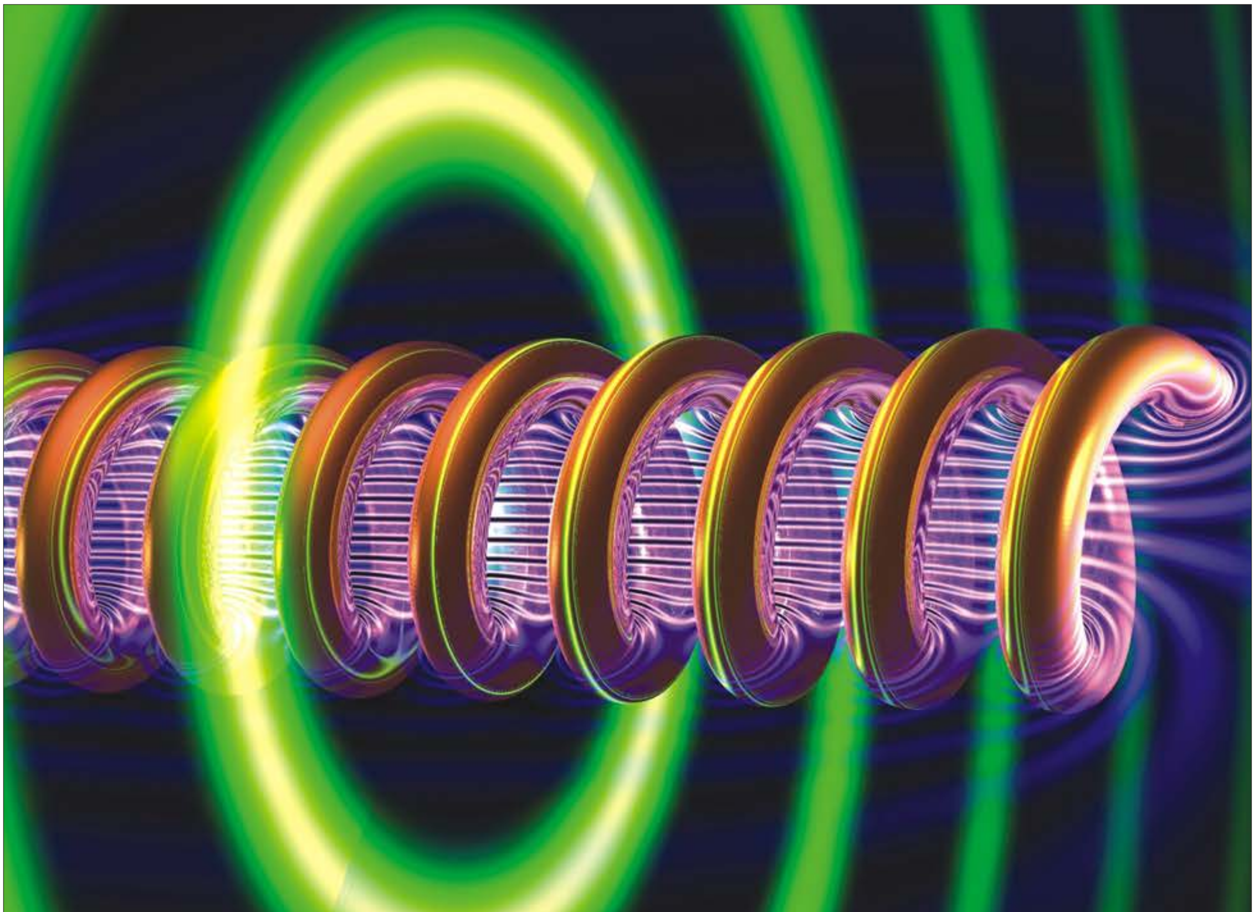


Current Research in Physics

ISSN 2154-3119

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS

Current Research in Physics

ISSN 2154-3119
DOI: 10.3923/crpaj.2024.8.20

Research Article

Current Comparison Experiment to Prove that Light Speed Remains Same Regardless of Types of Non-Opaque Mediums or Lights

[1]Liew Boon Hee and [2]Wong Lai Peng

[1]Engineering Council, London, United Kingdom
[2]University of Malaya, Kuala Lumpur, Malaysia

Abstract

Background and Objective: This study aims to verify the contradiction between Newton's corpuscular theory and the theories of Huygens, Young and Fresnel regarding the speed of light versus actual experimental results. The objective of this research is to compare the differences in light speed in air and glass. However, the results show that light travels at the same speed in both air and glass. The authors intend to establish an accurate scientific understanding of the current world. **Materials and Methods:** Laser, glass plate and small and big spherical objects were used in the study. Shine laser on near and far objects and observe to verify: Whether all the laser rays are lighted up or cut off at the same time and explain why same light speed during reflection, refraction, diffusion and dispersion. Shine laser on small and big spherical objects and observe the circular object's shadow to verify: Whether Fresnel spot is due to circumferential diffusion or diffraction. Shine laser in air and glass at the same time and compare the reflections to verify: Whether light travels the same speed for both mediums. **Results:** Method a: Not all the laser rays are always lighted up and cut off at the same time. Different colors of light travel at the same light speed. Method b: The Fresnel spot is due to circumferential diffusion only. Method c: The correct time frames from in air and in glass prove same light speed for both mediums. **Conclusion:** The experiments conclude that light speed remains the same regardless of types of non-opaque mediums or types of lights.

