Total Internal Reflection of Light

lecture 2

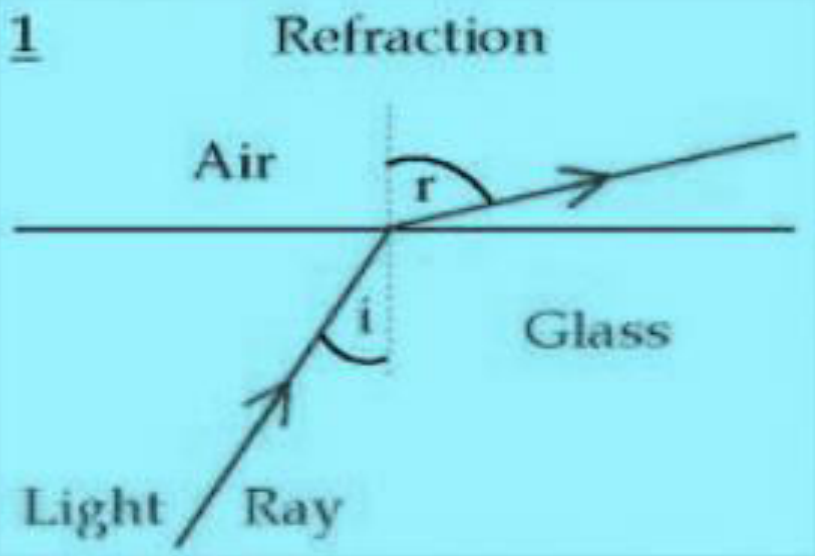
Minati Barman

Associate Professor

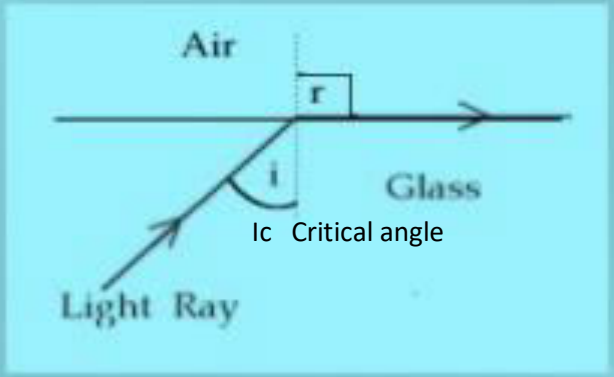
Head, Department of Physics

J N College, Boko

- When light ray enters from a denser medium to a rarer medium it bends away from the normal



- As angle of incidence (i) increases so does the angle of refraction
- At a particular angle of incidence the angle of reflection becomes 90^0
- Refracted ray grazes the surface at the interface between the two media

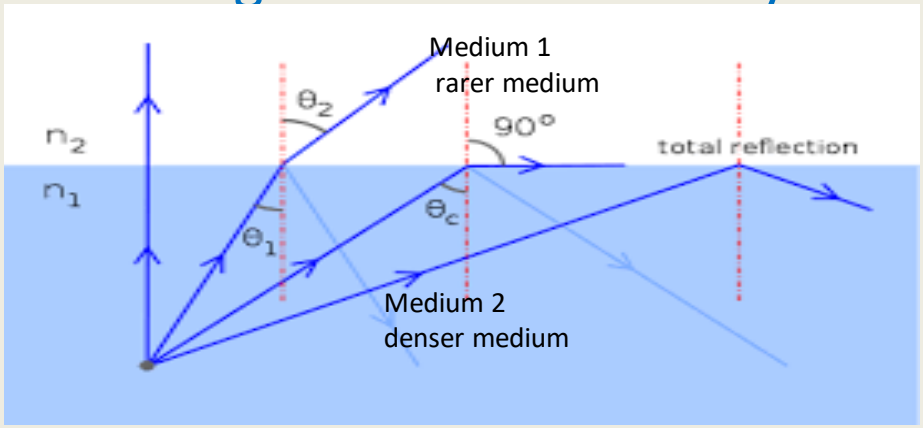


The angle of incidence for which angle of refraction becomes 90^0

CRITICAL ANGLE

Total internal reflection:

When light passes from an optically denser to a rarer medium , then at the interface of the two media one part of the light reflect back in denser medium and other part passes through the rarer medium. If the angle of incidence is gradually increased then the angle of refraction also increases and for a particular value of angle of incidence , the angle of refraction becomes 90°. That particular value of angle of incidence in the denser medium is called as critical angle and is denoted by ic.



