

Objective Formulation of Special Relativity

By **Yuri N. Keilman**
yuriflurryhurry@yahoo.com

Whether you want it or not, Special Relativity (SR) is a big discovery in theoretical physics. A. Einstein thought that it is an advantage that he was able to present it as a subjective science. But many physicists (me included) despise subjectivism. My opinion is that SR would not be of any value if it would not have an objective background. And SR does have it. To uncover it one has to turn attention to mathematics – “Vector and Tensor Algebra”. This mathematics was known long ago and was used in full extent by Riemann in his geometry. Below, I will try to put a “new face” on “Vector and Tensor Algebra” renaming it as the “Theory of N-dimensional Numbers” for the purpose of better understanding. I will assume that the reader has some knowledge of the Vector and Tensor Algebra but will try to be understandable even without that knowledge.

Theory of N-dimensional Numbers

Mathematics is a science about numbers. Let us take a real number and improve the concept by introducing a new term: “real construct”. Then we say: “real number” is a real construct that was assigned the “number status”. With the term “status” goes all the rules of handling of real numbers. Why did I do that? Because some real constructs can be assigned a “digit status” with different rules of handling. With the term “number” comes the status of “mathematical object” which brings about the uniqueness (definite multitudes of numbers can be also called mathematical objects). The status of being unique is very important in mathematics.

Real numbers are 1-dimensional numbers. If we want to widen our choice of numbers we can consider n-dimensional numbers. Here comes much wider choice of numbers. **Point** is a “number” that becomes definite when n ordered coordinates are given. The coordinates of a point are “real constructs” that have the “digit” status. Only “point” is a mathematical object and possesses the uniqueness property. The coordinates with their “digit status” are not unique. After a transformation of coordinates, the “point” remains the same (uniqueness) but the coordinates change. With the status “point” come the special rules of handling. **Vector** is a number (it is not an “arrow”) and becomes definite when n ordered components (in the form of a “real construct”) are given. The components of a vector have “digit status”. The status “vector” requires different handling compared to the status “point”. The uniqueness also comes with “vector status”. After a transformation of coordinates a “vector” remains the same (unique) but its components change. **Tensor** can be defined analogically. **Scalar** is a number given by one real construct. It does not change with a coordinate transformation because of uniqueness.

To be unique all n-dimensional numbers require the metric tensor to be known upfront before we can use all these numbers. The rules of vector and tensor algebra are fairly complicated if the metric tensor is given in an algebraic form (gik). But if

the tensor is Euclidean ($g_{11}=g_{22}=g_{33}=1$, $g_{12}=g_{13}=g_{23}=0$, 3-dimensions) then the algebra simplifies dramatically. For the Lorentz metric in 4-dimensions the algebra is also relatively simple.

Special Relativity

What about SR? Theoretical physics is a numerical description of physical reality. An **objective SR** says that we have to use 4-d numbers and the metric is Lorentz (This metric follows from Maxwell's equations). The physical properties – which are unique out there – have to be described by the unique (independent of the choice of coordinates) mathematical objects – points, scalars, vectors, tensors (and multitudes of those). It is obvious, that separate coordinates of a point, or separate components of a vector or tensor are not responsible for representation of physical reality. They have the “digit status”, they are different in different coordinate systems, and their responsibility is to define the corresponding point, vector, or tensor. A. Einstein assigned a physical meaning to them in order to give a subjective meaning to the whole of SR (I guess he was under the influence of fashion).

All that means is that SR is not a physical theory, it is not a mathematical theory. SR just gives us assurance that we will succeed if we use numbers (unique mathematical objects) to describe physical reality. SR is a philosophical/methodological advance.