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Re-interpretation of the Two-World Background of Special Relativity as Four-World Background II

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Authors contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Coexisting four universes in separate four-dimensional spacetimes constitute four-world background for the special theory of relativity (SR) in each universe, as developed in previous papers. The fact that the four universes exhibit perfect symmetry of state and perfect symmetry of natural laws is shown in this paper. The many universes concept involved is entitled compartment universes. Compartment universes are coexisting symmetrical universes in different four-dimensional spacetimes of identical extents. Material particles and bodies are symmetrically distributed in spacetimes and the same natural laws take on identical forms in compartment universes. These features differentiate the compartment universes concept from the multiverse of inflationary cosmology and the parallel branes of M-theory. The compartment universes concept opens new vista for many-world interpretations of the natural laws, as demonstrated for the special theory of relativity already, and it is a potential platform for the uniform formulation of the natural laws. Investigation of the possible existence of larger number of compartment universes than four and many-world interpretations of gravitation and other natural laws in the compartment universes picture are recommended.

Keywords: Two-world picture; four-world picture; four symmetrical universes; symmetry of state; symmetry of natural laws; compartment universes.

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1 INTRODUCTION

The two-world background of the special theory of relativity (SR), demonstrated by reformulating the theory on a two-world background in two papers [1, 2], is re-interpreted as four-world background in the first part of this paper [3], in which it is concluded that SR definitely rests on a four-world background. The new affine spacetime/intrinsic affine spacetime geometrical representations of Lorentz transformation (LT) and intrinsic Lorentz transformation (∅LT) and their inverses, comprising of four diagrams, developed in the two-world picture in [1], is shown to be rooted in the four-world picture in [3]. Two issues about the new geometry that cannot be explained within the two-world picture in [1] are explained in the four-world picture in [3].

What is left to be done in order to describe the coexisting four universes in separate spacetimes of the four-world picture as symmetrical universes, as remarked under the Conclusion of [3], is the demonstration of perfect symmetry of state and perfect symmetry of natural laws among the four universes. This is the purpose of this this paper. The previous three papers [1, 2, 3] and this fourth paper are meant to be read sequentially in the order in which they have been written. An initial less developed form of this paper has appeared as part of [4]. The unpublished initial states of a part of this paper and other unpublished papers on effort to subsume the theory of gravitation into the four-world picture had also been lodged with the viXra electronic archive (https://vixra.org) in 2010 through 2012.[1]

Extensive discussion of the various conceptions of many worlds (or universes) in physics in the more recent time, to which the compartment universes concept of the previous papers [1, 2, 3] and this paper is a new addition, have been done under the Introduction of [1]. They are the multiverse of inflationary cosmology (Linde and Vachurin [5]; Buosso and Susskind [6]; Aguirre and Tegmark [7]) and the brane worlds of M-theory (Maartens and Koyamme [8]), (Brax and Bruck [9]).

A distinguishing feature of the multiverse of inflationary cosmology and the compartment universes concept of the present papers is that, the multiverse is an assemblage of innumerable exponentially large disconnected regions of the universe (or spacetime), which accommodate different natural laws [10], whereas the symmetrical universes of the compartment universes concept exist in different four-dimensional spacetimes of identical extents and accommodate the same natural laws. The brane worlds of M-theory are likewise different from the compartment universes of the present papers, because they (the branes) can have different number of dimensions of different extents and accommodate different natural laws.

2 VALIDATING PERFECT SYMMETRY OF STATE AMONG THE FOUR UNIVERSES ISOLATED

Perfect symmetry of state will exist among the four universes if, apart from their different signs, the masses of the four members of every quartet of symmetry-partner particles and bodies in the four universes have identical magnitudes, identical shapes and identical sizes, and if they perform identical (or symmetrical) relative motions in their respective universes at all times. Identical magnitudes, identical shapes and identical sizes of masses of the members of every quartet of symmetry-partner bodies will guarantee symmetry of gravitational fields in the four universes. These conditions shall be shown to be met, leading to the conclusion of perfect symmetry of state among the four universes in this section.

[1] My name appears in its former form: A. O. J. Adekugbe and Akindele J. Adekugbe, as author's name, on the papers in the archive (https://vixra.org/abs/1002.0034; 1011.0011; 1101.0020; 1101.0021, etc.).

2.1 Identical Magnitudes of Masses and Intrinsic Masses of the Members of every Quartet of Symmetry-partner Particles and Bodies in the Four Universes

Although the equality of the rest mass m_0 of a particle in the proper Euclidean 3-space Σ' of our universe and the rest mass m_0^0 of the symmetry-partner particle in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe has been inferred in the third paragraph to the end of sub-section 2.1 of [3], this shall be done generally for the members of every quartet of symmetry-partner particles and bodies in the four universes in this sub-section. As illustrated in Fig. 12a of [3], reproduced as Fig. 1a of this paper, the one-dimensional intrinsic rest mass (or classical nomass) $\varnothing m_0$ in the one-dimensional isotropic proper (or classical) intrinsic space (or proper nospace) $\varnothing\rho'$, lies directly underneath (or is embedded in) the three-dimensional rest mass m_0 in the proper Euclidean 3-space Σ' of the positive (or our) universe, with respect to 3-observers in Σ'. Likewise the one-dimensional intrinsic rest mass $\varnothing m_0^0$ in the one-dimensional isotropic proper intrinsic space $\varnothing\rho^{0\prime}$, lies directly underneath (or is embedded in) the three-dimensional rest mass m_0^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe, with respect to 3-observers^0 in $\Sigma^{0\prime}$ in Fig. 12b of [3], reproduced as Fig. 1b of this paper.

As uniformly done in the previous papers [1, 2, 3] and as shall be done in this paper, the terms, "three-dimensional mass", "one-dimensional mass", "four-dimensional mass" and "one-dimensional intrinsic mass", are used to mean mass in three-dimensional space, mass in time-dimension, mass in four-dimensional spacetime and intrinsic mass in one-dimensional intrinsic space respectively.

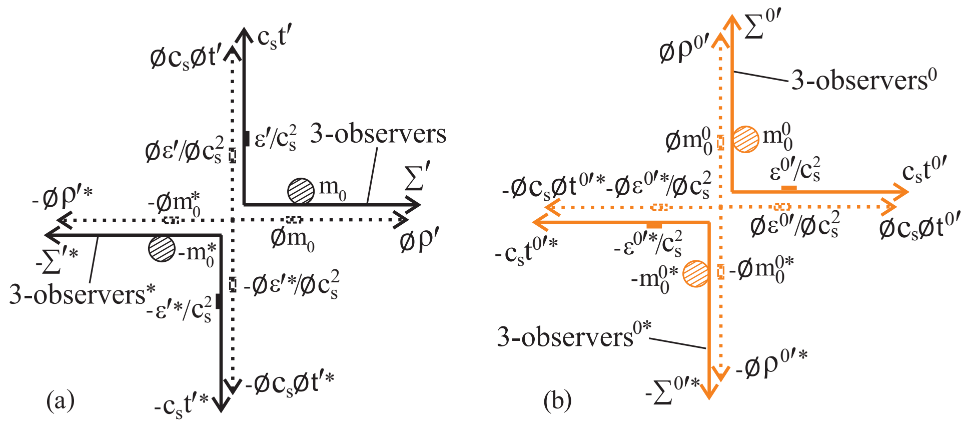

Fig. 1. Flat two-dimensional proper intrinsic metric spacetime containing two-dimensional intrinsic rest mass of a particle or object embedded in (or 'underlying') the flat four-dimensional proper metric spacetime containing the four-dimensional rest mass of the particle or object (a) in our universe and the negative universe and (b) in the positive time-universe and the negative time-universe (Figs. 12a and 12b of [3])

Now the fact that the three-dimensional rest mass m_0 is the outward (or physical) manifestation, in the proper physical Euclidean 3-space Σ', of the one-dimensional intrinsic rest mass $\varnothing m_0$ in the one-dimensional proper intrinsic space $\varnothing\rho'$ in Fig. 1a, implies that m_0 and $\varnothing m_0$ are equal in magnitude, that is, $m_0 = |\varnothing m_0|$.

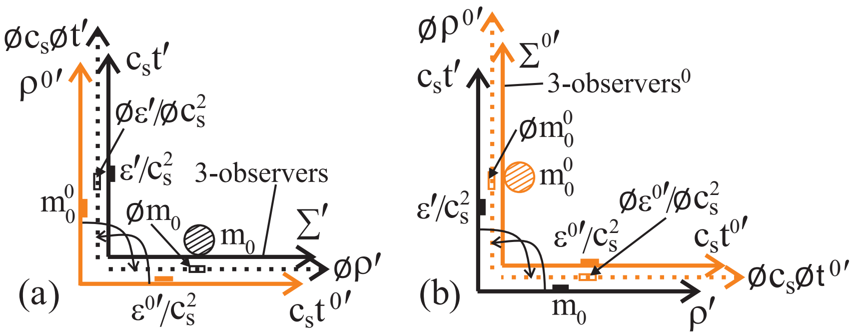

Fig. 2. (a) Two-dimensional rest mass $(m_0^0, \varepsilon^{0\prime}/c_s^2)$ of a particle on the flat two-dimensional proper metric spacetime $(\rho^{0\prime}, c_s t^{0\prime})$ of the positive time-universe, with respect to 3-observers in the proper Euclidean 3-space of our universe, forms two-dimensional intrinsic rest mass $(\varnothing m_0, \varepsilon'/c_s^2)$ in the projective two-dimensional proper intrinsic metric spacetime $(\varnothing\rho', \varnothing c_s \varnothing t')$ underneath (or that is embedded in) the flat four-dimensional rest mass of the symmetry-partner particle in the flat four-dimensional proper metric spacetime our universe and, (b) conversely (Figs. 11a and 11b of [3]).

Also the one-dimensional intrinsic rest mass $\varnothing m_0$ in $\varnothing\rho'$ along the horizontal is equal in magnitude to the one-dimensional rest mass m_0^0 in the scalar one-dimensional proper space $\rho^{0\prime}$ along the vertical, which forms (or effectively 'projects') $\varnothing m_0$ in $\varnothing\rho'$ along the horizontal in Fig. 11a of [3], reproduced as Fig. 2a of this paper, as derived in sub-section 3.1 of [3]. That is, $m_0^0 = |\varnothing m_0|$.

