

Interpreting the Axioms of Special Relativity as Theorems of Newtonian Kinematics

Koen Lefever and Gergely Székely

The aim of this talk is to present a new logic based understanding of the connection between special relativity and Newtonian kinematics.

We show that the axioms of special relativity can be interpreted in the language of Newtonian kinematics. This means that there is a logical translation function from the language of special relativity to the language of Newtonian kinematics which translates the axioms of special relativity into consequences of Newtonian kinematics. This translation is based on using light signals to construct modified coordinate systems of Newtonian observers such that these modified coordinate systems will satisfy the axioms of special relativity.

We will also show that if we distinguish a class of observers (representing the Newtonian observers stationary with respect to the “Ether”) in special relativity and exclude the non-slower-than light observers from Newtonian kinematics by an extra axiom, then the translation function from the language of special relativity to that of Newtonian kinematics becomes invertible. This means that with these modifications the two theories become definitionally equivalent (i.e., they become equivalent theories in the sense as the theory of lattices as algebraic structures is the same as the theory of lattices as partially ordered sets).

This investigation explicitly shows that Newtonian kinematics and special relativity basically differ only in the following:

1. In special relativity the distinguished class of stationary observers is missing.
2. In Newtonian kinematics the observers may move faster than (or with the) speed of light.

So the transition from Newtonian kinematics to special relativity (represented by the inverse relation of the non-invertible interpretation function between the unmodified theories) is the knowledge acquisition of that there is no “Ether” and inertial observers only move slower than the speed of light.

This research was mainly inspired by James Ax's "sound" model of spacetime [1, §4, pp.539-540] and by László Szabó's paper [2].

References

- [1] J. Ax, The elementary foundations of spacetime, *Foundations of Physics* Volume 8, Issue 7-8, pp 507-546 (1978).
- [2] L. E. Szabo, Lorentzian theories vs. Einsteinian special relativity – a logico-empiricist reconstruction, in A. Máté, M. Rédei and F. Stadler (eds.), *Vienna Circle and Hungary – Veröffentlichungen des Instituts Wiener Kreis*, Springer 2011.