The Division of One by Zero

Ilija Barukčić [1]

[1]   Horandstrasse, DE-26441 Jever, Germany
Email: Barukcic@t-online.de

Abstract

Unfortunately, however, the relation between a finite and an infinite is not always so straightforward. The infinite and the finite mutually related as sheer others are inseparable. A related point is that while the infinite is determined in its own self by the other of itself, the finite, the finite itself is determined by its own infinite. Each of both is thus far the unity of its own other and itself. The inseparability of the infinite and the finite does not mean that a transition of the finite into the infinite and vice versa is not possible. In the finite, as this negation of the infinite, we have the satisfaction that determinateness, alteration, limitation et cetera are not vanished, are not sublated. The finite is a finite only in its relation to its own infinite, and the infinite is only infinite in its relation to its own finite. As will become apparent, the infinite as the empty beyond the finite is burdened by the fact that determinateness, alteration, limitation et cetera are vanished. The relation between the finite and the infinite finds its mathematical formulation in the division of one by zero. As we will see, it is +1/+0=+∞.

Keywords

Number theory, Quantum theory, Relativity theory, Unified field theory, Causality

1. Introduction

Time determined as opposed to an other is negatively determined not only against an other but as an infinite it opposed to a finite. Even when time is represented as unlimited and infinite, a 'point in time' still constitutes its element. Is infinity itself free from any opposition? The infinite, a purely self-related, is something relative, it is related to its own other, it is the negation of its own other, of its own finite. The infinite even if determined by its own other, by the finite, is determined as the non-being of an other, while the finite itself stands as opposed to its own infinite. Both are equally others to each other. The infinite, in separation from the other, separated from the finite, above or beyond the finite, the finite as being here and the infinite being there, is related to the finite. What could justify the assumption that an infinite does stand as something complete and finished and superior or above to the finite? Even as separated, the infinite and the finite are connected by that which separates both. As therefore each is in its other and through its own other determining its own self, the finite and the infinite, even if separated are inseparable, which is equally the inner unity. Consequently, in the changing or the necessary

transition of the finite into the infinite and vice versa, is there a point where a finite becomes an infinite, where a finite negate its negation and changes to an infinite? In other words, where does infinity begins? How can and how can something pass beyond the finite into the infinite and vice versa?

In mathematics, several types of indeterminate forms are distinguished, in principle. Some typical indeterminate forms considered in the literature are denoted by 0/0 or by 1/0 or by ∞/∞ or by $0\times\infty$ or by $\infty-\infty$ or by 0^0 or by 1^∞ and by ∞^0 et cetera. Our today's contemporary mathematical viewpoint of infinity is attributed to the English mathematician John *Wallis*. In 1655, John Wallis (1616-1703) for the first time introduced the symbol ∞ for infinity. John Wallis, pointed out: "esto enim ∞ nota numeri infiniti" [1]. Translated into English: 'let the symbol ∞ denote infinity'. In particular, Wallis himself claimed in 1656 without a proof that "1/∞ ... habenda erit pro nihilo" [2] or

$$\frac{+1}{+\infty} = +0 \tag{1}$$

Thus far, John Wallis [3] is demanding without a mathematical proof too, that

$$\frac{+1}{+\infty} \times +\infty = +1 \tag{2}$$

Isaac *Newton* himself followed Wallis [4] in his position. In his own book *Opuscla,* Isaac Newton claimed without a proof that "**1 / 0 = Infinitae**" [5]. We may ask ourselves, can Einstein's theory of special relativity tell us anything about the division of one by zero?

2. Material and methods

2.1. Definitions

Definition. The time of a stationary observer $_R t$ and the time of a co-moving observer $_O t$

Time is dependent on the observer's reference frame. Especially, clocks moving at close to the speed of light c will slow down with respect to a stationary observer R (observer at rest). Thus far, let $_R t$ denote the time as measured by a stationary observer, i. e. the relativistic time. Let $_O t$ denote the time as measured by a moving observer O. The relationship between the time $_O t$ as measured by a clock moving at constant velocity v in relation to the time $_R t$ as measured by a clock of a stationary observer R is determined by Einstein's relativistic time dilation [6] as

$$_O t = _R t \times \sqrt[2]{1 - \frac{v^2}{c^2}} \tag{3}$$

where $_O t$ denotes time as measured by a moving observer O, $_R t$ denotes the time as measured by a stationary observer R, v denotes the relative velocity between both observers and c denotes the speed of light in vacuum. Equally, it is

$$\frac{_O t}{_R t} = \sqrt[2]{1 - \frac{v^2}{c^2}} \tag{4}$$

or

$$\frac{_O t}{c^2} \times \frac{c^2}{_R t} = \sqrt[2]{1 - \frac{v^2}{c^2}} \tag{5}$$

Scholium.

Coordinate systems can be chosen freely, deepening upon circumstances. In many coordinate systems, an event can be specified by one time coordinate and three spatial coordinates. The time as specified by the time coordinate is denoted as coordinate time. Coordinate time is distinguished from proper time. The concept of proper time, introduced by Hermann Minkowski in 1908 and denoted as $_{O}t$, incorporates Einstein's time dilation effect. In principle, Einstein is defining time exclusively for every place where a watch measuring this time is located.

