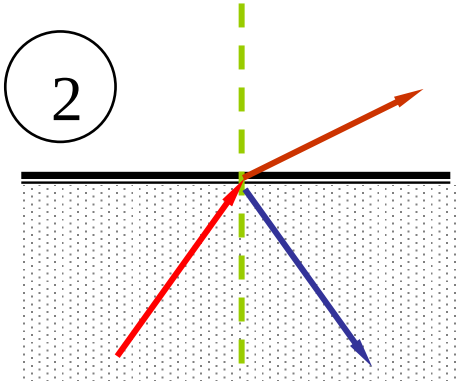
- $n_1<n_2 \rightarrow$ Cahaya terus dibelokkan mendekati normal
- $n_1>n_2 \rightarrow$ Cahaya terus dibelokkan menjauhi normal

Teori Cahaya

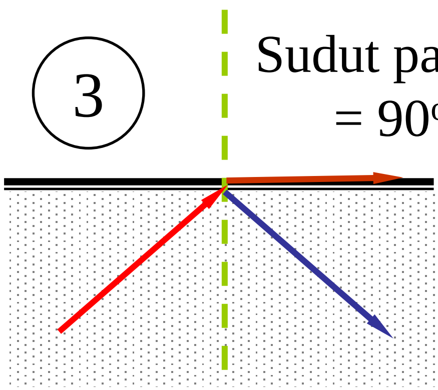
– TIR (Total Internal Reflection)



Cahaya datang dari medium dengan indeks bias yang lebih tinggi

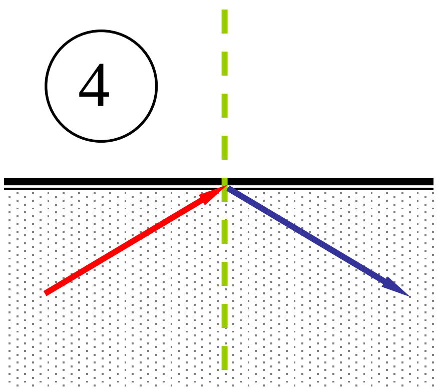


Sudut datang semakin besar, cahaya yang terus makin menjauhi normal



Sudut pantul = 90^o

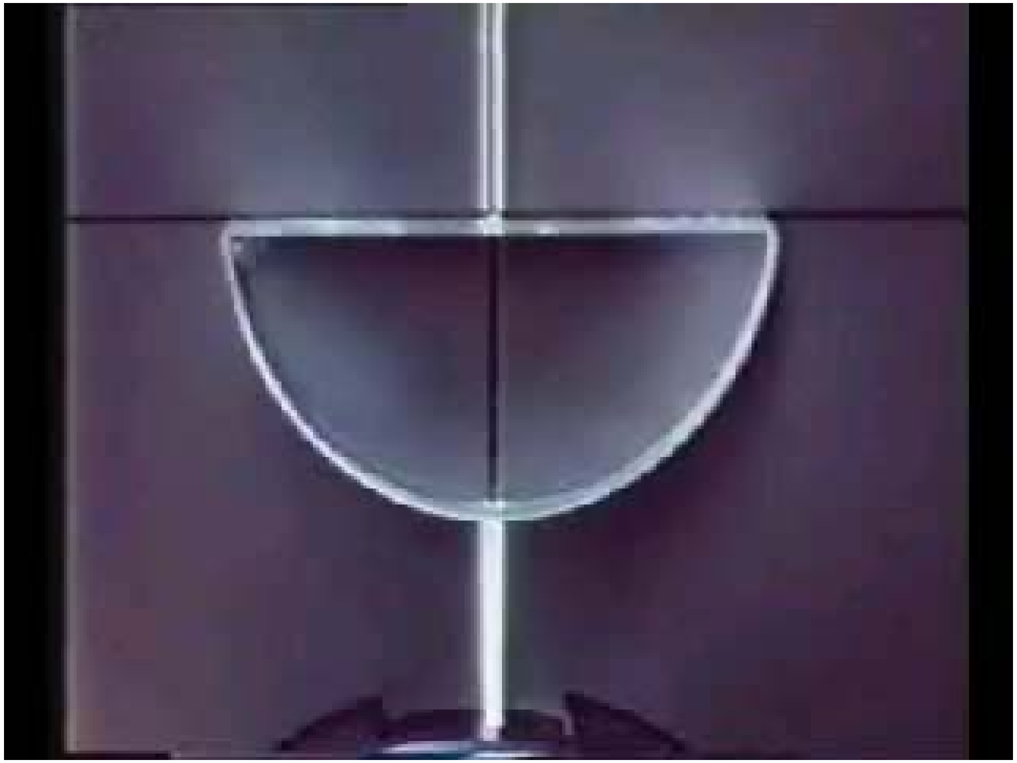
Kondisi ini sudut datang disebut sudut kritis



