Einstein's Relativity as Ethnomathematics

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Abstract. Mathematics and Physics are different research cultures. In comparison with mathematicians, physicists in some cases try to simplify and to introduce new cultural context into conventional pure mathematics. Cross-cultural differences between these cultures can be essential and some attempts to do alternative mathematics in the physical academic context could be defined as the new fields of ethnomathematics. Einstein’s Relativity as this kind of ethnomathematics is the first considered .

Introduction.

Mathematics and Physics are different research cultures of Human Science as whole. In comparison with mathematicians, however, physicists agree to disagree and to simplify mathematics because in some cases it “naturally” arises from physical experience. Hence, some basic mathematical assumptions are usually defined as “ wrong ”or “abstract “ statements in physical sciences and physicists try to invent own more realistically alternative mathematics (which probably could be defined as “Ethnomathematics “ of another kind in good agreement with known definition by Burton ,1996).

As is established, such kind of ethnomathematics by physicists may or may not satisfy today mathematical research ontology of what a pure mathematics should be.In some cases, whole systems of ethnomathematics invented by physicists (for example, Einstein’s Relativity and Dirac’s quantum algebra) can become dominant forms of exclusive quasi-mathematical thinking of the age. Moreover, in some cultural contexts, such *ethnomathematics* of the second kind can have a sort of “hidden existence” into physics and researchers are needed special efforts and ethnographic investigations to detect its presence, actually.

Main assumption of Einstein’s ethnomathematics.

As is known Albert Einstein accepted that Pythagoras theorem in two dimensional space is analogous to Pythagoras theorem in three dimensions . Hence, in Einstein’s Relativity a metric on a space is simply generalization of 2D Pythagoras’ theorem for the distance ds between two points separated by distance dx=(dx,dy,dz), i.e.

$$ds^2 = |dx^2| = dx^2 + dy^2 + dz^2.$$

Moreover, in Relativity we can always write this as a matrix equation of the form

$$ds^2 = \sum n_{ij}dx^{\wedge}i dx^{\wedge}j \ (i,j = 1,3)$$

where n_{ij} is merely the Relativity’s unit matrix . Generally, the matrix is refererred to as the metric of the three-dimensional Euclidean space. Hence, thus , we can write non-Euclidean spaces (for example Minkowsky space of Special Relativity specifying a different metric where the proper distance between two points in spacetime is given by

$$ds^2 = dt^2 - dx^2.$$

Hence, correspondingly, in General relativity, the metric becomes a dynamic object depending on space and time, etc.

Einstein's assumption in the pure mathematical context.

Following Einstein and modern textbooks, in three dimensions Pythagoras theorem is exactly analogous to conventional Pythagoras theorem of the plane geometry .This assumption is reproducing by scientific publishers today as the most obvious principle of scientific physics. In particular, international bestseller B. Russell 's "ABC of Relativity "(editions 1925 - 2007) uses further very suggestible illustration of Einstein's assumption : " Suppose that, instead of wanting merely to fix positions on the plain, you want to fix stations for captive balloons above it, you will then have to add a third quantity, the height at which the balloon is to be. If you call the height z, and if r is the direct distance from O to the balloon, you will have $r^2 = x^2 + y^2 + z^2$, and from this you can calculate r when you know x,y and z. For example, if you can get to the balloon by going 12 miles east, 4 miles north and then 3 miles up, your distance from the balloon in a straight line is thirteen miles, because 12×12 = 144, 4×4 = 16, 3×3 = 9, 144 + 16 + 9 = 169 = 13×13."(Russell, 1925-2007, 71).

In another cultural context , however, Einstein's ethnomathematics is not exact ! If you can get to the balloon by going in mysterious reality of Relativity x=13,15,17, 19,21,23,25,…∞ (any positive odd integer) miles east, and, y= 5,7,9,11,13,15,17, … ∞ (any positive odd integer) miles north , Pythagoras theorem in three dimensions CANNOT BE TRUE at all, because in accordance with Oliverio's Pythagoras Quadruple Problem (1996), only for positive even x and y there exist such z and r , i.e. only for positive even x and y there exists

$$r^2 = x^2 + y^2 + z^2$$

(skeptical reader can test this brilliant result with calculator or even with supercomputer).Thus, there is an infinite number of counterexamples with positive odd x and y for basic assumption of Einstein's which could be considered as a sufficient foundation for notion "Einstein's ethnomathematics".

