Transactions of the Nigerian Association of Mathematical Physics
Vol. 6 **(Jan., 2018), pp. 377– 381**

In honour of Prof. Ekhaguere at 70

Showing that our time dimension is Euclidean 3-space of another world

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Abstract. An attempt to compose a pair of three-dimensional Euclidean spaces into a singular six-dimensional Euclidean space, leads naturally to the contraction of one of them to a scalar one-dimensional space that lies along the fourth dimension to the other, and conversely. The scalar one-dimensional space is identified as the time dimension. A pair of 'orthogonal' four-dimensional space times, each with pseudo-orthogonal dimensions, of two coexisting worlds emerge.The time dimension of our world is the three-dimensional space of the other world, and conversely.

1. Introduction

Another spacetime that coexists with our spacetime and is placed 'orthogonal' to our spacetime is derived in this article. The other spacetime contains another universe, referred to as time-universe, of separate reality from this universe of ours in our spacetime.

The various conceptions of other universes (or worlds) in physics have been grouped into two categories Linde [1] namely, many different universes described by quantum cosmology, Everett [2], Wheeler [3], DeWitt [4], Page [5], Kent [6] and others, and many different exponentially large parts of the same inflationary universe (or the entire ensemble of innumerable regions of disconnected spacetime), referred to as the multiverse, Linde [1]; Buosso and Susskind [7]; Deutsche [8]; Aguirre and Tegmark [9]; Linde and Vachurin [10] and others.

The many universes constituting the multiverse of the second category in the preceding paragraph do not involve separate spacetimes (or separate realities), but are just disconnected parts of spacetme. Even if the many universes of the first category encompass separate spacetimes, none has been isolated. The isolation of another spacetime containing another universe that coexists with our spacetime containing our universe in this article is, therefore, a novel effort with potential to influence the conception of many universes (or worlds) and to impact research in this area henceforth.

2. Orthogonal Euclidean 3-spaces

Let us start with an operational definition of orthogonal Euclidean 3-spaces. Given a three-dimensional Euclidean space (or a Euclidean 3-space) $\mathbb{E}^{\nVdash}$ with mutually orthogonal straight line dimensions x^1, x^2 and x^3 and another Euclidean 3-space ^{03} with mutually orthogonal straight line dimensions x^{01}, x^{02} and x^{03}, the Euclidean 3-space ^{03} shall be said to be orthogonal to the Euclidean 3-space ^{3} if, and only if, each dimension x^{0j} of ^{03}; $j = 1, 2, 3$, is orthogonal to every dimension x^i; $i = 1, 2, 3$ of ^{3}. In other words, ^{03} shall be said to be orthogonal to ^{3} iff $x^{0j} \perp x^i$; $i, j = 1, 2, 3$, at every point of the Euclidean 6-space generated by the orthogonal Euclidean 3-spaces.

Graphically, let us consider the Euclidean 3-space ^{3} with mutually orthogonal straight line dimensions x^1, x^2 and x^3 as a three-dimensional hyper-surface, to be represented by a horizontal plane surface and the Euclidean 3-space ^{03} with mutually orthogonal straight line dimensions x^{01}, x^{02} and x^{03} as a three-dimensional hyper-surface, to be represented by a vertical plane surface. The union

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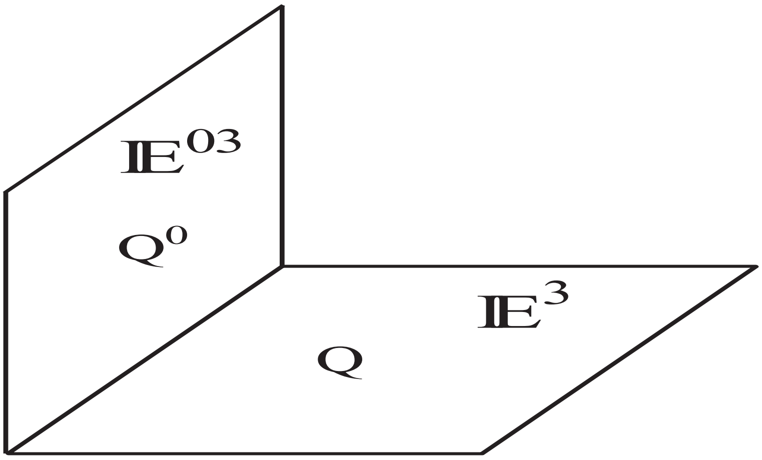

Figure 1. Co-existing two orthogonal Euclidean 3-spaces (considered as hyper-surfaces).

of the two orthogonal Euclidean 3-spaces yields a compound six-dimensional Euclidean space $(^{03},^{3})$ with mutually orthogonal dimensions x^{01}, x^{02}, x^{03}, x^1, x^2 and x^3 illustrated in Fig. 1.