Bila sudut datang > sudut kritis terjadi TIR

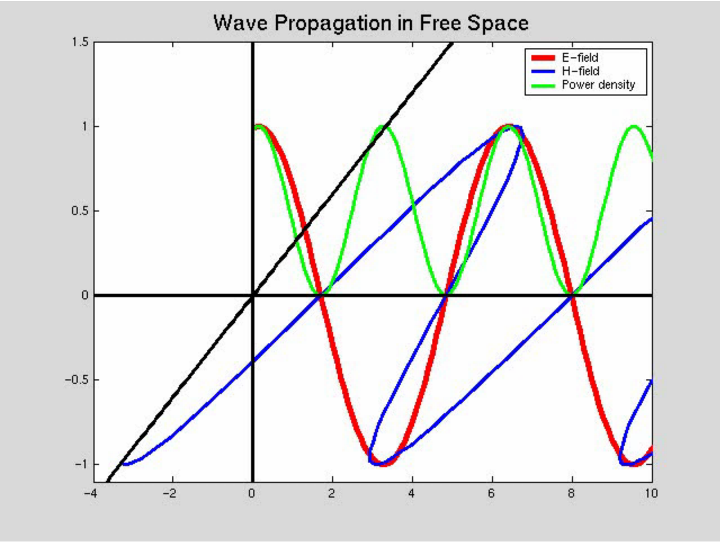
Teori Cahaya

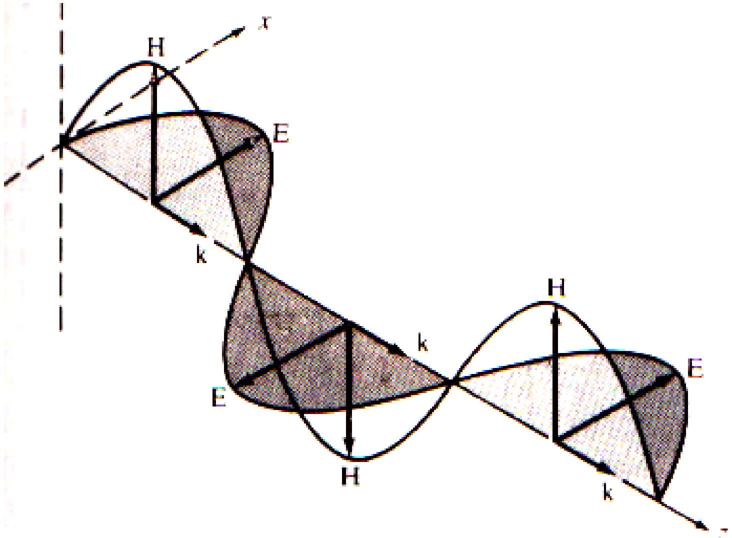
- TIR (total Internal Reflection)



