Koobee Wublee's blunder

Paul B. Andersen

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Introduction

The person posting in the usenet group sci.physics.relativity under the pseudonym Koobee Wublee has devised an 'experiment' which he claims illustrates that The Special Theory of Relativity is inconsistent.

Koobee Wublee's original 'experiment'

Koobee Wublee's solution to his 'experiment'

Koobee Wublee's solution is somewhat confused, but his claimed 'causality violation' seems to be this:

Events that are coinciding in one inertial frame of reference may according to the Lorentz transform not be coinciding in an inertial frame of reference which is moving relative to the first.

We will show that this is false.

The scenario

In an inertial frame of reference K, we have two stationary light sources A and B a distance L from each other. Simultaneously in K, A and B emit light pulses. We will call these events E_{A0} and E_{B0} respectively. A time $\frac{L}{c}$ later, A and B emit a second pair of simultaneous light pulses. We will call these events E_{A1} and E_{B1} respectively.

The light emitted from A at the event E_{A0} will hit B at an event we will call E_{B2}, and the light emitted from B at the event E_{B0} will hit A at an event we will call E_{A2}.

The scenario is observed in two frames of reference: K and K', where K is moving at the speed v along the x'-axis of K'. The origins are aligned at the time $t' = t = 0$.

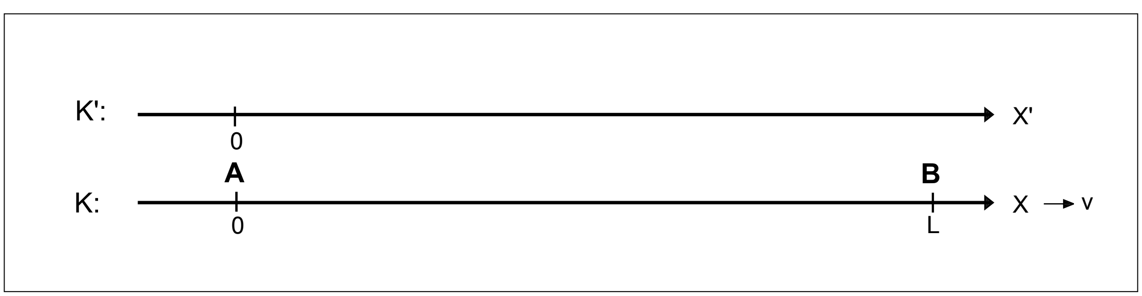

Figure 1: *The frames of reference*

Observations in frame K

The coordinates of the emission events are:

- Event E_{A0}, A emits the first pulse: $t_{A0} = 0$, $x_{A0} = 0$
- Event E_{B0}, B emits the first pulse: $t_{B0} = 0$, $x_{B0} = L$
- Event E_{A1}, A emits the second pulse: $t_{A1} = \frac{L}{c}$, $x_{A1} = 0$
- Event E_{B1}, B emits the second pulse: $t_{B1} = \frac{L}{c}$, $x_{B1} = L$

Since the transit times of the light from A to B and B to A both are $\frac{L}{c}$ as measured in K, the coordinates of the 'hit' events are:

- Event E_{A2}, A is hit by the first pulse from B: $t_{A2} = \frac{L}{c}$, $x_{A2} = 0$
- Event E_{B2}, B is hit by the first pulse from A: $t_{B2} = \frac{L}{c}$, $x_{B2} = L$

So as observed in K, the events E_{A1} and E_{A2} are coinciding, and so are the events E_{B1} and E_{B2}.

Simple causality demands that coinciding events must be coinciding in all frames of reference, but since Koobee Wublee claims that the Lorentz transform predicts otherwise, we will calculate the coordinates of the events, and the transit times of the light pulses between A and B in frame K' as well.

Observations in frame K'

Transformation of the coordinates of the emission events yields:

Event E_{A0}:

$$t'_{A0} = \frac{t_{A0} + \frac{v \cdot x_{A0}}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = 0$$

$$x'_{A0} = \frac{x_{A0} + vt_{A0}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = 0$$

Event E_{B0}:

$$t'_{B0} = \frac{t_{B0} + \frac{v \cdot x_{B0}}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = \frac{L}{c} \cdot \frac{\frac{v}{c}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$x'_{B0} = \frac{x_{B0} + vt_{B0}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = L \cdot \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

Event E_{A1}:

$$t'_{A1} = \frac{t_{A1} + \frac{v \cdot x_{A1}}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = \frac{L}{c} \cdot \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$x'_{A1} = \frac{x_{A1} + vt_{A1}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = L \cdot \frac{\frac{v}{c}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

Event E_{B1}:

$$t'_{B1} = \frac{t_{B1} + \frac{v \cdot x_{B1}}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = \frac{L}{c} \cdot \frac{1 + \frac{v}{c}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$x'_{B1} = \frac{x_{B1} + v t_{B1}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = L \cdot \frac{1 + \frac{v}{c}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

Calculation of the the transit time $\delta t'_{AB}$ of light from A to B

The light pulse is emitted from A at the event E_{A0} with the coordinates in K': $t'_{A0} = 0$, $x'_{A0} = 0$. Let's find B's position x'_B in K' at the time $t' = 0$. B's position in K is always $x_B = L$.

$$t' = \frac{t + \frac{v \cdot x_B}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = \frac{t + \frac{vL}{c^2}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = 0$$

$$x'_B = \frac{x_B + vt}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} = \frac{L + vt}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

Solving these yields: $x'_B = L\sqrt{1 - \frac{v^2}{c^2}}$

So the distance between A and B is $(x'_B - x'_{A0}) = L\sqrt{1 - \frac{v^2}{c^2}} = L'$

