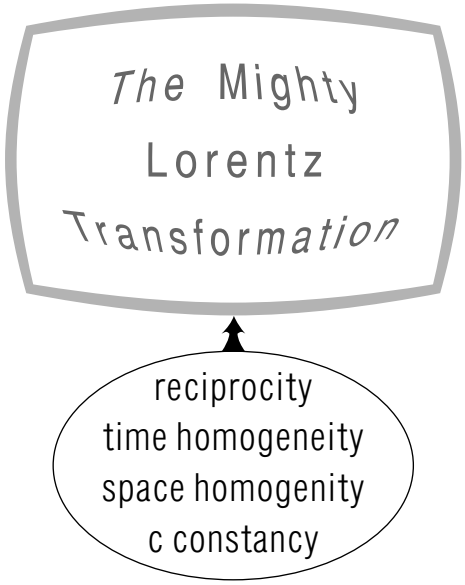
PHYSNET

MISN-0-76

DERIVATION OF THE LORENTZ TRANSFORMATION

Deriving:



Project PHYSNET Physics Bldg. Michigan State University East Lansing, MI

DERIVATION OF THE LORENTZ TRANSFORMATION

by

Frank Zerilli, Michigan State University

Title: **Derivation of the Lorentz Transformation**

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Version: 2/1/2000 Evaluation: Stage

Length: 1 hr; 8 pages

Input Skills:

1. Solve problems involving relative motion using the Galilean transformation (MISN-0-11).
2. State the postulates of special relativity (MISN-0-73).

Output Skills (Knowledge):

K1. Derive the Lorentz transformation using the two postulates of special relativity.

External Resources (Required):

1. R. T. Weidner and R. L. Sells, *Elementary Modern Physics*, Allyn and Bacon, Boston (1980). For availability, see this module's *Local Guide*.

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1. Study Guide

Unless otherwise stated, the references below are to: R. T. Weidner and R. L. Sells, *Elementary Modern Physics*, 3rd ed., Allyn and Bacon (1980). For availability, see this module's *Local Guide*.

- Study Section 2-5 and Appendix I carefully.
- Note the sentence on page 451, which reads:

  "We have assumed that Eqs. (I-1) are *linear* equations, involving the variables to the first power only, since only then would some single real event (x, y, t) in S correspond to a single real event (x', y', t') in S', and the converse."

  This is an incorrect reason (any one-to-one transformation, linear or not, would keep a one-to-one correspondence between events). The real reason to assume that the transformation is linear is that we postulate that space and time are the same in East Lansing as they are in Seattle, and that they are the same today as in 1649 A.D. Also, a linear transformation is the simplest transformation to assume, so why not start with the simplest possibilities first.[1]

Acknowledgments

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[1] See Einstein's original paper, "Sur Elektrodynamik bewegter Korper," *Annalen der Physik*, *17* (1905). A translation into English, of this article, appears in *The Principle of Relativity* by A. Einstein, H. A. Lorentz, H. Minkowski, and H. Weyl (Dover Publications, NY). For availability, see this module's *Local Guide*.

LOCAL GUIDE

The readings for this unit are on reserve for you in the Physics-Astronomy Library, Room 230 in the Physics-Astronomy Building. Ask for them as "The readings for CBI Unit 76." Do **not** ask for them by book title.