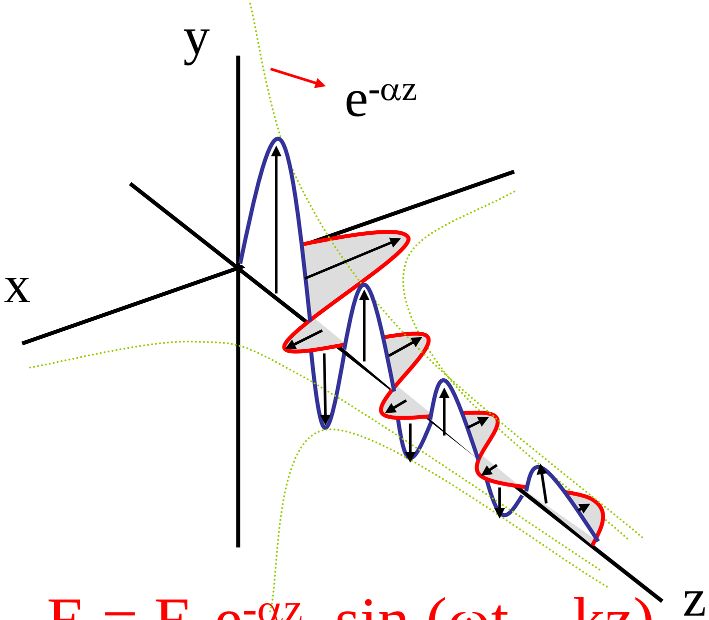
Teori Cahaya

- Pendekatan Gelombang EM
  - Cahaya : Gelombang EM → f ~ 10^{14} Hz





$$E = E_0 \sin(\omega t - kz)$$

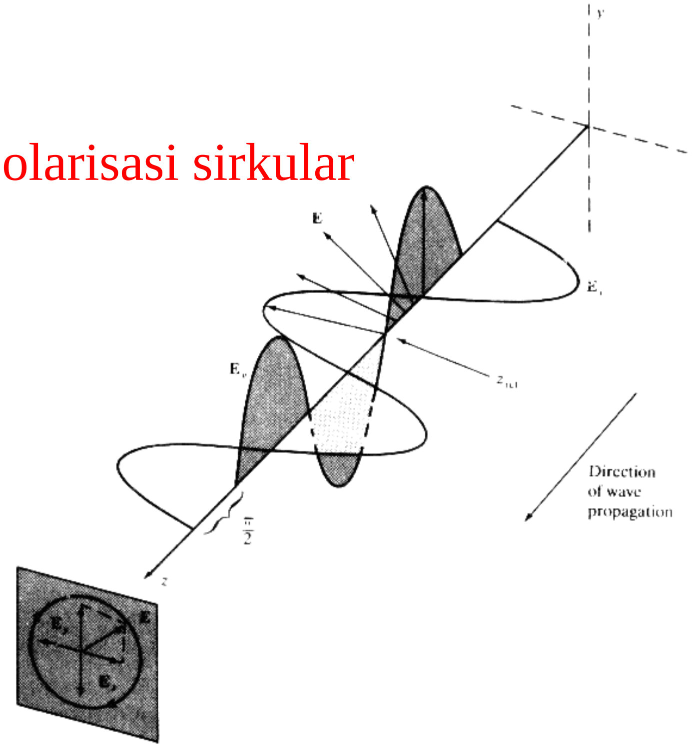


$$E = E_0 e^{-\alpha z} \sin(\omega t - kz)$$

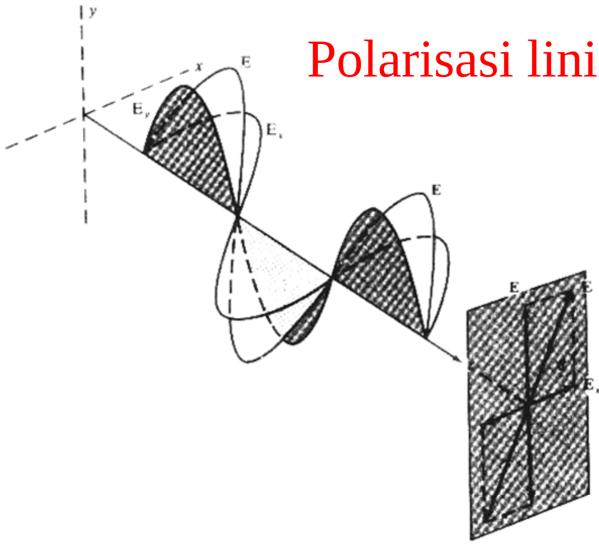
Teori Cahaya

