Is Michelson&Morley sufficient for SR?

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M&M: not a null-result, but just smaller than expected.

Suppose:

- Position space is absolute (coordinate-free)
- Time is absolute & metrically independant
- Each "event" is Dirac-like source, Green's-pulse.
- Simultaneous events have congruent Green's shells

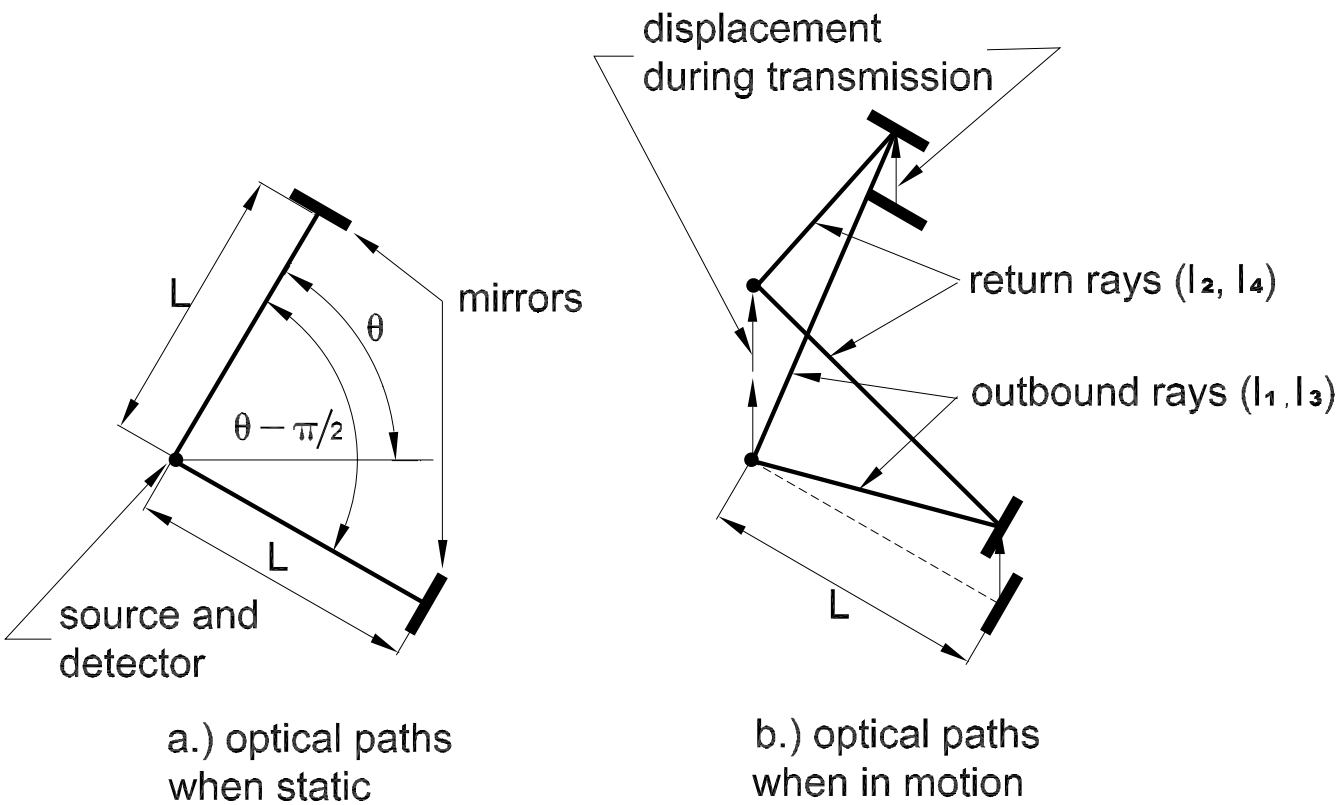

Figure 1.

$$l_1 = \sqrt{(L\cos(\theta))^2 + (L\sin(\theta) + vt)^2}, \tag{1}$$

where l_1 denotes the path length of the outbound ray. The term vt can be replaced by $v\,l_1/c$, to get:

$$l_1 = \sqrt{(L\cos(\theta))^2 + (L\sin(\theta) + vl_1/c)^2}. \tag{2}$$

Likewise, for the return ray, the path length must satisfy:

$$l_2 = \sqrt{(L\cos(\theta))^2 + (L\sin(\theta) - vl_2/c)^2}, \tag{3}$$

where the second term is formulated to take into account of both the displacement of the mirror to a new source-like position and then the additional displacement of the detector.