By combining $m_0 = |\varnothing m_0|$ arrived at in the penultimate paragraph with $m_0^0 = |\varnothing m_0|$ arrived at in the preceding paragraph, we have the equality in magnitude of the three-dimensional rest mass m_0 of a particle or body in our proper Euclidean 3-space Σ' and the one-dimensional rest mass m_0^0 of the symmetry-partner particle or object in the one-dimensional scalar proper metric space $\rho^{0\prime}$ of the positive time-universe, with respect to 3-observers in Σ' in Fig. 2a. That is, $m_0 = m_0^0$.

Finally the one-dimensional rest mass m_0^0 of a particle or body in the one-dimensional scalar proper space $\rho^{0\prime}$ along the vertical, with respect to 3-observers in our proper Euclidean 3-space Σ' in Fig. 2a, is what 3-observers^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe observe as three-dimensional rest mass m_0^0 of the particle or body in $\Sigma^{0\prime}$ in Fig. 2b. Consequently the one-dimensional rest mass m_0^0 of the particle or body in $\rho^{0\prime}$ in Fig. 2a is equal in magnitude to the three-dimensional rest mass m_0^0 of the particle or body in the proper Euclidean 3-space $\Sigma^{0\prime}$ in Fig. 2b. This is certainly so since the geometrical contraction of the Euclidean 3-space $\Sigma^{0\prime}$ to one-dimensional space $\rho^{0\prime}$ and the consequent geometrical contraction of the three-dimensional rest mass m_0^0 in $\Sigma^{0\prime}$ to one-dimensional rest mass m_0^0 in $\rho^{0\prime}$, with respect to 3-observers in our Euclidean 3-space Σ', does not alter the magnitude of the rest mass.

In summary, we have derived the relations, $m_0 = |\varnothing m_0|$ and $m_0^0 = |\varnothing m_0|$, from which we have, $m_0 = m_0^0$, in the above. Also since m_0^0 in $\Sigma^{0\prime}$ is the outward manifestation of $\varnothing m_0^0$ in $\varnothing\rho^{0\prime}$ in Fig. 1b, we have the equality in magnitude of m_0^0 and $\varnothing m_0^0$, that is, $m_0^0 = |\varnothing m_0^0|$, which, along with $m_0^0 = |\varnothing m_0|$ derived above gives, $\varnothing m_0^0 = \varnothing m_0$.

The conclusion then is that the rest mass m_0 of a particle or body in the proper Euclidean 3-space Σ' of our (or positive) universe, with respect to 3-observers in Σ', is equal in magnitude to the rest mass m_0^0 of the symmetry-partner particle or body in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe, with respect to 3-observers^0 in $\Sigma^{0\prime}$. The one-dimensional intrinsic rest mass $\varnothing m_0$ of the particle or object in our proper intrinsic space $\varnothing\rho'$ underlying m_0 in Σ' in Fig. 1a, is equal in magnitude to the intrinsic rest mass $\varnothing m_0^0$ of the symmetry-partner particle or object in the proper intrinsic space $\varnothing\rho^{0\prime}$ underlying m_0^0 in $\Sigma^{0\prime}$ in Fig. 1b.

By repeating the derivations done between the positive (or our) universe and the positive time-universe, which lead to the conclusion reached in the preceding paragraph, between the negative universe and the negative time-universe (which shall not be repeated in order to conserve space), we are also led to the conclusion that the rest mass $-m_0^*$ of a particle or object in the proper Euclidean 3-space $-\Sigma'^*$ of the negative universe, with respect to 3-observers in $-\Sigma'^*$, is equal in magnitude to the rest mass $-m_0^{0*}$ of the symmetry-partner particle or body in the proper Euclidean 3-space $-\Sigma^{0\prime*}$ of the negative time-universe, with respect to 3-observers^0 in $-\Sigma^{0\prime*}$. The one-dimensional intrinsic rest mass $-\varnothing m_0^*$ of the particle or body in the proper intrinsic space $-\varnothing\rho'^*$ underlying $-m_0^*$ in $-\Sigma'^*$ of the negative universe, is equal in magnitude to the intrinsic rest mass $-\varnothing m_0^{0*}$ of the symmetry-partner particle or body in the proper intrinsic space $-\varnothing\rho^{0\prime*}$ underlying $-m_0^{0*}$ in $-\Sigma^{0\prime*}$ in the negative time-universe.

The perfect symmetry of state between the positive (or our) universe and the negative universe prescribed in [1], implies that the rest mass m_0 of a particle or body in the proper Euclidean 3-space Σ' of the positive (or our) universe, is identical in magnitude, size and shape to the rest mass $-m_0^*$ of the symmetry-partner particle or body in the proper Euclidean 3-space $-\Sigma'^*$ of the negative universe, that is, $m_0 = |-m_0^*|$. Otherwise there cannot be symmetry of gravitational fields and, consequently, there cannot be symmetry of geometry of spacetime between our universe and the negative universe, which are prescribed in [1]. The corresponding prescribed perfect symmetry of state between the positive time-universe and the negative time-universe, likewise implies that the rest mass m_0^0 of a particle or object in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe is identical in magnitude, size and shape to the rest mass$-m_0^{0*}$ of its symmetry-partner in the proper Euclidean 3-space $-\Sigma^{0\prime*}$ of the negative time-universe, that is, $m_0^0 = |-m_0^{0*}|$.

By combining the equality of magnitudes of the symmetry-partner rest masses, $m_0 = |-m_0^*|$, which follows from the prescribed perfect symmetry of state between the positive (or our) universe and the negative universe and, $m_0^0 = |-m_0^{0*}|$, which follows from the corresponding prescribed perfect symmetry of state between the positive time-universe and the negative time-universe in the preceding paragraph, with $m_0 = m_0^0$ and hence, $-m_0^* = -m_0^{0*}$, derived earlier, we obtain the equality in magnitude of the rest masses of the four symmetry-partner particles or bodies in the four universes, that is, $m_0 = |-m_0^*| = m_0^0 = |-m_0^{0*}|$. Consequently there is equality in magnitude of the intrinsic rest masses in the one-dimensional intrinsic metric spaces of the quartet of symmetry-partner particles or bodies in the four universes, that is, $|\varnothing m_0| = |-\varnothing m_0^*| = |\varnothing m_0^0| = |-\varnothing m_0^{0*}|$.

2.2 Identical Shapes and Sizes of the Members of every Quartet of Symmetry-partner Particles and Objects in the Four Universes

Having demonstrated the equality of magnitudes of the three-dimensional rest masses of the members of every quartet of symmetry-partner particles or bodies in the four universes (to the extent that the prescribed, $m_0 = |-m_0^*|$, between the positive (or our) universe and the negative universe and, $m_0^0 = |-m_0^{0*}|$, between the positive time-universe and the negative time-universe are valid), let us also show their identical shapes and sizes.

Now the rest mass m_0 being the outward manifestation in our proper Euclidean 3-space Σ' of the intrinsic rest mass $\varnothing m_0$ of intrinsic length $\Delta\varnothing\rho'$ in the one-dimensional proper intrinsic space $\varnothing\rho'$, and the three-dimensional rest mass m_0^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$, with respect to 3-observers in $\Sigma^{0\prime}$, being what geometrically contracts to the one-dimensional rest mass m_0^0 of length $\Delta\rho^{0\prime}$ in $\rho^{0\prime}$, with respect to 3-observers in our Euclidean 3-space Σ' in Figs. 2a and 2b and, since $\Delta\rho^{0\prime}$ containing m_0^0 in $\rho^{0\prime}$ along the vertical projects $\Delta\varnothing\rho'$ containing $\varnothing m_0$ 'underneath' Σ' along the horizontal, then the length $\Delta\rho^{0\prime}$ of the one-dimensional rest mass m_0^0 in $\rho^{0\prime}$ has the same magnitude as the intrinsic length $\Delta\varnothing\rho'$ of the intrinsic rest mass $\varnothing m_0$ it projects into $\varnothing\rho'$ in Fig. 2a, that is, $\Delta\rho^{0\prime} = |\Delta\varnothing\rho'|$.

Moreover the length $\Delta\rho^{0\prime}$ along $\rho^{0\prime}$, with respect to 3-observers Σ', corresponds to a volume $\Delta\Sigma^{0\prime}$ of $\Sigma^{0\prime}$, with respect to 3-observers in $\Sigma^{0\prime}$. Also $\Delta\varnothing\rho'$ along $\varnothing\rho'$ is made manifested in a volume $\Delta\Sigma'$ of Σ', with respect to 3-observers in Σ'. The equality of $\Delta\rho^{0\prime}$ and $|\Delta\varnothing\rho'|$ concluded in the preceding paragraph then implies that the volume $\Delta\Sigma^{0\prime}$ of the Euclidean 3-space $\Sigma^{0\prime}$ occupied by the three-dimensional rest mass m_0^0, with respect to 3-observers in $\Sigma^{0\prime}$, is equal to the volume $\Delta\Sigma'$ of the Euclidean 3-space Σ' occupied by the rest mass m_0, with respect to 3-observers in Σ'. In other words, the rest mass m_0 in Σ' has the same size (or volume) as its symmetry-partner m_0^0 in $\Sigma^{0\prime}$.

Further more, the shape of the outward manifestation in the proper Euclidean 3-space Σ' of $\varnothing m_0$ in $\varnothing\rho'$, that is, the shape of m_0 in Σ', with respect to 3-observers in Σ', is the same as the shape of the three-dimensional rest mass m_0^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$, with respect to 3-observers in $\Sigma^{0\prime}$. In providing justification for this, let us recall the discussion leading to Fig. 6a and 6b of [1], reproduced as Figs. 3a and 3b of this paper that, the intrinsic rest masses $\varnothing m_0$ of particles and bodies, which appear as lines of intrinsic rest masses along the one-dimensional isotropic proper intrinsic space $\varnothing\rho'$ relative to 3-observers in the proper Euclidean 3-space Σ', as illustrated for a few objects in Fig. 3a, are actually three-dimensional intrinsic rest masses in three-dimensional proper intrinsic space $\varnothing\Sigma'$, with respect to three-dimensional 'intrinsic-rest-mass-observers' (or 'intrinsic 3-observers') in $\varnothing\Sigma'$, as also illustrated for a few objects in Fig. 3b.