Contra Arguments

Let us suppose that our claim on existence of Einstein's ethnomathematics is based on wrong definition of Einstein's equation – the terms of Einstein equation are real numbers, not integers, correspondingly, for any real numbers x,y,z there is always real number r that satisfies the equation of Einstein.(Popov,2012) Hence, Russell's example is valid, even-odd distinction for real numbers is not important and Einstein was not inventor of new alternative mathematics, hence, his relativity theory cannot have sufficient logical foundations for alternative theories and alternative mathematical refinements (?)

Pro Arguments

[1] As is established, Number theory starts from the positive whole numbers and from the ideas of addition , multiplication, division and subtraction. However, these operations are not always possible unless number theory admits new kinds of numbers. Hence, negative numbers (2-5, 3-7) as rational fractions are introduced. When mathematicians extended the list of arithmetical operations so as to include root extraction and the solution of equations, they have found these operations are not possible unless we widen our conception of a number, and admit the irrational numbers. Hence, new set of real numbers (including all the rational numbers, the rational fractions, all the irrational numbers and all transcendental numbers as π) with necessary are arising. Because in Relativity theory , Einstein uses notion time as the extraction of the square root of -1((the light – time L = ct and L = yi when yi = cti (i = √ - 1)), Albert Einstein cannot avoid an introduction of complex numbers. Indeed, Einstein invented a kind of complex number *(x + x' + x'') + yi* associated with a displacement, where y√(-1) =ct √(- 1) and, correspondingly, there is such " –t" = R{i×R(x+yi)}. Pure mathematicians may not satisfy this definition of complex number and Einstein's formulation of higher degree equation he uses. Hence, it is quite natural, that in 1968 mathematician Rodger Penrose (1968) developed new twistor algebra as further refinement of Relativity containing basic four- complex – dimensional object (twistor) and where twistor co-ordinates together with their complex conjugates could be used in place of the usual Einstein's x,y,z,t. In fact, what can be written in Minkowsky spacetime can be written in the terms of twistors.

[2] If we can re-write Pythagoras theorem in real numbers, such theorem could be become undistinguishable from Fermat theorem (1637) where the equation $x^n + y^n = z^n$ has only the trivial solutions in integers when n >2 (in other words, when $x^n + y^n = z^n$ is not Pythagoras theorem). In light of Wiles's proof of the Fermat theorem, it is quite natural to make some kind of semiotic experiment and to re-write Fermat theorem in real numbers as it suggested by physicists at FQXI dispute (Popov,2012) Indeed, following result by Marvin Jones and Jeremy Rouse [10] we can re-write Fermat cubic equation in quadratic fields in real numbers (i.e. using such irrational real numbers as √2, etc). In particular , we can find an existence of non-trivial solution of the type

$$(18 + 17 \sqrt{2})^3 + (18 - 17\sqrt{2})^3 = 42^3 ,$$

where *√2 is non-constructible by Euclidean methods irrational number* . Thus, in famous Russell's example, if you can get to the balloon by going $(18 + 17\sqrt{2})^3$ miles east and $(18 - 17\sqrt{2})^3$ miles north , your distance from the balloon in a straight line is 42^3 miles (!). Thus, Einstein's ethnomathematics may admit both very different mathematically Pythagoras theorem as well as the Fermat theorem at the same time in order to calculate a fundamental space-time interval. This means, in particular, that for Relativist ethnomathematics we always are able to re-write such mathematical theorem as Pythagoras theorem "in real numbers", because mathematics is considered as merely language of physics.

[3] Famous Russell book may suggests another fundamental characteristic of Einstein's ethnomathematics. When a particle which moves along a straight line has merely One degree of freedom and its position could be completely fixed by one measurement of position, a locus represented by the equation $Ax+By+Cz+D = 0$ belongs to the second (the straight line (2)) of these two classes of loci. However, when a particle which moves in a plane has already Two degrees of freedom and its position requires the determination of two coordinates (x and y), a locus represented by the equation

$$z = f(x, y)$$

belongs to the first (the plane) of these two classes of loci. As is known, $f(x,y) = 0$ represents the standard form of the equation of a plane curve, and $f(x,y,z) = 0$ is the standard form of equation of a surface. Correspondingly, two equations of the form $z=f(x,y)$ or $f(x,y,z)=0$ belong to the (1) class of loci, and is called a curve.