Corresponding to a point Q in the Euclidean 3-space ^{3} is a unique corresponding point Q^0 in the Euclidean 3-space ^{03}. The points Q and Q^0 shall be referred to as symmetry-partner points. There is one-to-one mapping of symmetry-partner points between the two Euclidean 3-spaces.

2.1 *Natural geometrical contraction of the vertical Euclidean 3-space to time dimension relative to 3-observers in the horizontal Euclidean 3-space and conversely*

Let us consider the $xy-$plane of the horizontal Euclidean 3-space ^{3} in Fig. 1. Corresponding to the $xy-$ plane of ^{3} is the x^0y^0-plane of the vertical Euclidean 3-space ^{03}. However since ^{3} and ^{03} are orthogonal Euclidean 3-spaces, following the operational definition of orthogonal Euclidean 3-spaces above, the dimensions x^0 and y^0 of the x^0y^0-plane of ^{03} are both perpendicular to each of the dimensions x and y of ^{3}. Hence x^0 and y^0 are effectively parallel dimensions normal to the $xy-$plane of ^{3}, with respect to 3-observers in ^{3}. (Note that the possibility of either x^0 or y^0 lying along z of ^{3} is ruled out by the definition of orthogonal Euclidean spaces.) Symbolically:

$$x^0 \perp x \text{ and } y^0 \perp x \, ; \;\; x^0 \perp y \text{ and } y^0 \perp y \;\Rightarrow x^0 || y^0 \, . \tag{1}$$

Likewise, corresponding to the $xz-$plane of ^{3} is the x^0z^0-plane of ^{03}. Again the dimensions x^0 and z^0 of the x^0z^0-plane of ^{03} are both perpendicular to each of the dimensions x and z of the $xz-$plane of ^{3}. Hence x^0 and y^0 are effectively parallel dimensions normal to the $xz-$plane of ^{3}, with respect to 3-observers in ^{3}. Symbolically:

$$x^0 \perp x \text{ and } z^0 \perp x \, ; \;\; x^0 \perp z \text{ and } z^0 \perp z \;\Rightarrow x^0 || z^0 \, . \tag{2}$$

Finally, corresponding to the $yz-$plane of ^{3} is the y^0z^0-plane of ^{03}. Again the dimensions y^0 and z^0 of the y^0z^0-plane of ^{03} are both perpendicular to each of the dimensions y and z of the $yz-$plane of ^{3}. Hence y^0 and z^0 are effectively parallel dimensions normal to the $yz-$plane of ^{3}, with respect to 3-observers in ^{3}. Symbolically:

$$y^0 \perp y \text{ and } z^0 \perp y \, ; \;\; y^0 \perp z \text{ and } z^0 \perp z \;\Rightarrow y^0 || z^0 \, . \tag{3}$$

Indeed $x^0||y^0$ and $x^0||z^0$ in (1) and (2) already implies $y^0||z^0$.

The combination of (1), (2) and (3) give $x^0||y^0||z^0$ with respect to 3-observers in ^{3}. This says that the mutually perpendicular dimensions x^0, y^0 and z^0 of the vertical Euclidean 3-space ^{03}, with respect to 3-observers in ^{03}, are effectively parallel dimensions with respect to 3-observers in the horizontal Euclidean 3-space ^{3} in Fig. 1.