"... Definition ... der ... Zeit ... für den Ort, an welchem sich die Uhr … befindet ..." [7]

In general, a watch is treated as being at rest relative to the place where the same watch is located.

"Es werde ferner mittels der **im ruhenden System** befindlichen **ruhend**en Uhren die Zeit t [$_{R}$t, author] des ruhenden Systems ... bestimmt, ebenso werde die Zeit τ [$_{O}$t, *autho*r] des **bewegten System**s, in welchen sich relativ zu letzterem **ruhend**e Uhren befinden, bestimmt..." [8]

Only, the place where a watch at rest is located can move together with the watch itself. Therefore, due to Einstein, it is necessary to distinguish between clocks as such which are qualified to mark the time $_{R}$t when at rest relatively to the stationary system R, and the time $_{O}$t when at rest relatively to the moving system O.

"Wir denken uns ferner eine der Uhren, welche **relativ zum ruhenden System ruhend** die Zeit t [$_{R}$t, author], **relativ zum bewegten System ruhend** die Zeit τ [$_{O}$t, *author*] anzugeben befähigt sind ..." [9]

In English:
<Further, we imagine one of the clocks which are qualified to mark **the time t** [$_{R}$t, author] **when at rest relatively to the stationary system**, and **the time τ** [$_{O}$t, *author*] **when at rest relatively to the moving system** …. >

Definition. The normalized relativistic time dilation
As defined above, due to Einstein's special relativity, it is

$$\frac{_{O}t}{_{R}t} = \sqrt[2]{1 - \frac{v^2}{c^2}} \tag{6}$$

The normalized relativistic time dilation relation [10] follows as

$$\frac{_{O}t^2}{_{R}t^2} + \frac{v^2}{c^2} = 1 \tag{7}$$

2.2. Axioms

The following theory is based on the next axiom.

Axiom I. (Lex identitatis)

$$+1 = +1 \tag{Axiom I}$$

3. Results

Isaac Newton [11] created his own world view. Centuries later, Albert Einstein's (1879-1955) published his theory of special relativity. Einstein's theory of special relativity which has passed a lot of observational and experimental investigations could be of use to solve the problem of the division of 1 by 0.

3.1. Theorem. The division of one by zero I

Let us perform a thought experiment under extreme conditions of inertial frames of reference where $_Rt = +\infty$, $_0t=+1$ and $v=c$.

Claim.
Under conditions of special relativity (inertial frames of reference) where $_Rt = +\infty$, $_0t=+1$ and $v=c$ the division of one by zero is possible and allowed. In particular, it is

$$\frac{+1}{+0} = +\infty \tag{8}$$

Direct proof.
Due to our Axiom I it is

$$+1 = +1 \tag{9}$$

Multiplying this equation with $_0t$, the "proper" time, we obtain

$$_0t \times 1 =_0 t \times 1 \tag{10}$$

In general, due to Einstein's special relativity it is equally

$$_0t =_R t \times \sqrt[2]{1 - \frac{v^2}{c^2}} \tag{11}$$

In general, Einstein's special relativity demands that

$$\frac{_0t}{\sqrt[2]{1 - \frac{v^2}{c^2}}} =_R t \tag{12}$$

Under conditions of inertial frames of reference, Einstein's relativistic time-dilation relation is generally valid. Thus far even under circumstances where $_Rt = +\infty$, Einstein's relativistic time-dilation relation stay valid. Rearranging equation before, we obtain

$$\frac{_0t}{\sqrt[2]{1 - \frac{v^2}{c^2}}} = +\infty \tag{13}$$

The validity of Einstein's relativistic time-dilation relation is not limited and will not break down if the co-moving observer measures the time $_0t=+1$. The equation before changes to

$$\frac{+1}{\sqrt[2]{1-\frac{v^2}{c^2}}} = +\infty \tag{14}$$

There are circumstances where the relative velocity between the stationary observer R and the co-moving observer 0 is equality to **v=c**. Even under these conditions, Einstein's relativistic time-dilation relation is valid. We obtain

$$\frac{+1}{\sqrt[2]{1-\frac{c^2}{c^2}}} = \frac{+1}{\sqrt[2]{1-\frac{1^2}{1^2}}} = \frac{+1}{\sqrt[2]{1-1}} = \frac{+1}{\sqrt[2]{0}} = +\infty \tag{15}$$

Finally, even under extreme conditions, where $_Rt = +\infty$, $_0t=+1$ and **v=c**, Einstein's relativistic time-dilation is valid. Based on these assumptions, we obtain

$$\frac{+1}{+0} = +\infty \tag{16}$$

Quod erat demonstrandum.

3.2. Theorem. The division of one by zero II

Einstein's theory of special relativity is valid even under conditions where $_Rt = +\infty$, $_0t=+1$ and **v=c**.