When the angle of incidence becomes greater than the critical angle then the light ray reflects back totally to the denser medium following the laws of reflection. This phenomenon is known as total internal reflection.

Necessary conditions of total internal reflection:

i) Light must travel from denser to rarer medium.
ii) The angle of incidence must be greater than the critical angle.

Relation between refractive index and the critical angle :

From Snell's law we get $^{2}n_{1} = \sin\theta_1/\sin\theta_2 = 1/ {}^{1}n_{2}$

When $\theta_1 = ic$, $\theta_2 = 90°$ then $\sin ic/\sin 90° = \sin ic$

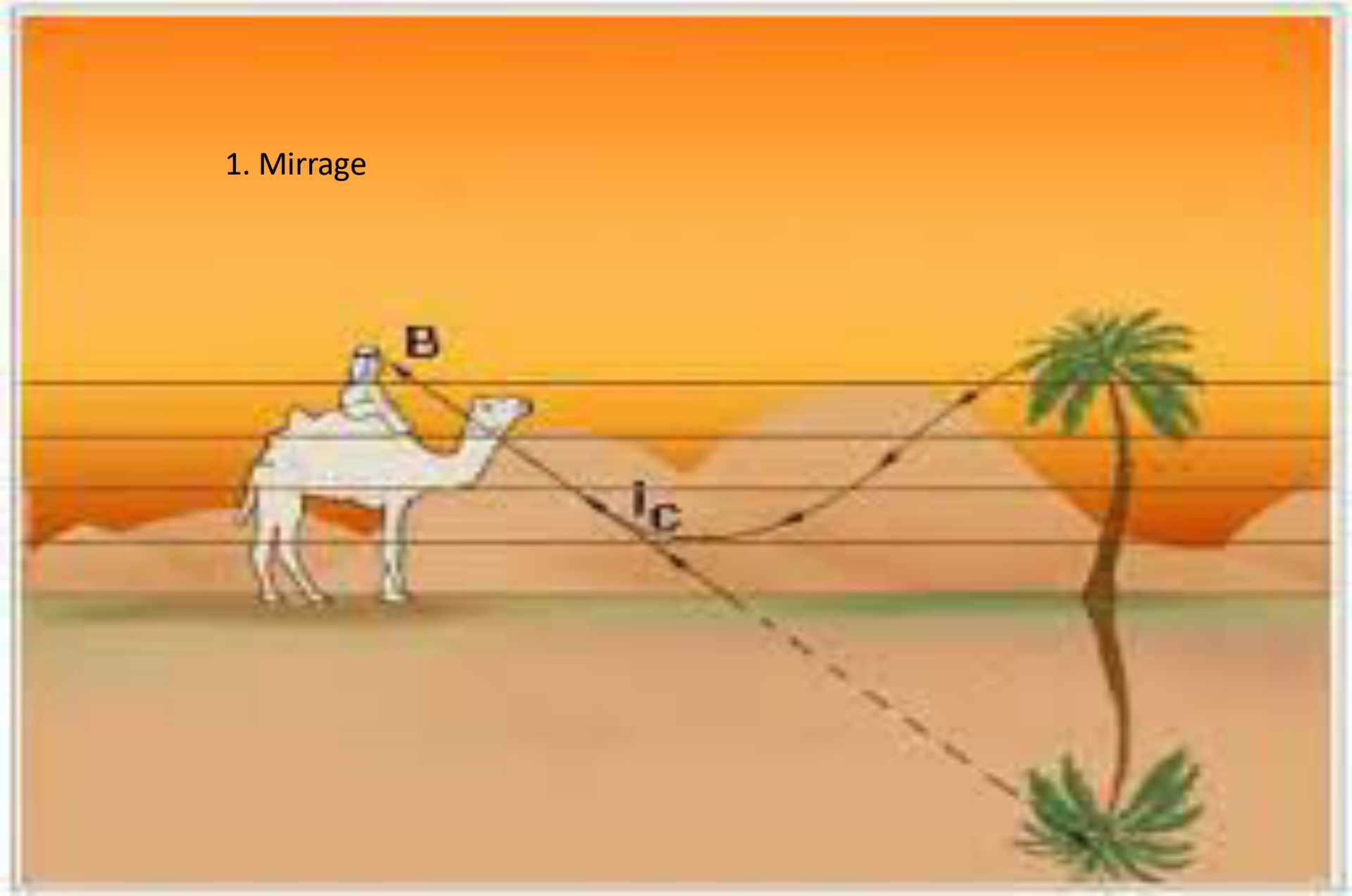
$\sin ic = 1 / {}^{1}n_{2}$

$^{1}n_{2} = 1/ \sin ic$

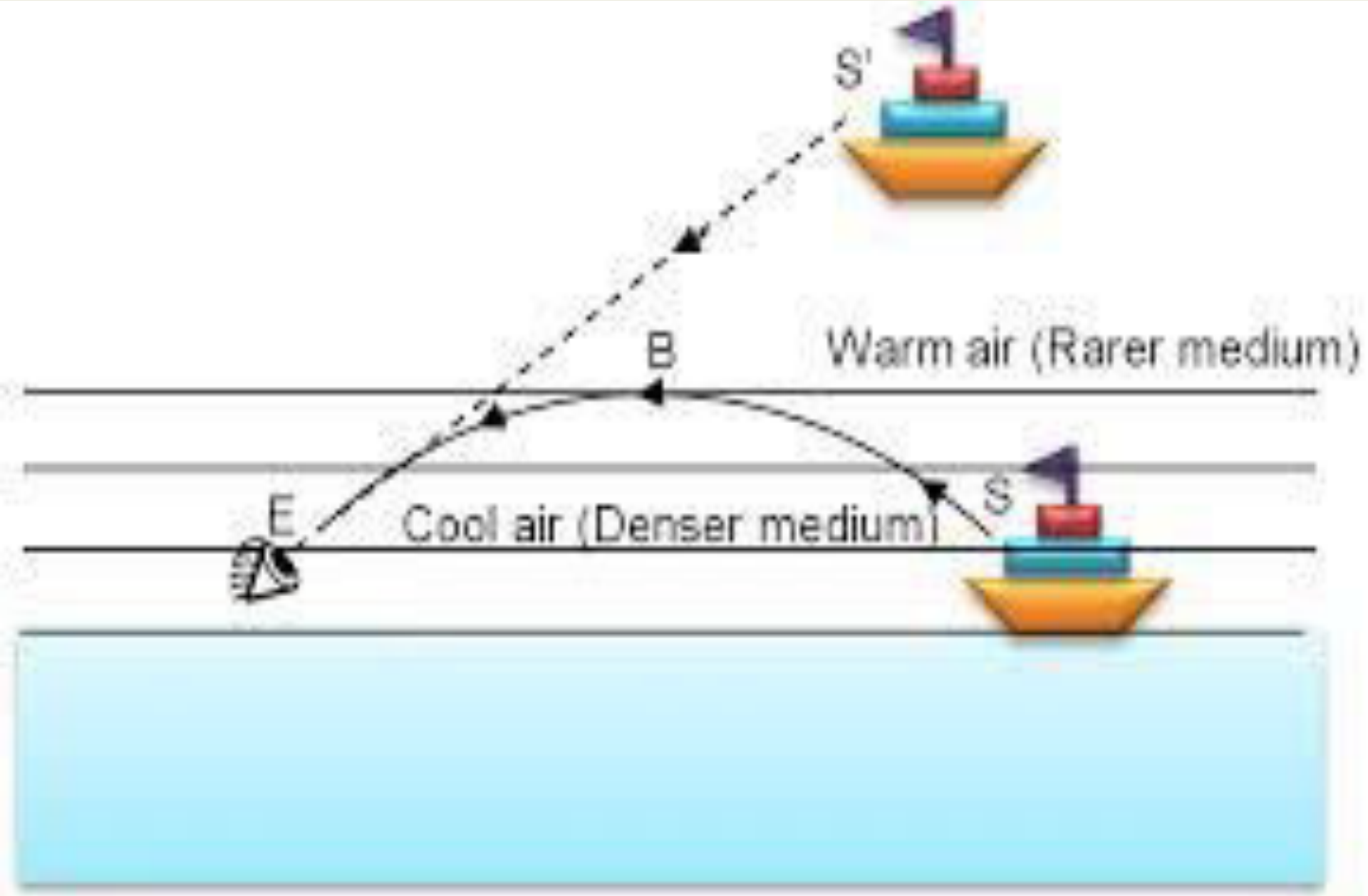
Thus refractive index of any medium is reciprocal of the sine of the critical angle.

