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Refraction due to Attraction

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Abstract— Refraction occurs due to attraction of photons with nucleus of an atom. When photon is incident with certain angle of incidence, it is attracted towards the nucleus of atom.This attraction of photon causes bending of photon towards or away from the nucleus of the atom depending upon the angle of incidence and nature of the medium. When incident angle increases, attraction also increases, this is due to decreasing the distance between photons and nucleus of atom. This proves that refraction is not due to velocity of photon, but it is due to attraction of the photon.

Index Terms — Photon, Force of attraction, Denser medium, angle of Incidence , and angle of refraction.

1. INTRODUCTION

In the early day, a photon beam was thought to consist of particles, which is proof by Compton Effect, Raman Effect and Photoelectric Effect [1]. According to modern elementary particle photon is a particle [2], [3].The change in the direction of the photon when it passes from one direction to another is called refraction or in other word's the bending of photon when it passes from one medium to another, is called refraction. When photon is incident with certain angle on the surface, angle of between the incidence ray and normal called angle of incident and the angle made by the refracted photon with normal is called angle of refraction angle. There are two cases on which these phenomenons take place:

a. When photon goes from rarer to denser medium, photon bends toward the normal and

b. When photon goes from denser to rarer medium, photon bends away from the normal [4].

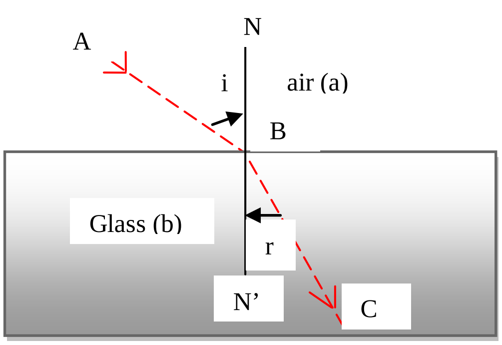

Fig1.

From fig1.
r= Angle of refraction and i=Angle of incidence.
And the relation is given by

$\mu = \text{sini}/\text{sinr}$

= velocity of light in vaccum/velocity of light in medium

$= c/v$.

This relation shows that velocity is changed when photon passes from one medium to another medium and there relation gives to find the angle of refraction, refractive index and also the velocity [5].

2. REVIEW

Photon travels in straight lines until it meets an object were mentioned by Euclid in approximately 300 BC. Euclid also studied the reflection of photon and described the laws of reflection. Approximately the same era, Hero of Alexandria investigated photon as it is reflected from a mirror and Photon follows the shortest path called law of refraction. Latter most important work was performed by Abu Ali al-Hasan ibn al-Hasan ibn al- Haytham (965–1039). According to Alhazen, was a purely external phenomenon that illuminated the objects around us, and it is the photon reflected from the surfaces of these objects that interacts with the eye to produce an image of the scene. Alhazen reversed the sense of direction of Euclid's photon rays; He affirmed the geometric concepts developed by the Greek philosophers [6], [7]. Ptolemy is credited with conducting a study of the refraction of photon, that is to say, how photon is bent as it leaves one medium such as air and enters another such as glass. On 12th or 13th century reflection and refraction of photon was studied. It was not until the early 1600s that glass lenses in the form of telescopes found use in manipulating photon arriving from the heavens [7], [8].
This law was first accurately described by the scientist Ibn Sahl at the Baghdad court in 984 and rediscovered by Thomas Harriot in 1602. In 1621, Snell derived a mathematically relation which is unpublished during his lifetime. Later in 1637 Descartes publish this law without unknowing Snell's work. And hence English countries this law called ``Snell's law'', but in French countries this law called ``Descartes' law'' [9]. It is possible to obtain an exact prediction of the observed speed of the photons in a given medium by application of Hamilton's equations of motion to the above formula, but at the same time to conclude, in agreement with the arguments of Newton and other classical physicists, that the photon momentum increases in direct proportion to n, thereby producing the well-known bending of photon rays toward the normal when entering water from air. The corresponding relativistic particle theory of photon indicates that the potential V encountered by the photons in a given medium is attractive for n>1 (where n is the refractive index of the given medium) and is momentum-dependent, which suggests the microscopic interactions responsible for the refraction of photon are non-Columbic in nature and are instead akin to the spin-orbit and orbit-orbit terms in the Breit-Pauli Hamiltonian for electrons moving in an external field [10].