- Pendekatan Gelombang EM
  - Polarisasi gelombang EM

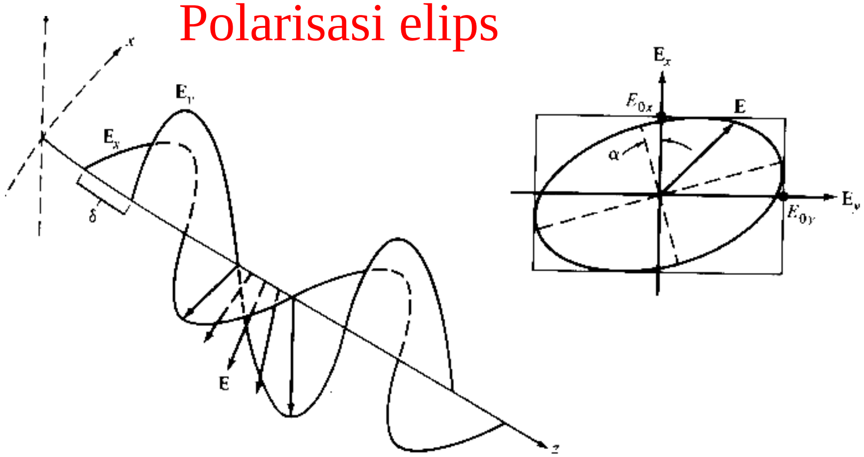
Polarisasi sirkular



Polarisasi linier



Polarisasi elips

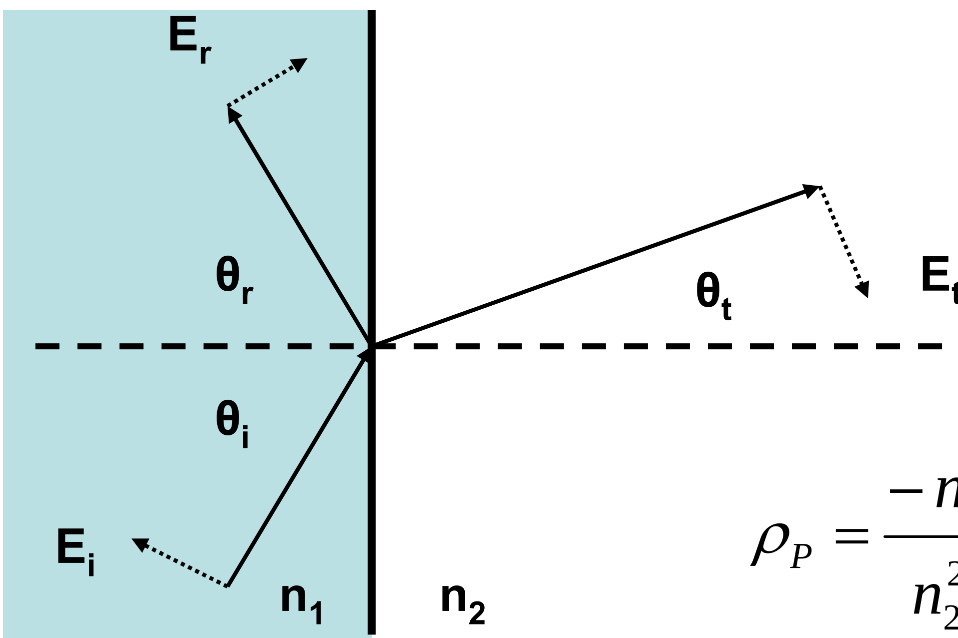


HUKUM FRESNEL

Bidang datang : bidang tegak lurus terhadap bidang batas dan melalui arah perambatan cahaya.

