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Aberration of Light and Speed of Light Relative to Moving Observer

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Abstract: An Observer moving with velocity **v**, relative to a source of light moving with velocity **u**, sees light coming at velocity **s** = **c** + **u** – **v**, where **c** is velocity of light, a vector of magnitude c. The speed c is a universal constant relative to the source only. For observer moving with velocity **v**, relative to a stationary source, light comes with velocity (**c** – **v**), at aberration angle α between the vectors **c** and (**c** – **v**). In motion away from a stationary source, speed of light is (c - v), toward the source, speed is (c + v), round the source, at right angle to ray, the speed is $sqrt(c^2 + v^2)$. Speed of light may be exceeded, relative to a moving observer, contrary to the relativistic principle of constancy of speed of light.

Keywords: Aberration Angle. Light Ray. Relative Velocity. Special Relativity. Speed. Vector Quantity.

1. Introduction: Aberration of light was discovered, in 1728, by English astronomer, James Bradley. One of the most significant discoveries in science, now relegated to the background in favour of constancy of speed of light, by the theory of special relativity. Aberration of light, illustrated in Figure 1, is independent of distance between source and observer at P. It shows nonconstancy of velocity of light **c**, of magnitude (speed) c, relative to moving observer.

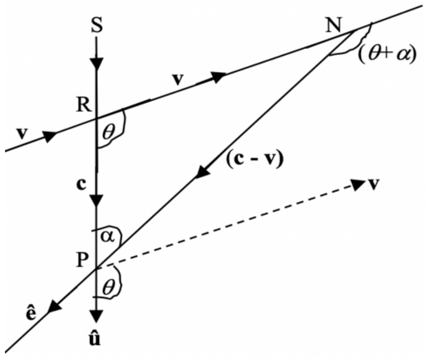

Figure 1: Aberration of light from a star with its light coming along line SRP, in the direction of unit vector **û**, as observed along line NP, at aberration angle α, by astronomer at P moving with velocity **v** at angle θ to the instantaneous line SRP

In Figure 1, an astronomer at P, moved with velocity **v** at angle θ to instantaneous line SRP of actual location of a star under observation. To see the star, the astronomer had to point his telescope forward for light to enter with velocity (**c** – **v**), along the line NP, in the direction of unit vector **ê**. It was as if the astronomer were given velocity **-v**, to become stationary at P, while light was propagated with velocity (**c** – **v**). He saw the star along NP, displaced through a small angle, aberration angle α, between the vectors **c** and (**c** - **v**), such sine rule in triangle RPN, gives:

$$\sin\alpha = (v/c)\sin(\theta + \alpha) \qquad (1)$$

With α as a very small angle and θ is about $\pi/2$ radians, equation (1) becomes:

$$\sin\alpha \approx \alpha \approx (v/c)\sin\theta \approx (v/c) \qquad (2)$$

Astronomer Bradley used equation (2), knowing $v = 3\times10^4\ m/s$, as the speed of revolution of the Earth, to estimate c.

Aberration is a common phenomenon, as with an observer running in the rains. Raindrops, falling down, appear to hit the runner's chest at an angle from the vertical. Aberration of light is well treated by the author [1, 2].

Bradley discovered aberration of light, from a visible northern Star (*Gamma Draconis, 150 light years away*), having failed to get its parallax, as it was too far away for his telescope. He obtained $3.1\times10^8\ m/s$ as the first estimate of speed of light, and confirmed the Earth's revolution round the Sun. The significance of this discovery has been submerged by the universal and overriding influence and mass-media bloated character of celebrated physicist, Albert Einstein, and his theory of special relativity, with its cardinal principle of constancy of speed of light.

Aberration of light is a clear, but ignored, demonstration of relativity of speed of light with respect to a moving observer. Today, aberration of light is ignored or denied. Some academia relativists even claim that it does not apply on the Earth, forgetting the fact that Reverend Bradley made his discovery, in measurements spanning thirty years, at a Rectory near London, in England. Aberration of light applies well at astronomical and atomic levels.

2. Relativity of Velocity of Light: In Figure 1, velocity of light **s**, along unit vector **ê**, relative to observer at P, is:

$$\mathbf{s} = (\mathbf{c} - \mathbf{v}) = \sqrt{c^2 + v^2 - 2cv\cos\theta}\,\hat{\mathbf{e}} \qquad (3)$$

For $\theta = 0$, rectilinear motion directly away from source of light, equations (3) gives speed of light: $s = c - v$ (4)

For $\theta = \pi$ radians, rectilinear motion directly towards source of light, equations (3) gives speed: $s = c + v$ (5)

For $\theta = \pi/2$ radians, circular motion round central source of light, equation (3) gives: $s = \pm\sqrt{c^2 + v^2}$ (6)

Equations (4), (5) and (6) show the relativity of speed of light, contrary to special relativity. No reason, in Fizeau's experiment (1850), Michelson-Morley experiment (1885) or Maxwell's electromagnetism (1892), to warrant the issue of principle of constancy of speed of light c, for all observers. It was an opinion of a renowned physicist, Albert Einstein, for observer moving at speed $v \neq 0$, where $(c - v) = c = (c + v)$, in a distortion of physics.

3. Conclusion: Speed of light, in vacuum, would be a constant for all observers, if it were infinitely large. It is very high but finite, the most accurately measured quantity $c = 299\ 792\ 458\ m/s$, a universal constant relative to the source only. Equations (4), (5) and (6) express the relativity of speed of light. Constancy of speed of light, a cardinal principle of theory of special relativity, is untenable. If speed of light were a constant c, for all observers, stationary or moving, there would be no Red or Blue Shift, seen at the spectrum of star light in astronomy. However, local Doppler Shift is explained to be the result of a shift in frequency of sound waves in air, due to motion of the listener.

References: [1]. doi.org/10.33140/ATCP.03.02.01 [2]. doi.org/10.47363/JPSOS/2023(5)186