Key words: Transparent, translucent, opaque, light interference, laser, reflection, refraction, diffraction, dispersion

Citation: Hee, L.B. and W.L. Peng, 2024. Current comparison experiment to prove that light speed remains same regardless of types of non-opaque mediums or lights. Curr. Res. Phys., 13: 8-20.

Corresponding Author: Liew Boon Hee, Engineering Council, London, United Kingdom Tel: +60197728923

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In year 2023, Liew Boon Hee presented a research paper to Science Alert entitled "Current Double-Slit Experiment Proves That There is No Light Interference"[1], which describes that there is no light interference during light traveling. Ever since the publication, the authors took the opportunity to use the discovery to carry out light-speed comparison experiments in air and in glass to verify Newton's corpuscular theory[2] which demands a speed of light greater in glass or water than in air and theories of Huygens[3], Young and Fresnel, which requires a speed of light in air must be greater than the speed of light in water or glass[4]. Refer to the statement extracted from Opticks, page XLV: "Whereas Newton's corpuscular theory demands a speed of light greater in glass or water than in air, the theory of Huygens requires a speed of light in air that must be greater than the speed of light in water or glass". However, the current findings through light speed comparison in air and in glass experiments prove that there is no difference in light speed for both mediums contradicts both of the theories.

Besides the light speed comparison experiment, the authors also carried out a circular object shadow experiment to verify the findings in optics, the Arago spot[5], Poisson spot[6] or Fresnel spot[7] where there is a bright point that appears at the center of a circular object's shadow due to Fresnel diffraction[8-11]. Through the experiment, off-centered spot was observed for a big spherical object due to diffusion, it is wrong to use this off-center diffused spot to claim the discovery of light interference since light is massless, there is no way for light interference, scientifically, the term diffusion is more appropriate then diffraction in this case.

Since the studies come to similar conclusions, for the sake of scientific truth, the authors also provided explanations on why all types of lights travel at the same speed during reflection, refraction, diffusion and dispersion, contradicting the involvement of different light frequencies or wavelengths.

The objective of this research is to compare the differences in light speed in air and glass. The authors aim to raise awareness among researchers that light travels at the same speed in all non-opaque mediums, regardless of the type of light. By presenting these findings, the authors intend to establish a scientific consensus and contribute to accurate physics knowledge for future generations.

MATERIALS AND METHODS

Study duration: This study was carried out in 2024 at the Kulai Private Science Laboratory in Malaysia.

Experimental procedure

Warning: Safety first, avoid direct eye exposure to the laser.

Materials: Laser, glass plate, small and big spherical objects.

Method 1: To establish methods to find out all the possible errors/wrong discoveries and make the necessary corrections before carrying out the actual light-speed comparison experiment.

The following test is not to measure light speed in the air, it is meant to find out the types of errors induced during testing:

- Shine a bundle of beams of light from laser at a far-distant object (less than 1 km) beside a near object. The choice of a near object can be a denser object to compare with air, such as a cogwheel, a beaker of water or glass, etc.
- Video record and reduce the video speed $4^5 = 1024$ times through video cut and video speed controller methods to make analysis possible

Method 2: The following steps were established to prove that the Fresnel spot is due to circumferential diffusion instead of diffraction:

- Use big and small spherical seeds for circumferential diffusion testing comparison as shown in Fig. 1
- Shine a bundle of laser beams to the small spherical seed at different angles and try to obtain a small light spot at the center of the seed's shadow on the screen
- Next shine a bundle of laser beams to the big spherical seed at different angles and try to obtain a light spot at the center of the seed's shadow on the screen

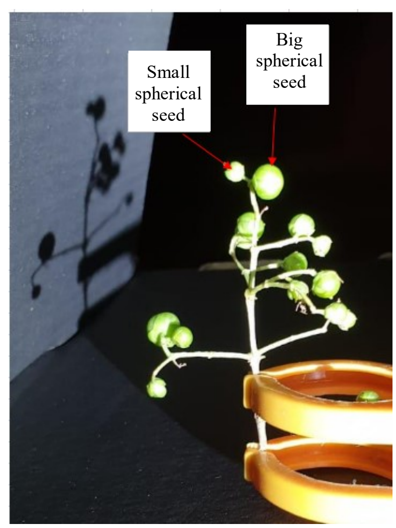


Fig. 1: Big and small spherical seeds

Fig. 2: A rectangular glass plate was placed flatly on top of a levelled table

Fig. 3: Use blanket to cover the top surface of the glass and press the laser pen head with mounted spot pattern cap against glass width with partial head on top of glass surface

Method 3

Method 3a: To establish comparison methods through error filtering in order to find out any difference in light speed when light travels in air and glass:

- Place a rectangular glass plate of size 110.4 cm length (length for light travels in glass)$\times$52 cm width (press against screen)$\times$0.5 cm thickness (able to allow laser head to press against glass partially and allow partial of head out from glass, in order to get light spots from air and glass on the screen) flatly on top of a levelled table as shown in Fig. 2
- Place a blanket as flatly as possible to cover the top surface of the glass to prevent external light reflection from in contact with the glass and then mount spot pattern cap to the head of the laser pen. Press the laser pen head against glass width with partial head on top of glass surface as shown in Fig. 3
- Shine laser spots through glass and surface of glass flatly. On and off the laser at alternate intervals
- Off the light of the room and video taking until sufficient information is captured. Refer to Fig. 4, for normal laser light up whereby light spots from air and glass can be seen
- Video speed reduction (4^3 = 64 times) to ensure video motion is clear for interpretation and analysis
- Prepared Table 1-3, filled up the tables with pictures of video speed reduction (4^3 = 64 times) and added observation remarks

Table 1 shows pictures and remarks for immediate initial laser light-up frames with video speed reduction (4^3 = 64 times).