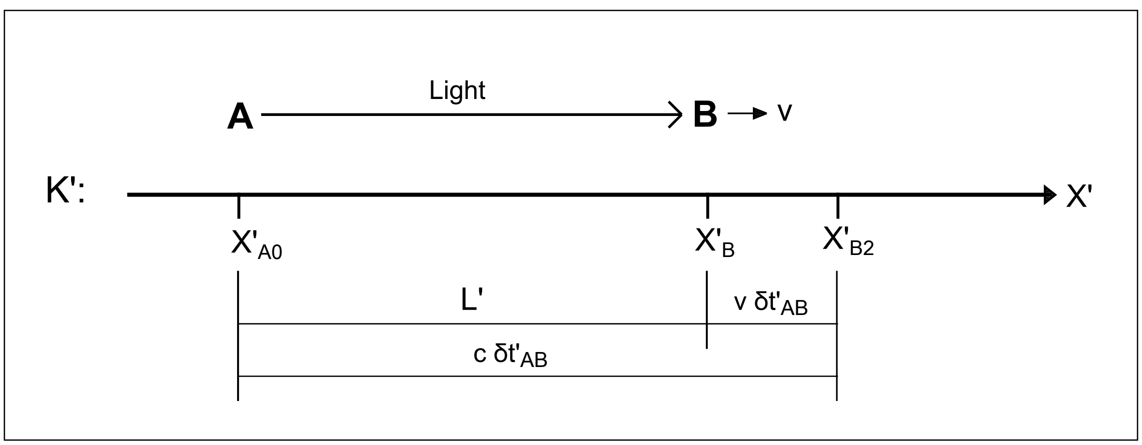

Figure 2: *Transit time of light from A to B*

$$c \cdot \delta t'_{AB} = L\sqrt{1 - \frac{v^2}{c^2}} + v \cdot \delta t'_{AB}$$

$$\delta t'_{AB} = \frac{L}{c}\sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$

Calculation of the coordinates of E_{B2} in K'

$$t'_{B2} = t'_{A0} + \delta t'_{AB} = \frac{L}{c}\sqrt{\frac{1+\frac{v}{c}}{1-\frac{v}{c}}}$$

$$x'_{B2} = x'_B + v \cdot \delta t'_{AB} = L\sqrt{\frac{1+\frac{v}{c}}{1-\frac{v}{c}}}$$

The events E_{B1} and E_{B2} are thus coinciding in K'.

Calculation of the the transit time $\delta t'_{BA}$ of light from B to A

The light pulse is emitted from B at the event E_{B0} with the coordinates in K':
$t'_{B0} = \frac{L}{c} \cdot \frac{\frac{v}{c}}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$, $x'_{B0} = L \cdot \frac{1}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$.

Let's find A's position x'_A in K' at the time $t' = \frac{L}{c} \cdot \frac{\frac{v}{c}}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$. A's position in K is always $x_A = 0$.

$$t' = \frac{t + \frac{v \cdot x_A}{c^2}}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}} = \frac{t}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}} = \frac{L}{c} \cdot \frac{\frac{v}{c}}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$$

$$x'_A = \frac{x_A + vt}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}} = \frac{vt}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$$

Solving these yields: $x'_A = -L\frac{\frac{v^2}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

So the distance between A and B is $(x'_{B0} - x'_A) = L\sqrt{1-\frac{v^2}{c^2}} = L'$

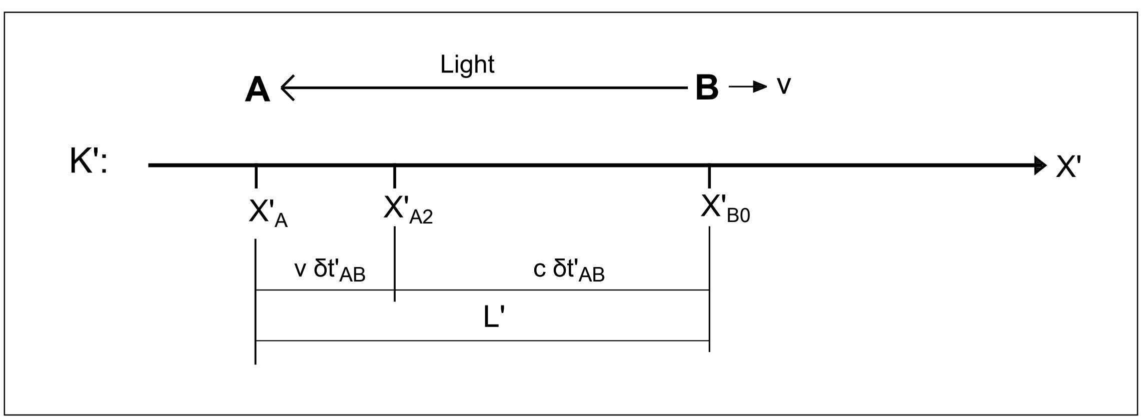

Figure 3: *Transit time of light from B to A*

$$c \cdot \delta t'_{BA} + v \cdot \delta t'_{BA} = L\sqrt{1 - \frac{v^2}{c^2}}$$

$$\delta t'_{BA} = \frac{L}{c}\sqrt{\frac{1 - \frac{v}{c}}{1 + \frac{v}{c}}}$$

Calculation of the coordinates of E_{A2} in K'

$$t'_{A2} = t'_{B0} + \delta t'_{BA} = \frac{L}{c} \cdot \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$x'_{A2} = x'_{A} + v \cdot \delta t'_{BA} = L \cdot \frac{\frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The events E_{A1} and E_{A2} are thus coinciding in K'.

Conclusion

We have shown that both the pairs of events E_{A1} and E_{A2}, and E_{B1} and E_{B2} which are pairwise coinciding in K, according to the Lorentz transform also are pairwise coinciding in K'.

Koobee Wublee's claim is thus proven to be a blunder.