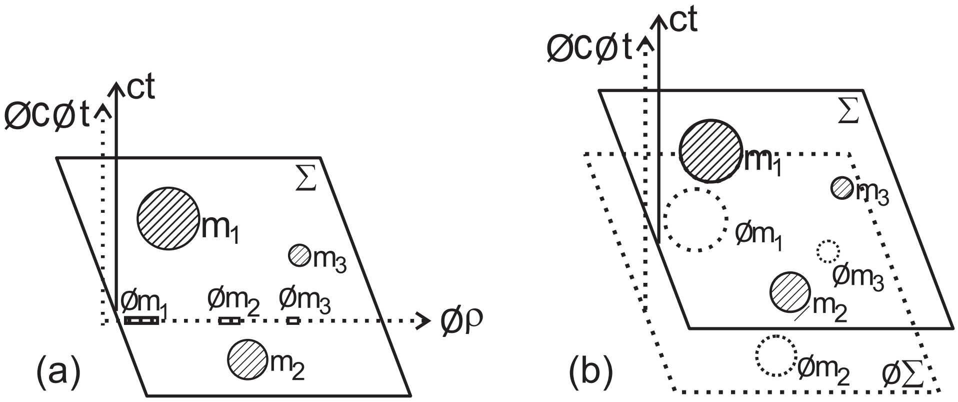

Fig. 3. (a) The flat 4-dimensional spacetime and its underlying flat 2-dimensional intrinsic spacetime with the inertial masses of three objects scattered in the Euclidean 3-space and their one-dimensional intrinsic inertial masses aligned along the one-dimensional isotropic intrinsic space with respect to observers in spacetime. (b) The flat 2-dimensional intrinsic spacetime with respect to observers in spacetime in (a) is a flat four-dimensional intrinsic spacetime containing 3-dimensional intrinsic inertial masses of particles and objects in 3-dimensional intrinsic space with respect to intrinsic-mass-observers in intrinsic spacetime (Figs. 6a and 6b of[1]).

The shape of the three-dimensional intrinsic rest mass $\varnothing m_0$ of a particle or body in the three-dimensional intrinsic space $\varnothing\Sigma'$, with respect to 'intrinsic 3-observers' in $\varnothing\Sigma'$, is the same as the shape of its outward manifestation in the proper Euclidean 3-space Σ', that is, the same as the shape of the rest mass m_0 in Σ', with respect to 3-observers in Σ'.

Since the line of intrinsic rest mass $\varnothing m_0$ in one-dimensional proper intrinsic space $\varnothing\rho'$, relative to 3-observers in Σ' (which is a three-dimensional intrinsic rest mass $\varnothing m_0$ in the three-dimensional proper intrinsic space $\varnothing\Sigma'$ with respect to 'intrinsic 3-observers' in $\varnothing\Sigma'$), is the effective 'projection' into $\varnothing\rho'$ along the horizontal of the line of rest mass m_0^0 in the one-dimensional proper space $\rho^{0\prime}$ along the vertical, relative to 3-observers in our proper Euclidean 3-space Σ' in Fig. 2a (where m_0^0 in $\rho^{0\prime}$ in Fig. 2a is a 3-dimensional rest mass m_0^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe with respect to 3-observers^0 in $\Sigma^{0\prime}$ in Fig. 2b), it follows that the shape of the three-dimensional intrinsic rest mass $\varnothing m_0$ in $\varnothing\Sigma'$, with respect to 'intrinsic 3-observers' in $\varnothing\Sigma'$, is the same as the shape of the three-dimensional rest mass m_0^0 in $\Sigma^{0\prime}$, with respect to 3-observers in $\Sigma^{0\prime}$. It then follows from this and the conclusion (that the shape of $\varnothing m_0$ in $\varnothing\Sigma'$ is the same as the shape of m_0 in Σ'), reached in the preceding two paragraphs that, the shapes of the rest masses m_0 in our proper Euclidean 3-space Σ' and m_0^0 in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe are the same.

The identical sizes and shapes of the rest mass m_0 of a particle or body in the proper Euclidean 3-space Σ' of our universe and of the rest mass m_0^0 of its symmetry-partner in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe, concluded in the preceding paragraph, is equally true between the rest mass $-m_0^*$ in the Euclidean 3-space $-\Sigma'^*$ of the negative universe and its symmetry-partner $-m_0^{0*}$ in the Euclidean 3-space $-\Sigma^{0\prime*}$ of the negative time-universe.

When the preceding paragraph is combined with the identical shapes and sizes of the rest mass m_0 of a particle or body in the proper Euclidean 3-space Σ' of the positive (or our) universe and of the rest mass $-m_0^*$ of its symmetry-partner in the proper Euclidean 3-space $-\Sigma'^*$ of the negative universe, which the prescribed perfect symmetry of state between our universe and the negative universe implies, as well as the identical shapes and sizes of the rest mass m_0^0 of a particle or body in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe and of the rest mass $-m_0^{0*}$ of its symmetry-partner in the proper Euclidean 3-space $-\Sigma^{0\prime*}$ of the negative time-universe, which the prescribed perfect symmetry of state between the positive time-universe and the negative time-universe implies, we have the identical shapes and sizes of the four members of a quartet of symmetry-partner particles or bodies in the Euclidean 3-spaces in the four universes, and this is true for every such quartet of symmetry-partner particles or bodies in the four universes.

The identical magnitudes, shapes and sizes of the members of every quartet of symmetry-partner bodies in the four universes, implies that they give rise to identical symmetry-partner gravitational fields in their respective universes. Since symmetry-partner particles and bodies are located at symmetry-partner points in spacetimes in the four universes, it follows that gravitational fields are symmetrically located in spacetimes within the universes.

This fact shall be shown to imply local Lorentz invariance (LLI) within gravitational fields in each universe elsewhere. Since perfect symmetry of gravitational fields among the four universes requires that the members of every quartet of symmetry-partner gravitational field sources in the four universes have same magnitude of masses, same sizes and same shapes, the symmetry of gravitational fields among the four universes (or the validity of LLI), implies the validity of the prescribed symmetry of state between our universe and the negative universe and between the positive time-universe and the negative time-universe, as shall be shown elsewhere.

2.3 Perfect Symmetry of Relative Motions among the Members of every Quartet of Symmetry-Partner Particles or Bodies in the four Universes Always

As mentioned at the beginning of this section, the second condition that must be met for symmetry of state to obtain among the four universes isolated in previous articles [1, 2, 3], whose proper metric spacetimes and proper intrinsic metric spacetimes are illustrated in Figs. 12a and 12b of [3], reproduced as Figs. 1a and 1b of this paper namely, the positive (or our) universe, the negative universe, the positive time-universe and the negative time-universe is that, the members of every quartet of symmetry-partner particles or bodies in the four universes, shown to have identical magnitudes of masses, identical sizes and identical shapes in the preceding sub-section, are involved in identical motions relative to identical symmetry-partner observers or frames of reference in their respective universes at all times. The *reductio ad absurdum* method of proof shall be applied to show that this second condition is also met. We shall assume that the quartet of symmetry-partner particles or bodies in the four universes are not involved in identical relative motions and show that this leads to violation of Lorentz invariance in each universe.

Let us start with the assumption that the members of a quartet of symmetry-partner particles or bodies in the four universes are in arbitrary motions at different speeds relative to the symmetry-partner observers or frames of reference in their respective universes at every given moment. This assumption implies that, given an object on earth in our universe in motion at a speed v_x^+ along the north pole of the earth, say, relative to our earth at a given instant, then its symmetry-partner on earth in the negative universe is in motion at a speed v_x^-, say, along the north pole relative to the earth of the negative universe at the same instant; the symmetry-partner object on earth in the positive time-universe is in motion at a speed $v_{x^0}^+$, say, along the north pole relative to the earth of the positive time-universe, at the same instant and the symmetry-partner object on earth in the negative time-universe is in motion at a speed $v_{x^0}^-$, say, along the north pole relative to the earth of the negative time-universe, at the same instant, where it is being assumed that the speeds, v_x^+, v_x^-, $v_{x^0}^+$ and $v_{x^0}^-$, have different magnitudes and each can take on arbitrary values lower than c, including zero. They may as well be assumed to be moving along arbitrary directions on earths in their respective universes.

The geometrical implication of the assumption made in the preceding paragraph is that the equal intrinsic angle $\varnothing\psi$ of relative rotations of intrinsic affine space and intrinsic affine time coordinates in the four quadrants of the hyper-plane of the larger spacetime of combined positive (or our) universe and the negative universe, drawn upon the reference proper metric spacetimes and intrinsic metric spacetimes of the positive (or our) universe and the negative universe in Fig. 1a of this article, as Fig. 8a of [1] reproduced as Fig. 4 of this article, will take on different values, $\varnothing\psi_x^+$, $\varnothing\psi_x^-$, $\varnothing\psi_t^+$ and $\varnothing\psi_t^-$, as illustrated in Fig. 5a.

Only the inclined primed intrinsic affine spacetime coordinates, their projective flat unprimed intrinsic affine spacetime coordinates and the outward manifestations of the latter namely, the unprimed four-dimensional affine spacetimes, $(\tilde{\Sigma}, c_s\tilde{t})$ and $(-\tilde{\Sigma}^*, -c_s\tilde{t}^*)$, of our universe and the negative universe are shown in Fig. 5a. The flat four-dimensional proper metric spacetimes, $(\Sigma', c_s t')$ and $(-\Sigma'^*, -c_s t'^*)$, in which the 'stationary' observers are located, and their underlying two-dimensional proper intrinsic metric spacetimes, $(\varnothing\rho', \varnothing c_s\varnothing t')$ and $(-\varnothing\rho'^*, -\varnothing c_s\varnothing t'^*)$, are not shown in Fig. 5a for convenience. The proper metric spacetimes and underlying proper intrinsic metric spacetimes are shown in Fig. 8a of [1], reproduced as Fig. 4 of this article for the normal situation, $\varnothing\psi_x^+ = \varnothing\psi_x^- = \varnothing\psi_t^+ = \varnothing\psi_t^-$.

The rotations of the primed intrinsic affine space coordinate $\varnothing\tilde{x}'$ by intrinsic angle $\varnothing\psi_x^+$ relative to the unprimed intrinsic affine space coordinate $\varnothing\tilde{x}$ along the horizontal in the first quadrant and the rotation of the primed intrinsic affine time coordinate $\varnothing c_s\varnothing\tilde{t}'$ by intrinsic angle $\varnothing\psi_t^+$ relative to the unprimed intrinsic affine time coordinate $\varnothing c_s\varnothing\tilde{t}$ along the vertical in the second quadrant in Fig. 5a, are valid with respect to the 'stationary' 3-observer in the proper Euclidean 3-space Σ' (not shown in that figure) where, $\sin\varnothing\psi_x^+ = \varnothing v_x^+/\varnothing c$ and $\sin\varnothing\psi_t^+ = \varnothing v_t^+/\varnothing c$, have been derived in [1].