Table 2 shows pictures and remarks for normal laser light-up frames with video speed reduction (4^3 = 64 times).

Table 3 shows pictures and remarks for immediate laser trailing light before total light off frames with video speed reduction (4^3 = 64 times).

- Selected all the frame numbers that have both the light spots from air and glass observed during the immediate initial laser light up and immediate laser trailing light before total light off. Continued to reduce the video speed of the selected frames up to $4^{15} = 1.07\times10^9$ times which is equivalent to able to detect motion difference up to $0.25^{15} = 9.31\times10^{-10}$ sec

$4^{15} = 1.073741824e+9$

$0.25^{15} = 9.31322574615479e-10$

- Prepare below tables, fill up the tables with pictures of video speed reduction ($4^{15} = 1.07 \times 10^9$ times) and add observation remarks

Table 4 shows pictures and remarks for immediate initial laser light up of selected frames with video speed reduction ($4^{15} = 1.07 \times 10^9$ times).

Table 5 shows pictures and remarks for immediate laser trailing light before total light off of selected frames with video speed reduction ($4^{15} = 1.07 \times 10^9$ times).

- Make conclusion out of the findings

Method 3b: The following steps are meant to explain insignificant impact of light reflection, refraction and dispersion within a small piece of glass as compare with light speed for Method 3a.

- Shine laser light (without spot pattern cap) into a smaller transparent glass plate for ease of taking picture and better explanation
- Take photograph for the observed light paths

Results: Method 1a

Observation for Method 1a: Upon immediate switching on the laser, the video showed different distinguished appearances in the time frames as shown in Fig. 5 and 6. One of the most obvious observations for two frames below is the immediate appearance of light at a near object followed by the appearance of a light path beside the near object and light reflection from a distant object. The in-between time of the two frames = (61-27 sec)/1024 = 0.0332 sec.

On the other hand, there was a different phenomenon in some of the recorded frames which have shown spontaneous reflection at the same time for both near and far objects which is a different phenomenon from the above finding.

Findings for Method 1a

Error 1: The observer noticed that light has reached the near object first and unable to notice any light ray pass by and moving toward the far object, the observer might assume light travels faster in denser medium then light travels in air of less dense medium.

Conclusion for Method 1a: Not all the visible rays of the laser bundle are always lighted up at the same time.

Results: Method 1b

Observation for Method 1b: Upon immediate switching off the laser, time frame pictures of trailing light are shown in Fig. 7 and 8. The most obvious different between two frames were the immediate disappearance of light reflection at near object and yet still could observe reflected light from distant object at that moment. The in between time of the two frames = (242-208 sec)/1024 = 0.0332 sec.

On the other hand, there was different phenomenon in some of the recorded frames which had shown spontaneous cut off of reflected lights at the same time for both near and distant objects.