With analogous reasoning, the equations for the orthogonal or lower leg in Fig. 1 are found to be:

$$l_3 = \sqrt{(L\cos(\theta - \pi/2))^2 + (L\cos(\theta - \pi/2) - v\,l_3/c)^2},$$

$$l_4 = \sqrt{(L\cos(\theta - \pi/2))^2 + (L\sin(\theta - \pi/2) + vl_4/c)^2}.$$

From these individual path length expressions, the total difference giving the interference displacement is:

$$\Delta(\theta, v, L) = (l_1 + l_2) - (l_3 + l_4). \tag{4}$$

Analysis of a Michelson-Morley experiment

- Position space == Cosmic microwave background
- Earth has v $\cong$ 365 k./sec
- Munera experiment (Bogata)

$$l = 2.044 \text{ meters}$$
$$\lambda = 5320 \text{ Angstroms}$$

- Maxima calculation (no approximations)

```
(%i1) fpprec:32$ L:2.044$ c:3*10^8$
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```
(%i4) l[1](theta,v):=(find_root(l1 -
((L*cos(theta))^2 + (L*sin(theta)
+
v*l[1](theta,v)/c)^2)^(1/2)),l1,.8*L,1.2*L);
l[2](theta,v):=(find_root(l2 -
((L*cos(theta))^2 + (L*sin(theta)
-
v*l[1](theta,v)/c)^2)^(1/2)),l2,.8*L,1.2*L);
l[3](theta,v):=(find_root(l3 -
((L*cos(theta - %pi/2))^2 + (L*sin(theta -
%pi/2)
-
v*l[1](theta,v)/c)^2)^(1/2)),l3,.8*L,1.2*L);
l[4](theta,v):=(find_root(l4 -
((L*cos(theta - %pi/2))^2 + (L*sin(theta -
%pi/2)
-
v*l[1](theta,v)/c)^2)^(1/2)),l4,.8*L,1.2*L);
delta(theta,v):=(l[1](theta,v) +
L[2](theta,v))
- (l[3](theta,v) -
l[4](theta,v))/(lambda/2)
```

$$\delta = \Delta/(\lambda/2)\,\text{fringe shifts}$$

- IFF velocity lies in the plane of the experiment!

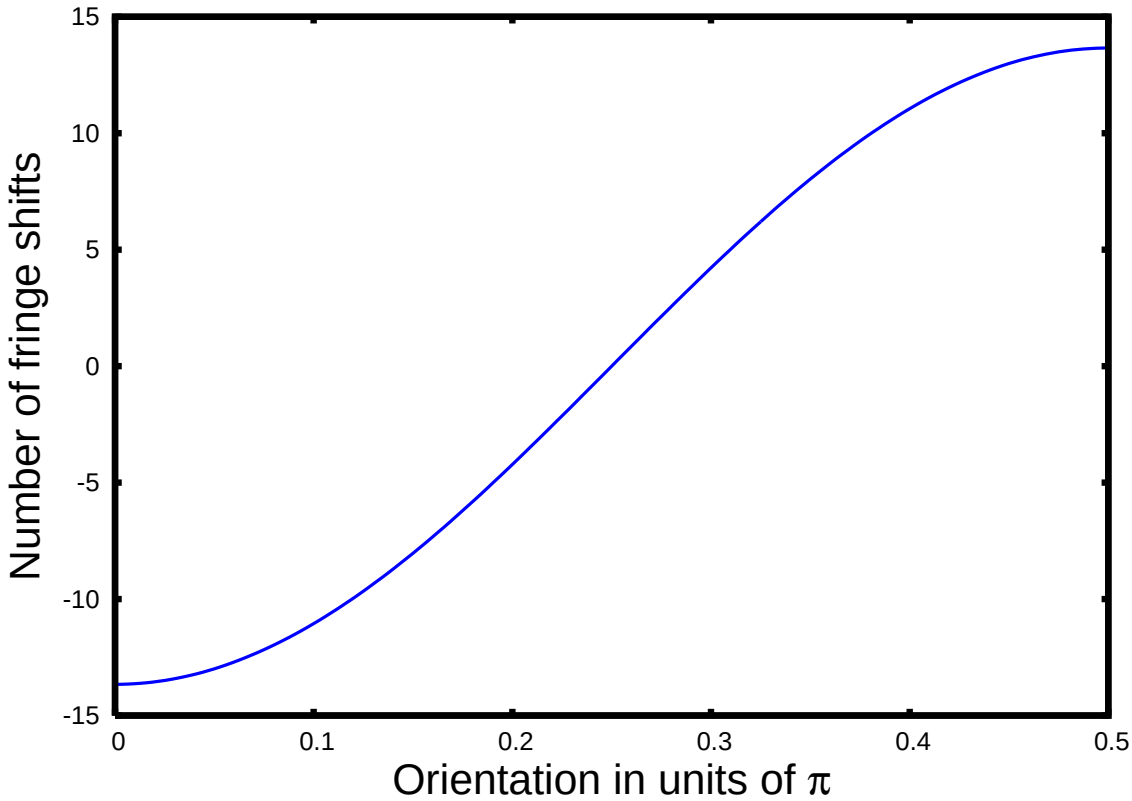

Figure 2.

