

An Extension of Abraham-Minkowski Controversy to Extend Abraham-Minkowski Friendship: A Theoretical Study in Astrophysics

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Abstract: The Abraham-Minkowski controversy of light refracting to a system is a century-old milk and water at light refraction on a medium. The physicists are in long debate to pick and choose the Abraham or Minkowski formula at calculating momentum of light in a medium during reflection at dynamic environment in astrophysics. This study is designed to ride an anchor in view of mitigating these ongoing hot water in physical geospatialities. Results divulged Abraham-Minkowski friendship on the equation (16) envelop can turn over a new leaf to the contrary of these Abraham-Minkowski controversy in light physics. Also, it can be a uniquely functional modeling to be used as $\rho = \eta E / c = E / \eta c$ dancing in worldwide confusion over the controversy.

Keywords: Abraham-Minkowski Controversy, Refraction, Abraham-Minkowski Friendship, Refractive Index, Astrophysics, Theoretical Study

1. Introduction

Light is a moving particles generated from an electromagnetic radiation called photons [1, 2]. The photon is the single particle of light having field vector of electric charge [3, 4]. The photon is a massless particle occupying the momentum [5, 6]. This photon is a natural agent stimulating the sight and making things around us visible [7]. This is usually refer to visible light to the human eye creating the sense of sight where visible light is defined as the light of wavelengths ranging 400 to 700nm, between the infrared and the ultraviolet rays [8, 9].

The photonic body of sunlight is the suprb over other manual light sources in living world [10]. This light is moving sometimes in wave forms and sometimes in straight lines maintaining the rules of reflection sometimes and refraction sometimes based on environmental geospatialities [11, 12]. Refraction is the change of direction of wave propagation due to change in its trasmission medium in different settings [13]. Refraction follows Snell's law as $v_1 \sin \theta_2 = v_2 \sin \theta_1$; θ_1 is the angle of incidence, θ_2 is the angle of refraction and v_1 / v_2 is the phase velocities in the dual

media in the system [14, 15]. The momentum of the refracted rays is going to be on brown study now-a-days due to Abraham-Minkowski controversy in modern physics [16, 17]. Therefore, this study is conducted in quest of a meddle with bid to escape from this controversy forming a modeling as a new leaf naming Abraham-Minkowski friendship in worldwide astrophysics.

2. Methodology

This is a methodological review study in cross-sectional multivariate analysis using secondary data analysis method. Secondary data refers to data collected by some researchers in their studies and by some writers in their scientific books. This data analysis technique in mathematical and physical statistics is in galore use to attain the ultimate gaining in a new study. The data is collected from the speed of light, its mass, velocity, momentum and Snell's law in theoretical physics as well as Newtonian mechanics, refractive index, phase velocity, Minkowski and Abraham formula, Stephen Barnett postulates, Albert Einstein's mass-energy equivalence in astrophysics. These theoretical and thematic instruments are used in

different mathematical calculations in applied physics. These instruments have then taken the turn on inventing Abraham-Minkowsky friendship in equational gesture aiming to overcome Abraham-Minkowski controversy at light photon reflection in modern engineering physics.

3. Results and Discussions

Momentum is the product of the mass and velocity of an object. It is a 3D vector quantity, possessing a magnitude and a direction [18-20].

Let, m is an object's mass, v is its velocity and ρ is the momentum. We get the following equation in this fair play in Newtonian mechanics,

$$\rho = mv \tag{1}$$

Considering ρ as the momentum of light, m as its mass and v as the speed in vacuum, we get,

$$v = c \tag{2}$$

where,

c = speed of light in vacuum ($\approx 3 \times 10^8 \text{ ms}^{-1}$) [21-23].

Putting the value of equation (2) into equation (1),

$$\rho = mc \tag{3}$$

In 1908, Hermann Minkowski calculates the momentum ρ of the refracted ray [24-27] as follows:

$$\rho = \eta_M E / c \tag{4}$$

where,

η_M = refractive index of the medium stated in Minkowski's calculation,

E = energy of photon and

c = speed of light in vacuum.

Just a year later, in 1909, Max Abraham proposed the following formula [28-32] in this connection,

$$\rho = E / \eta_A c \tag{5}$$

where,

η_A = refractive index of the medium stated in Abraham's calculation,

E = energy of photon and

c = speed of light in vacuum.

A 2010 study suggested by physicist Stephen Barnett proposed the correctness of both the Abraham's and the Minkowski's formulas on his one study in applied physics in measuring the momentum of the refracted ray [33]. The Barnett's study is on the laughing stock to some physicists in the worldwide theoretical mathematics and engineering physics. A comparison between Abraham and the Minkowski momenta is prevailed till today to the physicists [34].

Let give up these confusion rather than knowing the definition of refractive index in astrophysics. The refractive index is the dimensionless number applied to describe the light propagation nature through the medium and

mathematically it is on the following dance [35-38],

$$\eta = c / v \tag{6}$$

where,

c = speed of light in vacuum and

v = phase velocity of light in the medium [39-41].

Let us have a glance on mass-energy equivalence derived by world renowned physicist Albert Einstein as the energy E is on the following modeling [42-45],

$$E = mc^2 \tag{7}$$

Investigating the equations (3) and (4), we get,

$$\eta_M E / c = mc$$

$$\text{Or, } \eta_M E = mc^2 \tag{8}$$

Again, Investigating the equations (3) and (5), we get,

$$E / \eta_A c = mc$$

$$\text{Or, } E = \eta_A mc^2 \tag{9}$$

Now, dividing the equation (8) by the equation (7), we get,

$$\eta_M E / E = mc^2 / mc^2$$

$$\text{Or, } \eta_M = 1 \tag{10}$$

Again, dividing the equation (9) by the equation (7), we get,

$$E / E = \eta_A mc^2 / mc^2$$

$$\text{Or, } \eta_A = 1 \tag{11}$$

Investing the duo equations (11) and (12), we get,

$$\eta_M = \eta_A = 1 \tag{12}$$

investigating equation (6) and (12), we get,

$$\eta_M = \eta_A = 1 = \eta \tag{13}$$

Putting the value of equation (13) in equation (4) and (5), we get,

$$\rho = 1 \times E / c = \eta E / c \tag{14}$$

$$\rho = E / 1 \times c = E / \eta c \tag{15}$$

The overall investigation of equations (13) and (14) directs the following modeling,

$$\rho = \eta E / c = E / \eta c \tag{16}$$

The equation (16) can be a solvable bid to the peril prevailing on Abraham and Minkowsky controversy in an anew hearing to Abraham-Minkowsky friendship in astrophysics giving vent to the derived equation (16) in the study.

4. Conclusions

The battle between Minkowsky and Abraham formula is

the greatest World War in astrophysics and in applied mathematics. The current study dynamics has shown a smooth route to deviate this war rendering the mathematical relation $\rho = \eta E / c = E / \eta c$ in equation (16). Future research should adopt this cozy modeling for taking intervention to understand the aptness of Minkowsky and Abraham formula in astrophysics and also in computation mathematics.

Completing of Interests

The author declares that he has no competing interests.

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