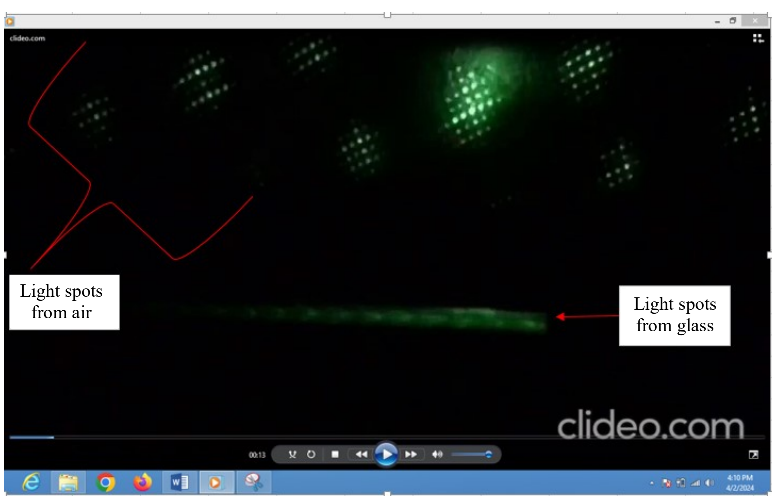


Fig. 4: Normal laser light up whereby light spots from air and glass can be seen

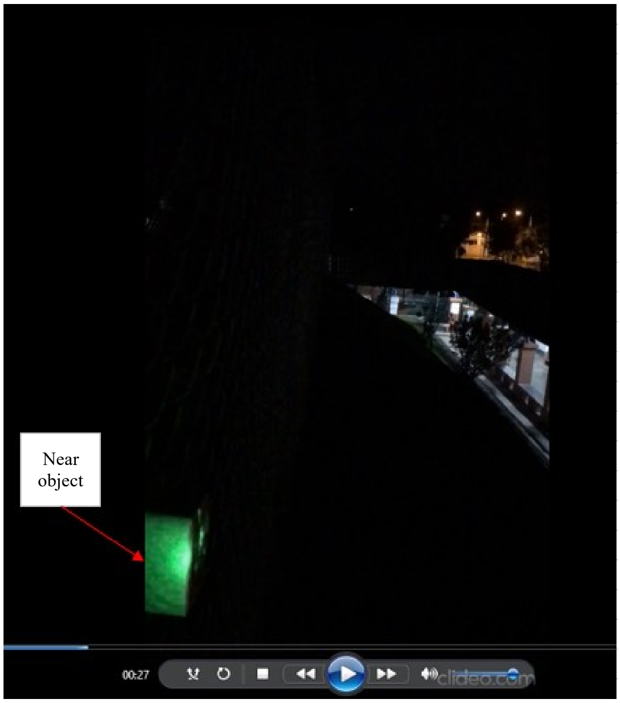


Fig. 5: Laser light shined on near object was detected first

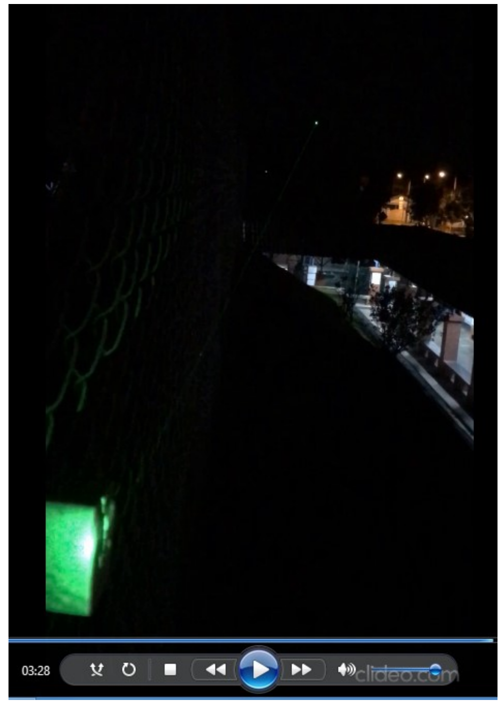


Fig. 7: Reflected lights from both near and distant objects

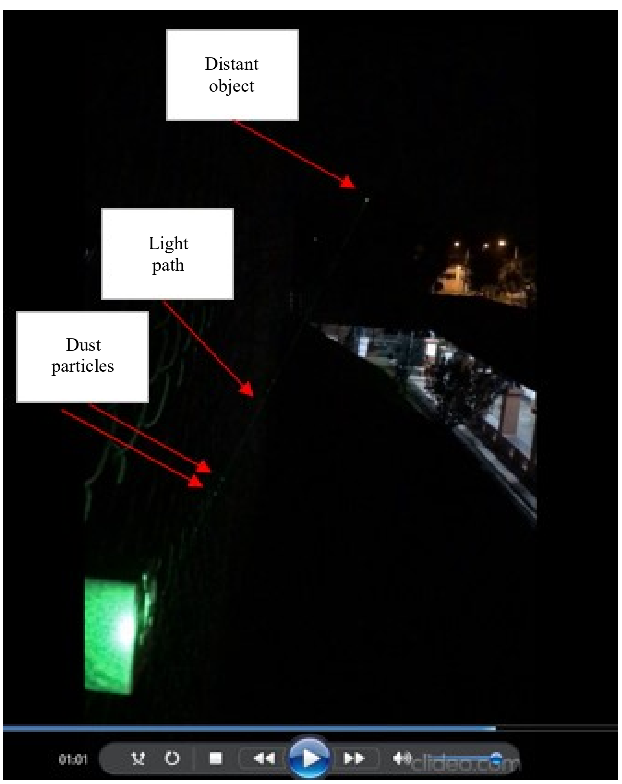


Fig. 6: Picture of laser light shined on dust particles along the light path and reflection of light from distant object were observed later

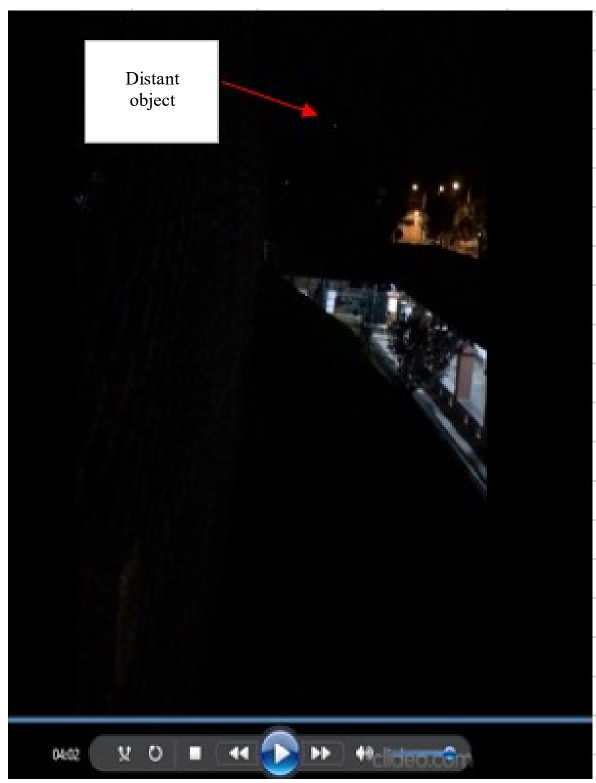


Fig. 8: Immediate disappearance of reflected light at near object and light path and visible of reflected light from distant object at that moment

