

Abstract: The paper links Aberration of Light with Doppler Shift. It gives expressions for speed of light in vacuum and sound in air, relative to observer, and derives formulas for frequency and wavelength of light and sound waves. The aim is to correct the questionable principle of constancy of speed of light, for Physics to advance without an encumbrance of Special Relativity.

Keywords: Aberration Angle. Air. Frequency. Light. Sound. Special Relativity. Speed. Vacuum. Velocity. Wavelength.

1. Aberration of Light

Discovery of Aberration of light, in 1728, by English Astronomer, James Bradley, was one of the most significant findings in science. It clearly demonstrated the relativity of speed of light with respect to a moving observer. In Figure 1, astronomer at P, moved with velocity \mathbf{u} (of magnitude u) at angle θ to instantaneous line SRP of actual location of a star under observation, with its light emitted at velocity \mathbf{c} . To see the star, the astronomer had to point his telescope forwards, for light to enter with velocity $(\mathbf{c} - \mathbf{u})$, along the line NP, in direction of unit vector $\hat{\mathbf{e}}$. It was as if the astronomer at P were given velocity $-\mathbf{u}$, to become stationary, while light was propagated at velocity $(\mathbf{c} - \mathbf{u})$. He saw the star along NP, displaced through small aberration angle α , between the vectors \mathbf{c} and $(\mathbf{c} - \mathbf{u})$, such that sine rule in triangle RPN, gives the equation:

$$\sin\alpha = (u/c) \sin(\theta + \alpha) \tag{1}$$

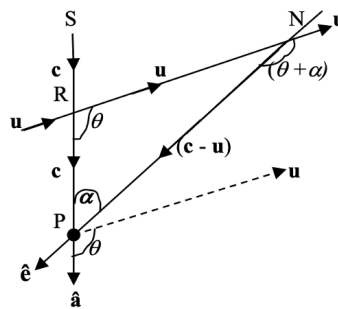


Figure 1: Aberration of light from a star with its light at velocity \mathbf{c} along line SRP, in the direction of unit vector $\hat{\mathbf{a}}$, observed along line NP, at aberration angle α , by astronomer at P moving with velocity \mathbf{u} at angle θ to the line SRP.

Measuring α as small angle and with $\theta \approx \pi/2$, Bradley used equation (1) to get better estimate ($3.1 \times 10^8 \text{ m/s}$) of light speed.

The astronomer at P saw light coming along NP, in the direction of unit vector $\hat{\mathbf{e}}$ with velocity \mathbf{s} , such that:

$$\mathbf{s} = (\mathbf{c} - \mathbf{u}) = \sqrt{c^2 + u^2 - 2cu \cos\theta} \hat{\mathbf{e}} \tag{2}$$

For $\theta = 0$, rectilinear motion directly away from source of light, equation (2) gives speed of light $s = c - u$(3)

For $\theta = \pi$ radians, rectilinear motion directly towards source of light, equations (2) gives speed $s = c + u$(4)

For $\theta = \pi/2$ radians, circular motion round a central source of light, equation (2) gives $s = \pm\sqrt{c^2 + u^2}$ (5)

2 Doppler Shift

First described in 1842 by Austrian Physicist, Christian Doppler. It gives the change in frequency of a wave if there is relative motion between the source and the receiver. If the light source moves with velocity \mathbf{v} , equation (2), becomes:

$$\mathbf{z} = \mathbf{c} + \mathbf{v} - \mathbf{u} \tag{6}$$

where \mathbf{c} is velocity of light, in vacuum, relative to source. The vectors \mathbf{c} , \mathbf{v} and \mathbf{u} may be in any direction. In linear motion:

$$z = c + v - u \tag{7}$$

For light wave, frequency f and wavelength λ perceived by the observer, are obtained from equation (7), as:

$$f = (f_o/c)(c + v - u) \text{ and } \lambda = (c\lambda_o)/(c + v - u) \tag{8}$$

where f_o and λ_o are the stationary frequency and wavelength, respectively, for $v = u$.

For sound wave, transmitted in the air with speed w , frequency f and wavelength λ , are:

$$f = f_o(w - u)/(w - v) \text{ and } \lambda = \lambda_o(w - v)/(w - u) \tag{9}$$

There is sonic boom (infinite frequency and zero wavelength), for sound in equation (9), if $w = v$. No such boom for light.

3. Concluding Remarks

- Equations (3), (4), (5) and (7) clearly give speed of light as dependent on motions of the source and the observer.
- Aberration Light cannot be regarded as an illusion, denied, or ignored, in favor of the theory of special relativity.
- Equations (8) and (9) give the frequency and wavelength, in Doppler Shift, as results of relativity of speed of light.
- Constancy of light speed is relative to source, a universal constant accurately measured as $c = 299\,792\,458 \text{ m/s}$.
- An electrical force, transmitted at the speed of light c , makes a moving charge subject to aberration of electric field.
- Aberration of electric field is the missing link, necessitating the conception of relativistic and quantum mechanics.
- Physics is fettered by mathematics and misinterpretation of experimental results, to promote theories of relativity.
- The relativistic principle of constancy of speed of light should be discarded, to allow physics to progress naturally.