SPECIAL REPORT

Re-Identification of the Many-World Background of Special Relativity as Four-World Background. Part I.

Akindele O. Joseph Adekugbe

Center for The Fundamental Theory, P. O. Box 2575, Akure, Ondo State 340001, Nigeria.
E-mail: adekugbe@alum.mit.edu

The pair of co-existing symmetrical universes, referred to as our (or positive) universe and negative universe, isolated and shown to constitute a two-world background for the special theory of relativity (SR) in previous papers, encompasses another pair of symmetrical universes, referred to as positive time-universe and negative time-universe. The Euclidean 3-spaces (in the context of SR) of the positive time-universe and the negative time-universe constitute the time dimensions of our (or positive) universe and the negative universe respectively, relative to observers in the Euclidean 3-spaces of our universe and the negative universe and the Euclidean 3-spaces of or our universe and the negative universe constitute the time dimensions of the positive time-universe and the negative time-universe respectively, relative to observers in the Euclidean 3-spaces of the positive time-universe and the negative time-universe. Thus time is a secondary concept derived from the concept of space according to this paper. The one-dimensional particle or object in time dimension to every three-dimensional particle or object in 3-space in our universe is a three-dimensional particle or object in 3-space in the positive time-universe. Perfect symmetry of natural laws is established among the resulting four universes and two outstanding issues about the new spacetime/intrinsic spacetime geometrical representation of Lorentz transformation/intrinsic Lorentz transformation in the two-world picture, developed in the previous papers, are resolved within the larger four-world picture in this first part of this paper.

1 Origin of time and intrinsic time dimensions

1.1 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) $\boldsymbol{E}^3$ with mutually orthogonal straight line dimensions x^1, x^2 and x^3 and another Euclidean 3-space $\boldsymbol{E}^{03}$ with mutually orthogonal straight line dimensions x^{01}, x^{02} and x^{03}, the Euclidean 3-space $\boldsymbol{E}^{03}$ shall be said to be orthogonal to the Euclidean 3-space $\boldsymbol{E}^3$ if, and only if, each dimension x^{0j} of $\boldsymbol{E}^{03}$; $j = 1, 2, 3$, is orthogonal to every dimension x^i; $i = 1, 2, 3$ of $\boldsymbol{E}^3$. In other words, $\boldsymbol{E}^{03}$ shall be said to be orthogonal to $\boldsymbol{E}^3$ if, and only if, $x^{0j} \perp x^i$; $i, j = 1, 2, 3$, at every point of the Euclidean 6-space generated by the orthogonal Euclidean 3-spaces.

We shall take the Euclidean 3-spaces $\boldsymbol{E}^3$ and $\boldsymbol{E}^{03}$ to be the proper (or classical) Euclidean 3-spaces of classical mechanics (including classical gravity), to be re-denoted by Σ' and $\Sigma^{0\prime}$ respectively for convenience in this paper. The reason for restricting to the proper (or classical) Euclidean 3-spaces is that we shall assume the absence of relativistic gravity while considering the special theory of relativity (SR) on flat spacetime, as shall be discussed further at the end of this paper.

Graphically, let us consider the Euclidean 3-space Σ' with mutually orthogonal straight line dimensions $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ as a hyper-surface to be represented by a horizontal plane surface and the Euclidean 3-space $\Sigma^{0\prime}$ with mutually orthogonal straight line dimensions $x^{01\prime}$, $x^{02\prime}$ and $x^{03\prime}$ as a hyper-surface to be represented by a vertical plane surface. The union of the two orthogonal proper (or classical) Euclidean 3-spaces yields a compound six-dimensional proper (or classical) Euclidean space with mutually orthogonal dimensions $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$, $x^{01\prime}$, $x^{02\prime}$ and $x^{03\prime}$ illustrated in Fig. 1.

