AMERICAN JOURNAL of PHYSICS

Geometric Representation of the Lorentz Transformation

Henri Amar

Citation: Am. J. Phys. **25**, 326 (1957); doi: 10.1119/1.1934453
View online: http://dx.doi.org/10.1119/1.1934453
View Table of Contents: http://ajp.aapt.org/resource/1/AJPIAS/v25/i5
Published by the American Association of Physics Teachers

LETTERS TO THE EDITOR

Temperature Scales

I WAS interested to read the comments made by Mr. E. S. Greene[1] of San Jose State College with reference to the method of converting from centigrade temperatures to Fahrenheit temperatures, and the reverse process, as suggested by Mr. Clifford C. Little[2] of the Hill School. His comments reminded me of a method I used with reasonable success when I was teaching physics at the secondary school level. Perhaps it will be of interest or use to someone else in their teaching.

As Mr. Greene says, it is preferable to have the students think something through and understand its foundations, than it is to be able to put figures into a formula, turn the crank, and get the answer out, without any idea of why the formula works. Probably the best place to start a discussion of any phase of scientific work is with something which is already familiar, from which further knowledge may be generated and expanded with accepted methods of development. In the case of the matter being considered, what can be more generally known or thought of than the freezing and boiling points of water? In general most people know them on one scale, so the corresponding points on the other scale are not hard to become familiar with. Thus, having these points, 0° and 100°, respectively, on the centigrade scale, and 32° and 212°, respectively, on the Fahrenheit scale, we see that the temperature interval between the two points is 100 centigrade degrees or 180 Fahrenheit degrees. This leads to the conclusion that 1 centigrade degree corresponds to 1.8 Fahrenheit degrees. From this, any temperature conversion may be very easily accomplished, as the following examples show:

1. Change 186°C, the melting point of lithium, to its corresponding Fahrenheit temperature.

186°C is 186 centigrade degrees above the freezing point of water, or $(186)(1.8)=334.8$ Fahrenheit degrees above the freezing point of water. The corresponding Fahrenheit temperature is, therefore,

$$32+334.8=366.8°\text{F}.$$

2. Change −422.95°F, the boiling point of hydrogen, to its corresponding Centigrade temperature.

−422.95°F is 422.95 Fahrenheit degrees below zero on the Fahrenheit scale, but it is $32+422.95=454.95$ Fahrenheit degrees below the freezing point of water. This is $454.95/1.8=252.75$ centigrade degrees below the freezing point of water. Thus the corresponding centigrade temperature is

$$0-252.75=-252.75°\text{C}.$$

Consideration of the method used in these examples, with respect to the first example, will show that it is possible, when working with temperatures above the boiling point of water, to use the boiling point as the basis of operation in finding the needed temperature differences and the final corresponding temperature. The method illustrated will be usable for any temperature conversion between the two scales, as well it should, for it is in reality nothing more than the same old conversion formulas in slightly different, and less confusing garb, which makes very clear just where the two formulas come from.

During the time that I was teaching I found that my students had, in many cases, an easier time with this method than they did with some of the other processes available to them. Perhaps it may be of use to someone else.

William R. Barron
1884 Massachusetts Avenue
Lexington, Massachusetts

[1] E. S. Greene, Am. J. Phys. **24**, 590 (1956).
[2] Clifford C. Little, Am. J. Phys. **24**, 375 (1956).

Very Real Demonstration of Pascal's Principle

A COLLEAGUE of mine reports the following observation: He engaged a man to build an extension to his home, which included a bathroom. The sewer line, in a trench about 4 feet deep, was made of lengths of 4-inch clay sewer pipe, cemented at the junctions. The building code requires a vent that opens at roof level, and this was properly installed. The only thing that remained was to check the sewer line for leaks before filling the trench back. This the workman proceeded to do by blocking the lower end of the line with sand bags and then filling the vent at its open end with the hose. He was astonished to discover that nearly every cemented junction leaked. Moreover, the water spurted in many directions at each junction, and the vertical streams reached nearly to the height of the vent—roughly 20 feet. Being thus dismayed at the ineffectiveness of his joints he cemented them all again and after letting the cement set he repeated the test, certain this time that he had it licked. Again the junctions leaked. At this point, fortunately, my colleague came upon the scene and made clear the physics of the situation since he had heard from me one time on the breaking of a cask by adding a beaker or two of water.

