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 unit 4, 5-6 pm on Wed (May 1). Location TBA.
1. Light propagation thru medium

* Macroscopic point of view

Interaction between EM waves & the medium
(specifically with electrons in the medium)
\[ \mathbf{a} = \frac{e\mathbf{E}}{mc} \]

Resultant electric fields are complex
Origins need, radiation field, retardation field...

* Macroscopic description - Light ray + wave front

- Luminous particle (photon).
  - Speed in medium: \( v = \frac{c}{n} \)
  - Index of refraction: \( n \)
- Wavefront: \( f = \frac{c}{n} \) determined by osc. frequency of wave
  - Source: \( n = 1 \)
  - \( f = \frac{c}{n} \cdot n = \frac{c}{n} \)

2. Refraction phenomena

* Snell's law

\[ \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1} \]

If \( n_2 > n_1 \):
\[ \sin \theta_1 = n_2 \sin \theta_2 \]
\[ \theta_2 < \theta_1 \]

\[ \text{ecshik, from IG-library, 29.38।} \]
Explanada:

Small angle approximation:

\[ \frac{1}{n_1} = 1 \]
\[ \frac{1}{n_2} = \approx 1.33 \]

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]

\[ \Rightarrow n_1 \theta_1 = n_2 \theta_2 \]

\[ \frac{OC}{h'} = \frac{n \cdot OC}{k} \quad k' = \frac{k}{n} \]

Total reflection region:

As \( \theta_2 \) increases, \( \theta_1 \) increases more rapidly.
At critical angle: \( \theta_2 = \theta_c \), \( \theta_c = \frac{\pi}{2} \).

Check: Which angular range corresponds to the total reflection region?
Applications: Optical fiber

\[ \theta > \theta_c, \quad \phi < \phi_c \]
\[ \theta < \theta_c, \quad \phi > \phi_c \quad \text{Total reflection region.} \]

3. Deviation of Snell’s law

\[
\frac{\sin \theta_2}{\sin \theta_1} = \frac{AB}{AB'} = \frac{n_2}{n_1} = \left( \frac{v_2}{v_1} \right)^2 \]

**Conclusion:**
\[ n_1 \sin \theta_1 = n_2 \sin \theta_2. \]

4. Prism

- **Color dispersion**

  At each surface, the ray is bending.

  Violet has more bending.
A pair of prisms: Conv. vs Div.

Conv. wave front

Div. wave front

Initial wave front

Final wave front

Wave fronts in conv. & div. cases.