HPT successfully explains all known physical interactions involving photons, and also predicts the existence of additional physical interactions involving photons. For example, the telescope, like the interferometer, could contain additional pieces of transparent glass that would also slow the forward velocity of photon as it travels within the telescope. That is to say, the angle of aberration does not depend on the forward velocity of photon within the telescope. Therefore, each individual photon of photon must be interacting with the telescope on a macroscopic scale. This interaction must cause each individual photon of photon to move sideways while also traveling forward in its photon through the telescope. This interaction must move the photon sideways in its photon, without changing the photons basic properties such as its electromagnetic wavelength, its total energy, or its color [11].

Optical tweezers work because transparent particles with a higher index of refraction than their surrounding medium are attracted towards the region of maximum laser intensity. By moving the focus of the beam around, it is therefore possible to transport the particle. Indeed, with optical tweezers it is possible to grab and move dielectric objects and biological samples – ranging in size from tens of nanometers right up to tens of microns – at will. Although the optical forces might only be of the order of Pico Newtons, such forces can often be dominant at the micro-level [12]. Photon passing from a less dense medium to a more denser medium is slowed down. Conversely, going from a denser to less dense medium photon speeds up. The amount of bending that occurs depends not only on the refractive index of the medium but on the angle that the photon enters. If the angle of incidence is small then the ray is refracted less than if the angle of incidence were high [13]. .If a photon wave passes from a medium of lower refractive index to one of higher refractive index, it is bent toward the normal. However, if the wave travels from a medium of higher refractive index to a medium of lower refractive index, it is bent away from the normal [4], [14]. Newton assumed that when photon is a particle comes within a very small limiting distance from the refracting surface, it began to experience a force of attraction toward the surface and because of this bending of photon take place when the medium is change [15].The nuclear force is powerfully attractive between nucleons at distances of about 1 fm between their centers, but rapidly decreases to insignificance at distances beyond about 2.5 fm. At distances less than 0.7 fm, the nuclear force becomes repulsive. This repulsive component is responsible for the physical size of nuclei, since the nucleons can come no closer than the force allows. By comparison, the size of an atom, measured in Angstroms (Å), is five orders of magnitude larger. The nuclear force is not simple, however, since it depends on the nucleon spins, has a tensor component, and may depend on the relative momentum of the nucleons [16].

3. Possibilities

The phenomenon of refraction states that when photon is passed from one homogenous medium to another homogenous medium, then the bending of the photon takes place either towards the normal or away from the normal. When the photon passes from one rarer homogenous medium to another denser homogenous medium, then photon bends towards the normal at the point of interaction or incident. However, the opposite case is seen when the photon passes from denser homogenous medium to rarer homogenous medium. When the photon passes from rarer homogenous medium to denser one, the angle of refraction goes on decreasing corresponding too its incident . The angle of incidence is greater than the angle of refraction when photon incident is from rarer to denser. However, when photon passes from denser homogenous medium to rarer homogenous medium the angle of refraction goes on increasing corresponding incidence angle. Angle of Incidence is the angle between the normal and incidence rays, whereas refraction angle is the angle between refraction rays and normal. Normal is the perpendicular drawn on the paper, where incidence and refracted rays meet. Here rarer medium is the medium having low optical density, whereas the denser is those media where optical density is greater. We are going to show that the phenomena of the refraction are not due to change in the velocity of the photon but it is because of attraction of the photon with the molecules on which photon is incidence. This force is special force having shorter range about nanometer-fathometer range which seen at the boundary of two media where photon change direction and passes straight through medium. At the point of interaction photon is absorbed, emitted and finally emerged out .Therefore there is no chance of attraction of photon.

4. Method

When photon is incidence from denser to rarer, it bends towards the normal and when the photon is incidence from denser to rarer, it bends away from the normal. However this phenomenon is not due to the velocity of photon, it is due to the force of attraction between photon and mass of nucleus at the point of incidence. When the photon passes from the rarer to the denser, the distance of the photon to the surface molecule goes on decreasing and at point of incidence, it is very small. This phenomenon does not occur on the homogenous medium that means in the medium having same optical density. It only occurs at the boundary point when its optical density changes [15]. Refraction phenomenon is because of attraction not due to the velocity. The attraction depends upon the mass of the photon and mass of the nucleus on which it is incident. So the greater mass, greater will be attraction and angle of refraction will be smaller for the same angle of incidence.

