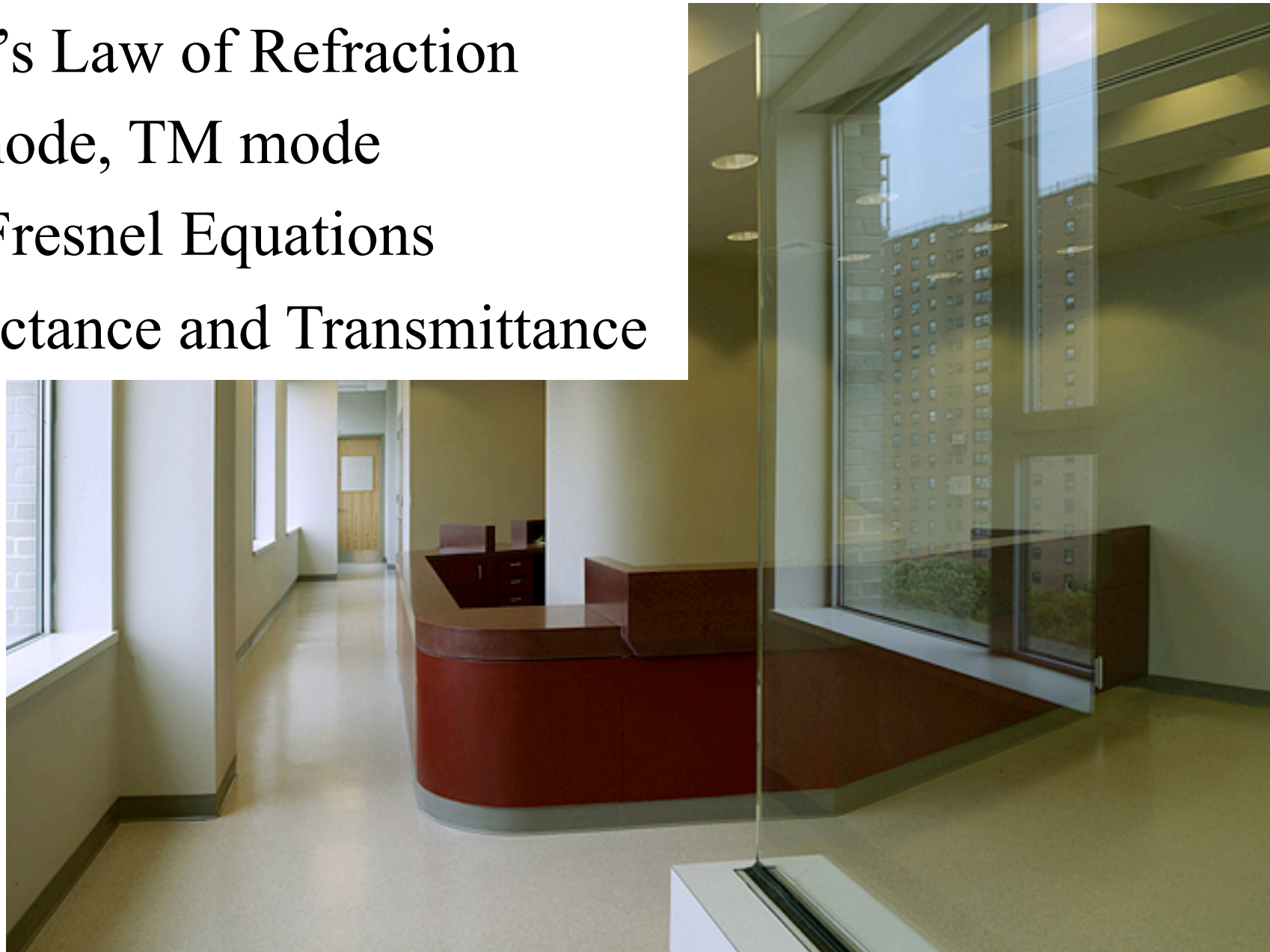
PHY385-H1F Introductory Optics

Class 7 – Outline: Sections 4.4, 4.5, 4.6

- Snell's Law of Refraction
- TE mode, TM mode
- The Fresnel Equations
- Reflectance and Transmittance



In-Class Task from Last time.. I asked:

For any wave, it is true that $v = \lambda f$.

Light starts in air, where $n = 1$, and enters glass, where $n = 5$.

