# Lecture 41 iq36

1. Light propagation through medium
   - micro- description superposition of fields – very complex
   - macro-description: a light ray + wave fronts
2. Refraction phenomena
   - Snell's law
   - Apparent depth
   - Total reflection region. Fiber optics
   - Snell's law
3. Color dispersion
   - Pair prisms, concepts of convergent and divergent rays
   - Wave fronts in the convergent and divergent lenses.

Class announcement:

- The updated course summary of unit 4 has been posted with the date 4/21/13.
- Office hour today will be from 9:15 to 10:15. I will be available until 12:30. Let me know immediately after the class if you want to see me between 10:15 to 12:30 today.
- Mark your calendar: Review on unit4, 5-6 pm on Wed (May1). Location TBA.

Ch36

1. Light propagation thru medium

- Microscopic point of view —

Interaction between EM waves + the medium (specially with electrons in the medium —

$a = \frac{eE}{m_e}$ )

Resultant electric fields are complex —

Original field, radiation field, irradiation field ...

- Macroscopic description — Light ray + wave front

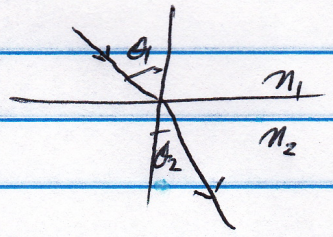
- Light particle (photon) — Speed in medium $v = \frac{c}{n}$

$n$ — index of refraction

- Wavefront: $f = f'$ determined by osc. frequency of original source. $\lambda' = \frac{v}{f} = \frac{c}{f} \cdot \frac{1}{n} = \frac{\lambda}{n}$.

2. Refraction phenomena —

- Snell's law —



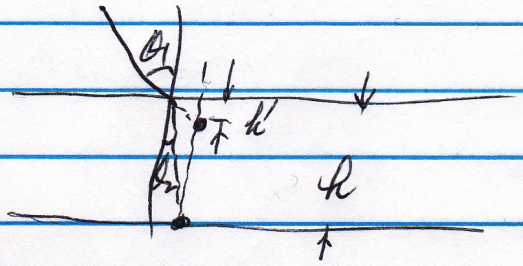

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

If $n_2 > n_1$, $\therefore n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\theta_2 < \theta_1$

clicker: from IQ-library IQ 38.1c

Explanation –




Small angle approximation:

$n_1 = 1$

$n_2 = n \approx 1.33$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

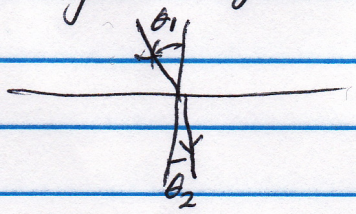
$\Rightarrow n_1\theta_1 \approx n_2\theta_2$

$\| \quad \|$

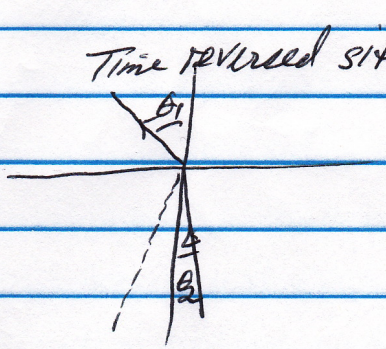
$1 \quad n$

$\frac{OC}{h'} \approx n\frac{OC}{h}, \quad h' = \frac{h}{n}.$

Total reflection region –

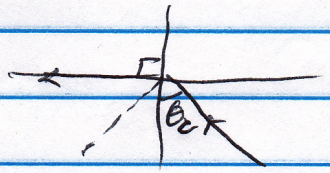



Time reversed situation



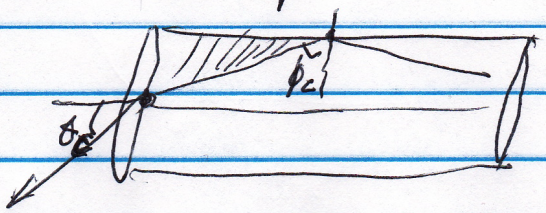

As $\theta_2$ increases, $\theta_1$ increases more rapidly.

At critical angle: $\theta_2 = \theta_c$, $\theta_1 = 90°$.




Clicker: Which angular range corresponds to the total reflection region?