The verification of the attraction of photon is given below:

When photon is incidence on the surface, it gets attracted by the atom of the medium. Therefore, this attraction causes the photon to bend towards or away from the normal. Let F is force of attraction between them.

$$F = (SM_P M_A)/d_i^2 \quad (1)$$

Here M_P = Mass of incident photon

M_A = Mass of transparent atom on which photon is incident

S = proportionality constant =8.77×10^{42} and

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d_i = distance, inclined between an incident photon and an atom of the surface and the subscript i= no. of atoms such as 1, 2, 3, 4 as shown in Fig2.

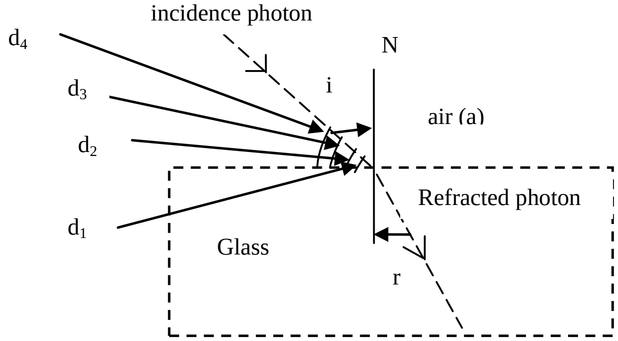

Fig2.

This force occurs when the photon is incidences on the surface of the medium. When the photon incident with certain angle is on the surface of the distance between the surface atom and the incident individual photon the separation goes on decreasing and hence, the attraction increases and becomes greater at the point of the incidence and so the bending occurs. If we take same color of photon incident with same angle on the different surfaces of the transparent medium like water and glass, we see the angle of refraction will be difference. This is because of the force which directly proportional to the mass of the photon and the atom of the interacting medium. Since the mass of the glass molecules will be greater than the mass of the water molecules therefore the attraction of the photon on the glass is greater than the water as shown in (1) and fig3 and fig4.

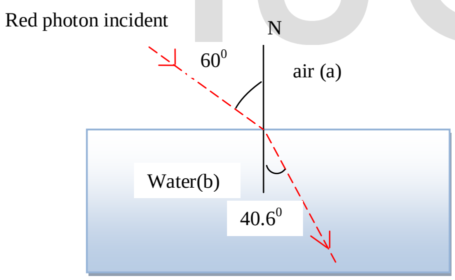

Fig.3

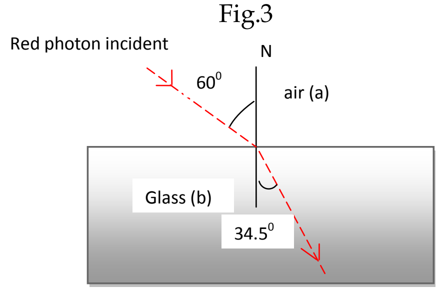

Fig4.

4.1. Section A: Analytical Part

Case-I: For Red and Violent photon in water medium [Fig5 and fig6]

Let F_R =Force of attraction for red photon

F_V =Force of attraction for violent photon

d = distance between the photon and atom is byound nanometer.

We have,

Mass of red photon (M_R) =0.27×10^{-35}kg

Mass of atom M_A= $18\times1.66\times10^{-27}$kg.

Distance between photon and atom byound (d) = 10^{-19}m

Putting **these** values in (1) we get

F_R=0.7075N

Also for Voilent phootn

Mass of violent photon (M_V) = 0.43×10^{-35}

Mass of atom M_A= $18\times 1.66\times10^{-27}$kg.

Distance between photon and atom byound (d) = 10^{-19}m

Putting these values in equation 1 we get

F_V=1.0861N

Now F_V/F_R=1.5.