Claim.
Under conditions of special relativity (inertial frames of reference) there are circumstances, where $_Rt = +\infty$, $_0t=+1$ and **v=c**. Under conditions where the relative velocity **v = c** we must accept that

$$\frac{+1}{+0} = +\infty \tag{17}$$

Direct proof.
Due to our Axiom I it is

$$+1 = +1 \tag{18}$$

Multiplying this equation with $_0t$, the "proper" time, we obtain

$$_0t \times 1 =_0 t \times 1 \tag{19}$$

In general, due to Einstein's special relativity it is equally

$$_0t =_R t \times \sqrt[2]{1-\frac{v^2}{c^2}} \tag{20}$$

In general, Einstein's special relativity demands that

$$\frac{_o t \times _o t}{_R t \times _R t} + \frac{v \times v}{c \times c} = 1 \tag{21}$$

Under experimental conditions of special relativity where **v=c** we obtain

$$\frac{_o t \times _o t}{_R t \times _R t} + \frac{c \times c}{c \times c} = 1 \tag{22}$$

or

$$\frac{_o t \times _o t}{_R t \times _R t} + 1 = 1 \tag{23}$$

or

$$\frac{_o t \times _o t}{_R t \times _R t} = +0 \tag{24}$$

In particular, even under extreme conditions, where $_R t = +\infty$, $_0 t = +1$ and v=c, Einstein's normalized relativistic time-dilation is valid. Based on these assumptions, we obtain

$$\frac{+1 \times +1}{+\infty \times +\infty} = +0 \tag{25}$$

Due to our theorem before, it is $+1/+\infty = +0$. We obtain

$$+0 \times +0 = +0 \tag{26}$$

or at the end

$$+0 = +0 \tag{27}$$

Quod erat demonstrandum.

4. Discussion

In general, there is some evidence, that $+1/+0 = +\infty$. Even if the proof itself is self-consistent, there are still some questions about the validity of such an approach. Why should it be allowed that a stationary observer measures a stationary time of $_R t = +\infty$ while the co-moving observer measures the time $_0 t = +1$ and all this while the relative velocity between the stationary observer and the co-moving observer is equal to v=c. Are there such circumstances at all? Equally, under conditions where the relative velocity between the stationary observer R and the co-moving observer 0 is equal to v=c, the rest-mass is equal to zero.

5. Conclusions

There is some evidence that the problem of the division of one by zero is solved. In general, under conditions of special relativity, it is $(+1/+0) = +\infty$.

Acknowledgements

None.

Appendix

None.

References

[1] Wallisii, Johannis. (1655) De sectionibus conicis, nova methodo expositis, tractatus. Typis Leon: Lichfield Academix Typographi, Impensis Tho. Robinson, Oxonii, p. 4.

[2] Wallisii, Johannis. (1656) Arithmetica infinitorum, Sive Nova methodus inquirendi in curvilineorum quadraturam, aliaq difficiliora problemata matheseos. Typis Leon: Lichfield Academix Typographi, Impensis Tho. Robinson, Oxonii, p. 152.

[3] Wallisii, Johannis. (1656) Arithmetica infinitorum, Sive Nova methodus inquirendi in curvilineorum quadraturam, aliaq difficiliora problemata matheseos. Typis Leon: Lichfield Academix Typographi, Impensis Tho. Robinson, Oxonii, p 152.

[4] Romig, H. G. (1924) Discussions: Early History of Division by Zero. *The American Mathematical Monthly*, 31, No. **8**, 387-389.

[5] Newton, Isaac. (1744) Opuscula mathematica philosophica et philologica. In Tres Tomos Distributa. Tomus primus. Joh. Castillionues, Juris consultus, Lusannae et Genevae, p. 4. http://dx.doi.org/10.3931/e-rara-8608

[6] Einstein, A. (1905) Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, vol. **322**, Issue 10, 904.

[7] Einstein, A. (1905) Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, vol. **322**, Issue 10, 893.

[8] Einstein, A. (1905) Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, vol. **322**, Issue 10, 898.

[9] Einstein, A. (1905) Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, vol. **322**, Issue 10, 903-904.

[10] Barukčić, Ilija. (2013) The Relativistic Wave Equation. *International Journal of Applied Physics and Mathematics*, vol. 3, no. 6, 387-391.

[11] Newton, Isaac. (1686) Philosophiae naturalis principia mathematica. S. Pepys, London.

[12] Barukčić, Ilija. (2013) The Relativistic Wave Equation. *International Journal of Applied Physics and Mathematics*, vol. **3**, no. 6, 387-391.

[13] Einstein, Albert. (1912) Relativität und Gravitation. Erwiderung auf eine Bemerkung von M. Abraham. *Annalen der Physik*, Volume **343**, Issue 10, 1059-1064.

[14] Wallisii, Johannis. (1656) Arithmetica infinitorum, Sive Nova methodus inquirendi in curvilineorum quadraturam, aliaq difficiliora problemata matheseos. Typis Leon: Lichfield Academix Typographi, Impensis Tho. Robinson, Oxonii, p 152.