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Immobile state of an invisible medium - ether

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Abstract — *The effects of interference and diffraction of light precisely established the wave nature of light. As all the known waves are transmitted by some or the other medium, it is quite natural to assume that light waves are also transmitted by a medium which obviously fills the space around us and the interplanetary and interstellar space. If the properties of a medium decide the velocity of light after passing through it, then it is evident that questions arise about how the vacuum and medium can have almost identical values of velocity of light. Scientists have often made several unsuccessful attempts in identifying such an invisible medium which wrapped up the entire universe and predicting this medium completely gives rise to the existence of an immovable state. Consequently, 19th century concocted the medium and named it Luminiferous or Ether. Michelson and Morley tried and failed to detect the existence of this medium with their device Interferometer.*

Keywords — **Ether – Michelson – Morley experiment - ether wind – homogenous medium - interferometer**

I. INTRODUCTION

The disturbance in a medium leads to the process of creation of energy. In any given medium, only particles vibrate and transfers energy from one place to another. This distribution is often termed as wave motion. This motion of a wave can be classified by taking vibrations of particles as the key factor. Longitudinal and Transverse wave motions play a main role in deciding how the particles in a wave to move and vibrate. Sound waves are longitudinal and are also known as mechanical waves and the velocity of these mechanical waves depends on the medium they choose to travel. On the other hand, light waves i.e., electromagnetic waves are transverse and they travel in the absence of a medium at a rate of 3000000 meter per second. Light waves are polarized when they interact with a transparent material. The physical properties of light get changed after every single interaction with obstacles. But here a question gets generated. Does the same physical properties of light change when it chooses to travel in vacuum? At the back of many questions, assumptions and considerations that take place every time in regard to the existence of the medium in space which has the capability to carry the light from millions of kilometres. Finally, after several discussions and conclusions the mysterious medium that took birth was started to be called as ETHER.

Amongst various ambiguities, scientists have managed to give two options for the existence of the ether which is as interpreted below:

(1) Ether is completely in stationary state and encloses all celestial bodies in it.

(2) Matter drags along the ether in its surroundings.

With the acceptance of wave theory of light, it was thought that the space is filled with a substance called as ether. This hypothetical medium was suppose to be invisible, mass less, perfectly transparent and non –resistive having high elasticity and low density. If the ether hypothesis is correct then it is possible to determine the absolute velocity of the earth with respect to other frame. Michelson and Morley carried out an experiment using Michelson interferometer for this purpose.

The negative result of this Michelson –Morley experiment suggests that it is impossible to measure the speed of the earth or the concept of a fixed frame of reference (like ether filing all space) cannot be verified. The null result of the experiment leads to the total rejection of the ether hypothesis.

So from the theory of relativity "The speed of light in vacuum is the same in all frames of reference which are in uniform relative motion"

II. EXPERIMENTAL SECTION

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Before giving conclusion about the existence of ether medium and an opinion on it, let us check the familiar Michelson interferometer experiment and its ultimate result. The Fig.1 schematically shows the instrument Michelson designed for this purpose, an instrument now known as Michelson interferometer.

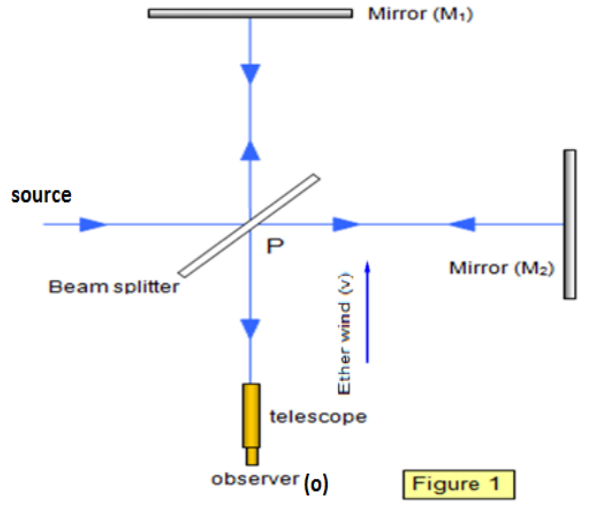

Figure 1

Light from a source falls on a beam splitter P, a partially coated mirror that partly reflects; partly transmit light, as is shown in Fig1. The reflected beam travels back and forth in one arm of interferometerPM_1, the transmitted beam in other PM_2 .

The two beams are combined at P and parts of both are reflected and transmitted so as travel together in the direction observer (o). An observer (o) examines the interference pattern produced by the beams. If the apparatus is at rest in ether, the two reflected beams would take equal time to return the glass plate P. But actually the whole apparatus is moving with the earth. Suppose think that the direction of motion of earth is in the direction of the initial beam (i.e., origin of source). Due to the motion of the earth, the optical paths traversed by both the rays are not the same.