The rotation of $-\varnothing\tilde{x}'^*$ by intrinsic angle $\varnothing\psi_x^-$ relative to $-\varnothing\tilde{x}^*$ along the horizontal in the third quadrant and the rotation of $-\varnothing c_s\varnothing\tilde{t}'^*$ by intrinsic angle $\varnothing\psi_t^-$ relative to $-\varnothing c_s\varnothing\tilde{t}^*$ along the vertical in the fourth quadrant in Fig. 5a, are valid with respect to the 'stationary' 3-observer* in the proper Euclidean metric 3-space $-\Sigma'^*$ (also not shown) where, $\sin\varnothing\psi_x^- = \varnothing v_x^-/\varnothing c$ and $\sin\varnothing\psi_t^- = \varnothing v_t^-/\varnothing c$.

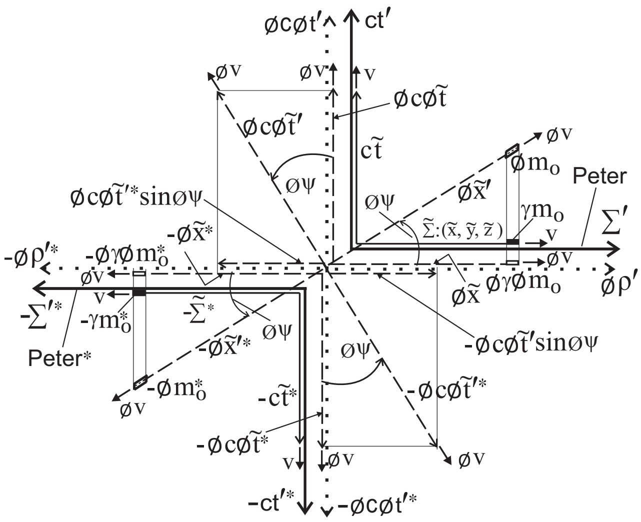

Fig. 4. The projective unprimed intrinsic affine spacetime is embedded in the proper intrinsic metric spacetime and the unprimed affine spacetime is embedded in the proper metric spacetime (Fig. 8a of [1]).

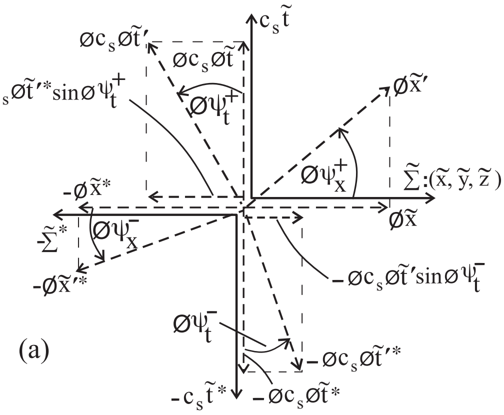

Fig. 5. (a) Rotations of intrinsic affine spacetime coordinates of the particles' primed intrinsic affine frames relative to particles' unprimed intrinsic affine frames in our universe and negative universe, with respect to the 'stationary' symmetry-partner 3-observers in the proper Euclidean 3-spaces of our (or positive) universe and the negative universe (not shown), due to assumed non-symmetrical motions of symmetry-partner particles relative to symmetry-partner observers in our universe and negative universe.

The assumption, $\varnothing v_x^+ \neq \varnothing v_x^- \neq \varnothing v_t^+ \neq \varnothing v_t^-$, which implies, $\varnothing\psi_x^+ \neq \varnothing\psi_x^- \neq \varnothing\psi_t^+ \neq \varnothing\psi_t^-$, between our universe and the negative universe, corresponds to the assumption, $\varnothing v_{x^0}^+ \neq \varnothing v_{x^0}^- \neq \varnothing v_{t^0}^+ \neq \varnothing v_{t^0}^-$, which implies, $\varnothing\psi_{x^0}^+ \neq \varnothing\psi_{x^0}^- \neq \varnothing\psi_{t^0}^+ \neq \varnothing\psi_{t^0}^-$, between the positive time-universe and the negative time-universe. Thus corresponding to Fig. 5a in our universe and the negative universe is Fig. 5b in the positive time-universe and the negative time-universe.

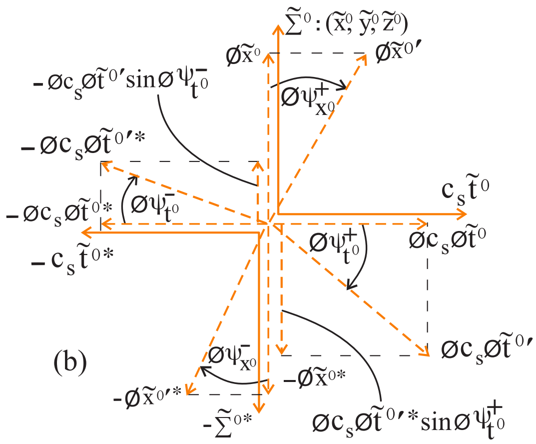

Fig. 6. (b) Rotations of intrinsic affine spacetime coordinates of the particles' primed intrinsic affine frames relative to particles' unprimed intrinsic affine frames in the positive time-universe and the negative time-universe, with respect to the 'stationary' symmetry-partner 3-observers in the proper Euclidean 3-spaces of the positive time-universe and the negative time-universe (not shown), due to assumed non-symmetrical motions of symmetry-partner particles relative to symmetry-partner observers in the positive time-universe and the negative time-universe

The rotations of the primed intrinsic affine space coordinate $\varnothing\tilde{x}^{\,0\prime}$ by intrinsic angle $\varnothing\psi^{+}_{x0}$ relative to the unprimed intrinsic affine space coordinate $\varnothing\tilde{x}^{\,0}$ along the vertical in the first quadrant, and the rotation of the primed intrinsic affine time coordinate $\varnothing c_s\varnothing\tilde{t}^{\,0\prime}$ by intrinsic angle $\varnothing\psi^{+}_{t0}$ relative to the unprimed intrinsic affine time coordinate $\varnothing c_s\varnothing\tilde{t}^{\,0}$ along the horizontal in the fourth quadrant in Fig. 5b, are valid with respect to the 'stationary' 3-observer^0 in $\Sigma^{0\prime}$ along the vertical in the first quadrant (not shown) in Fig. 5b where, $\sin\varnothing\psi^{+}_{x0} = \varnothing v^{+}_{x0}/\varnothing c$ and $\sin\varnothing\psi^{+}_{t0} = \varnothing v^{+}_{t0}/\varnothing c$.

The rotation of the primed intrinsic affine space coordinate $-\varnothing\tilde{x}^{\,0\prime *}$ at intrinsic angle $\varnothing\psi^{-}_{x0}$ relative to the unprimed intrinsic affine space coordinate $-\varnothing\tilde{x}^{\,0*}$ along the vertical in the third quadrant and the rotation of $-\varnothing c_s\varnothing\tilde{t}^{\,0\prime *}$ by $\varnothing\psi^{-}_{t0}$ relative to $-\varnothing c_s\varnothing\tilde{t}^{\,0*}$ along the horizontal in the second quadrant in Fig. 5b, are valid with respect to the 'stationary' 3-observer^{0*} in $-\Sigma^{0\prime *}$ aong the vertical in the third quadrant (also not shown) in Fig. 5b where, $\sin\varnothing\psi^{-}_{x0} = \varnothing v^{-}_{x0}/\varnothing c$ and $\sin\varnothing\psi^{-}_{t0} = \varnothing v^{-}_{t0}/\varnothing c$.

By following the procedure used to derive partial intrinsic Lorentz transformation with respect to the 'stationary' 3-observer in Σ' in [1] from Fig. 8a of that article, reproduced as Fig/4 of this article, the unprimed intrinsic affine coordinate $\varnothing\tilde{x}$ along the horizontal is the projection of the inclined $\varnothing\tilde{x}\,'$ in the first quadrant in Fig. 5a. That is, $\varnothing\tilde{x} = \varnothing\tilde{x}\,'\cos\varnothing\psi^{+}_{x}$. We must express the inclined $\varnothing\tilde{x}\,'$ in terms of its projection $\varnothing\tilde{x}$ along the horizontal and write

$$\varnothing\tilde{x}\,' = \varnothing\tilde{x}\sec\varnothing\psi^{+}_{x}\ . \qquad (1)$$

Equation (1) is all the intrinsic affine coordinate transformation that could have been possible with respect to the 3-observer in Σ' along the horizontal in the first quadrant in Fig. 5a, but for the fact that the inclined negative intrinsic affine time coordinate $-\varnothing c_s\varnothing\tilde{t}\,'^{*}$ of the negative universe rotated into the fourth quadrant in that figure also projects a component $-\varnothing c_s\varnothing\tilde{t}\,'\sin\varnothing\psi^{-}_{t}$ along the horizontal, which must be added to the right-hand side of Eq. (1) to have

$$\varnothing\tilde{x}\,' = \varnothing\tilde{x}\sec\varnothing\psi^{+}_{x} - \varnothing c_s\varnothing\tilde{t}\,'\sin\varnothing\psi^{-}_{t}\ ; \qquad (2a)$$

$$(\text{w.r.t } 3-\text{observer in } \Sigma').$$

The dummy star label on $-\varnothing c_s\varnothing\tilde{t}\,'^{*}\sin\varnothing\psi^{-}_{t}$ projected along the horizontal has been removed, since this projected component is now an intrinsic coordinate in the positive universe. Figure 5a is the same as Fig. 4 of this article, except that the different intrinsic angles, $\varnothing\psi_x^+$, $\varnothing\psi_x^-$, $\varnothing\psi_t^+$ and $\varnothing\psi_t^-$ in Fig. 5a are each equal to $\varnothing\psi$ in Fig. 4.

Now, $-\varnothing c_s\varnothing\tilde{t}^* = -\varnothing c_s\varnothing\tilde{t}'^* \cos\varnothing\psi_t^-$, along the vertical in the fourth quadrant in Fig. 5a. This implies $\varnothing c_s\varnothing\tilde{t}\,' = \varnothing c_s\varnothing\tilde{t}\sec\varnothing\psi_t^-$. This equation exists alongside the transformation (2a). Using it at the right-hand side of (2a) gives

$$\varnothing\tilde{x}\,' = \varnothing\tilde{x}\sec\varnothing\psi_x^+ - \varnothing c_s\varnothing\tilde{t}\sec\varnothing\psi_t^-\sin\varnothing\psi_t^- \;; \tag{2b}$$

$(\text{w.r.t } 3-\text{observer in } \Sigma')$. Equation (2b) is the final form of the partial intrinsic Lorentz transformation that the 'stationary' 3-observer in Σ' in our universe can derive along the horizontal in the first quadrant from Fig. 5a.