However, in Einstein's ethnomathematics, two points marked on a rigid body in 3-dimensional space form "an interval" (or a straight line where particle's position can be completely fixed by one physical measurement and a particle has only one degree of freedom).Such sort of the length of straight line or "interval" (which we "always" can put it equal to 1 as unit of length) can be oriented at rest, relatively to our space of reference, in a multiplicity of ways. If the points of this space can be referred to coordinates x, y, and z in such a way that the differences of coordinates, Δx, Δy, Δz of the two ends of the interval furnish the same sum of square $\Delta x^2 +\Delta y^2 + \Delta z^2$ for every orientation of the interval, then the space of reference is called Euclidean (the co - ordinates Cartesians) and, the locus represented by a single equation $s^2 =\Delta x^2 +\Delta y^2 + \Delta z^2$ must belong to the first (plane) of established two classes of loci in space… Thus, in Einstein's ethnomathematics there are no two fundamentally different kinds of loci at all, their fundamental difference is defined as insignificant and a particle's movement along a straight line can be written by "wrong" equation which describes particle movement in a plane .

Unsolved problems inspired by Einstein's ethnomathematics.

There is also historical argument for existence of Einstein's ethnomathematics. It was developed by group of nuclear physicists (1980s -2010s) attempted to refine General Relativity (Einstein's Gravity theory) in the new cultural context. In accordance with A. A. Logunov (2002 :14-16) from Einstein assumption new mysterious consequence for under-standing of the equivalence principle (of inertia and gravitation) in gravitational physics is deduced. Indeed, because " in Special Relativity only such coordinate changes (transformations) are allowed that provide for the quantity dsffl (a fundamental invariant) in the new coordinates having the form of the sum of square differentials of the new coordinates " (Einstein,1930 in A. Logunov's translation), it is possible to suggest, hence, that "The gravitational field "exists" with respect to the system K′ in the same sense as any other physical quantity that can be defined in a certain reference system, even though it does not exist in system K. There is nothing strange, here, and it may be readily demonstrated by the following example taken from classical mechanics. Nobody doubts the “reality”of kinetic energy, since otherwise it would be necessary to renounce energy in general. It is clear, however, that the kinetic energy of bodies depends on the state of motion of the reference system: by an appropriate choice of the latter it is evidently possible to provide for the kinetic energy of uniform motion of a certain body to assume, at a certain moment of time, a given positive or zero value set before hand. In the special case, when all the masses have equal in value and equally oriented velocities, it is possible by an appropriate choice of the reference system to make the total kinetic energy equal to zero. In my opinion the analogy is complete “.(Einstein’s passage in Logunov’s translation)

In other words, similar with Levi-Bruhl’s observer-dependent symbolism in ethnography, by an appropriate choice of the symbolic system of coordinates it is evidently in some uncertain context to reduce gravitational field to zero. Such assumption produced a new alternative theory of gravitation and currently many theorists have been troubled by given consequences of Einstein’s ethnomathematics (Brian Pitts (2013)).

Conclusion

Einstein’s *ethnomathematics* case study may suggest that cross-cultural differences between physical and mathematical research cultures could be essential and some attempts to do “alternative” mathematics in the physical academic context can be correspondingly defined as the new field of *ethnomathematics.*

References

Barton W.D.(1996) Ethnomathematics : Exploring Cutural Diversity in Mathematics. A Thesis. University of Auckland

Popov, M .A. (2012) http://fqxi.org/community/forum/topic/1426 "*Which of Our Basic Mathematical Assumptions in Physics are Wrong ?* " FQXI Essay Contest – Spring .

Russell, B (1925-2007) *ABC of Relativity* .Routledge ,NY & London

Oliverio,P 'Self – Generating Pythagorean Quadruples and N-tuples' *Fib.Quart.***34**, 98-01(1996)

Penrose,R (1968) "Twistor quantisation and curved space-time", *International Journal of Theoretical Physics* (Springer Netherlands) **1**: 61–99, Bibcode 1968IJTP....1...61P, doi:10.1007/BF00668831

Jones, M & Rouse,J , Solutions of the cubic Fermat equation in quadratic fields' - ArXiv : 1211.3610v1 (November 5 2012).

Logunov , A.A. – arXiv gr-qc 0210005v2 : 14-16 (October 21 2002).

Pitts,B "Energy and Change in Langrangian and Hamiltonian of General Relativity"- paper presented at Oxford University Philosophy of Physics seminar at 24.01.2013.