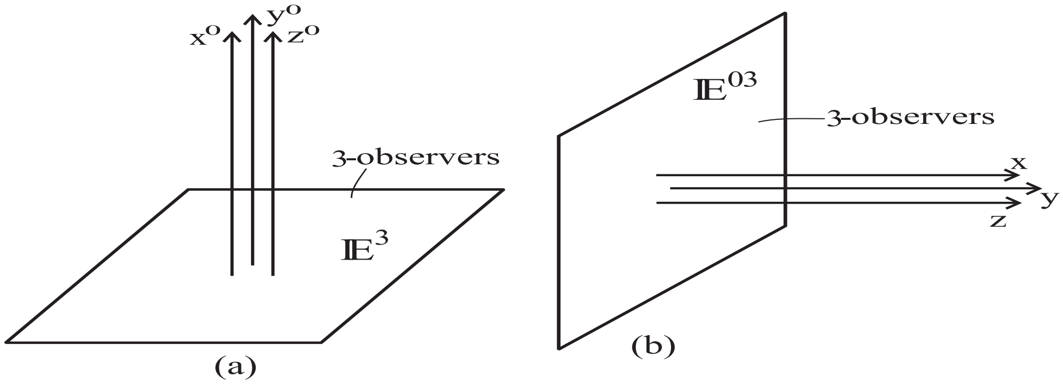

Figure 2. Geometrical "bundling' of the mutually orthogonal dimensions of a Euclidean 3-space into parallel dimensions relative to observers in another Euclidean 3-space orthogonal to it.

The dimensions x^0, y^0 and z^0 of ^{03} shall temporarily be considered to constitute a "bundle", which is perpendicular to each of the dimensions x, y and z of ^{3}, with respect to 3-observers in ^{3} in Fig. 1. This "bundle" must lie along a fourth dimension with respect to 3-observers in ^{3} consequently, as illustrated in Fig. 2a. The horizontal Euclidean 3-space ^{3} is yet considered as a three-dimensional hyper-surface in Fig. 2a.

Conversely, the mutually perpendicular dimensions x, y and z of the horizontal Euclidean 3-space ^{3} with respect to 3-observers in it are effectively parallel dimensions with respect to 3-observers in the vertical Euclidean 3-space ^{03} in Fig. 1. Again the dimensions x, y and z of ^{3} shall temporarily be considered to constitute a "bundle", which is perpendicular to each of the dimensions x^0, y^0 and z^0 of ^{03}, with respect to 3-observers in ^{03} in Fig. 1. The "bundle" of x, y and z must lie along a fourth dimension with respect to 3-observers in ^{03} consequently, as illustrated in Fig. 2b.

The three dimensions x^0, y^0 and z^0 that are shown as separated parallel dimensions, thereby constituting a 'bundle' along the vertical with respect to 3-observers in ^{3} in Fig. 2a, are not actually separated. Rather they lie along the singular fourth dimension, thereby constituting a one-dimensional space to be denoted by ρ^0, with respect to 3-observers in ^{3} in Fig. 2a. Likewise the "bundle" of parallel dimensions x, y and z effectively constitutes a one-dimensional space, to be denoted by ρ, with respect to 3-observers in ^{03} in Fig. 2b.

Thus Fig. 2a shall be replaced with the temporary Fig. 3a, which is valid with respect to 3-observers in the Euclidean 3-space ^{3}, while Fig. 2b shall be replaced with the temporary Fig. 3b, which is valid with respect to 3-observers in the Euclidean 3-space ^{03}. Representation of the Euclidean 3-spaces ^{3} and ^{03} (considered as three-dimensional hyper-surfaces), by plane surfaces in Fig. 1 and Figs. 2a and 2b, has been changed to representation by lines in Figs. 3a and 3b, in line with the practice in the Minkowski diagram.

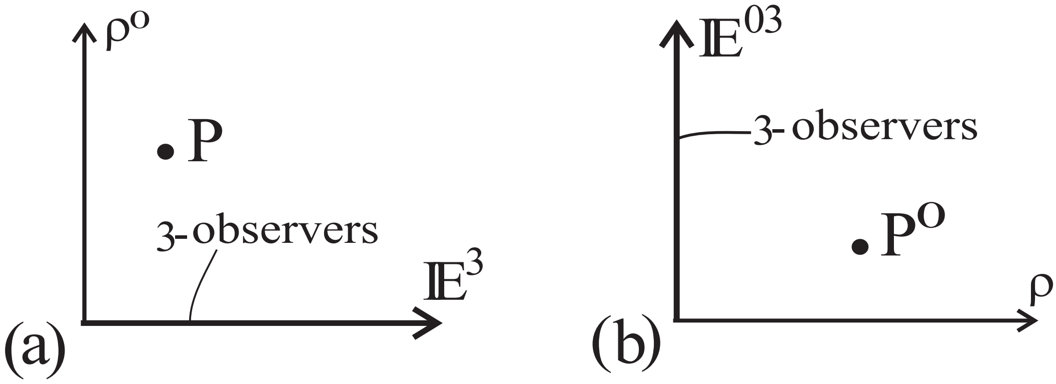

Figure 3. (a) The "bundles" of parallel space dimensions in Figs. 2a and 2b are effectively one-dimensional scalar spaces relative to the respective 3-observers.