By applying the same procedure used to derive Eq. (2b) from the first and fourth quadrants of Fig. 5a to the first and second quadrants of Fig. 5b, the counterpart of Eq. (2b), which is valid with respect to the 'stationary' 3-observer^0 in $\Sigma^{0\prime}$ along the vertical in the first quadrant in that figure is the following

$$\varnothing\tilde{x}^{\,0\prime} = \varnothing\tilde{x}^{\,0}\sec\varnothing\psi^{+}_{x\,0} - \varnothing c_s\varnothing\tilde{t}^{\,0}\sec\varnothing\psi^{-}_{t\,0}\sin\varnothing\psi^{-}_{t\,0} \;; \tag{3}$$

$(\text{w.r.t } 3-\text{observer}^0 \text{ in } \Sigma^{0\prime})$. Again Eq. (3) is the final form of the partial intrinsic Lorentz transformation that the 'stationary' 3-observer^0 in $\Sigma^{0\prime}$ in the positive time-universe can derive along the vertical in the first quadrant in Fig. 5b.

Figure 5b cannot serve the role of the complementary diagram to Fig. 5a, because it contains the spacetime and intrinsic spacetime coordinates of the positive time-universe and negative time-universe, which are elusive to observers in our universe and negative universe and cannot appear in physics in our universe and negative universe. The partial intrinsic Lorentz transformation (3) derived with respect to the 'stationary' 3-observer^0 in $\Sigma^{0\prime}$ in the positive time-universe from Fig. 5b, cannot complement Eq. (2b) derived with respect to the symmetry-partner 'stationary' 3-observer in Σ' in our universe from Fig. 5a.

In order to make Fig. 5b a valid complementary diagram to Fig. 5a, the spacetime and intrinsic spacetime coordinates of the positive and negative time-universes in it must be transformed into those of our universe and the negative universe, as done with the aid of system (15) of of [3], reproduced here as system (4)

$$\begin{aligned}
&\tilde{\Sigma}^0 && \rightarrow && c_s\tilde{t}\;;\; c_s\tilde{t}^{\,0} \rightarrow \tilde{\Sigma}\;;\; -\tilde{\Sigma}^{\,0*} \rightarrow -c_s\tilde{t}^{\,*}\;;\\
&-c_s\tilde{t}^{\,0*} && \rightarrow && -\tilde{\Sigma}^*\;;\; \varnothing\tilde{x}^{\,0} \rightarrow \varnothing c_s\varnothing\tilde{t}\,;\varnothing c_s\varnothing\tilde{t}^{\,0} \rightarrow \varnothing\tilde{x}\;;\\
&-\varnothing\tilde{x}^{0*} && \rightarrow && -\varnothing c_s\varnothing\tilde{t}^{\,*}\;;\; -\varnothing c_s\varnothing\tilde{t}^{\,0*} \rightarrow -\varnothing\tilde{x}^*\;;\\
&\varnothing\tilde{x}^{\,0\prime} && \rightarrow && \varnothing c_s\varnothing\tilde{t}\,'\;;\; \varnothing c_s\varnothing\tilde{t}^{\,0\prime} \rightarrow \varnothing\tilde{x}\,'\;;\\
&-\varnothing\tilde{x}^{0\prime*} && \rightarrow && -\varnothing c_s\varnothing\tilde{t}\,'^*\,;-\varnothing c_s\varnothing\tilde{t}^{\,0\prime*} \rightarrow -\varnothing\tilde{x}\,'^*.
\end{aligned} \tag{4}$$

By implementing system (4) on Fig. 5b we have Fig. 5c that can serve as complementary diagram to Fig. 5a.

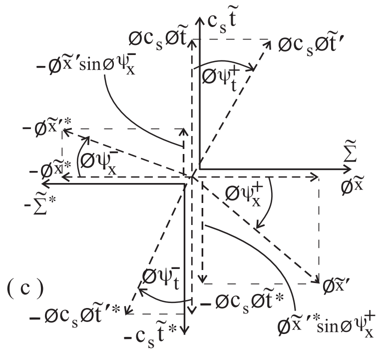

Fig. 7. (c) Complementary diagram to Fig. 5a obtained by transforming the spacetime and intrinsic spacetime coordinates of the positive time-universe and the negative time-universe in Fig. 5b into the spacetime and intrinsic spacetime coordinates of our universe and the negative universe; is valid with respect to 1-observers in the proper metric time dimensions of our universe and the negative universe (not shown)

It has so far been assumed that the break in symmetry of relative motions of the quartet of symmetry-partner particles or objects in the four universes is such that the eight intrinsic angles in Figs. 5a and 5b are different in general, that is, $\varnothing\psi_x^+ \neq \varnothing\psi_x^- \neq \varnothing\psi_t^+ \neq \varnothing\psi_t^- \neq \varnothing\psi_{x^0}^+ \neq \varnothing\psi_{x^0}^- \neq \varnothing\psi_{t^0}^+ \neq \varnothing\psi_{t^0}^-$, and consequently, the associated eight relative intrinsic speeds are different in general, that is, $\varnothing v_x^+ \neq \varnothing v_x^- \neq \varnothing v_t^+ \neq \varnothing v_t^- \neq \varnothing v_{x^0}^+ \neq \varnothing v_{x^0}^- \neq \varnothing v_{t^0}^+ \neq \varnothing v_{t^0}^-$. However this assumption is invalid as explained hereunder.

What appears as primed intrinsic affine time coordinate $\varnothing c\varnothing\tilde{t}\,'$ that is rotated relative to unprimed intrinsic affine time coordinate $\varnothing c\varnothing\tilde{t}$ at intrinsic angle $\varnothing\psi_t^+$ along the vertical in the second quadrant, with respect to the 3-observer in our Euclidean 3-space Σ' in Fig. 5a, is the rotated primed intrinsic affine space coordinate $\varnothing\tilde{x}^{\,0\prime}$ relative to unprimed intrinsic affine space coordinate $\varnothing\tilde{x}^{\,0}$ at intrinsic angle $\varnothing\psi_{x^0}^+$ along the vertical in the first quadrant, with respect to the 3-observer^0 in $\Sigma^{0\prime}$ in Fig. 5b. Hence the intrinsic angles $\varnothing\psi_t^+$ in Fig. 5a and $\varnothing\psi_{x^0}^+$ in Fig. 5b are equal. The same reasoning leads to the equality of the intrinsic angle $\varnothing\psi_t^-$ in Fig. 5a and $\varnothing\psi_{x^0}^-$ in Fig. 5b.

Also the rotation of the primed intrinsic affine space coordinate $\varnothing\tilde{x}\,'$ relative to the unprimed intrinsic affine space coordinate $\varnothing\tilde{x}$ at intrinsic angle $\varnothing\psi_x^+$ along the horizontal in the first quadrant, with respect to the 3-observer in our Euclidean 3-space Σ' in Fig. 5a, is what appears as rotated primed intrinsic affine time coordinate $\varnothing c\varnothing\tilde{t}^{\,0\prime}$ relative to unprimed intrinsic affine time coordinate $\varnothing c\varnothing\tilde{t}^{\,0}$ at intrinsic angle $\varnothing\psi_{t^0}^+$ along the horizontal in the fourth quadrant in Fig. 5b. Hence the intrinsic angles $\varnothing\psi_x^+$ in Fig. 5a and $\varnothing\psi_{t^0}^+$ in Fig. 5b are immutably equal. The same reasoning leads to the immutable equality of the intrinsic angles $\varnothing\psi_x^-$ in Fig. 5a and $\varnothing\psi_{t^0}^-$ in Fig. 5b.

In summary, we have the following equalities of intrinsic angles between Figs. 5a and 5b and the implied equalities of the associated relative intrinsic speeds

$$\varnothing\psi_{t^0}^+ = \varnothing\psi_x^+ \,; \varnothing\psi_{t^0}^- = \varnothing\psi_x^- \,; \varnothing\psi_{x^0}^+ = \varnothing\psi_t^+ \,; \varnothing\psi_{x^0}^- = \varnothing\psi_t^- \tag{5a}$$

and

$$\varnothing v_{t^0}^+ = \varnothing v_x^+ \,; \varnothing v_{t^0}^- = \varnothing v_x^- \,; \varnothing v_{x^0}^+ = \varnothing v_t^+ \,; \varnothing v_{x^0}^- = \varnothing v_t^- \;. \tag{5b}$$

System (5a) or (5b) states that break in symmetry of relative motion between symmetry-partner particles in our (or positive) universe and the positive time-universe and between the negative universe and the negative time-universe does not exist in nature. This shall be described as unbroken (or perfect) vertical symmetry of relative motion among the four universes.

Whereas, apart from the so far prescribed perfect symmetry of state (which includes symmetry of relative motion), between our universe and the negative universe and between the positive time-universe and the negative time-universe, broken symmetry of relative motion between symmetry-partner particles in our universe and the negative universe and between symmetry-partner particles in the positive time-universe and the negative time-universe, are assumable. The symmetry of relative motion between our universe and the negative universe and between the positive time-universe and the negative time-universe shall be described as horizontal symmetry of relative motions among the four universes.

While system (5a) or (5b) states the perfect (or unbroken) vertical symmetry of relative motions among the four universes, the following inequalities state the assumed broken horizontal symmetry of intrinsic relative motions in intrinsic spacetimes between our universe and the negative universe and, consequently, between the positive time-universe and the negative time-universe, or among the four universes

$$\varnothing\psi_x^+ \neq \varnothing\psi_x^- \neq \varnothing\psi_t^+ \neq \varnothing\psi_t^- , \;\; or, \;\; \varnothing v_x^+ \neq \varnothing v_x^- \neq \varnothing v_t^+ \neq \varnothing v_t^- \;. \tag{6a}$$

The outward manifestation in spacetime of system (6a) that states assumed break in horizontal symmetry of relative motions in spacetimes among the four universes is

$$\psi_x^+ \neq \psi_x^- \neq \psi_t^+ \neq \psi_t^-, \;\; or, \;\; v_x^+ \neq v_x^- \neq v_t^+ \neq v_t^- \;. \qquad (6b)$$

It is to be observed that, apart from implementing the transformations of intrinsic affine spacetime coordinates and affine spacetime coordinates in system (4) on Fig. 5b in drawing Fig. 5c, the equalities of intrinsic angles of system (5a) have also been implemented. In other words, only break in horizontal symmetry of relative motions among the four universes, stated by systems (6a) and (6b), is what has been assumed in Fig. 5a and its complementary diagram of Fig. 5c in our universe and the negative universe.

