Reflection

As light travels from one medium to another medium, it bends away from the normal.

Glass slab

\[ \theta_1 > \theta_2; \ \eta_1 > \eta_2 \]

Why does light bend?

\[ A_B \rightarrow \text{Too much bending} \]

\[ A_{CB} \rightarrow \text{Reasonable} \]

\[ A_{CB} \rightarrow \text{Smallest path, smallest path, but not the shortest time} \]

\[ A_{CB} \rightarrow \text{Shortest time} \]

Since you run faster than you swim,

It makes more sense to spend more time running.

\[ m_C < m_A \]

\[ n = c/n \]

\[ n_2 < n_1 \]

\[ A_{CB} \rightarrow \text{Smallest path, but not the shortest time} \]

\[ A_{CB} \rightarrow \text{Shortest time} \]

\[ B_2 = 0; \ \text{light bends towards the normal} \]

\[ \eta_1 \]

\[ \theta_1 \]

\[ \theta_2 \]
**SNELL’S LAW:** \[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]

**Hint:** Using Snell’s principle, prove Snell’s law.

**Hint:**

![Diagram](image)

Time taken to go from \( A \) to \( C \) = \[ \frac{AC}{v_1} = \frac{\sqrt{x^2 + y^2}}{c/n_1} \]

Time taken to go from \( A \) to \( B \) = \[ \frac{AO}{v_2} = \frac{\sqrt{(X-x)^2 + (Y-y)^2}}{c/n_2} \]

Total time taken to go from \( A \) to \( B \) = \[ t(x) = \frac{AC}{v_1} + \frac{AO}{v_2} \]

Set \( \frac{dt(x)}{dx} = 0 \) to find the shortest time.

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

**Critical Angle:**

\[ \beta_1 \in [0, \eta_1] \quad \beta_2 \in [0, \eta_2] \]

At \( \beta_1 \), \( \beta_2 \) = \( \gamma_2 \)

At \( \beta_1 = \beta_2 = \theta_c \) = critical angle, \( \theta_c = \gamma_2 \)
If \( \theta > \theta_c \), there is no reflection.

Light undergoes total internal reflection (TIR).

\[ \theta_c = 70^\circ \]
\[ \theta_i < \theta_c = 65^\circ \]

\( \theta \) and \( \theta' \) are reflected light.

Total internal reflection occurs when the incident angle surpasses the critical angle.

Light phenomenon plan 

\( \theta_i < \theta \)

\( \theta \) and \( \theta' \) are reflected light.

\( \theta_i \in [0^\circ, 90^\circ] \), \( \theta \in [0^\circ, 90^\circ] \)

\( \theta = 90^\circ \) \( \theta < 90^\circ \)

Reflected ray always exists.

\( \theta \), no TIR

Limit propagation in fiber

\( \theta \) close

\( \theta \) core

Limit undergoes TIR at \( \theta \)
Light undergoes total internal reflection at B.

Annotated TIR = frustrated TIR.