Need to take Earth's orientation into account

$$v_{\text{eff.}} = 380 \sin((2\pi/360) \times (50^\circ + 23^\circ \sin(2\pi \text{ days}/365)) \times \sin((2\pi/360) \times \text{latitude}^\circ). \quad (5)$$

- Solar ecliptic to galactic ecliptic= 50°
- Earth's delcination = 23°
- Laboratory's latitude 5-35°

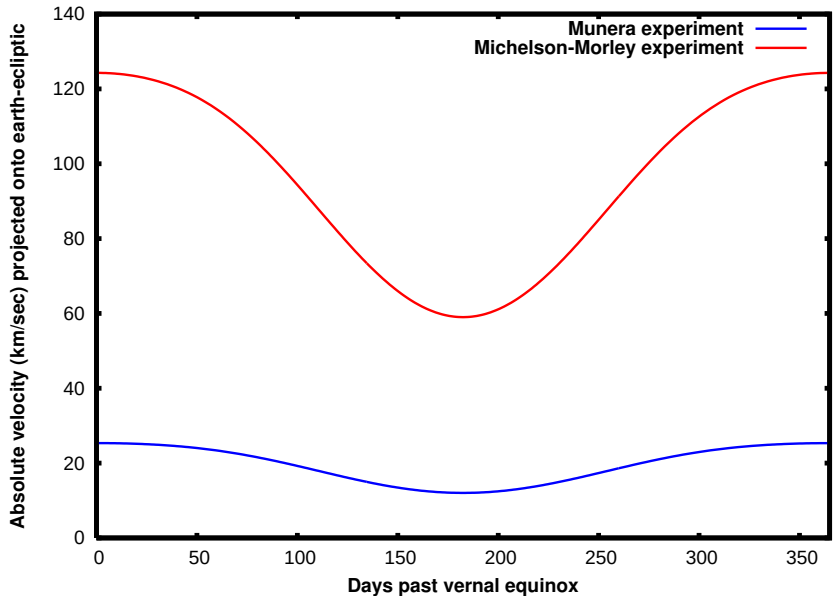

Figure 3.

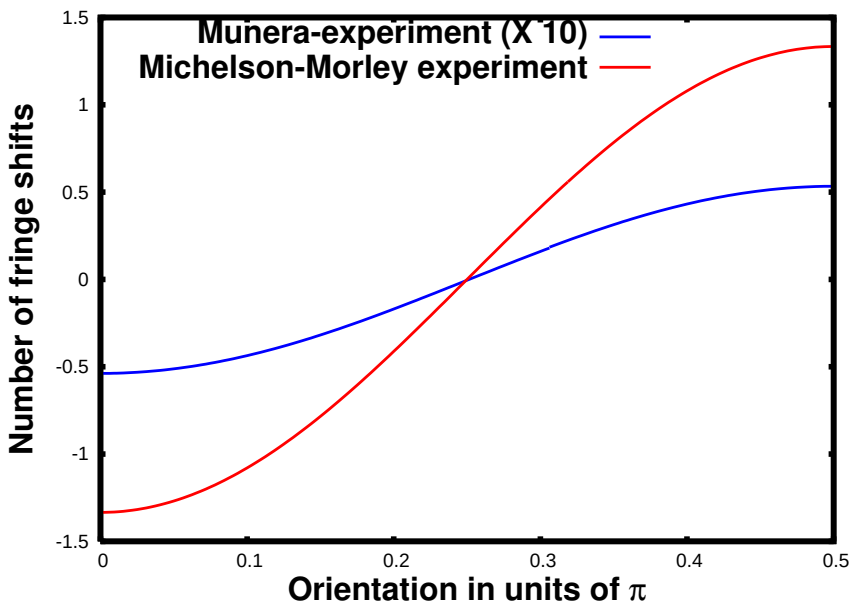

Figure 4.

Conclusion:

The foundational experiment for SR is contestable!