As introduced (as *ansatz*) in [1] and as shall be derived formally in the two parts of this paper, the hyper-surface (or proper Euclidean 3-space) Σ' along the horizontal is underlied by an isotropic one-dimensional proper intrinsic space denoted by $\phi\rho'$ (that has no unique orientation in the Euclidean 3-space Σ'). The vertical proper Euclidean 3-space $\Sigma^{0\prime}$ is likewise underlied by an isotropic one-dimensional proper intrinsic space $\phi\rho^{0\prime}$ (that has no unique orientation in the Euclidean 3-space $\Sigma^{0\prime}$). The underlying intrinsic spaces $\phi\rho'$ and $\phi\rho^{0\prime}$ are also shown in Fig. 1.

Inclusion of the proper time dimension ct' along the vertical, normal to the horizontal hyper-surface (or horizontal Euclidean 3-space) Σ' in Fig. 1, yields the flat four-dimensional proper spacetime (Σ', ct') of classical mechanics (CM), (including classical gravitation), of the positive (or our) universe and inclusion of the proper intrinsic time dimension $\phi c\phi t'$ along the vertical, normal to the proper intrinsic space $\phi\rho'$ along the horizontal, yields the flat 2-dimensional proper intrinsic spacetime $(\phi\rho', \phi c\phi t')$ of intrinsic classical mechanics

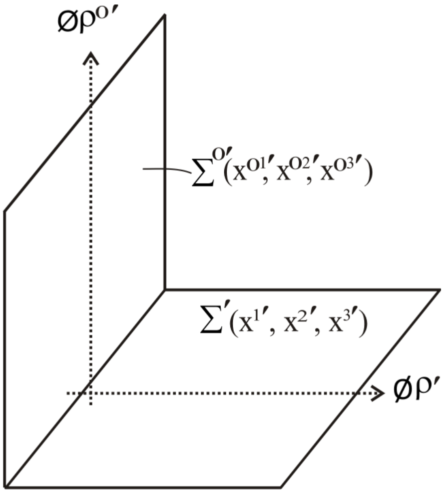

Fig. 1: Co-existing two orthogonal proper Euclidean 3-spaces (considered as hyper-surfaces) and their underlying isotropic one-dimensional proper intrinsic spaces.

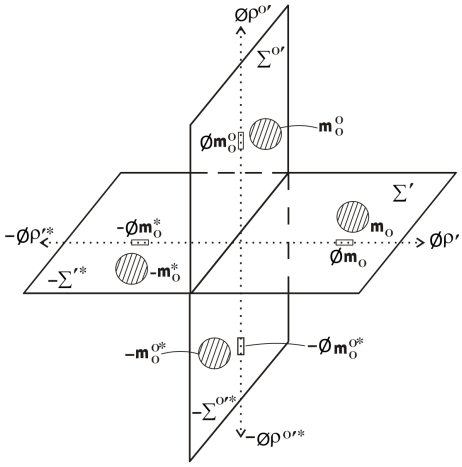

Fig. 2: Co-existing four mutually orthogonal proper Euclidean 3-spaces and their underlying isotropic one-dimensional proper intrinsic spaces, where the rest masses in the proper Euclidean 3-spaces and the one-dimensional intrinsic rest masses in the intrinsic spaces of a quartet of symmetry-partner particles or object are shown.

(ϕCM), (including intrinsic classical gravitation), of our universe. The proper Euclidean 3-space Σ' and its underlying one-dimensional proper intrinsic space $\phi\rho'$ shall sometimes be referred to as our proper (or classical) Euclidean 3-space and our proper (or classical) intrinsic space for brevity.

The vertical proper Euclidean 3-space $\Sigma^{0\prime}$ and its underlying one-dimensional proper intrinsic space $\phi\rho^{0\prime}$ in Fig. 1 are new. They are different from the proper Euclidean 3-space $-\Sigma'^{*}$ and its underlying proper intrinsic space $-\phi\rho'^{*}$ of the negative universe isolated in [1] and [2]. The Euclidean 3-space $-\Sigma'^{*}$ and its underlying proper intrinsic space $-\phi\rho'^{*}$ of the negative universe are "anti-parallel" to the Euclidean 3-space Σ' and its underlying intrinsic space $\phi\rho'$ of the positive universe, which means that the dimensions $-x^{1\prime *}$, $-x^{2\prime *}$ and $-x^{3\prime *}$ of $-\Sigma'^{*}$ are inversions in the origin of the dimensions $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ of Σ'.