1. Does the speed, v, of the light increase, decrease, or stay the same when it enters the glass?

$v = c/n$, $n>1$, speed decreases

2. Does the wavelength, λ, of the light increase, decrease, or stay the same when it enters the glass?

$v = \lambda f$, v decreases, f stays the same, so λ must decrease

3. Does the frequency, f, of the light increase, decrease, or stay the same when it enters the glass?

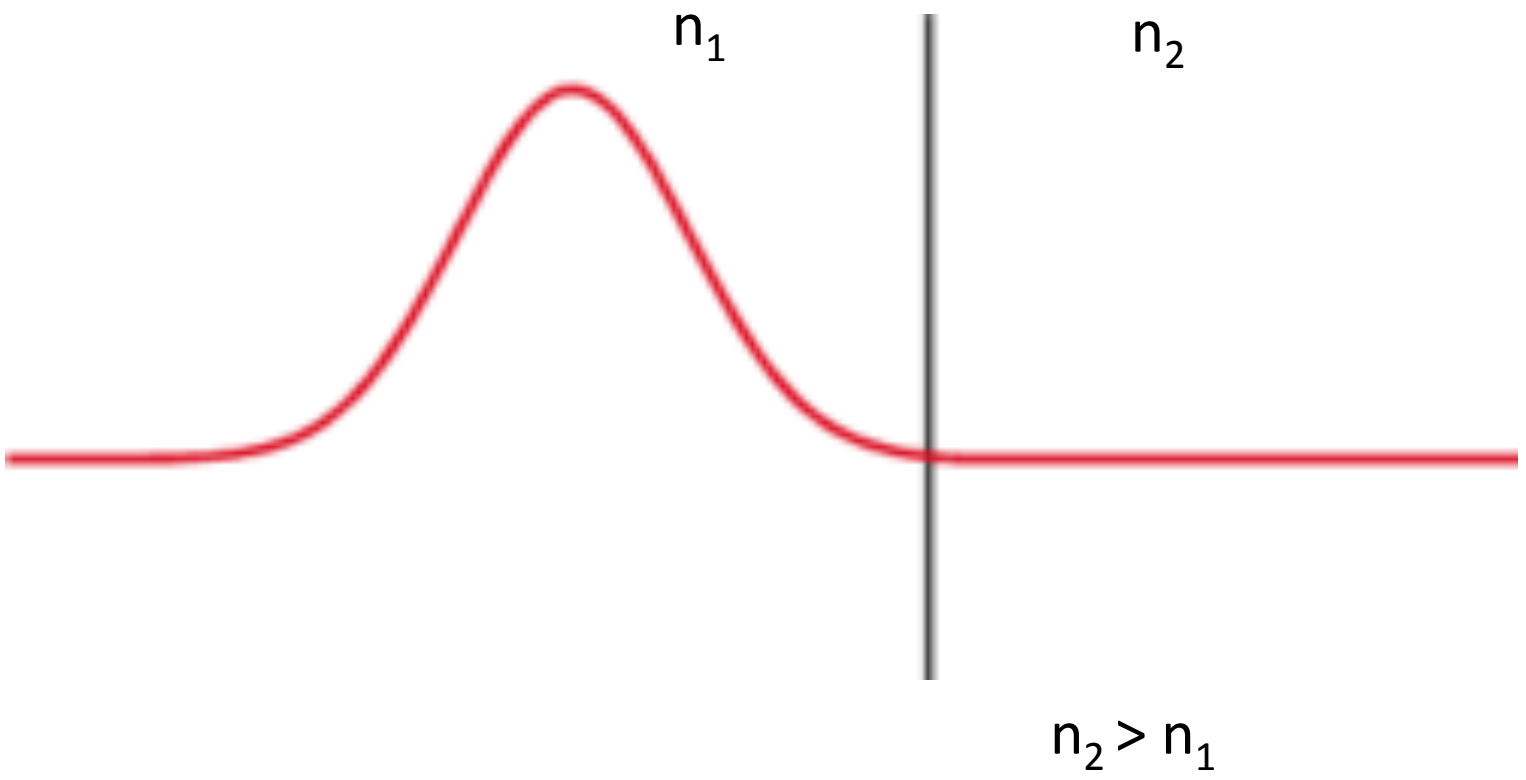
E and B are continuous across the boundary, therefore f must stay the same

External Reflection ($n_2 > n_1$)

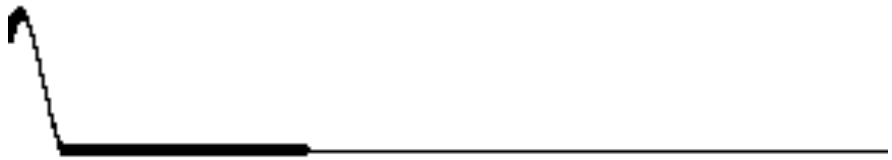
- Animation shows a pulse traveling to the right on a light string attached to a heavier string
- Speed suddenly decreases
- Analogous to light in air reflecting off glass surface
- Phase shift = π

External Reflection – another animation

Partial transmission and reflection amplitudes of a wave travelling from a low to high refractive index medium.

