Critical Comments on "On the Constancy of the Velocity of Light"\textsuperscript{1}

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A new theory of four-dimensional symmetry introduced by Hsu has been criticized as logically inconsistent. We answer the criticisms that have been raised and show that in fact this theory is not logically inconsistent.

1. INTRODUCTION

The new four-dimensional symmetry theory with universal time introduced by Hsu\textsuperscript{1} has been criticized.\textsuperscript{2} The new theory has been expounded more recently by Chiu \textit{et al.}\textsuperscript{3} In Ref. 2, the authors claim to have shown logical inconsistencies in the original work of Hsu. Moreover, they assert that any attempt to work with such a symmetry framework is wrong, by appealing to a derivation of the Lorentz transformation based on hypotheses which are different from those in Ref. 1. As a result, they reject entirely the new symmetry theory.

We wish to comment on their article and to answer all their criticisms in this note. First we acknowledge that certain of their criticisms of the new symmetry theory, as originally presented, are valid. This was noted independently by the present authors, and the corresponding changes have been made in the theory.\textsuperscript{3,4} However, other criticisms arise from misunderstanding the text of our work. Their further assertion that any such space-light transformation between inertial frames is wrong and must be dismissed, we also answer. This is quite a basic and subtle point that has to do with the original hypotheses upon which one builds one's theory. Their argument

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essentially compares the space–light transformation in our theory with the allowed transformations in a different theory. A scientific theory should be dismissed on the basis of contradiction with established experiment rather than contradiction with a theory built on different hypotheses. We shall now discuss in what sense the theories are different.

The authors in an earlier paper\(^{(5)}\) show that they believe that the concepts of space and time should have special symmetry properties. This amounts to assuming that space \(r\) and time \(t\) must change \(\sigma\) under the transformation between inertial frames. They claim that “the relativity principle (for physical laws) together with the homogeneity and isotropy of space and the homogeneity of time” leads to an unspecified universal constant \(\sigma\) which is the coefficient of time in the transformation and is the upper limit of speeds for physical objects. This has been correctly criticized in that the coefficient of time \(\sigma\) is implicitly assumed (in their derivation) to be unchanged under transformations.\(^{(6)}\) Our work, however, relies in hindsight on the fact that the Lorentz transformations form a four-dimensional symmetry group of \(r\) and \(\sigma t\). It is not space and time as such that possess the homogeneity and isotropy properties, but rather space and the product of \(\sigma\) and time. The point to note here is that the coefficient of time is assumed to be unchanged in special relativity and one derives uniquely the Lorentz transformation. But we hold that the four-dimensional symmetry scheme allows one to make a different assumption, thereby obtaining a different transformation.

In our approach, we begin with a four-dimensional framework, which we identify as the three space dimensions and a fourth dimension \(x^0\). The symmetry properties are then expressed for \(x, y, z,\) and \(x^0\). We yet have to specify, by an additional postulate, how \(x^0\) is to be identified. It is clear that the identification\(^{(5)}\)

\[
x^0 = ct_R \text{ (or } \sigma t_R\text{)}
\]

where \(c\) is a universal constant and \(t_R\) is to be called the time, gives us the special theory of relativity. However, we must recognize that this is a particular choice for \(x^0\), and that other choices may also be made.\(^{(3)}\) We make the alternative choice

\[
x^0 = bt_u
\]

where \(t_u\), which we call the time, or the universal time, is to be the same in all frames, and \(b\) is not to be universally constant. In general, the coefficient of the universal time is a function in the four-dimensional transformation. We note here that as a result of this property the usual arguments to show

\[^{4}\text{This is basically the same as Robertson's definition of interval as } dr^2 = dt^2 - dx^2/c^2.\]

\[^{5}\text{As pointed out in Ref. 1, this very definition excludes the possibility of universal time.}\]