Findings for Method 1b

Error 2: The observer had noticed the reflected light at the near object and light path were cut off first, yet the observer still noticed there was reflected light from distant object at that moment, the observer might assume light travels faster in denser medium then light travels in air of less dense medium.

Conclusion for Method 1b: Not all the visible rays of the laser bundle are always cut off at the same time.

Results: Method 1c

Observation for Method 1c: Observed light reflection from floating dust particles along the light path as shown in Fig. 6. Picture of laser light shined on dust particles along the light path and reflection of light from distant object were observed later.

Findings for Method 1c:

Error 3: Along the light path there was tiny floating dust particles and causing reflection and diffusion. The lighted impurities and the lighted medium had made the medium to look shallower/nearer then its actual depth/length.

The lighted path was due to collision of light with air molecules/dust and some part of the air medium in the pictures was also lighted up through reflection and diffusion. The lighted up condition made the medium to look shallower/nearer then its actual depth/length. This phenomenon is more prominent when viewing through denser medium, such as water and glass. Refraction makes an object with partial immersion between two different mediums looks bend even though the object is actually straight in length. Mirage is also expected when involves temperature difference among/within the mediums.

Conclusion for Method 1c: In optics one important and familiar consequence of dispersion is the change in the angle of refraction of different colors of light, light regains mass when its speed is stopped completely on the surface of an opaque mediums or on the surface and/or within the material of non-opaque (transparent/translucent) mediums, whereby lighted spot/lighted path due to collision can be observed on the surface or within the non-opaque medium. There is no mass lost if the traveling medium is vacuum (perfect transparency), however, the regained mass of light is lesser through air upon light striking other medium.

Indeed error 3 leads to new explanation of light dispersion on why all color lights travel the same light speed.

During inelastic collision, light is possible to have under gone the following processes: Such as diffusion, dispersion, reflection, refraction, scattering process, transmission, re-emission, absorption or re-absorption. Part of the light re-gained mass re-absorbs the sufficient amount of energy from inelastic collision and sustain traveling at light speed again on the surface, within or out of the mediums. The amount of energy absorbed can be seen from the dispersion of light. Red color of visible light absorbs the least energy due to smallest bending angle and least inelastic collision energy lost as compare with other color lights with bigger bending angles and higher inelastic collision energy lost which require higher energy absorption in order to sustain light speed. In fact the bending gets bigger gradually by following rainbow color sequence starting from red color, another good example of color sequence is the spectrum produced by a dispersive prism.

This explains on why different color lights can travel at the same light speed during dispersion.

Dispersion of reflected light is hardly noticeable due to very small amount of energy re-absorbed during close elastic collision.

Results: Method 2

Findings and reasons for Method 2:

- For step 2b, when shining a bundle of laser beams to the small spherical seed at different angles, a small light spot at the center of the seed's shadow on the screen can be seen
- **Reason of the observation:** Light engulfs the whole circumference of the seed and it is possible to obtain a small light spot at the center of the small seed's shadow as shown in Fig. 9
- For step 2c, when shining a bundle of laser beams to the big spherical seed at different angles but it was unable to obtain a light spot at the center of the seed's shadow on the screen
- **Reason of the observation:** Light can only engulfs the circumference of the big seed partially and it can only obtain off-centered small light spot of the seed's shadow on the screen as shown in Fig. 10, it is impossible to get the light spot at center of the big seed's shadow on the screen

