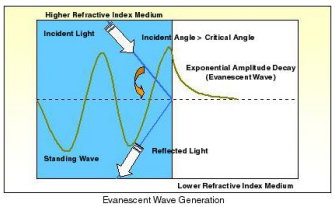
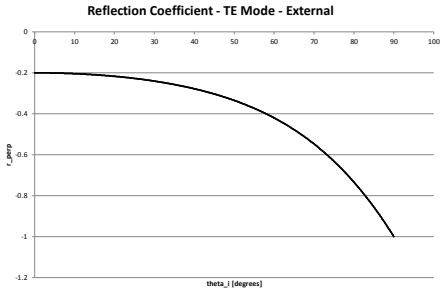
PHY385-H1F Introductory Optics
Class 8 – Outline: Finishing Chapter 4

- Finishing Fresnel Equations
- Total Internal Reflection
- Evanescent Waves
- Colour: Additive and Subtractive Primaries

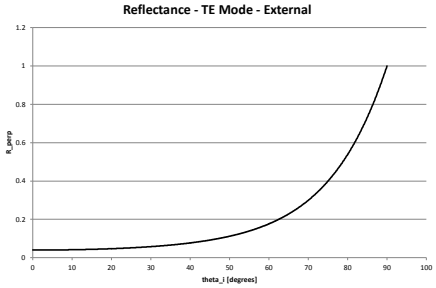


Evanescent Wave Generation

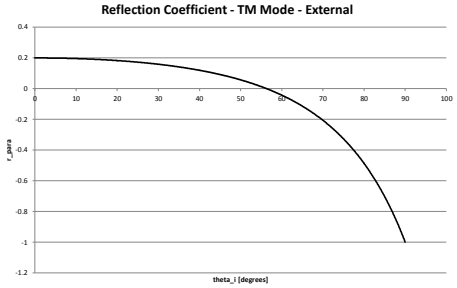
Fresnel's Equations



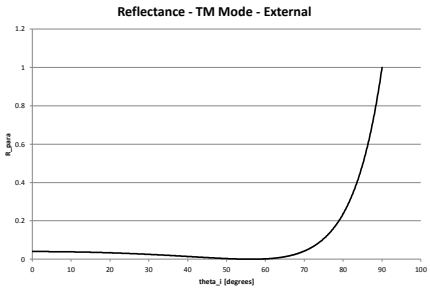
Fresnel's Equations



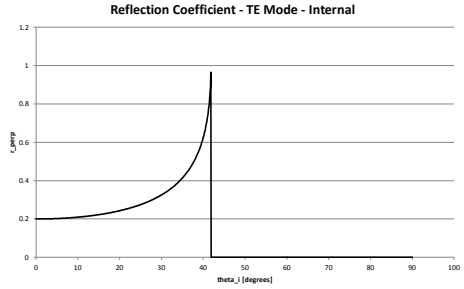
Fresnel's Equations



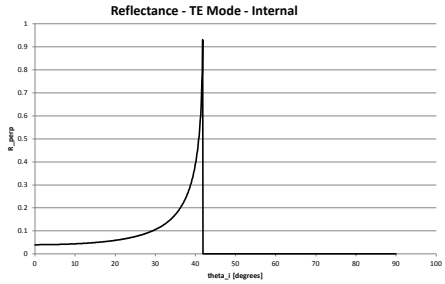
Fresnel's Equations



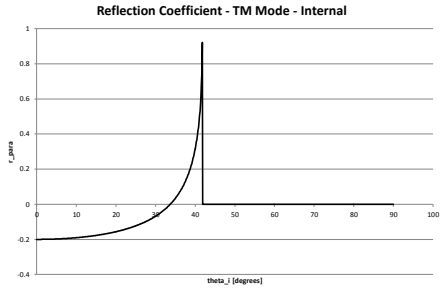
Fresnel's Equations



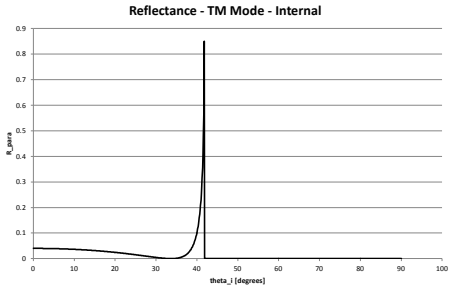
Fresnel's Equations



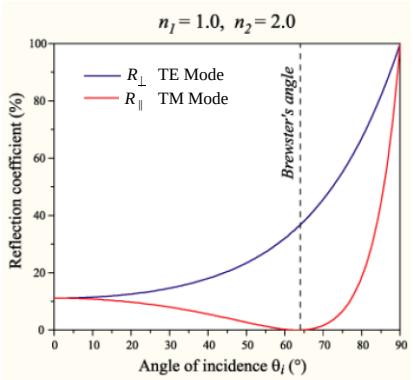
Fresnel's Equations



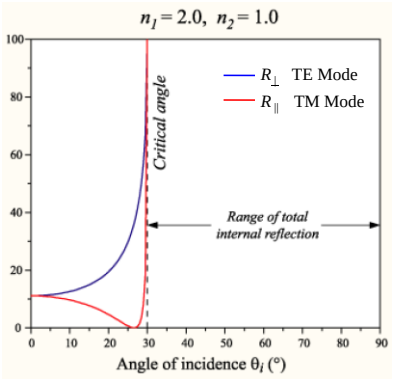
Fresnel's Equations



Reflection Coefficient, External Reflection



Reflection Coefficient, Internal Reflection



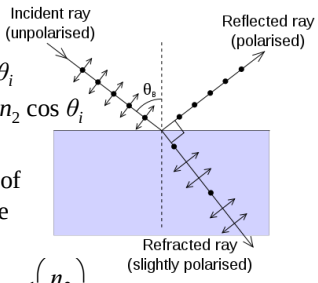
Brewster's Angle

David Brewster

- Sir David Brewster invented the kaleidoscope in 1815
- He discovered the polarization angle empirically.
- Consider light incident on a boundary $n_1 \rightarrow n_2$ at angle θ_i.
- If the reflected and transmitted beams are orthogonal, then only the component polarized parallel to the surface will be reflected.

Brewster's Angle

- $\theta_t + \theta_r + 90° = 180°$
- $\theta_t = 90° - \theta_r = 90° - \theta_i$
- $n_1 \sin\theta_i = n_2 \sin\theta_t = n_2 \cos\theta_i$
- $\tan\theta_i = n_2/n_1$
- This particular angle of incidence is called the Brewster's angle.

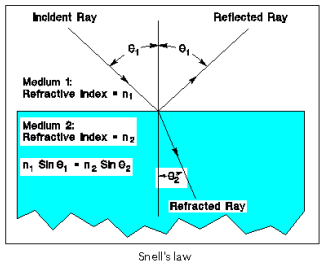


$$\theta_p = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

Two Special Angles at n_1/n_2 boundary!

$$\theta_p = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

Linear Polarization by Reflection is maximum when $\theta_i = \theta_p$

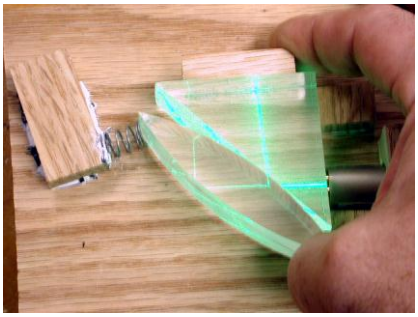


Snell's law

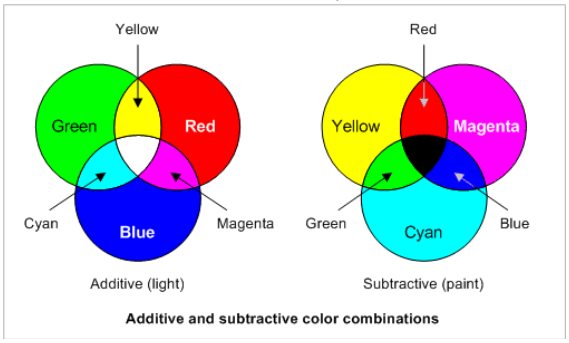
$$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

Total Internal Reflection occurs when $\theta_i > \theta_c$