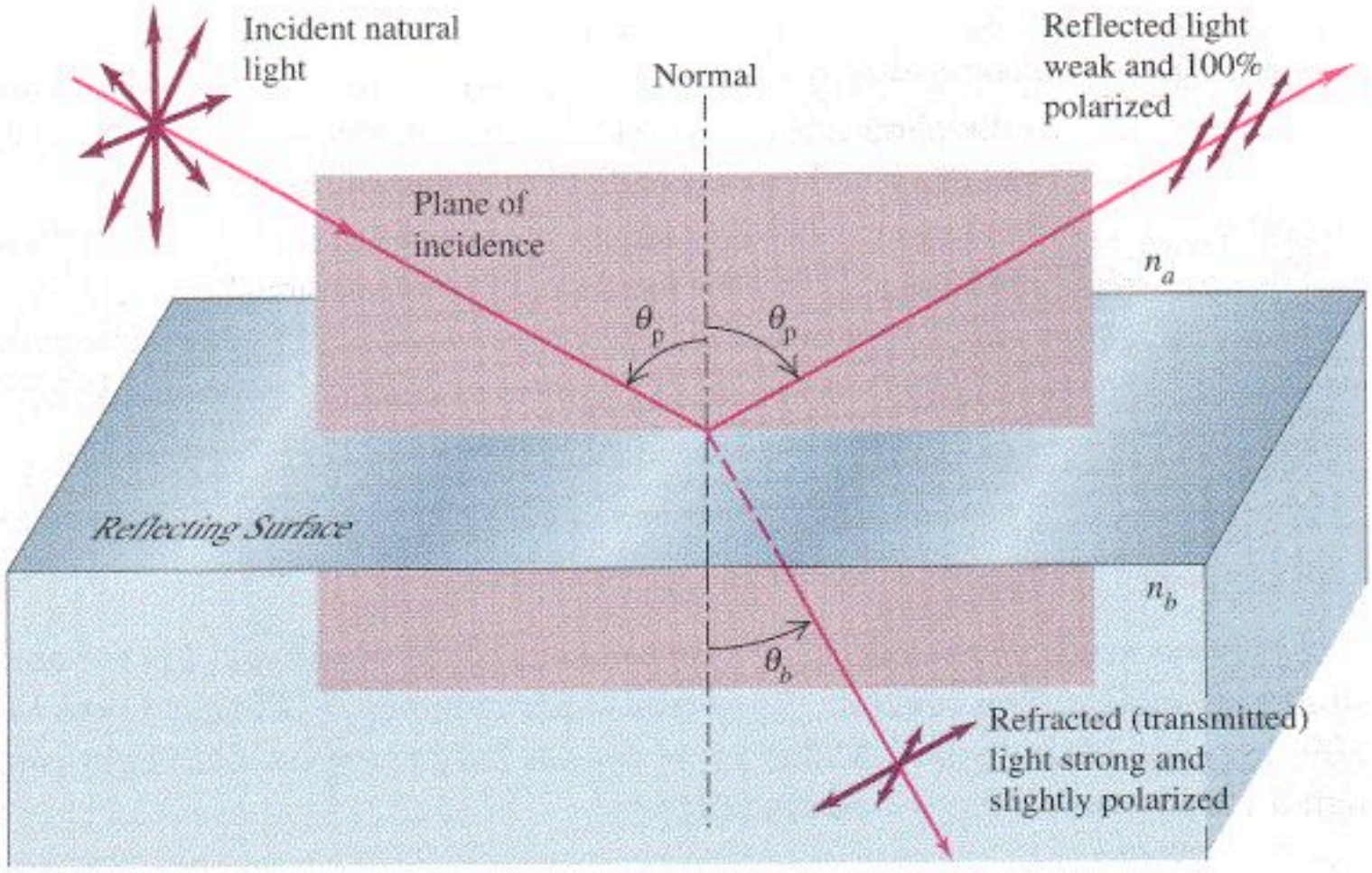


Internal Reflection ($n_2 < n_1$)



- Animation shows a pulse traveling to the right on a heavy string attached to a lighter string
- Speed suddenly increases
- Analogous to light in glass reflecting off the boundary to air
- Phase shift = 0