Vektor medan listrik tegak lurus arah perambatan cahaya

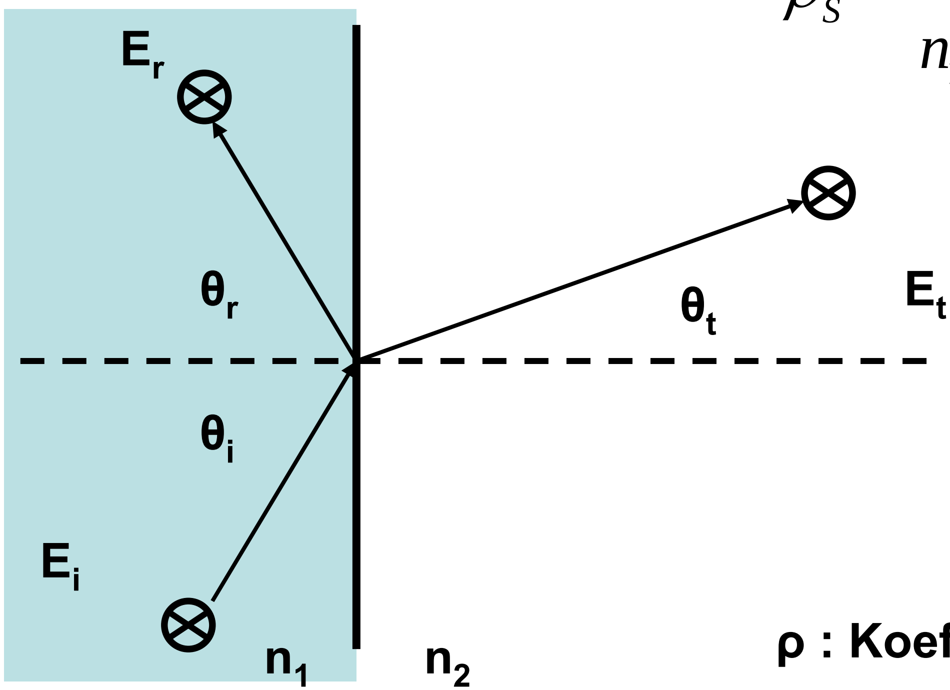
Polarisasi sejajar bidang batas :



$$\rho_P = \frac{-n_2^2 \cos\theta_i + n_1\sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}{n_2^2 \cos\theta_i + n_1\sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}$$

Polarisasi tegak lurus bidang batas :

$$\rho_S = \frac{n_1 \cos\theta_i - \sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}{n_1 \cos\theta_i + \sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}$$



ρ : Koefisien refleksi

Reflektansi :

$$R = |\rho|^2$$

$$\rho_P = 0 ==> R = 0 ==> \tan\theta_B = \frac{n_1}{n_2}$$

θ_B : Sudut BREWSTER

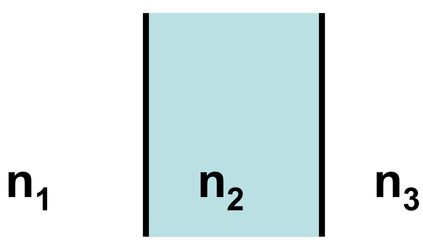
Sudut Kritis :

$$\sin\theta_C = \frac{n_2}{n_1}$$

$$\theta_i > \theta_C ==> \sin\theta_i > \sin\theta_C ==> n_1^2 \sin^2\theta_i > n_2^2 ==> R = |\rho|^2 = 1$$

$$n_2^2 - n_1^2 \sin^2\theta_i = 0 ==> |\rho_P| = |\rho_S| = 1$$

Anti refleksi :



$$R = \frac{[n_1 n_3 - n_2^2]^2}{[n_1 n_3 + n_2^2]^2}$$

$$R = 0 ==> n_2 = \sqrt{n_1 n_2}$$

Teori Cahaya

- Pendekatan Teori Kuantum
  - Cahaya merupakan serangkaian energi yang terkuantisasi secara diskrit yang disebut quanta atau photons
  - Energi cahaya bergantung pada frekuensi

$$E = hf$$

h = konstanta Plack = 6,626 x 10^{-34} [J.s]

f = frekuensi [Hz]

1 eV = 1,6 x 10^{-19} J

  - Dapat menjelaskan fenomena dispersi, emisi, dan absorpsi

Contoh :

Untuk mendapatkan daya 1μW berkas cahaya pada panjang gelombang 0,85 μm, dibutuhkan berapa photon per detik ?