Frustrated Total Internal Reflection



Additive Primary Colours (light bulbs) and Subtractive Primary Colours (ink)



Discussion Question

- Why is this square red?

1. The light bulbs in the projector emit light with wavelengths in the "B" range (~450 nm)
2. The light bulbs in the projector emit light with wavelengths in the "G" range (~520 nm)
3. The light bulbs in the projector emit light with wavelengths in the "R" range (~600 nm)
4. Both 1 and 2

Discussion Question

- Why is Harlow's shirt red?

1. The pigments in the cloth absorb light with wavelengths in the "B" range (~450 nm)
2. The pigments in the cloth absorb light with wavelengths in the "G" range (~520 nm)
3. The pigments in the cloth absorb light with wavelengths in the "R" range (~600 nm)
4. Both 1 and 2

Discussion Question

- What if the pigments Harlow's shirt only absorbed light with wavelengths in the "R" range (~600 nm)?

1. It would be red.
2. It would be cyan.
3. It would be yellow.
4. It would be magenta.

Discussion Question

- What if the pigments Harlow's shirt only absorbed light with wavelengths in the "G" range (~520 nm)?

1. It would be red.
2. It would be cyan.
3. It would be yellow.
4. It would be magenta.

Discussion Question

- What if the pigments Harlow's shirt only absorbed light with wavelengths in the "B" range (~450 nm)?

1. It would be red.
2. It would be cyan.
3. It would be yellow.
4. It would be magenta.

Term Test 1

- Test 1 on Tuesday will cover all of Chapters 2, 3 and 4, including some stuff I did *not* cover thoroughly during lecture
- Exceptions: Section 3.7 and 4.10, 4.11, the last sections of chapters 3 and 4, will *not* be covered in this course
- There will be some conceptual multiple choice questions, plus some problems for which you must show your work.

Term Test 1

- Test 1 will be held IN HERE: MP134
- Tuesday Oct. 9, 1:10 to 2:00pm (50 minutes)
- Please try to be here early and we can all begin exactly at 1:10
- AIDS ALLOWED: A calculator and one 8.5"x11" piece of note paper, double-sided, prepared by you