

Hoek, Fizeau, and Einstein's Special Relativity

Copyright © Walter Babin

physics@wbabin.net

3/29/2008

Modified, Apr. 15, 2008

One of the principal concerns of early experimenters in electromagnetism was the detection of a carrier for light waves (the aether). Theories in the mid 1800's ranged from that of Stokes, where it was assumed the aether was completely carried along by matter, to Fresnel and partial convection, to Maxwell and the universal aether, where light did not participate in the motion of matter in the slightest. The main problem in resolving the issue lay in an inability to obtain accuracy greater than first order in terrestrial experiments, because of the exceedingly small ratio between the velocities attainable for material objects and that of light (v/c).

An interferometer experiment was carried out by Hoek in 1868, where light rays travelled in opposite directions through a container of water, and an equivalent distance in air, relative to a fixed observer. The purpose was to detect the earth's motion through the universal aether. Regardless of the direction of the apparatus, no interference shift was found. In other words, there was **no appreciable difference in the times taken by the rays to complete opposite and equal paths**.

One might reasonably assume that the result confirmed Stoke's theory, but it was not accepted as such. The current belief was that full convection could not explain stellar aberration¹. Therefore, the attempt was made to assign the null result to Fresnell's theory of partial convection by the addition of a convection coefficient, ϕ , to the motion in water².

In the following: l , = distance travelled in water and in air; c_1 = speed of light in water; t_1 , t_2 , times taken for opposing paths; $c/c_1 = n$ = refractive index

$$t_1 = (l/c_1 + \phi - v) + (l/c + v) \quad (1)$$

Then in the reverse direction,

$$t_2 = (l/c_1 - \phi + v) + (l/c - v) \quad (2)$$

Since the experiment gave a null result,

$$(l/c_1 + \phi - v) + (l/c + v) = (l/c_1 - \phi + v) + (l/c - v), \text{ and } t_1 = t_2 \quad (3)$$

It is stated that if the coefficient is 0, there is no convection; if v , full convection occurs. Solving equation (3),

$$\phi = (1 - 1/n^2)v \quad (4)$$

The equation obviously represents full convection which is modified by a factor to account for the speed of light measured in absolute aether, relative to its speed in a material body. That is to say, full convection is modified by zero convection! **This does not infer partial convection in any way! It does infer an incompatible juxtaposition of theories.**

If we re-arrange equations 1 and 2,

$$(l/c_1 + \phi - v) - (l/c_1 - \phi + v) = (l/c - v) - (l/c + v) = 2lv/c^2 - v^2 = t_1 - t_2 \quad (5)$$

it is evident that the second equivalence in (5) directly parallels the Michelson Morley experiment, **which provided a null result**, as does equation (3). Therefore, the first equivalence in (5) also gives a null result. This allows us to simplify the problem by separating the motion in air and in water. This does not in any way affect the purpose or the result of the experiment. It does, however, make it easier to analyze.

Opposing paths in water:

$$\begin{aligned} (l/c_1 + \phi - v) - (l/c_1 - \phi + v) &= 0 \\ (l/c_1 + \phi - v) &= (l/c_1 - \phi + v) \\ l &= c_1 - \phi + v / c_1 + \phi - v \\ c_1 + \phi - v &= c_1 - \phi + v \\ 2\phi &= 2v = \text{full convection!} \end{aligned} \quad (6)$$

Opposing paths in air:

$$\begin{aligned} l/c + \phi - v - l/c - \phi + v &= 0 \\ l/c + \phi - v &= l/c - \phi + v \\ l &= c - \phi + v / c + \phi - v \\ c + \phi - v &= c - \phi + v \\ 2\phi &= 2v = \text{full convection!} \end{aligned} \quad (7)$$

Of course, equation (3) is mathematical nonsense since v must equal zero!

To summarize:

1. If a universal aether exists, then a fringe shift equivalent to $(1 - 1/n^2)$ would have been evident in the Hoek experiment, or an equivalent mathematical modification in speed (or space and time) must be introduced to create the null result.
2. A belief in a universal aether is the sole reason for not adopting full convection. (This is difficult to understand since this negates the equivalence of inertial frames.)

Fizeau

The Fizeau experiment differed from that of Hoek in that the water was set in motion. Two tubes were used, doubling the distance of equation (5). Some displacement (fringe shift) was observed, but less than could be attributed to full convection. The motion of the water in Fizeau's experiment was approximately 7 metres per second $1/4200$ times the orbital speed of the earth.) According to the original paper, the observed fringe shift was .23016, which represented approximately $1/2$ the expectation value³

The dimensions were⁴

$l = 1.4875m$ = length of water tube

$v = 7.059m/s$ = speed of water

$n = 1.333$ = refractive index of water

$c_l = c/n$ = speed of light in water

$\lambda = 5.26 \times 10^{-7}m$ = wavelength of light source in air,

$\lambda/c = 1.75454714074 \times 10^{-15} sec$ = 1/ frequency of light source

The time difference, $t_1 - t_2 = (4lv/c_l^2 - v^2)$ for full convection is $8.30384130173 \times 10^{-16}$ sec. giving a fringe shift of .47327547, better than double the experimental value.

According to Max Born, "Exact measurement (of the Fizeau experiment) disclosed perfect agreement with Fresnel's convection formula⁵". However, based on the above analysis, the partial convection of Fresnel, whose velocity relative to a fixed aether is $(c_l + (1 - 1/n^2)v)$, would indicate a fringe shift of .20692486, or approximately .9 times the experimental value. Since equations (6) and (7) indicate "full convection", and partial convection allows considerable room for error, the discrepancy between experiment and the predicted values must be assigned to causes other than those mentioned.

The Fresnel interpretation and relativity have 4 things in common:

- 1.They are both based on a null result (Hoek, Michelson-Morley).
- 2.They assume the existence of a universal aether (or none⁶), despite overwhelming evidence to the contrary.
- 3.They both misinterpret the physical and theoretical results.
- 4.They both ignore the simplest explanation - full convection (Occam's razor).

Since relativity theory has unequivocally and irrefutably been proven to be tautological in a previous paper⁵ (and in many by other authors), the same applies to any theory that incorporates a universal aether as a basic tenet.

We have witnessed a 150-year commitment to preserving an absolute frame of reference based on a null result. A null result can only mean that the assumption does not exist! One is reminded of the children's poem -

One day I saw upon the stair
A little man who wasn't there
He wasn't there again today
Oh, how I wish he'd go away!

Addendum, Apr. 3, 2008:

Light is assumed to retain its frequency in transparent media. While the wavelength would change in water on entry, it would return to its former length on exit (as confirmed by the Hoek experiment). Any fringe shift would then depend solely on the motion of the water.

This phenomenon must also be considered *de facto* proof that the propagation of light is dependent on,

and maintained by the medium traversed.

¹ A discontinuous wavefront as posited by Huygens completely resolves this problem.

² Formulas taken from Max Born, *Einstein's Theory of Relativity*, Dover Publications, 1962, p135, 136

³ M. H. Fizeau, On the Effect of the motion of a Body upon the Velocity with which it is traversed by Light, *Philosophical Magazine and Journal of Science*, April 1860. See copy, <http://wbabin.net/fizeau.pdf>

⁴ Ibid 3

⁵ Ibid 2, p140

⁶ The only difference between zero and full convection is a reversal of sign.