Julius Sumner Miller
El Camino College
El Camino College, California

Geometric Representation of the Lorentz Transformation

IN the course of an investigation on the spinor representation of the Lorentz transformation, I formulated a geometric representation of the Lorentz equations, which appeared in the November, 1955 issue of the *American Journal of Physics* (**23**, 487). The paper, whose interest is mostly pedagogic, shows also how the major implications of the space-time transformation can be simply and graphically derived. Before submitting my paper for publication, I had scanned practically all available texts on relativity and innumerable papers. It turns out, however, that formulas identical to mine were written for the first time by Professor Enrique Loedel in a paper published in January, 1948 in the *Anales de la Sociedad Cientifica Argentina* and entitled "Aberracion y Relatividad." I regret my unfamiliarity with South American literature and wish to acknowledge the priority of Professor Loedel's work.

HENRI AMAR

The Franklin Institute Laboratories
Solid State Division
Philadelphia, Pennsylvania

The geometric representation introduced by Professor Henri Amar in his paper "New Geometric Representation of the Lorentz Transformation" [Am. J. Phys. **23**, 487 (1955)] is identical with the representation found by me and published more than eight years ago in *Anales de la Sociedad Cientifica Argentina*. It can be found in the following papers and books.

(1) "Aberración y Relatividad," Anales soc. cient. argentina **145**, 3–13 (1948), p. 6, Fig. 2 and Fig. 6, p. 13.

(2) "Deducción directa de los tres efectos cruciales de la teoría de la gravitación de Einstein a partir del principio de la velocidad parabölióa," Actas acad. N. de ciencias exact., fís. y nat. Lima (Perú). **42**, 3–38 (1954), p. 17, Fig. 1.

(3) "Un nuevo principio que permite calcular directamente los potenciales gravitatorios g_{ik} de Einstein." Anales de la soc. cient. argentina **160**, 7–36 (1955), 16, Fig. 3.

(4) *Enseñanza de la Física* (Editorial Kapelusz, Buenos Aires, 1949), pp. 492–498, Figs. 217, 218, 219.

(5) *Física Relativista* (Editorial Kapelusz, Buenos Aires, 1955).

In this book dealing with the special and general theory of relativity, the geometric representation of the Lorentz transformation is discussed and explained in detail.

It is regrettable that works published in Spanish American are to a great extent unknown to our northern colleagues. Perhaps this incident may help to improve that situation.

ENRIQUE LOEDEL

La Plata
Calle 54 No. 528 2p.
Rca. Argentina

AMERICAN JOURNAL OF PHYSICS VOLUME 25, NUMBER 5 MAY, 1957

RECENT MEETINGS

Minnesota Area Association

The Minnesota Area Association of Physics Teachers held its regular fall meeting October 27, 1956, at the Brainerd Junior College, Brainerd, Minnesota.

The following program was presented:

1. **Physics in the junior college.** JAMES H. GARFUNKEL, *Brainerd Junior College.*

2. **Sodium *D*-lines intensity during warmup of sodium arc lamp.** HOWARD G. HANSON, *University of Minnesota, Duluth Branch.*—The intensities of the D_2 and D_1 lines were measured during warmup of a commercial Pirani-type sodium arc lamp. During the first 20 minutes, the total intensity increases rapidly with the D_1 line more intense than the D_2 line. A rapid reversal then occurs and the D_2 becomes more intense with a final ratio D_2/D_1 of about 1.20. Over an hour is required for an equilibrium ratio to be established. Accompanying the reversal of D_2/D_1 ratio is a rapid 50% decrease in the total intensity. The peak intensity was reached at about 20 minutes. A concurrent measurement of the temperature of the outside envelope of the lamp was made. The lamp can be made to operate at higher final intensity by lowering the input voltage from 110 to 90 volts but a much longer time is required for the lamp to reach equilibrium. The behavior of the intensity ratio of the lines can be explained in terms of the difference in absorption coefficients for the two D lines and the presence of cool sodium vapor surrounding the arc. The measurements were made with a 1P21 photomultiplier tube and the D lines were resolved with a reflection grating monochromator.

3. **Carleton Conference on improving the quality and effectiveness of introductory physics courses.** FRANK VERBRUGGE, *University of Minnesota.*

4. **"Brainstorming."** An experiment in developing new ideas to solve old problems. J. W. BUCHTA, *University of Minnesota*

Following the listed program, luncheon was served at the Ransford Hotel, and a short business meeting followed.

GEORGE R. STUBBS
Secretary-Treasurer

Texas Section

The second annual meeting of the Texas Section of the American Association of Physics Teachers was held on December 13–15 on the campus of Howard Payne College, Brownwood, Texas, jointly with the Physical Science Section of the Texas Academy of Science. Four invited papers, twenty-nine contributed papers and a panel discussion were divided among six half-day sessions.