# Light is only particle

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***Abstract***- Light is electromagnetic radiation within a certain portion of the electromagnetic spectrum. The word usually refers to visible light, which is visible to the human eye and is responsible for the sense of sight.[1] Visible light is usually defined as having wavelengthsin the range of 400–700 nanometres (nm), or 4.00 × 10−7 to 7.00 × 10−7 m, between the infrared (with longer wavelengths) and theultraviolet (with shorter wavelengths).[2][3]This wavelength means a frequency range of roughly 430–750 terahertz (THz).

The main source of light on Earth is the Sun.Sunlight provides the energy that green plantsuse to create sugars mostly in the form of starches, which release energy into the living things that digest them. This process ofphotosynthesis provides virtually all the energy used by living things. Historically, another important source of light for humans has been fire, from ancient campfires to modern kerosene lamps. With the development of electric lights and power systems, electric lighting has effectively replaced firelight. Some species of animals generate their own light, a process calledbioluminescence. For example, fireflies use light to locate mates, and vampire squids use it to hide themselves from prey.

The primary properties of visible light areintensity, propagation direction, frequency or wavelength spectrum, and polarization, while its speed in a vacuum, 299,792,458 metres per second, is one of the fundamentalconstants of nature. Visible light, as with all types of electromagnetic radiation (EMR), is experimentally found to always move at this speed in a vacuum.[citation needed]

In physics, the term light sometimes refers to electromagnetic radiation of any wavelength, whether visible or not.[4][5] In this sense,gamma rays, X-rays, microwaves and radio waves are also light. Like all types of light, visible light is emitted and absorbed in tiny "packets" called photons and exhibits properties of both waves and particles. This property is referred to as the wave–particle duality. The study of light, known as optics, is an important research area in modern physics.

Generally, EM radiation, or EMR (the designation "radiation" excludes static electric and magnetic and near fields), is classified by wavelength into radio, microwave, infrared, the visible region that we perceive as light,ultraviolet, X-rays and gamma rays.

The behavior of EMR depends on its wavelength. Higher frequencies have shorter wavelengths, and lower frequencies have longer wavelengths. When EMR interacts with single atoms and molecules, its behavior depends on the amount of energy per quantum it carries.

Light is a visible ray travelling in straight line with speed of 300000kmps. It has dual nature and shows characteristics of both wave and particle, but it's wave nature is an special case under certain conditions.We know that all experiments related to light favours it's both nature but as we know that nature of anything is free from any external effect and wave nature of light is result of any external effect on it.

***Index Terms***- Visible ray, dual nature, special case, external effect, collides, vibration and emission, interplaneticalatmosphere, vibrating comes and emitting comes.

## I. Introduction

The speed of light in a vacuum is defined to be exactly 299,792,458 m/s (approx. 186,282 miles per second). The fixed value of the speed of light in SI units results from the fact that the metre is now defined in terms of the speed of light. All forms of electromagnetic radiation move at exactly this same speed in vacuum.

Different physicists have attempted to measure the speed of light throughout history.Galileo attempted to measure the speed of light in the seventeenth century. An early experiment to measure the speed of light was conducted by Ole Rømer, a Danish physicist, in 1676. Using a telescope, Rømer observed the motions of Jupiter and one of its moons,Io. Noting discrepancies in the apparent period of Io's orbit, he calculated that light takes about 22 minutes to traverse the diameter of Earth's orbit.[14] However, its size was not known at that time. If Rømer had known the diameter of the Earth's orbit, he would have calculated a speed of 227,000,000 m/s.

Another, more accurate, measurement of the speed of light was performed in Europe byHippolyteFizeau in 1849. Fizeau directed a beam of light at a mirror several kilometers away. A rotating cog wheel was placed in the path of the light beam as it traveled from the source, to the mirror and then returned to its origin. Fizeau found that at a certain rate of rotation, the beam would pass through one gap in the wheel on the way out and the next gap on the way back. Knowing the distance to the mirror, the number of teeth on the wheel, and the rate of rotation, Fizeau was able to calculate the speed of light as 313,000,000 m/s.

Léon Foucault carried out an experiment which used rotating mirrors to obtain a value of 298,000,000 m/s in 1862. Albert A. Michelson conducted experiments on the speed of light from 1877 until his death in 1931. He refined Foucault's methods in 1926 using improved rotating mirrors to measure the time it took light to make a round trip fromMount Wilson to Mount San Antonio in California. The precise measurements yielded a speed of 299,796,000 m/s.[15]

The effective velocity of light in various transparent substances containing ordinarymatter, is less than in vacuum. For example, the speed of light in water is about 3/4 of that in vacuum.