Application of total internal reflection:

1. Mirrage

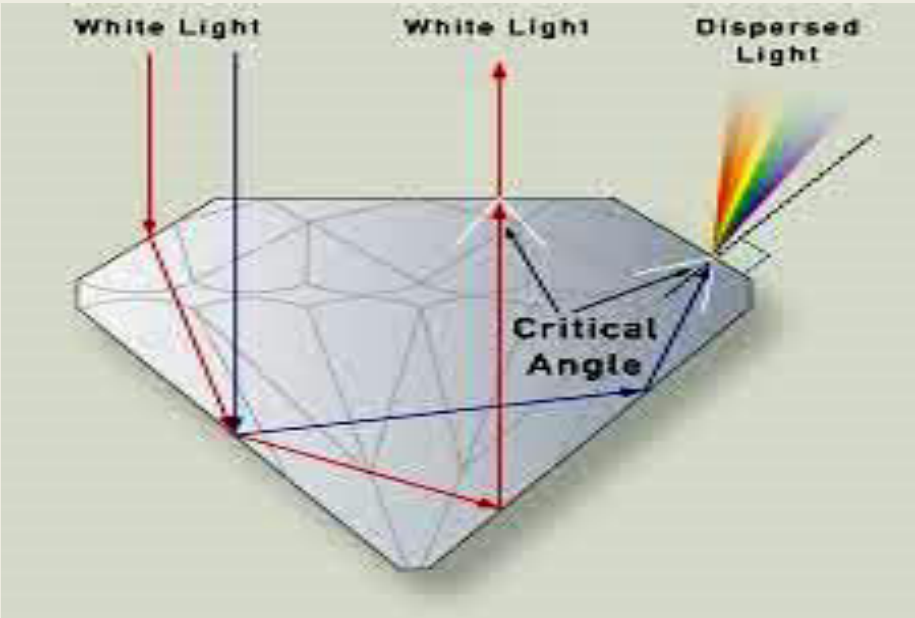


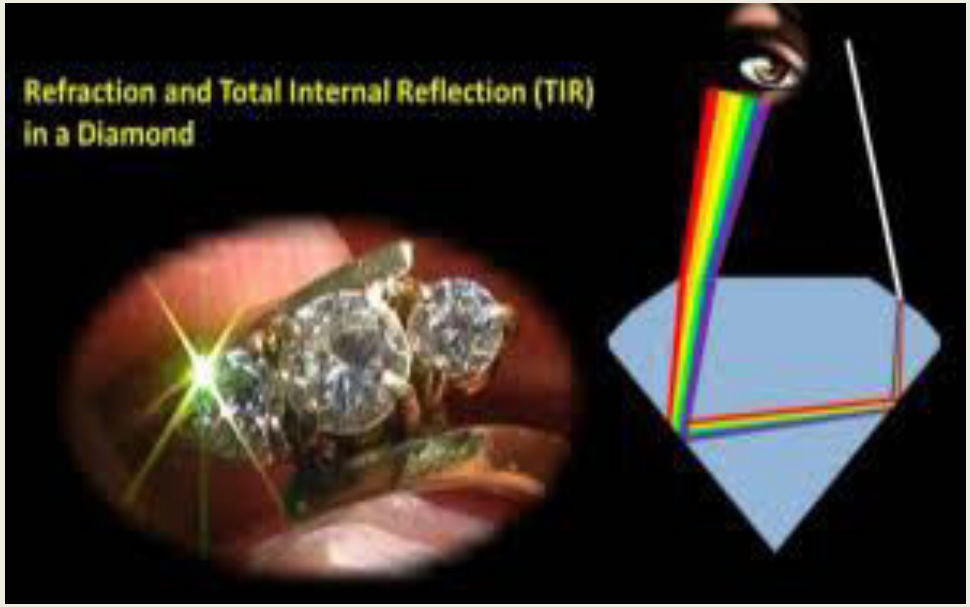
2. Looming



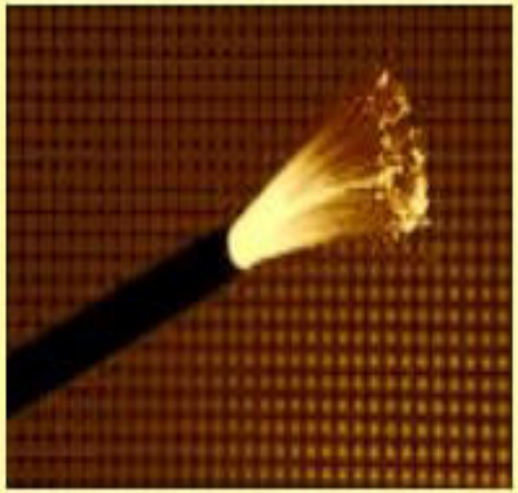
4. Sparkling of Diamond

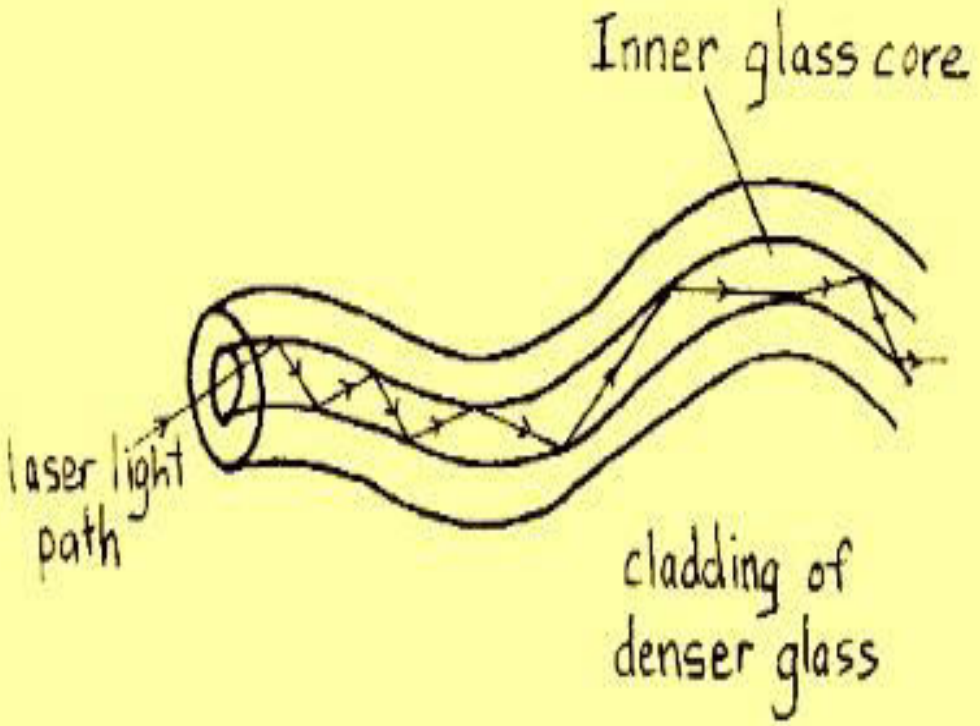
CRITICAL ANGLE OF DIAMOND : 24.4˚





3. Optical fiber





Optical fibre:

An optical fibre is a flexible, transparent fibre made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibres are used most often as a means to transmit light between the two ends of the fibre and find wide usage in fibre-optic communications.

