Theory of Special Relativity *vs.* Preferred Reference Frame Theory: A Theoretical Distinction: UPDATE

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This paper is an update to our earlier paper[1] entitled "Theory of Special Relativity vs. Preferred Reference Frame Theory: A theoretical distinction". This updated version simplifies the arguments used in the former paper by removing unnecessary calculations and using only logical arguments. It does not involve calculations or use of the Lorentz equations. This will remove many ambiguities and objections some might have concerning our earlier paper. We will once more conclude that Einstein's Theory of Special Relativity is not equivalent to modern ether theories. We suggest that the reader review section 1 and section 2 of the former paper in which we introduce Preferred reference Frame Theories (PFT).

1. Experimental setup

The experiment consists of two rockets initially at rest wrt each other as depicted in Figure 1. The distance between them is measured to be D meters. The frame in which they are initially at rest will be called the *initial frame*. A "rigid" rod joins the rockets, such that one end is firmly attached to rocket #1 and the other end is in contact but not attached to rocket #2. Thus, the rod also has a measured length of D meters. The rockets are made to *accelerate identically* at the same *instant* wrt the initial frame for a specified amount of time, after which they will maintain a constant speed V (wrt the initial frame). For simplicity, all trajectories will be collinear with the x axis of the preferred frame. We analyze the case in which the initial frame has a speed v_1 to the "right" wrt the preferred frame. The rockets will initially travel to the "right" wrt the initial frame.

What is meant by "accelerate identically" is that the accelerations of the two rockets are identical as observed from the initial frame. One way to ensure that both rockets have the "same" acceleration wrt the initial frame is to have two detectors, one fixed at $x = 0$ and the other fixed at $x = D$. Each detector observes the position (motion) of its rocket as a function of the detector's hypothetical clocks (which are clocks in the initial frame and thus tick at the same rate). The two detectors' logs are then compared. If they are the same, then the accelerations of both rockets are the same wrt the initial frame. This also implies that both rockets have the same proper acceleration. Note that the acceleration need not be uniform.

"At the same instant" means that as one rocket starts to accelerate, the other does so as well. This refers to absolute synchronization. Although absolute synchronization is believed to be impossible to achieve in practice, the concept can be used in a theoretical analysis. The concept of *same instant* is not the same as *simultaneity* of TSR.

Another way to obtain events "at the same instant" is by chance: It may happen that one rocket leaves at the same instant as the other, although a verification would be impossible.

Algebraically, "accelerate identically" at the same "instant" can mean the following: If $x_1(s)$ represents the position of rocket 1 within the initial frame, the parameter s representing the value indicated by a particular clock, and without loss of generality $x_1(0) = 0$, then the position of rocket 2 is $x_2(s) = x_1(s) + D$.

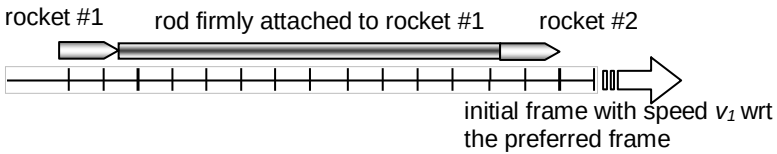

Figure 1. the initial setup within the initial frame.

We now ask the main question of interest to us:

After accelerations, what happens to the free end of the rod as both rockets maintain the speed V? Does it overlap, retract or remain in contact with rocket #2?

2. Analysis of the experiment

Analysis according to TSR

Either the rod overlaps, retracts or remains in contact with rocket #2. One and only one of these states is possible and we will call it Λ.

If the rocket-rod-rocket apparatus moved in the other direction (the apparatus moved to the "left" wrt the initial frame where rocket 1 is on the right and rocket 2 on the left), then by the relativity principle,

or by symmetry argument, the final state of the free end of the rod must again be Λ.

Analysis according to PFT

Since the rockets accelerate identically, their separation remains constant. However, the rod now has a speed greater than v_1. Hence the rod shortens and thus retracts from rocket 2. If the rocket-rod-rocket apparatus moved in the other direction, then the rod has a speed smaller than v_1, hence the rod elongates† and thus overlaps rocket 2.

Therefore, depending in which direction the experiment is done, PFT predicts two distinct outcomes whereas TSR predicts only one outcome.

> *Hence TSR and PFT are not mathematically equivalent theories.*

3. Conclusion

In Einstein's Theory of Special Relativity, a rod moving in the x or $-x$ direction will be acted upon by spacetime in a symmetrical fashion. This symmetry does not exist in the Preferred Reference Frame Theories. Using this fact, we have shown that there are thought experiments that can discriminate between the Theory of Special Relativity and the Preferred Reference Frame Theory. We therefore conclude that TSR and PFT are not equivalent theories, since their predictions differ. Although we have given a thought experiment that can discriminate between the two theories, similar experiments based on similar concepts may be feasible, thus permitting experimental verification of the existence of a preferred frame or falsification of the relativity principle of TSR.

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† It will elongate provided its new speed v_2 is such that $|v_2| < v_1$.

References

[1] S. Baune, Theory of Special Relativity vs. Preferred Reference Frame Theory: A theoretical distinction, *Apeiron* Vol.12, #4 October 2005 pp. 385-392