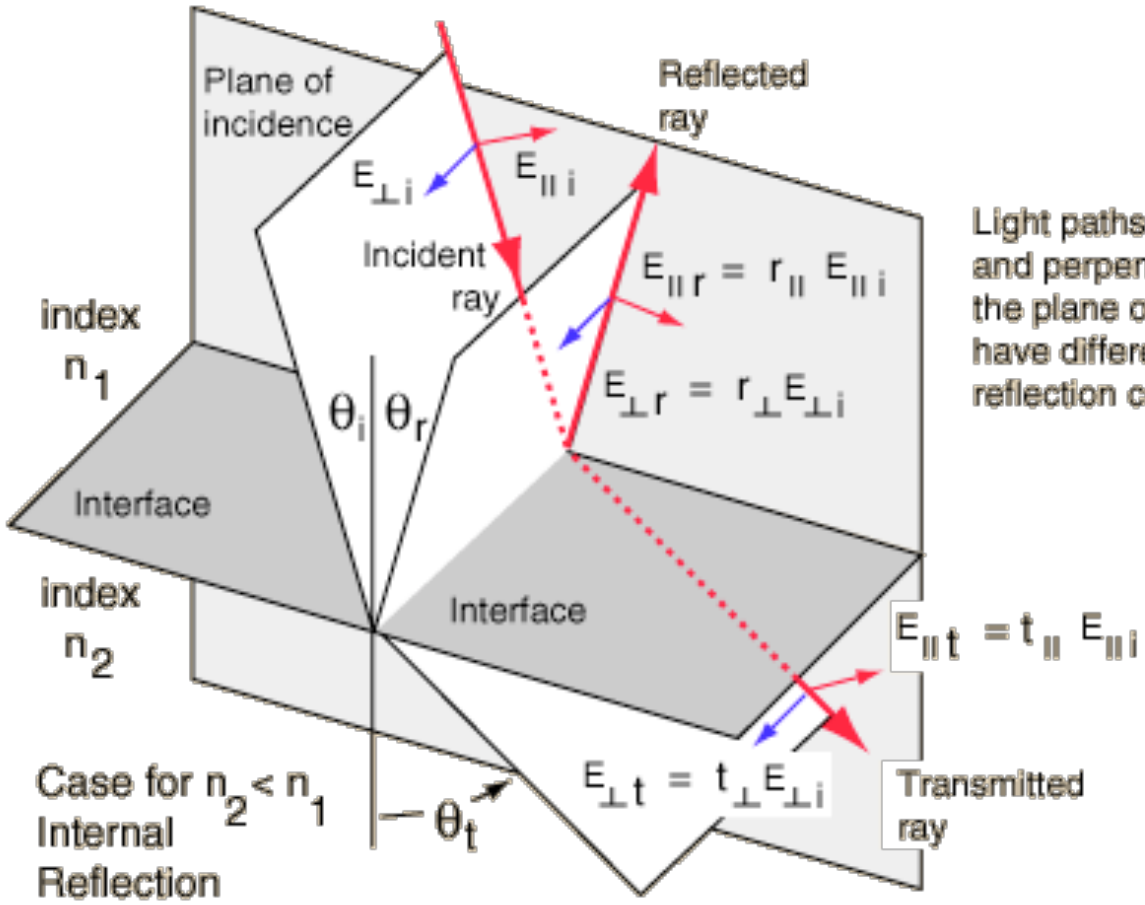
The incident, reflected and transmitted beams each lie in the plane-of-incidence.



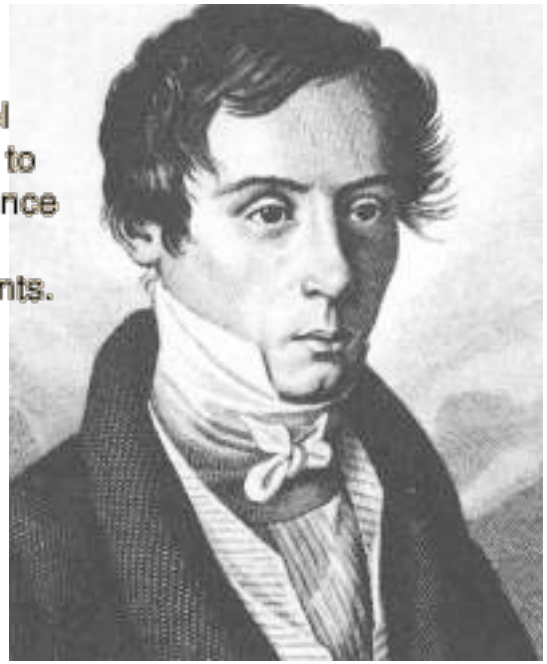
This figure shows the polarization for the particular angle of incidence called Brewster's Angle, θ_p.