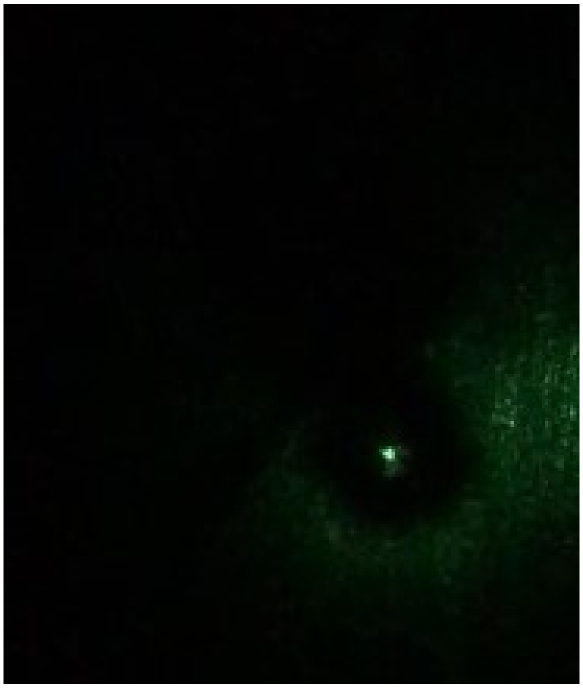


Fig. 9: A small light spot at the center of the small spherical seed's shadow

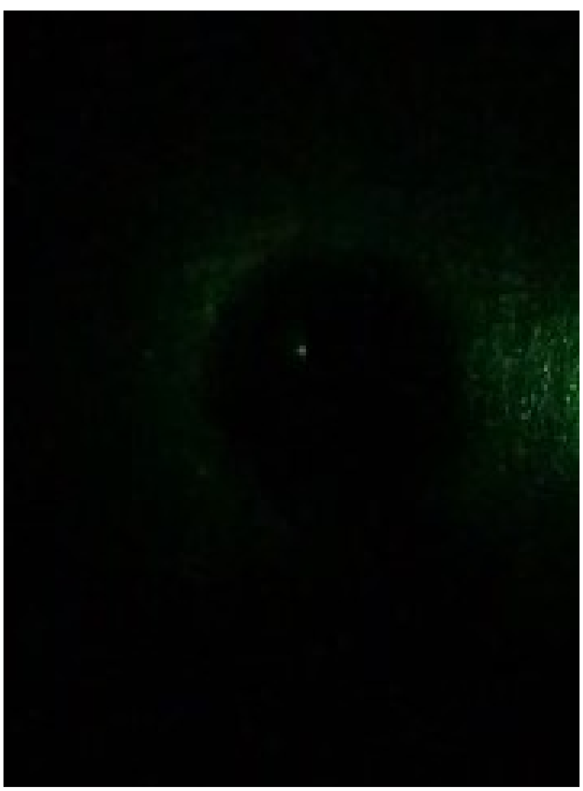


Fig. 10: An off-centered small light spot on big spherical seed's shadow

Conclusion for Method 2: In the case upon light striking the spherical surface of an object, light experiences close to elastic or inelastic collisions. The collisions emitted light in the form of circular diffusion for small object. Since the small seed circumference is engulfed by the diffused light. The light is able to reach the center of the shadow, however, it is another different case for the big seed, whereby the partial engulfed circumference of the big seed, the diffused light can only give off centered light spot of the shadow. The findings have proven that the Fresnel spot is due to circumferential diffusion instead of diffraction, since there is no light interference during light travels.

Results: Method 3a: Table 1 is the filled up pictures and remarks for immediate initial laser light up frames with video speed reduction ($4^3 = 64$ times).

Table 2 is the filled up pictures and remarks for normal laser light up frames with video speed reduction ($4^3 = 64$ times).

Table 3 is the filled up pictures and remarks for immediate laser trailing light before total light off frames with video speed reduction ($4^3 = 64$ times).

Observation results from Table 1-3: Based on the remarks from Table 1-3, Out of all of the frame numbers from 1 to 9, only frame numbers 3, 6 and 7 have both the light spots from air and glass were observed during immediate initial laser light up and immediate laser trailing light before total light off. Continued to reduce the video speed of the selected frames up to $4^{15} = 1.07\times10^9$ times which is equivalent to able to detect motion difference up to $0.25^{15} = 9.31\times10^{-10}$ sec.

Table 4 is the filled-up pictures and remarks for immediate initial laser light-up of selected frames with video speed reduction ($4^{15} = 1.07\times10^9$ times).

Table 5 is the filled-up pictures and remarks for immediate laser trailing light before total light off of selected frames with video speed reduction ($4^{15} = 1.07\times10^9$ times).

Conclusion for Method 3a: Frame numbers 3, 6 and 7 were found to have both the air and glass video frames without difference in light speed during comparison for immediate initial laser light up and immediate laser trailing light before total light off. Based on findings from the experiment, it concludes that the speed of light in air and glass are same.

Results: Method 3b: After shining laser light into the transparent glass, the phenomenon with infinite number of refractions, reflections and diffusions could be observed as shown in Fig. 11.

Table 1: Pictures and remarks for immediate initial laser light up frames with video speed reduction (4^3 = 64 times)

Frame No.	Immediate initial laser light up	Remarks
1		Only the light spots from glass were shown. Discard this frame due to unbalanced immediate initial light up
2 to 9		Both the light spots from air and glass were shown

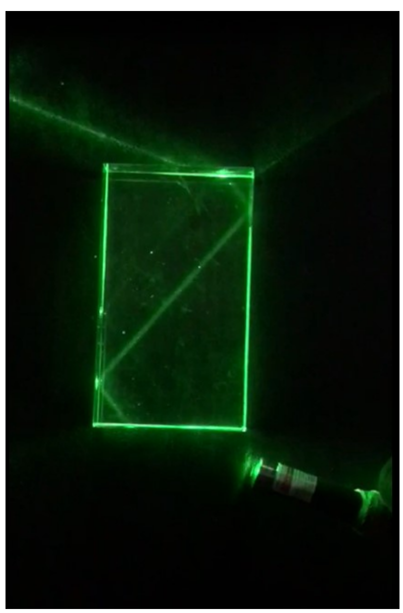


Fig. 11: Picture of infinite number of refractions, reflections and diffusions

Table 2: Pictures and remarks for normal laser light up frames with video speed reduction ($4^3 = 64$ times)