Construction:

It consists of three main parts:

(i) Core (ii) Cladding and (iii) Buffer coating

Totally reflecting prism:

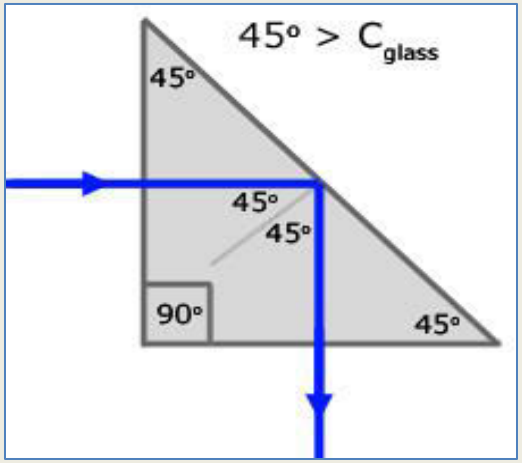
A right angled isosceles prism is called totally reflecting prism.

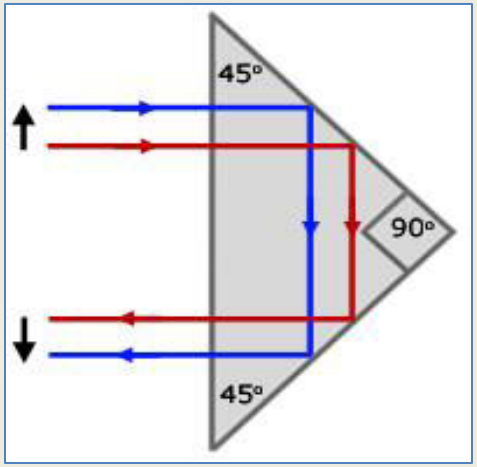
Whenever a light ray incident normally on it , the ray makes an angle 45° at the inside face of the prism, which is greater than the critical angle . Hence the ray suffers total internal reflection

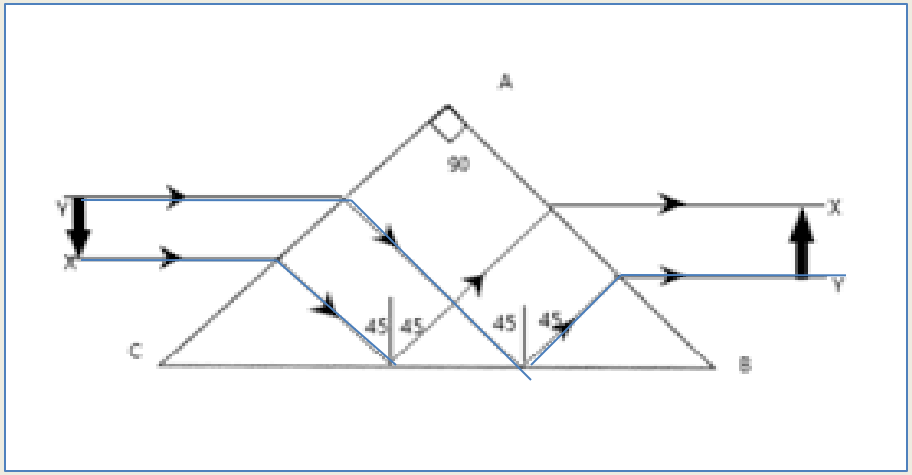
Totally reflecting prism:

Here, angle of incidence>critical angle of glass.

Hence light rays suffer total internal reflection.







Any questions ?

Thank You