Two independent teams of physicists were said to bring light to a "complete standstill" by passing it through a Bose–

Einstein condensate of the element rubidium, one team at Harvard University and the Rowland Institute for Science in Cambridge, Massachusetts, and the other at the Harvard–Smithsonian Center for Astrophysics, also in Cambridge.[16] However, the popular description of light being "stopped" in these experiments refers only to light being stored in the excited states of atoms, then re-emitted at an arbitrary later time, as stimulated by a second laser pulse. During the time it had "stopped" it had ceased to be light.

Light is only particle. When it emits from any sources, it collides with particle present in atmosphere and becomes change into wave form due to vibration of that particle. Emitted light comes on collision,formswave nature. After collision, mass of particle readily changes into two ways vibration and emission and energiesreleased in both cases are in form of wave.Newton and Heisenberg had their own concept about light but Newton’s concept is much accurate and natural while Heisenberg’s concept is only special case of light.

Explanation:- When light emitted from sun,itbe in particle form before leaving surface of sun. When it enters in interplanetical atmosphere or gravitational field of earth and collides with air particle, readily changes into wave form. Light shows particle nature only in vacuum and this is it’s original form because there is no any external effect (particle present in atmosphere). Original form of anything is a state in which no any external effect affect it. On earth, sunlight or other kinds of light are in form of wave because vacuumgenerated on earth have some impurities as particle in it. If there will be cent percent vacuumon earth then there will be also it’s wave nature due to collision with particle present in between sun and gravitational field of earth. If we manage such a system that a vacuumpath may exist from sun to earth then light will show particle nature on earth everywhere and everytime. But we know that this is an impossible event. Projected light in vacuum tube on earth shows particle nature. Photoelectric effect, Compton effect and other such particle theory based experiments occur on earth due to some reason.

When light enters on metal surface, it’s wave form affects the particle of metal. Hence particles of that metal disturb and vibrate. Finally electrons of that metal face vibration and come out from metal surface. On projection of electrons in vacuum, formed fringes on screen occur due to collision of particle (collision of electrons with particle present in that vacuum tube) because some light enters in vacuumtube by refraction. If there will be no any external light then light on screen for fringes be responsible for it and ifthere will no light then we can’t see fringes. It’s means to see particle nature of light, we have to form complete vacuumtube and then pass light through it. De-Broglie’s phenomena deals about dual nature of light (quantum theory of light) only in non vacuum region which is obviously not general case of light because it doesn’t say clearly phenomena of light in pure vacuum.

When a beam of light crosses the boundary between a vacuum and another medium, or between two different media, the wavelength of the light changes, but the frequency remains constant. If the beam of light is not orthogonal (or rather normal) to the boundary, the change in wavelength results in a change in the direction of the beam. This change of direction is known as refraction.

The refractive quality of lenses is frequently used to manipulate light in order to change the apparent size of images. Magnifying glasses, spectacles, contact lenses,microscopes and refracting telescopes are all examples of this manipulation.

LightWave 3D combines a state-of-the-art renderer with powerful, intuitive modeling, and animation tools. Tools that may cost extra in other professional 3D applications are part of the product package, including 999 free cross-platform render nodes, support for Windows and Mac UB 64 and 32-bit operating systems, free technical support and more. LightWave is enjoyed worldwide, as a complete 3D production solution for feature film and television visual effects, broadcast design, print graphics, visualization, game development, and Web. LightWave is responsible for more artists winning Emmy Awards than any other 3D application.

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After emitting two types of comes(in wave form) i.e. vibrating and emitting comes. Vibrating comesoccur in particle, not can be use to do any work (due to wasting this comes in exciting electrons) whereas emitting comes can use in any work. So we can say that vibrating comes is just showing comes not useful and emitting comes is useful comes.

Technically, quantum theory is actually the theory of any objects isolated from their surroundings but, because it is very difficult to isolate large objects from their environments, it essentially becomes a theory of the microscopic world of atoms and sub-atomic particles. This is especially true for those parts of the theory which rely on the absolute indistinguishability of fundamental particles, an indistinguishability which is impossible to find in the everyday world of composite, large-scale objects.

Quantum theory is used in a huge variety of applications in everyday life, including lasers, CDs, DVDs, solar cells, fibre-optics, digital cameras, photocopiers, bar-code readers, fluorescent lights, LED lights, computer screens, transistors, semi-conductors, super-conductors, spectroscopy, MRI scanners, etc, etc. By some estimates, over 25% of the GDP of developed countries is directly based on quantum physics. It even explains the nuclear fusion processes taking place inside stars.