Frame No.	Normal laser light up	Remarks
1 to 9		Both the light spots from air and glass were shown

Table 3: Pictures and remarks for immediate laser trailing light before total light off frames with video speed reduction ($4^3 = 64$ times)

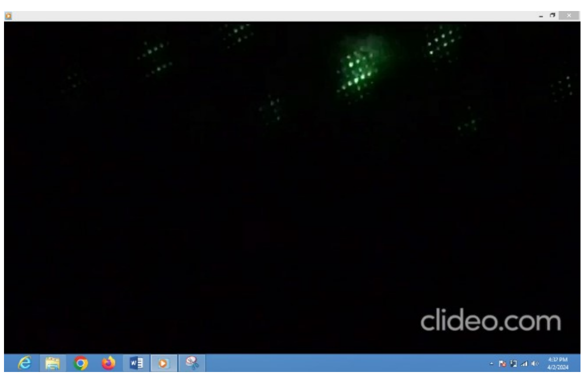
Frame No.	Immediate laser trailing light before total light off	Remarks
1		Both the light spots from air and glass were shown
2		Only the light spots from air were shown. Discard this frame due to unbalanced immediate trailing light before total light off
3		Both the light spots from air and glass were shown

Table 3: Continue

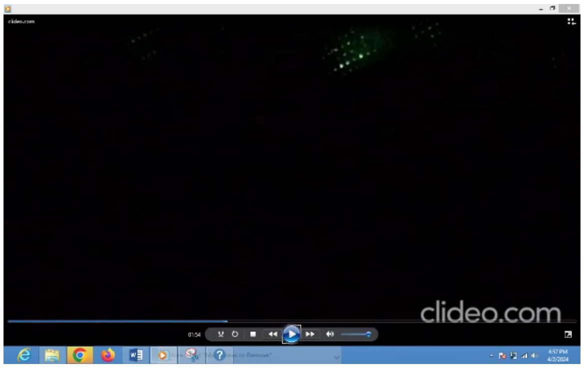
Frame No.	Immediate laser trailing light before total light off	Remarks
4		Only the light spots from air were shown. Discard this frame due to unbalanced immediate trailing light before total light off
5		Only the light spots from air were shown. Discard this frame due to unbalanced immediate trailing light before total light off
6		Both the light spots from air and glass were shown
7		Both the light spots from air and glass were shown

Table 3: Continue

Frame No.	Immediate laser trailing light before total light off	Remarks
8		Only the light spots from air were shown. Discard this frame due to unbalanced immediate trailing light before total light off
9		Only the light spots from air were shown. Discard this frame due to unbalanced immediate trailing light before total light off

Table 4: Pictures and remarks for immediate initial laser light up of selected frames with video speed reduction ($4^{15} = 1.07\times10^{9}$ times)

Frame No.	Immediate Initial laser light up	Remarks
3, 6 and 7		Both the light spots from air and glass were shown

Table 5: Pictures and remarks for immediate laser trailing light before total light off of selected frames with video speed reduction ($4^{15} = 1.07\times10^{9}$ times)

Frame No.	Immediate laser trailing light before total light off	Remarks
3, 6 and 7		Both the light spots from air and glass were shown

Conclusion for Method 3b: Light travels within the glass has undergone an infinite number of reflections, refractions and diffusions, it was also found that frames 3, 6 and 7 have both the air and glass video frames without differences in speed during comparison for immediate initial laser light up and immediate laser trailing light before total light off by reducing the video speed up to $4^{15} = 1.07\times10^{9}$ times which is equivalent to able to detect motion difference up to $0.25^{15} = 9.31\times10^{-10}$ sec. Indirectly, it also means that infinite reflection, refraction and diffusion were unnoticeable in the glass plate in the experiment immediately after the total light off. The infinite phenomenon diminished and vanished instantaneously in the glass plate and it can be considered to be insignificant and negligible as compared with the speed of light. Hence the above explanation is acceptable to prove that the speed of light in air and glass are the same.

DISCUSSION

The comparison method for light speed in air and glass experiment has proven that light travels in the air have the same speed as in a glass, indirectly the experiment has also explained why light speed remains the same regardless of types of non-opaque mediums or types of light.

- Below is the similarity of finding in the listed reference material[1]

"Current Double-Slit Experiment Proves That There is No Light Interference"[1].

There is no light interference as proven in the above double-slit experiment, it is wrong to assume activating/lighting up filaments/bulbs/tubes/crystal/birefringent material electrically by using alternate current and taking the frequency of the input alternate current or output of the changed frequency or phase of alternate current can be used to derive the wavelengths of the lights. It is also wrong to assume a change of light direction or reduction in light intensity by shining light on crystal/birefringent material/polarizer can change the speed of light. Unlike other particles with mass, light is massless basically, speed or phase change to light though the above methods are impossible to happen as there is no light interference after all.

Hence light speed is not influenced by light waves during traveling. In actual fact, light is found to travel at light speed of approximately 300,000 km/sec approximately, it means that light does not travel at different wavelengths, as different light wavelengths do not give the overall same light speed.