Figure 5c, obtained from Fig. 5b, contains the affine spacetime and intrinsic affine spacetime coordinates of the positive (or our) universe and the negative universe. It is now a valid complementary diagram to Fig. 5a for the purpose of deriving ∅LT and LT in our universe and negative universe. It is to be remembered that the 3-observers^0 in the Euclidean 3-spaces, $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$, of the positive time-universe and the negative time-universe (not shown) in Fig. 5b, have transformed into 1-observers in the proper time dimensions, $c_s t'$ and $-c_s t'^*$, of our universe and the negative universe (not shown) in Fig. 5c.

The partial intrinsic Lorentz transformation with respect to the 'stationary' 1-observer in $c_s t'$ along the vertical in the first quadrant (not shown) in Fig. 5c, must be derived as done from Fig. 8b of [1], reproduced as Fig. 4 of this article. However the required partial intrinsic Lorentz transformation shall be obtained by transforming the intrinsic affine spacetime coordinates of the positive time-universe in Eq. (3) derived from Fig. 5b to the intrinsic affine spacetime coordinates of our universe using system (4) giving

$$\varnothing c_s \varnothing \tilde{t}\,' \;=\; \varnothing c_s \varnothing \tilde{t} \sec \varnothing\psi_t^+ - \varnothing\tilde{x} \sec\varnothing\psi_x^- \sin\varnothing\psi_x^- \;; \qquad (7)$$

$(\text{w.r.t. } 1-\text{oberver in } c_s t')$.

The partial intrinsic Lorentz transformation (7) with respect to the 'stationary' 1-observer in $c_s t'$, derived from Fig. 5c, is a valid complementary intrinsic Lorentz transformation to Eq. (2b) derived with respect to the 'stationary' 3-observer in Σ' from Fig. 5a. Collecting Eqs. (2b) and (7) gives the full intrinsic Lorentz transformation (∅LT) with assumed break in horizontal symmetry, that is, break in symmetry of relative motions of symmetry-partner particles between our universe and the negative universe and, consequently, between the positive time-universe and the negative time-universe.

$$\begin{aligned} \varnothing\tilde{x}\,' &= \varnothing\tilde{x} \sec\varnothing\psi_x^+ - \varnothing c_s \varnothing\tilde{t} \sec\varnothing\psi_t^- \sin\varnothing\psi_t^- \;; \\ & \quad (\text{w.r.t } 3-\text{observer in } \Sigma') \;; \\ \varnothing c_s \varnothing\tilde{t}\,' &= \varnothing c_s \varnothing\tilde{t} \sec\varnothing\psi_t^+ - \varnothing\tilde{x} \sec\varnothing\psi_x^- \sin\varnothing\psi_x^- \;; \\ & \quad (\text{w.r.t. } 1-\text{oberver in } c_s t') \;. \end{aligned} \qquad (8)$$

Using the definitions,

$$\sin\varnothing\psi_x^+ = \varnothing v_x^+/\varnothing c \,; \sin\varnothing\psi_x^- = \varnothing v_x^-/\varnothing c \,; \sin\varnothing\psi_t^+ = \varnothing v_t^+/\varnothing c \;\text{ and } \\ \sin\varnothing\psi_t^- = \varnothing v_t^-/\varnothing c \;, \qquad (9)$$

system (8) is given explicitly in terms of relative intrinsic speeds as

$$\begin{aligned} \varnothing\tilde{x}\,' &= \left(1 - \frac{(\varnothing v_x^+)^2}{\varnothing c^2}\right)^{-1/2} \varnothing\tilde{x} - \left(1 - \frac{(\varnothing v_t^-)^2}{\varnothing c^2}\right)^{-1/2} (\varnothing v_t^-)\varnothing\tilde{t} \;; \\ & \quad (\text{w.r.t. } 3-\text{observer in } \Sigma') \;; \\ \varnothing\tilde{t}\,' &= \left(1 - \frac{(\varnothing v_t^+)^2}{\varnothing c^2}\right)^{-1/2} \varnothing\tilde{t} - \left(1 - \frac{(\varnothing v_x^-)^2}{\varnothing c^2}\right)^{-1/2} \frac{\varnothing v_x^-}{\varnothing c^2} \varnothing\tilde{x} \;; \\ & \quad (\text{w.r.t. } 1-\text{observer in } ct') \end{aligned} \qquad (10)$$

The outward manifestation on the flat four-dimensional spacetime of systems (8) and (10) are given respectively as

$$\begin{aligned} \tilde{x}' &= \tilde{x}\sec\psi_x^{+} - c_s\tilde{t}\sec\psi_t^{-}\sin\psi_t^{-} \; ; \\ & (\text{w.r.t } 3 - \text{observer in } \Sigma') \; ; \\ c_s\tilde{t}' &= c_s\tilde{t}\sec\psi_t^{+} - \tilde{x}\sec\psi_x^{-}\sin\psi_x^{-} \; ; \\ & (\text{w.r.t. } 1 - \text{oberver in } c_s t') \; . \end{aligned} \tag{11}$$

and

$$\begin{aligned} \tilde{x}' &= (1 - \frac{(v_x^{+})^2}{c^2})^{-1/2}\tilde{x} - (1 - \frac{(v_t^{-})^2}{c^2})^{-1/2}(v_t^{-})\tilde{t} \; ; \\ & (\text{w.r.t. } 3 - \text{observer in } \Sigma') \; ; \\ \tilde{t}' &= (1 - \frac{(v_t^{+})^2}{c^2})^{-1/2}\tilde{t} - (1 - \frac{(v_x^{-})^2}{c^2})^{-1/2}\frac{v_x^{-}}{c^2}\tilde{x} \; ; \\ & (\text{w.r.t. } 1 - \text{observer in } c_s t') \end{aligned} \tag{12}$$

As can be easily shown, system (8) or (10) contradicts (or does not lead to) intrinsic Lorentz invariance (∅LI) in ∅SR, given break in horizontal symmetry of relative intrinsic motions in intrinsic spacetimes among the four universes of system (6a). System (11) or (12) likewise does not lead to Lorentz invariance (LI) in SR, given break in horizontal symmetry of relative motions in spacetimes among the four universes of system (6a).

Even if only one of the four intrinsic angles in Figs. 5a and 5c (or in system (6a)) is different from the rest (or if only one of the four associated intrinsic speeds in those figure is different from the rest), system (8) or (10) will still contradict ∅LI. And if only one of the four angles is different from the rest (or if only one of the four associated speeds is different from the rest) in system (6b), system (11) or (12) will still contradict LI.

The assumption made initially that members of a quartet of symmetry-partner particles or objects in the four universes are in non-symmetrical relative motions in the universes, is tantamount to break in both vertical and horizontal symmetries of relative motions among the four universes. However as shown in the development that leads to system (5a) or (5b), only a break in horizontal symmetry of relative motions, stated by systems (6a) and (6b), is assumable, while vertical symmetry of relative motions (system (5a) or (5b)) is immutable.

Thus the assumption of break in horizontal symmetry of relative motions of symmetry-partner particles (between our universe and the negative universe and, consequently, between the positive time-universe and the negative time-universe), stated by systems (6a) and (6b), along with immutable vertical symmetry stated by system (5a) or (5b), which gives rise to Figs. 5a and 5c, leads to non-validity of intrinsic Lorentz invariance in intrinsic special relativity (∅SR) and, consequently, the non-validity of Lorentz invariance in special relativity (SR) in our universe and, indeed, in the four universes. This negates the assumption of break in horizontal symmetry of relative motions of symmetry-partner particles in the four universes, since Lorentz invariance is immutable on the flat four-dimensional spacetime of SR in each universe.

The unbroken (or perfect) horizontal symmetry of relative motions of symmetry-partner particles among the four universes ($\varnothing\psi_x^{+} = \varnothing\psi_x^{-} = \varnothing\psi_t^{+} = \varnothing\psi_t^{-}$, or, $\varnothing v_x^{+} = \varnothing v_x^{-} = \varnothing v_t^{+} = \varnothing v_t^{-}$), implied by the preceding paragraph, along with immutable vertical symmetry of relative motions of symmetry-partner particles in the four universes (system (5a) or (5b)), implies that all the four members of every quartet of symmetry-partner particles or objects in the four universes are in identical (or symmetrical) relative motions at all times.

It has been shown that the members of every quartet of symmetry-partner particles or objects in the four universes have identical magnitudes of masses, identical shapes and identical sizes in the preceding sub-section. They therefore give rise to identical gravitational fields in spacetimes in their respective universes. There is however the underlying assumption in the derivations that symmetry-partner particles and bodies in our universe and the negative universe have identical magnitudes of masses, identical shapes and identical sizes and, consequently, symmetry-partner particles and bodies in the positive time-universe and the negative time-universe, have identical magnitudes of masses, identical shapes and identical sizes. This underlying assumption is the same as the assumption of symmetry of gravitational fields between our universe and the negative universe and between the positive time-universe and the negative time-universe. It requires the propagation of the four-world picture to the theory of gravitation to validate this underlying assumption.

It has also been shown that the members of every quartet of symmetry-partner particles or objects in the four universes are involved in symmetrical relative motions at all times in this sub-section.

Perfect symmetry of gravitational fields in spacetimes and perfect symmetry of relative motions of symmetry-partner particles in spacetimes in the four universes are the requirements for symmetry of states to obtain among the four universes, as mentioned at the beginning of this section. Thus perfect (or unbroken) symmetry of state among the four universes has been established in this section. The underlying assumption of symmetry of gravitational fields between our (or positive) universe and the negative universe and between the positive time-universe and the negative time-universe in the derivations, requires the propagation of the four-world picture to the theory of gravitation to validate, as mentioned above.