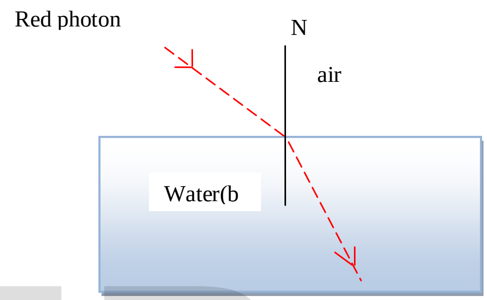

Fig.5

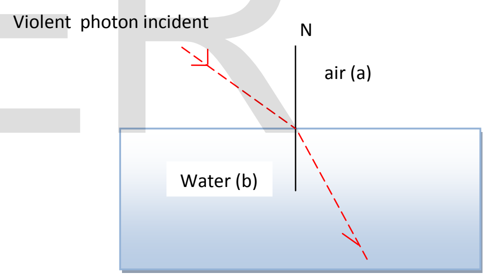

Fig.6

Case-II: For Red and Violent photon in glass medium [Fig7 and fig8]

When red photon incident is on the surface of the glass, the force of attraction is given by [Different photon same surface for same angle of incidence]

Mass of red photon (M_R) = 0.27×10^{-35}kg

MassofatomM$_A$=60.08 $\times1.66\times10^{-27}$kg.

Distance between photon and atom byound (d) = 10^{-19}m

Putting these values in (1) we get

F_R=2.3616N

Mass of violent photon (M_V) =0.43×10^{-35}kg

Mass of atom M_A= $60.08\times 1.66\times10^{-27}$kg.

Distance between photon and atom byound (d)= 10^{-19}m

Putting these values in (1) we get

F_V=3.7610N

Now F_V/F_R=1.6

Here, the force of attraction of the violent is also greater than that of attraction of the red for the constant distance.

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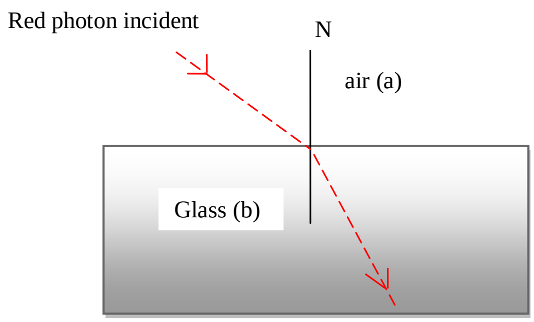

Fig.7.

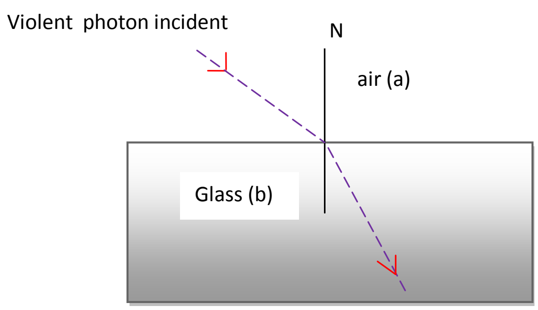

Figure 8

Thus we can see from the above mention cases force of attraction for violent light is greater than the red light and angle of deviation will be for then that of red light. Therefore, the bending of the photon towards the normal depends upon force of attraction between the photon and medium.

Photon itself neither absorbs nor bends it is due to attraction of molecules of the medium [17]. Therefore we can prove that bending of the photon is not due to the velocity, it is because of attraction of the force between photon mass and atom.

If we suppose that bending is due to velocity of the photon then for the different angle of incidence we have different angle of refraction, there should be the same angle difference between two refracted rays but we did not find the same angle of the difference, this prove that the refraction is due to the force of attraction not due to the velocity as shown in Fig9.

Let us consider atom A, atom B and atom C. If the photon angle of incident is on the nucleus of an atom B with certain angle of incident, the influence of the atom A is greater than the influence of the C. Now the total influence or attraction of the photon = attraction of photon by nucleus of an atom B + the attraction of atom A > the attraction of photon by the nucleus of atom A + attraction of C atom.

Hence, the attraction of photon is greater towards atom A and photons bend toward the normal or away from the normal.

When photon incident with some angle like 15 degree the influence of the atom C to photon is very less, the angle of refraction is that case is greater than other refracted ray but if the angle is increased, then the influence of the atom A increase and atom C decrease which cause decreasing of the difference between the refracted angles. Hence ratio of the corresponding incident and refracted goes on decreases.