However, some of its findings and principles are distinctly counter-intuitive and fiendishly difficult to explain in simple language, without resorting to complex mathematics way beyond the comfort level of most people (myself included!). This situation is not helped by the fact that the “theory” is largely a patchwork of fragments accrued over the last century or so, that some elements of it are still not well understood by the scientists themselves, and that some of the bizarre behaviour it predicts appears to fly in face of what we have come to think of as common sense.

Richard Feynman, winner of the 1965 Nobel Prize for Physics and arguably one of the greatest physicists of the post-war era, is unapologetically frank: “I think I can safely say that nobody understands quantum mechanics”. Niels Bohr, one the main pioneers of quantum theory, claimed that: “Anyone who is not shocked by quantum theory has not understood it”.

In the 1920s and 1930s, Bohr, Schrödinger, Heisenberg and others discovered that the atomic world is in fact full of murkiness and chaos, and not the precision clockwork suggested by classical theory. Classical physics can be considered as a good approximation to quantum physics, typically in circumstances with large numbers of particles. Indeed, classical physics has served us well up until the 20th Century, and for most everyday purposes it still does. But modern physics, which includes quantum physics and general relativity, is more all-encompassing, more fundamental and altogether more accurate - physics taken to a different level.Momentum and position, for instance, are approximations of the world of larger-sized things that we call the classical world, but the underlying reality of the quantum world is quite different.

As we will see, even a rough understanding of quantum theory requires some background discussion of atomic theory and some discussion of the uncertainty principle before any sense at all can be made of it. Only then will some of the more obscure and bizarre aspects of quantum theory (such as wave-particle duality, superposition, nonlocality, decoherence, etc) make a little more sense. So, please, bear with me.

A central concept of quantum mechanics, duality addresses the inadequacy of conventional concepts like "particle" and "wave" to meaningfully describe the behaviour of quantum objects.

The idea of duality is rooted in a debate over the nature of light and matter dating back to the 1600s, when competing theories of light were proposed by Christiaan Huygens and Isaac Newton.

Through the work of Albert Einstein, Louis de Broglie and many others, it is now established that all objects have both wave and particle nature (though this phenomenon is only detectable on small scales, such as with atoms), and that a suitable interpretation of quantum mechanics provides the over-arching theory resolving this ostensible paradox.

Maxwell calculated the speed of travel for the waves, i.e. electromagnetic waves, revealed by his mathematical formulas. He said speed was simply one over the square root of the electric permittivity in vacuum times the magnetic permeability in vacuum. When he assigned "9 x 109/4π for the electric permittivity in vacuum" and "4π x 10-7 for the magnetic permeability in vacuum," both of which were known values at the time, his calculation yielded 2.998 x 108 m/sec. This exactly matched the previously discovered speed of light. This led Maxwell to confidently state that light is a type of electromagnetic wave.

The light particle conceived by Einstein is called a photon. The main point of his light quantum theory is the idea that light's energy is related to its oscillation frequency (known as frequency in the case of radio waves). Oscillation frequency is equal to the speed of light divided by its wavelength. Photons have energy equal to their oscillation frequency times Planck's constant. Einstein speculated that when electrons within matter collide with photons, the former takes the latter's energy and flies out, and that the higher the oscillation frequency of the photons that strike, the greater the electron energy that will come flying out. In short, he was saying that light is a flow of photons, the energy of these photons is the height of their oscillation frequency, and the intensity of the light is the quantity of its photons.

Einstein proved his theory by proving that the Planck's constant he derived based on his experiments on the photoelectric effect exactly matched the constant 6.6260755 x 10-34 (Planck's constant) that German physicist Max Planck (1858 to 1947) obtained in 1900 through his research on electromagnetic waves. This too pointed to an intimate relationship between the properties and oscillation frequency of light as a wave and the properties and momentum (energy) of light as a particle, or in other words, the dual nature of light as both a particle and a wave.

## II. Conclusion

It is clear that particle of light occurs in vacuumaswell as entering in metal surface (in medium) whereas wave nature occurs only in medium.Therefore light shows it original form in vacuumwhich is particle nature. So it is clear that light is only particle.

## REFERENCES

[1] Newton and Heisenberg's concept about light.
[2] *Wave theory of light* , https://en.m.wikipedia.org
[3] *Light wave-production proven,* https://www.lightwave3d.com
[4] *Light wave-About light wave,* https://www.lightwave3d.com>overview
[5] *Is light a wave or particle?* https://www.wired.com
[6] The nature of light, physics.info>light.
[7] https://www.sciencedaily.com/terms/wave-particle_duality.htm
[8] *Light,* http://www.dictionary.com/browse/light
[9] http://www.physicsoftheuniverse.com/topics_quantum.html

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