The time taken by the ray to travel back and forth in the arm PM_1 of the length parallel to v is given by (longitudinally)

$$t_1 \approx \frac{l}{c+v} + \frac{l}{c-v} = \frac{2lc}{c^2-v^2} \approx \frac{2l}{c}\left(1+\frac{v^2}{c^2}\right) - - - (1)$$

The time taken by the ray to travel back and forth in the arm PM_2 of the length perpendicular to v is given by (transversally)

$$t_2 \approx \frac{2l}{\sqrt{c^2-v^2}} \approx \frac{2l}{c}\left(1+\frac{v^2}{2c^2}\right) - - - (2)$$

Thus the difference in times of travel of longitudinal and transverse directions of the beams is

$$\Delta t = t_2 - t_1 = \frac{2l}{c}\frac{v^2}{2c^2} = \frac{lv^2}{c^3} - - - (3)$$

Optical path difference between two beams is given by $\frac{lv^2}{c^2}$

If λ is the wavelength of the light use in the experiment, then the path difference in terms of wavelength is given by $\frac{lv^2}{c^2\lambda}$

Michelson and Morley performed the experiment in two different ways i.e., first way as shown in fig and the second way performed by rotating total apparatus through 90^0. The positions of the two mirrors of the apparatus are changed. Now the path difference is $-\frac{lv^2}{c^2\lambda}$ for the same wavelength.

The resultant path difference is now changes into $\frac{2lv^2}{c^2\lambda}$ Fitz Gerald and Lorentz suggested that the negative result of the experiment can be explained by assuming that the bodies which are in motion through the ether experience a contraction in the direction of motion by a factor of $\sqrt{1-\frac{v^2}{c^2}}$. In that particular case, the length l of the arm must be replaced by $l\sqrt{1-\frac{v^2}{c^2}}$ in the calculation of the travel time when ether drift is parallel to arm of the interferometer. If the arm of interferometer is perpendicular to the ether drift then the same as the travel time.

Michelson –Morley experiment was devised on the basis that if ether exists in space, then earth moving through that ether medium would result in "Ether wind" just like how a car moving through air would cause air wind. Due to this reason Michelson and Morley rotated their device in two different

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directions. The results of the experiment always proved to be negative. The negative results of Michelson - Morley experiment contradicts the famous Galileo's relativity principle. Moreover it showed that motion relative to ether cannot be detected and the velocity of light is independent of the motion of a light source, since its motion with respect to the ether is different at different seasons of the year.

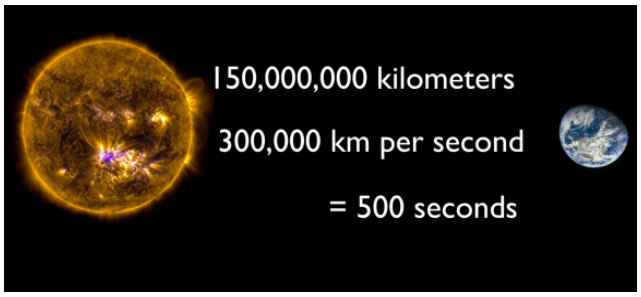
III. RESULTS AND DISCUSSION

Michelson and Morley were strongly confirmed the absence of the medium in the space by their Interferometer experiment. Here, some examples letting to think about the existence of medium differently. From the fundamental experiment of refractive index, a pencil which is immersed into a half filled glass of water as shown in Fig 2. The part of the pencil in the water has no change in its shape because of light passing equally through a homogenous water medium simultaneously other part of the pencil remained in air also in shape because light passing equally through homogenous air medium. Every medium have been their appropriate refractive index values. According to this, one can assume that vacuum is also a homogeneous invisible medium where the value of speed of light is slightly greater than the value of speed of light in air. Fig 3, Tabulated with refractive index of different mediums. The value of refractive index of air slightly differs with refractive index of vacuum (Fig 3).

Index of Refraction for various media

Media	Index of Refraction
Vacuum	1.00
Air	1.0003
Carbon dioxide gas	1.0005
Ice	1.31
Pure water	1.33
Ethyl alcohol	1.36
Quartz	1.46
Vegetable oil	1.47
Olive oil	1.48
Acrylic	1.49
Table salt	1.51
Glass	1.52
Sapphire	1.77
Zircon	1.92
Cubic zirconia	2.16
Diamond	2.42
Gallium phosphide	3.50

Another example explains, the radiation from the sun takes time exactly 8 minutes 20 seconds to reach the earth. The distance (d) between sun and earth is 150,000,000 kilometres. Velocity (V) of radiation from the sun to earth is 300000kilometers per second. If we divide the distance some equal parts, then the time taken the radiation to travel each part of the distance is not equal because the velocity of the radiation is decreases at earth atmosphere due to high density state of particle.



From this asumption, the radiataion from the sun traves faster in vacuum then earth atmosphere. So the speed of light both in vacuum and air is not equal.

IV. CONCLUSION

In summary, the Michelson – Morley experiment was conducted for verification of existence of ether medium. The interferometer direction has been changed by keeping direction of initial light to parallel and perpendicular to the direction of ether wind. I concluded that this invisible medium is completely available in homogeneous and immovable state in space. Being a homogenous medium the speed of light anywhere in vacuum is the same. The same light slightly takes a change in its speed when it travels in different homogenous mediums of different materials.

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