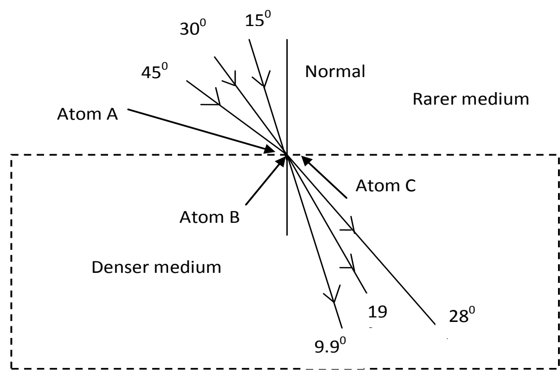

Fig 9.

4.2. Section B: Experiment Part

Let us consider a Laser of the different colors and incidents, the Laser on the surface of the different glasses slab of the size 100X60X18mm at the room's temperature. When the red photon is incident on the surface of the glass slab, different angle of refraction is obtained with different angle of incident. Let us consider AB is red incident of photon from rarer medium on the surface of the glass slab at the room temperature and BC is refraction angle on the denser medium. Let angle ABN be incident angle (i), N be the normal, and angle CBN' be refracted angle (r). When different angle of incident of red photon is incident on the surface such as i_1=15degree, i_2=30degree, i_3=45degree i_5=60degree, i_6=75degree and so on then the angle of refraction for each angle of incident are obtain as r_1=9.9degree, r_2=19degree, r_3=28degree r_5=35degree, r_6=40degree and so on. Also seen in to table 1.

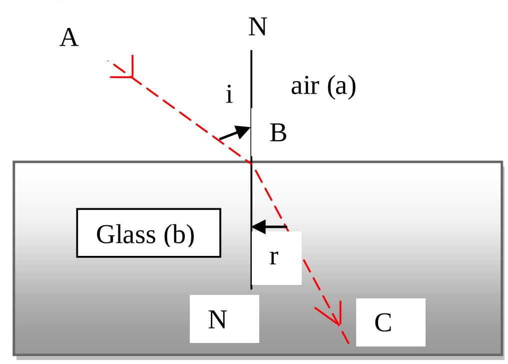

Fig10. Experimental arrangement of refraction of light.

The result of red is as given below for the same angle of incident in the table here n=1, 2, 3, 4…

S.N.	Incident angle i_n in degree	Difference of incidence angle $(i_{n+1}-i_n)$	Refraction angle r_n	Difference of refraction angle $(r_{n+1}-r_n)$

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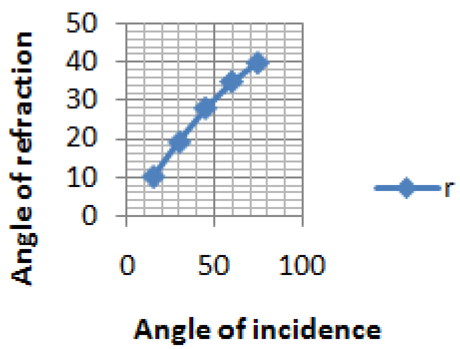
1	15	15	9.9	9.1
2	30	15	19	9
3	45	15	28	7
4	60	15	35	5
5	75		40	

Similarly we can obtain for blue, green, violent, and other pho ton.
Result of the experimental value in fig.11



Graph of incidence angle and refracted angle.

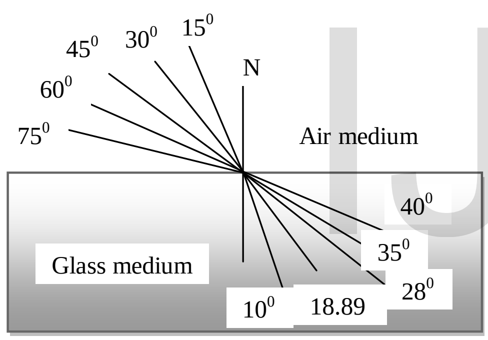


Fig.11

5. Conclusion

We can conclude that from both theory and experiment as mentioned in Section A: and Section B: respectively, the phenomenon of the refraction is due to the attraction between the photon and the molecules of the medium. It is also true for different optical densities where interaction takes place.

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