3 SHOWING PERFECT SYMMETRY OF NATURAL LAWS AMONG THE ISOLATED FOUR UNIVERSES

The four universes encompassed by Figs. 1a and 1b are the positive (or our) universe with flat proper metric spacetime $(\Sigma', c_s t')$ of classical gravitation (CG) and SR and its underlying flat two-dimensional proper intrinsic metric spacetime $(\varnothing\rho', \varnothing c_s \varnothing t')$ of intrinsic classical gravity (∅CG) and intrinsic special relativity (∅SR) and the negative universe with flat proper metric spacetime $(-\Sigma'^{*}, -c_s t'^{*})$ of CG and SR and its underlying two-dimensional flat proper intrinsic metric spacetime $(-\varnothing\rho'^{*}, -\varnothing c_s \varnothing t'^{*})$ of ∅CG and ∅SR in Fig. 1a.

The third universe is the one with flat proper metric spacetime $(\Sigma^{0\prime}, c_s t^{0\prime})$ of CG and SR and its underlying flat proper intrinsic metric spacetime $(\varnothing\rho^{0\prime}, \varnothing c_s \varnothing t^{0\prime})$ of ∅CG and ∅SR in Fig. 1b. This third universe is the positive time-universe. It is so referred to, because its proper Euclidean 3-space $\Sigma^{0\prime}$ and its proper intrinsic space $\varnothing\rho^{0\prime}$ are the proper time dimension $c_s t'$ and proper intrinsic time dimension $\varnothing c_s \varnothing t'$ respectively of the positive (or our) universe. It thereby appears as the time dimensions $c_s t'$ containing one-dimensional particles and objects relative to 3-observers in our Euclidean 3-space Σ'.

The fourth universe is the one with flat proper metric spacetime $(-\Sigma^{0\prime *}, -c_s t^{0\prime *})$ of CG and SR and its underlying flat proper intrinsic metric spacetime $(-\varnothing\rho^{0\prime *}, -\varnothing c_s \varnothing t^{0\prime *})$ of ∅CG and ∅SR in Fig. 1b. This fourth universe is the negative time-universe. It is so referred to, because its proper Euclidean 3-space $-\Sigma^{0\prime *}$ and its proper intrinsic space $-\varnothing\rho^{0\prime *}$ are the proper time dimension $-c_s t'^{*}$ and the proper intrinsic time dimension $-\varnothing c_s \varnothing t'^{*}$ respectively of the negative universe. It thereby appears as the time dimensions $-c_s t'^{*}$ containing one-dimensional particles and objects relative to 3-observers* in the Euclidean 3-space $-\Sigma'^{*}$ of the negative universe.

The four worlds (or universes) encompassed by Figs. 1a and 1b, listed above, co-exist in nature and exhibit perfect symmetry of state, as established in the preceding section. Perfect symmetry of natural laws among the four universes shall be demonstrated hereunder. Perfect symmetry of natural laws among the four universes is inevitable, otherwise symmetry of state will be impossible among them.

In Table I is summarized the signs of spacetime intervals and dimensions, some parameters and intrinsic parameters and some physical constants and intrinsic constants in the positive time-universe and the negative time-universe. Table I of this paper has been built in symmetry with Table I of [2] between our (or positive) universe and the negative universe.

Table 1. Signs of spacetime and intrinsic spacetime dimensions, some physical parameters and intrinsic parameters and physical constants and intrinsic constants in the positive time-universe and the negative time-universe

Physical quantity or constant	Symbol	Intrinsic quantity or constant	Sign	
			positive time-universe	negative time-universe
Distance (or dimension) of space	dx^0 or x^0	$d\varnothing x^0$ or $\varnothing x^0$	$+$	$-$
Interval (or dimension) of time	dt^0 or t^0	$d\varnothing t^0$ or $\varnothing t^0$	$+$	$-$
Mass	m^0	$\varnothing m^0$	$+$	$-$
Electric charge	q^0	$\varnothing q^0$	$+$ or $-$	$-$ or $+$
Absolute entropy	S^0	$\varnothing S^0$	$+$	$-$
Absolute temperature	T^0	$\varnothing T^0$	$+$	$+$
Energy (total, kinetic)	E^0	$\varnothing E^0$	$+$	$-$
Potential energy	U^0	$\varnothing U^0$	$+$ or $-$	$-$ or $+$
Radiation energy	$h\nu^0$	$\varnothing h \varnothing \nu^0$	$+$	$-$
Electrostatic potential	Φ_E^0	$\varnothing \Phi_E^0$	$+$ or $-$	$+$ or $-$
Gravitational potential	Φ_g^0	$\varnothing \Phi_g^0$	$-$	$-$
Gravitational field	$\vec{g}^0$	$\varnothing g^0$	$-$	$+$
Electric field	$\vec{E}^0$	$\varnothing E^0$	$+$ or $-$	$-$ or $+$
Magnetic field	$\vec{B}^0$	$\varnothing B^0$	$+$ or $-$	$-$ or $+$
Planck constant	h^0	$\varnothing h^0$	$+$	$+$
Boltzmann constant	k^0	$\varnothing k^0$	$+$	$-$
Thermal conductivity	k^0	$\varnothing k^0$	$+$	$-$
Specific heat capacity	c_p^0	$\varnothing c_p^0$	$+$	$+$
velocity	$\vec{v}$	$\varnothing v$	$+$ or $-$	$+$ or $-$
Speed of light	c	$\varnothing c$	$+$	$+$
Electric permittivity	ϵ_o^o	$\varnothing \epsilon_o^o$	$+$	$+$
Magnetic permeability	μ_o^o	$\varnothing \mu_o^o$	$+$	$+$
Angular measure	θ^0, φ^0	$\varnothing \theta^0, \varnothing \varphi^0$	$+$ or $-$	$+$ or $-$
Parity	Π^0	$\varnothing \Pi^0$	$+$ or $-$	$-$ or $+$
Ang. momentum	$\vec{L}^0$	$\varnothing L^0$	$+$ or $-$	$+$ or $-$
Intrinsic spin	s^0	$\varnothing s^0$	$+$ or $-$	$+$ or $-$
Mag. moment	μ^0	$\varnothing \mu^0$	$+$ or $-$	$+$ or $-$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

The superscript "0" that appears on dimensions and intrinsic dimensions, parameters and intrinsic parameters and on constants and intrinsic constants in Table I, is a dummy label used to differentiate the spacetime dimensions and intrinsic spacetime dimensions, physical parameters and intrinsic parameters and physical constants and intrinsic constants of the positive time-universe and the negative time-universe from those of the positive (or our) universe and the negative universe in Table I of [2]. In other words Table I of [2] between our (or positive) universe and the negative universe is the same as Table I of this paper between the positive time-universe and the negative time-universe, but for the appearance of the dummy superscript "0" label on dimensions/intrinsic dimensions, parameters/intrinsic parameters and constants/intrinsic constants in Table I of this paper.

Now the demonstration of perfect symmetry of natural laws between the positive (or our) universe and the negative universe in [2], involves three steps. At the first step, affine spacetime/intrinsic affine spacetime diagrams are derived in [1] upon the flat proper metric spacetime and proper intrinsic metric spacetime of combined positive (or our) universe and the negative universe in Fig. 7 of that article, reproduced as Fig. 1a of this article. The intrinsic Lorentz transformations and Lorentz transformations (∅LT/LT) are then derived in the positive universe and the negative universe from those diagrams, thereby establishing intrinsic Lorentz invariance (∅LI) on flat two-dimensional intrinsic spacetimes and Lorentz invariance (LI) on flat four-dimensional spacetimes in the two universes in [1].

The first step in demonstrating perfect symmetry of laws between the positive (or our) universe and the negative universe in Fig. 1a of this article described above, applies directly between the positive time-universe and the negative time-universe. The counterparts of the affine spaetime/intrinsic affine spacetime diagrams toward the derivations of intrinsic Lorentz transformation (∅LT) and Lorentz transformation (LT), which are drawn upon the combined metric spacetimes and intrinsic metric spacetimes of the positive universe and negative universe, encompassed by Fig. 1a of this article as reference, can be drawn upon the combined metric spacetimes and intrinsic metric spacetimes of the positive time-universe and negative time-universe encompassed by Fig. 1b of this article as reference. Intrinsic Lorentz transformations and Lorentz transformation (∅LT/LT) can then be derived from them in the positive time-universe and the negative time-universe. These shall not be done here however in order to conserve space, but it is straight forward to do. Intrinsic Lorentz invariance (∅LI) on flat two-dimensional intrinsic spacetimes and Lorentz invariance (LI) on flat four-dimensional spacetimes in the positive time-universe and the negative time-universe then follow with respect to observers in those universes.

The second step in demonstrating the symmetry of natural laws between the positive (or our) universe and the negative universe in [2], involves the derivation of the relative signs of spacetime dimensions and intrinsic spacetime dimensions, physical parameters and physical constants and of intrinsic parameters and intrinsic constants, between the our universe and negative universe and summarized in Table I of that article. Again this second step applies directly between the positive time-universe and the negative time-universe. The relative signs of spacetime dimensions and intrinsic spacetime dimensions, physical parameters and physical constants and of intrinsic parameters and intrinsic constants, which are derivable between the positive time-universe and the negative time-universe, summarized in Table I above, follow directly from the derived signs of spacetime dimensions and intrinsic spacetime dimensions, physical parameters and physical constants and of intrinsic parameters and intrinsic constants, in the positive (or our) universe and the negative universe in [1] and summarized in Table I of that paper.

The third and final step in demonstrating the symmetry of natural laws between the positive (or our) universe and the negative universe in [2], consists in replacing the positive spacetime dimensions and the signs of physical parameters and physical constants that appear in (the local instantaneous differential) natural laws in our (or positive) universe by the negative spacetime dimensions and the derived signs of physical parameters and physical constants of the negative universe (summarized in Table I of [2]), and showing that these operations leave all natural laws unchanged in the negative universe, as demonstrated in section 5 of [2].

The third step in the demonstration of the perfect symmetry of natural laws between the positive (or our) universe and the negative universe described in the preceding paragraph, applies directly between the positive time-universe and the negative time-universe as well. Having established Lorentz invariance between the positive time-universe and the negative time-universe at the first step, it is straight forward to use Table I above and follow the procedure in section 5 of [2] to demonstrate the invariance of natural laws between the positive time-universe and negative time-universe.

Finally the established validity of Lorentz invariance in the four universes encompassed by Figs. 1a and 1b, coupled with the identical signs of spacetime dimensions, physical parameters and physical constants in the positive (or our) universe and the positive time-universe and the identical signs of spacetime dimensions, physical parameters and physical constants in the negative universe and negative time-universe in, Table I of [2] and Table I above, guarantee the invariance of natural laws between the positive (or our) universe and the positive time-universe and between the negative universe and the negative time-universe. These along with the established invariance of natural laws between the positive (or our) universe and the negative universe and between the positive time-universe and the negative time-universe, then guarantee the invariance of natural laws among the four universes.

