Is Lorentz Contraction Observable?

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ABSTRACT. In a recent issue of this Journal O. Costa de Beauregard, refuting a Gedankenexperiment by J.S. Bell, comes to the conclusion that Lorentz contraction is not observable, but compensated by Bradley aberration. In the same issue C.W. Rietdijk publishes a paper based upon and frequently quoting one of his previous papers which gives a prescription how to prove the reality of Lorentz contraction. It will be shown that and why both are in error.

RESUME. Dans un numéro récent de cette revue, O. Costa de Beauregard, réfutant une expérience de pensée de J.S. Bell, arrive à la conclusion que la contraction de Lorentz n'est pas observable, mais compensée par l'aberration de Bradley. Dans le même numéro C.W. Rietdijk publie un article basé sur l'un de ses précédents articles qui donne une manière de démontrer la réalité de la contraction de Lorentz. On montre que tous deux sont dans l'erreur, et on explique pourquoi.

1. Consider two identical space ships at distant positions which are at rest with respect to each other. They gently begin to fire their identical rockets at the same time and in the same direction and, hence, obtain the same acceleration. Suppose that a fragile thread is tied between them, just long enough to span their initial distance. Will it break ? J.S. Bell, who reports and discusses this Gedankenexperiment [1], say yes. O. Costa de Beauregard [2] says no, incorrectly arguing with the Bradley aberration appearing to some observers who watch a train, moved by two identically accelerating engines at front and tail. But this is not at all Bell's question. He asks as stated above or, in other words, what is the distance between the space ships or between front and tail of the train when being measured by a passenger?

If two space ships or two metro engines accelerate *in exactly the same way*, their velocities with respect to the initial rest system are equal at every instant, and so their mutual distance with respect to the initial rest system remains constant by definition (otherwise one of them would accelerate faster than the other). In his Fig. 1 Costa de Beauregard gives an improper account of Bell's Gedankenexperiment, and there lies his error.[1]

Any Lorentz contraction can be measured in an objective way, simply by utilizing Einsteins original methods depicted by his "long trains", either using a variety of synchronized clocks equidistantly distributed along the rails, or, what is the same, by using simultaneous light signals from front and end of the train ("synchronized" and "simultaneous", taken with respect to the rest system of the rails). Today one would use digital quartz-clocks or laser signals. But that is the only difference to Einstein's early prescription.

If, now, the distance between the moved space ships or metro engines measured in the rest system remains constant at the initial length Δx of the thread, then this distance measured in the moved system becomes $\Delta x' > \Delta x$ and the thread must break. Therefore, just by looking at the broken thread, *Lorentz contraction can be observed!*

A simple question makes this point even more obvious: What is the distance between two light signals when the second one arrives at an observer one second after the first one? In the rest system of the observer it is roughly 3.10^8 m. In the "rest system of the light signals" it would be ∞.

2. According to C.W. Rietdijk [3], on the other hand, Lorentz contraction is so real that a body moving fast enough can pass through a tiny hole. Although Lorentz contraction is real indeed, this predicted utilization is not.

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[1] What argument determines the positions A and B relative to the origin? None! They were arbitrarily chosen. But they are of importance for the conclusion, because, according to Costa de Beauregard, both trajectories are asymptotes of the same dotted line through the origin, representing c. The invalidity of his conclusion is revealed by trying to draw the trajectories of those points lying on the negative x-axis, or even at $x = 0$.

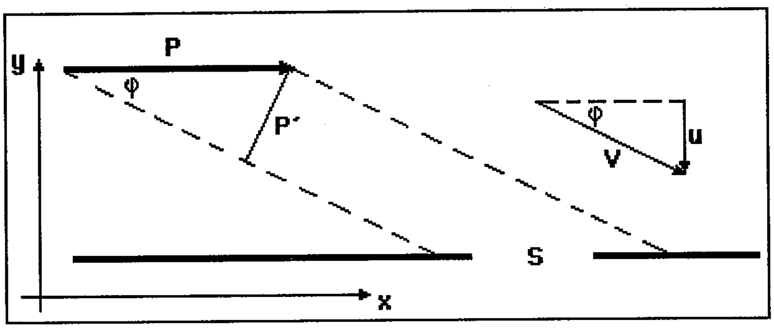

Figure 1.

The original argument reads (cf. Fig.1):"...if an arrow P with rest length $100cm$ moves in x direction at a velocity v such that $\sqrt{1-(v^2/c^2)} = 1/2$, whereas it has an (arbitrarily small) additional velocity in $-y$ direction, it can indeed pass the hole S of $51cm$, P being contracted to $50cm$."

The arrow axis lies parallel to the wall (otherwise no special trick would be required to shoot it through the hole). Let the arrow's velocity be V with

$$u = |V| \sin\varphi \tag{1}$$

its component in $(-y)$ direction, arbitrarily small or not. What is the extent (projection) P' of P perpendicular to V ? In this direction there is no Lorentz contraction. Hence, P' can be obtained from the rest length P of the arrow and eq. (1)

$$P' = P \sin\varphi \tag{2}$$

if the thickness of the arrow is negligible. The projection S' of the hole perpendicular to V can be calculated in a similar way (also for a rider on the arrow there is no Lorentz contraction in this direction)

$$S' = S \sin\varphi \tag{3}$$

In order to pass through, the arrow has to meet only one condition, obtained from eqs.(2) and (3)

$$P' < S' \Rightarrow P < S.$$

with no regard to the magnitude of its velocities u and $|V|$.

References

[1] J.S. Bell, *Speakable an Unspeakable in Quantum Mechanics*, Cambridge University Press, Cambridge 1987.
[2] O. Costa de Beauregard, Annales Fond. L. de Broglie **16** (1991) 267.
[3] C.W. Rietdijk, Four-dimensional character of micro-physical phenomena, in *The Wave-Particle Dualism*, S. Diner, D. Fargue, G. Lochak and F. Sellerie (eds.), Reidel, Dordrecht 1984.

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