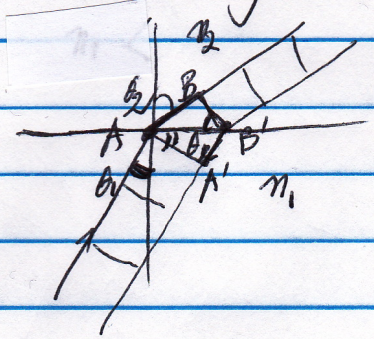
Application: Optical fiber. HW - Ch24. h4. 009




$\theta > \theta_c$ , $\phi < \phi_c$

$\theta < \theta_c$ , $\phi > \phi_c$ Total reflection region.

3. Derivation of Snell's law

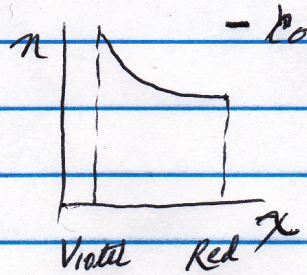


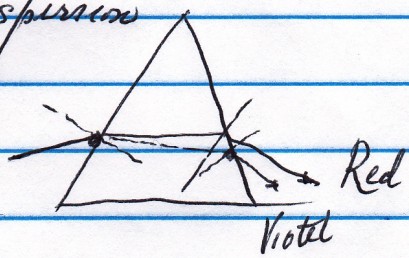

$$\frac{\sin\theta_2}{\sin\theta_1} = \frac{AB/AB'}{A'B'/AB'} = \frac{v_2}{v_1} = \left(\frac{c}{v_1}\right)\left(\frac{v_2}{c}\right)$$

$$\therefore \; n_1 \sin\theta_1 = n_2 \sin\theta_2.$$

4. Prism

- color dispersion

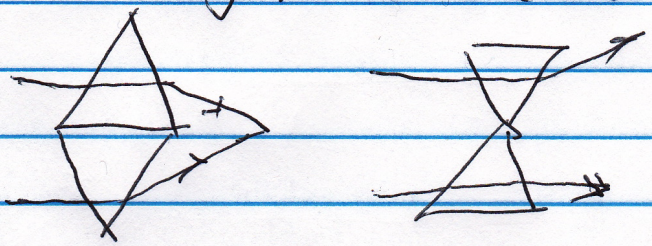


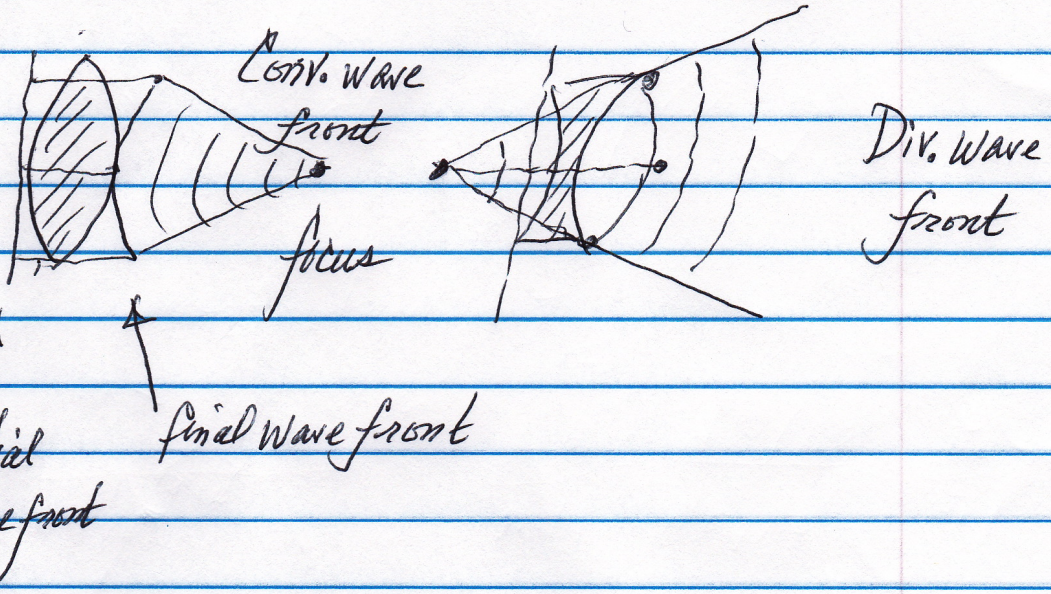




At each surface, the ray is bending

violet has more bending

- A pair of prisms : Conv. vs Div.






Wave fronts in conv. & div. cases.