Recall Class 1: History of Light

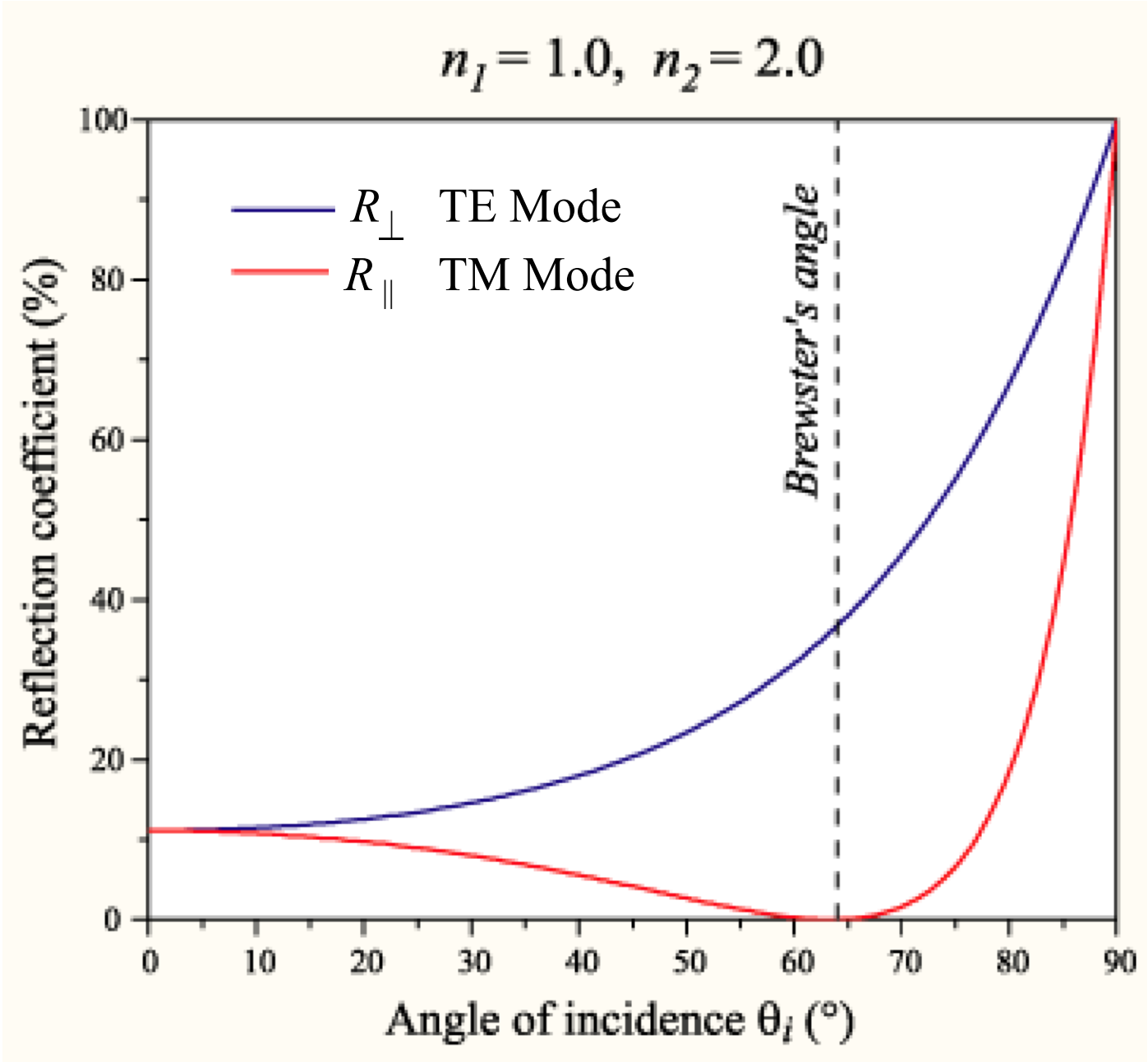
- 1814 – **Jean Fresnel** used the idea of polarization to predict amplitudes of reflected and transmitted light from glass interfaces.



Light paths parallel and perpendicular to the plane of incidence have different reflection coefficients.



Reflection Coefficient, External Reflection



Reflection Coefficient, Internal Reflection