Symmetry of natural laws among the four universes encompassed by Figs. 1a and 1b of this paper namely, the positive (or our) universe and the negative universe (in Fig. 1a), the positive time-universe and the negative time-universe (in Fig. 1b), has thus been shown. Perfect symmetry of state among the universes has been demonstrated in the preceding section. The coexisting four universes can therefore be described as coexisting symmetrical universes. They have also been described as compartment universes (coexisting symmetrical universes in separate spacetime 'compartments') in [3].

The fact that the coexisting universes exist in separate four-dimensional spacetimes of identical extents; that particles and bodies are symmetrically distributed in spacetimes within the universes and that the universes exhibit perfect symmetry of state and perfect symmetry of natural laws, in the new concept of many universes of the previous papers [1, 2, 3] and this paper (referred to as compartment universes concept), differentiate the new concept from the existing concepts of many universes, as remarked under the Introduction of [3].

4 NON-EVOLUTION OF THE FLAT FOUR-DIMENSIONAL PROPER METRIC SPACETIME AND ITS UNDERLYING FLAT TWO-DIMENSIONAL PROPER INTRINSIC METRIC SPACETIME IN THE CONTEXTS OF SPECIAL RELATIVITY AND INTRINSIC SPECIAL RELATIVITY

The flat four-dimensional proper metric spacetime, which is composed of the proper Euclidean metric 3-space Σ' and the proper metric time dimension $c_s t'$ in the first quadrant in Fig. 1a, is the flat four-dimensional proper metric spacetime of classical gravitation, classical mechanics, the special theory of relativity (SR) and relativistic mechanics, in the positive (or our) universe. It is usually denoted by $(x^{0\prime}, x^{1\prime}, x^{2\prime}, x^{3\prime})$, but the more convenient notation $(\Sigma', c_s t)$, where Σ' is the proper Euclidean 3-space with dimensions, $x^{1\prime}, x^{2\prime}$ and $x^{3\prime}$, has been adopted uniformly in the previous papers [1, 2, 3] and this paper. The $(\Sigma', c_s t)$ is the flat proper four-dimensional spacetime manifold in which different metric spacetime frames, $(x^{1\prime}, x^{2\prime}, x^{3\prime}, c_s t')$, $(x^{1\prime\prime}, x^{2\prime\prime}, x^{3\prime\prime}, c_s t'')$, $(x^{1\prime\prime\prime}, x^{2\prime\prime\prime}, x^{3\prime\prime\prime}, c_s t''')$, etc, can be prescribed, in the adopted notation.

When the special theory of relativity operates on the flat four-dimensional proper metric spacetime $(\Sigma', c_s t')$ (in our notation), it is extended straight line primed intrinsic affine spacetime coordinates, $\varnothing\tilde{x}'$ and $\varnothing c_s \varnothing\tilde{t}'$, of the particle's primed intrinsic affine frame $(\varnothing\tilde{x}', \varnothing c_s \varnothing\tilde{t}')$ that are rotated relative to their projective extended straight line unprimed intrinsic affine spacetime coordinates, $\varnothing\tilde{x}$ and $\varnothing c_s \varnothing\tilde{t}$, of the particle's unprimed intrinsic affine frame $(\varnothing\tilde{x}, \varnothing c_s \varnothing\tilde{t})$. It is consequently extended straight line primed intrinsic affine coordinates, $\varnothing\tilde{x}'$ and $\varnothing c_s \varnothing\tilde{t}'$, that transform into extended straight line unprimed intrinsic affine coordinates, $\varnothing\tilde{x}$ and $\varnothing c_s \varnothing\tilde{t}$, in intrinsic Lorentz transformation (∅LT), in the context of intrinsic special theory of relativity (∅SR).

It is extended straight line primed affine coordinates, $c_s\tilde{t}\,', \tilde{x}\,', \tilde{y}\,'$ and $\tilde{z}\,'$, of the particle's primed affine frame $(c_s\tilde{t}\,', \tilde{x}\,', \tilde{y}\,', \tilde{z}\,'$ embedded in the flat four-dimensional proper metric spacetime (Σ', c_st') that transform into extended straight line special-relativistic (or unprimed) affine spacetime coordinates, $c_s\tilde{t}$, $\tilde{x}$, $\tilde{y}$ and $\tilde{z}$, of the particle's unprimed affine frame $(c_s\tilde{t}, \tilde{x}, \tilde{y}, \tilde{z})$, which is also embedded in the unchanged flat four-dimensional proper metric spacetime (Σ', c_st'), in Lorentz transformation (LT) in the context of the special theory of relativity (SR).

The special theory of relativity, as an isolated phenomenon, cannot transform the extended flat proper metric spacetime (Σ', c_st') on which it operates into extended flat relativistic metric spacetime (Σ, c_st), because SR involves the transformation of extended straight line affine spacetime coordinates with no metrical quality. Or because the spacetime geometry associated with SR is affine spacetime geometry.

A recall of the discussion of metric and affine spacetimes in sub-section 4.4 of [1] is appropriate here. The literal definitions of metric spacetime as ponderable, that is, observable and measurable spacetime and of affine spacetime as non-ponderable, that is, non-observable and non-measurable spacetime, are evoked in that sub-section. Further more, it is mentioned in that sub-section that the proper metric spacetime (Σ', ct') is the physical proper four-dimensional spacetime, which is flat with constant Lorentzian metric tensor (in the classical gravitational field). The rest masses of particles and bodies are contained in the proper metric 3-space Σ' (with Euclidean metric tensor), and they move on the flat four-dimensional proper metric spacetime, with the assumed absence of strong gravitational field. It is also mentioned in that sub-section that affine spacetime are mere mathematical entities without physical (or metrical) quality, used to identify the positions and to track the motions of the masses of material particles and bodies (as mass-points), relative to specified origins on the flat proper metric spacetime (Σ', ct'). The path (i.e. the loci of points) of a material point through a metric spacetime are affine coordinates without metrical quality.

The flat four-dimensional intrinsic spacetime $(\varnothing\Sigma', \varnothing c\varnothing t')$ with respect to intrinsic observers in it in Fig. 3b, is ponderable, that is, it is observable and measurable to intrinsic observers in it. The $(\varnothing\Sigma', \varnothing c\varnothing t')$ is consequently a metric spacetime with respect to the intrinsic observers in it, while it is an intrinsic metric spacetime with respect to observers in the proper metric spacetime (Σ', ct').

The primed affine coordinates, $\tilde{x}\,'$, $\tilde{y}\,'$, $\tilde{z}\,'$ and $c_s\tilde{t}\,'$, of the particle's primed affine frame and the unprimed affine coordinates, $\tilde{x}$, $\tilde{y}$, $\tilde{z}$ and $c_s\tilde{t}$, of the particle's unprimed affine frame in the context of SR, are with no metrical quality and both are embedded in the flat proper (or classical) metric spacetime (Σ', c_st'), but knowing that the particle's primed affine frame $(c_s\tilde{t}\,', \tilde{x}\,', \tilde{y}\,', \tilde{z}\,')$ no longer exists, having transformed into the particle's unprimed affine frame $(c_s\tilde{t}\,, \tilde{x}\,, \tilde{y}\,, \tilde{z})$, which is now embedded in (Σ', c_st') in the context of SR, in the new geometries of Fig. 8a (reproduced as Fig. 4 of this paper) and it complementary diagram and their inverse of [1]. Figure 8a of that paper, reproduced as Fig. 4 of this paper, is adequate to illustrate the embedding of the affine coordinates, $\tilde{x}$, $\tilde{y}$, $\tilde{z}$ and $c_s\tilde{t}$ (represented by $(\tilde{\Sigma}', c_s\tilde{t})$, in the metric spacetime (Σ', c_st').

It is strong gravity (gravity being a metric phenomenon) that can transform the extended flat four-dimensional proper (or classical) metric spacetime (with prime label) (Σ', c_st') into extended four-dimensional relativistic metric spacetime (Σ, c_st) (without prime label), where (Σ, c_st) is known to be curved in the gravitational field in the context of the general theory of relativity (GR). The rest mass m_0 of a test particle on the flat proper (or classical) metric spacetime (Σ', c_st') is also known to transform into the inertial mass m on the curved metric spacetime (Σ, c_st) in the context of GR, where m is known to be trivially related to m_0 as, $m = m_0$, by virtue of the Einstein principle of equivalence (EPE), as noted in [11].

However our interest in the previous papers [1, 2, 3] and this paper, is not in the metric phenomenon of gravity, but in the special theory of relativity (with affine spacetime geometry), considered to be isolated from strong gravitational field. We have assumed the absence of strong gravitational field by restricting to the extended flat four-dimensional proper (or classical) metric spacetime $(\Sigma', c_s t')$ of Newtonian gravitation, as the underlying metric spacetime (or 'platform') on which SR in affine spacetime operates in the previous three papers and this paper.

The transformation of the flat proper metric spacetime $(\Sigma', c_s t')$ into relativistic metric spacetime $(\Sigma, c_s t)$, in strong gravitational fields in the present four-world picture, in which four-dimensional metric spacetime is underlay by two-dimensional intrinsic metric spacetime in each of the four symmetrical universes, is worthy of investigation elsewhere.

5 CONCLUSION

The co-existence of four symmetrical universes, identified as positive (or our) universe, negative universe, positive time-universe and negative time-universe, in different four-dimensional spacetimes, is derived in this and three previous papers. A two-dimensional intrinsic spacetime that underlies the four-dimensional spacetime in each universe is also isolated in the papers. The four universes exhibit perfect symmetry of natural laws and perfect symmetry of states. This means that the same natural laws take on identical forms in the four universes. It also means that material particles and bodies are symmetrically distributed in spacetimes in the four universes and all members of every quartet of symmetry-partner particles or bodies in the four universes have identical magnitudes of masses, identical shapes and identical sizes and are involved in symmetrical motions in their respective universes at all times.

The four universes constitute four-world background for the special theory of relativity in each universe, as demonstrated in this and the previous papers. The possibility of subsuming the theory of gravitation into the four-world picture is the next natural step. The investigation of the possibility of the coexistence of larger number of symmetrical universes in different spacetimes than four isolated already is also recommended.

COMPETING INTERESTS

No competing interests are involved in this work.

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