- Below are the contradiction of findings against the listed reference materials[2-11]

By taking into consideration that not all the visible rays of the laser bundle are always lighted up at the same time and not all the visible rays of the laser bundle are always cut off at the same time, the results from the comparison method have proven that light travels in air has the same speed as in glass contradict with Newton's corpuscular theory[2] which demands a speed of light greater in glass or water than in air and theories of Huygens[3], Young and Fresnel, which requires a speed of light in air must be greater than the speed of light in water or glass[4].

Upon having an inelastic light collision with non-opaque mediums (except vacuum), part of the light re-gained mass re-absorbs the sufficient amount of energy from inelastic collision and sustains traveling at light speed again. This explains why during dispersion, red color, as the visible light has the least energy absorption due to its smallest bending angle and also the least inelastic collision energy lost as compared with the other colors which have bigger bending angles and higher inelastic collision energy lost and requiring higher energy absorption to sustain the speed of light. The explanation of why different colors of light can travel at the same light speed during dispersion contradicts Isaac Newton's explanation of different light frequencies or wavelengths of light traveling in the spectrum produced by a dispersive prism.

It is also important to carry out the circular object's shadow experiment again to verify ambiguity in optics, however, the off-centered spot that appears in the circular object's shadow contradicts the findings of the Arago spot[5], Poisson spot[6] or Fresnel spot[7] where there is a bright point that appears at the center of a circular object's shadow due to Fresnel diffraction[8-11], in actual fact, the off-centered spot is due to diffusion and not because of diffraction.

Since there is no light interference during light traveling, it is wrong to claim that there is diffraction and discovery of light interference from the off-center diffused spot.

Through logical analysis and after filtering all the errors, misconceptions and misinterpretations, finally, by selecting the correct video frames, the authors confirmed the correctness of the findings from both the air and glass video frames without difference in speed during comparison for immediate initial laser light up and immediate laser trailing light before total light off, hence, in summary, it is acceptable to conclude that the speed of light in air and glass are same.

CONCLUSION

The selected video frames have proven that both of the air and glass video frames without differences in speed during comparison for immediate initial laser light up and immediate laser trailing light before total light off, in addition, with the new explanation on why all types of lights have the same light speed and also based on the findings from the current experiment, it concludes that the speed of light in air and glass are the same, indirectly it also concludes that all types of lights travel the same light speed within non-opaque mediums.

This study provides a future perspective on no change of light speed during light traveling regardless of the types of non-opaque mediums or types of lights that affect the quantum mechanics concept.

SIGNIFICANCE STATEMENT

This research paper proves that Isaac Newton had wrongly demanded light in glass traveled faster than light in air and also proves that Christiaan Huygens, Thomas Young and Augustin-Jean Fresnel had misinterpreted there was light interference during light traveling and wrongly concluded that light in air traveled faster than light in water or glass. In fact, after carrying out the current comparison method for light speed in air and glass, the results prove that light travels in the air has the same speed as in glass, in order to meet the criteria of the findings, the research paper also explains why all types of lights sustain the same speed even during dispersion by having energy re-absorption and the research paper also proves that there is light diffusion instead of diffraction since there is no light interference during light traveling. The research paper serves the purpose of proving that lights travel the same speed in transparent or translucent mediums is the correct academic knowledge in physics.

REFERENCES

1. Hee, L.B., 2024. Current double-slit experiment proves that there is no light interference. Curr. Res. Phys., 13: 1-7.
2. Newton, I., 1952. Opticks, Or, A Treatise of the Reflections, Refractions, Inflections & Colours of Light. Courier Corporation, North Chelmsford, Massachusetts, ISBN: 9780486602059, Pages: 406.
3. Huygens, C., 2015. Treatise on Light. CreateSpace Independent Publishing Platform, Scotts Valley, California, ISBN: 9781518800894, Pages: 136.
4. Anderson, F.L., 2021. Huygens' principle geometric derivation and elimination of the wake and backward wave. Sci. Rep., Vol. 11. 10.1038/s41598-021-99049-7.
5. Reisinger, T., A.A. Patel, H. Reingruber, K. Fladischer and W.E. Ernst *et al*., 2009. Poisson's spot with molecules. Phys. Rev. A, Vol. 79. 10.1103/PhysRevA.79.053823.
6. Law, J. and R. Rennie, 2015. A Dictionary of Physics. 7th Edn., Oxford University Press, Walton Street, Oxford, ISBN: 9780198714743, Pages: 666.
7. Kelly, W.R., E.L. Shirley, A.L. Migdall, S.V. Polyakov and K. Hendrix, 2009. First- and second-order poisson spots. Am. J. Phys., 77: 713-720.
8. Pedrotti, F.L., L.S. Pedrotti and L.M. Pedrotti, 2007. Introduction to Optics. 3rd Edn., Pearson Prentice Hall, New Jersey, United States, ISBN: 9780131499331, Pages: 622.
9. Zhang, H., L. Cao and G. Jin, 2019. Scaling of three-dimensional computer-generated holograms with layer-based shifted fresnel diffraction. Appl. Sci., Vol. 9. 10.3390/app9102118.
10. Ohanian, H.C., 1989. Physics. 2nd Edn., Norton, New York, ISBN: 9780393957501, Pages: 1170.
11. Hecht, E., 2002. Optics. 4th Edn., Addison-Wesley, United States, ISBN: 9780805385663, Pages: 698.