The point P in Fig. 3a possesses coordinates (x^0, x^1, x^2, x^3), where x^0 is coordinate along the one-dimensional space ρ^0 along the vertical. The symmetry-partner point P^0 in Fig. 3b possesses coordinates (x, x^{01}, x^{02}, x^{03}), where x is coordinate along the one-dimensional space ρ along the horizontal.

Now x^0 in the familiar spacetime coordinate notation (x^0, x^1, x^2, x^3) in the theories of relativity is the time coordinate, that is, $x^0 = ct$, as known. Since, indeed, ρ^0 lies along the fourth dimension normal to the Euclidean 3-space ^{3} (as three-dimensional hyper-surface along the horizontal), it has to be the fourth time dimension with respect to 3-observers in ^{3} in Fig. 3a. The x in the coordinates (x, x^{01}, x^{02}, x^{03}) of point P^0 in Fig. 3b is likewise time coordinate. That is, $x = ct^0$ relative to 3-observers in the Euclidean 3-space ^{03} in Fig. 3b.

The one-dimensional spaces ρ^0 and ρ shall be replaced with the time dimensions ct and ct^0 respectively in Figs. 3a and 3b, by virtue of the preceding paragraph, to have the final Figs. 4a and 4b.

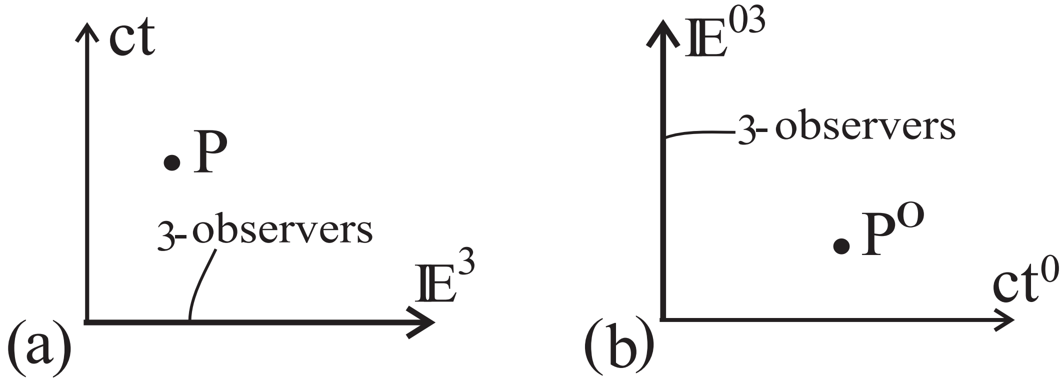

Figure 4. (a) The scalar one dimensional spaces along the fourth dimensions along the vertical in Fg. 3a and horizontal in Fig. 3b are time dimensions relative to the respective 3-observers.

The flat four-dimensional spacetime (the Minkowski space) of Fig. 4a is our spacetime, as known. Our vast universe is located in this spacetime. The flat four-dimensional spacetime of Fig. 4b, isolated in this article, is the spacetime of another universe. The other universe cannot be perceived better than the time dimension ct of our universe by observers in our universe. It shall be referred to as time-universe.

As follows from the derivations in this article, and as can be read off from Figs. 4a and 4b, the time dimension ct of our universe is the three-dimensional space ^{03} of the time-universe and the time dimension ct^0 of the time-universe is the three-dimensional space ^{3} of our universe. Should you make transition into the time dimension ct of our universe, you would find yourself living in the Euclidean 3-space ^{03} of the time-universe.

Many-world interpretation (MWI) of the natural laws (laws of physics) has been found a highly promising platform for the unification of the laws in an effort that has been ongoing for some years. Apart from our universe and the time-universe above, several other universes in different spacetime domains have been isolated in the ongoing effort.

The isolation of the first four universes (our universe, time-universe, negative universe and negative time-universe) and the formulation of complete theory of gravitation and of unification of gravity, dynamics, electromagnetism and propagation of light satisfactorily, in the pertinent four-world picture, are contained in [11, 12, 13, 14], as well as volume one of the monograph series dedicated to the ongoing work [15] and a book announcing the work [16].

Acknowledgement

Grateful acknowledgement is made to Professor G. O. S. Ekhaguere for his ever ready attention with interest to my discussions with him at the early stage of my independent work, during 1992 – 1995 when I was a member of the academic staff of Mathematics Department, and for his friendly disposition and help to me since then.

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