3. Michelson – Morley experiment and length contraction

This experiment was designed to detect the effect of a hypothetical ether on the speed of light for two orthogonal axes. The prediction of measurable light interference patterns failed in the experiment [2]. The most popular explanation for the failure is a physical length contraction in the direction of motion, of the slab supporting the equipment. Based on electromagnetic phenomena, the em field adjusts to a new state of equilibrium as proposed by Heaviside [3] and others.

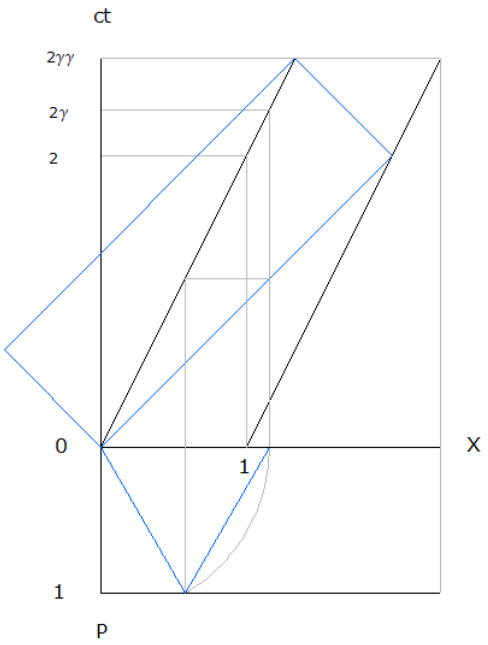

fig.3

In fig.3, inertial motion alters spherical symmetry into a skew symmetry in the direction of motion x (above x axis), and circular symmetry in any perpendicular direction p (below x axis). The difference in time being one order of gamma. The path length L is equal for the x and p direction in the lab. Using an exaggerated lab speed of .5c for clarity (the assumed speed was approx. 30 km/sec), and light speeds relative to the observer, there was an expected difference in return times measured in a few wave lengths of light.

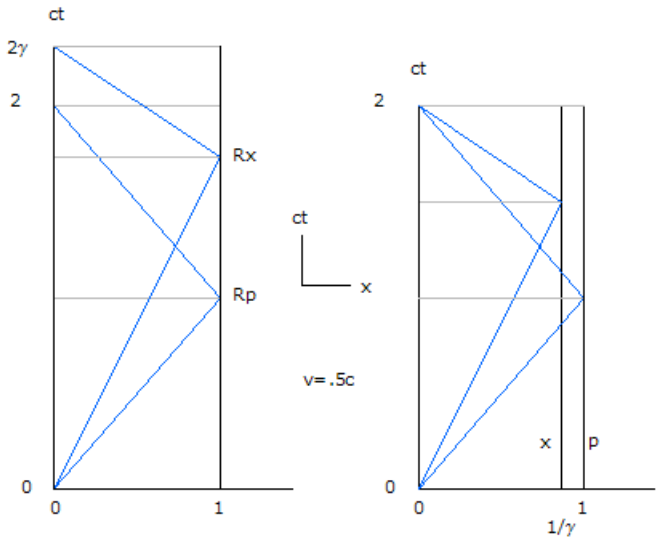

fig.3.1

Fig.3.1 left, is based on no change of L in the x and p directions.
Fig.3.1 right, offers a solution based on length contraction in the x direction.
The following is quantification of this effect, with a = v/c.
The time for the forward and backward exchange of photons over a distance d is

$$t_1 = \frac{d}{c(1-a)} \quad \text{and} \quad t_2 = \frac{d}{c(1+a)} \tag{3.1}$$

Multiplying t_1 and t_2 by c gives revised distances producing effects equivalent to the times in 3.1.
The corresponding forces in units of f, expressed as an inverse square rule are

$$f_1 = \frac{f}{d_1^2} = f\frac{(1-a)^2}{d^2} \quad \text{and} \quad f_2 = \frac{f}{d_2^2} = f\frac{(1+a)^2}{d^2} \tag{3.2}$$

The effective force for one cycle is

$$f_e = \frac{f_1 t_1 + f_2 t_2}{t_1 + t_2} = f\frac{(1-a^2)}{d^2} = \frac{f}{(\gamma d)^2} \tag{3.3}$$

The reduced em force is equal to the force in any perpendicular direction, and offers less resistance to acceleration in the direction of motion.

references

[2] www.aip.org/history/gap/Michelson/Morley.html

[3] http://en.wikipedia.org/wiki/Oliver_Heaviside