There are likewise the proper Euclidean 3-space $-\Sigma^{0\prime *}$ and its underlying proper intrinsic space $-\phi\rho^{0\prime *}$, which are "anti-parallel" to the new proper Euclidean 3-space $\Sigma^{0\prime}$ and its underlying proper intrinsic space $\phi\rho^{0\prime}$ in Fig. 1. Fig. 1 shall be made more complete by adding the negative proper Euclidean 3-spaces $-\Sigma'^{*}$ and $-\Sigma^{0\prime *}$ and their underlying one-dimensional intrinsic spaces $-\phi\rho'^{*}$ and $-\phi\rho^{0\prime *}$ to it, yielding Fig. 2.

The proper Euclidean 3-space Σ' with dimensions $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ and the proper Euclidean 3-space $\Sigma^{0\prime}$ with dimensions $x^{01\prime}$, $x^{02\prime}$ and $x^{03\prime}$ in Fig. 2 are orthogonal Euclidean 3-spaces, which means that $x^{0j\prime} \perp x^{i\prime}$; $i, j = 1, 2, 3$, as defined earlier. The proper Euclidean 3-space $-\Sigma'^{*}$ with dimensions $-x^{1\prime *}$, $-x^{2\prime *}$ and $-x^{3\prime *}$ and the proper Euclidean 3-space $-\Sigma^{0\prime *}$ with dimensions $-x^{01\prime *}$, $-x^{02\prime *}$ and $-x^{03\prime *}$ are likewise orthogonal Euclidean 3-spaces.

Should the vertical Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ and their underlying isotropic intrinsic spaces $\phi\rho^{0\prime}$ and $-\phi\rho^{0\prime *}$ exist naturally, then they should belong to a new pair of worlds (or universes), just as the horizontal proper Euclidean 3-space Σ' and $-\Sigma'^{*}$ and their underlying one-dimensional isotropic proper intrinsic spaces $\phi\rho'$ and $-\phi\rho'^{*}$ exist naturally and belong to the positive (or our) universe and the negative universe respectively, as found in [1] and [2]. The appropriate names for the new pair of universes with flat four-dimensional proper spacetimes $(\Sigma^{0\prime}, ct^{0\prime})$ and $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ of classical mechanics (CM) and their underlying flat two-dimensional proper intrinsic spacetimes $(\phi\rho^{0\prime}, \phi c\phi t^{0\prime})$ and $(-\phi\rho^{0\prime *}, -\phi c\phi t^{0\prime *})$ of intrinsic classical mechanics (ϕCM), where the time dimensions and intrinsic time dimensions have not yet appeared in Fig. 2, shall be derived later in this paper.

As the next step, an assumption shall be made, which shall be justified with further development of this paper, that the four universes encompassed by Fig. 2, with flat four- dimensional proper spacetimes (Σ', ct'), $(-\Sigma'^{*}, -ct'^{*})$, $(\Sigma^{0\prime}, ct^{0\prime})$ and $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ and their underlying flat proper intrinsic spacetimes $(\phi\rho', \phi c\phi t')$, $(-\phi\rho'^{*}, -\phi c\phi t'^{*})$, $(\phi\rho^{0\prime}, \phi c\phi t^{0\prime})$ and $(-\phi\rho^{0\prime *}, -\phi c\phi t^{0\prime *})$ respectively, where the proper time and proper intrinsic time dimensions have not yet appeared in Fig. 2, exist naturally and exhibit perfect symmetry of state and perfect symmetry of natural laws. Implied by this assumption are the following facts:

1. Corresponding to every given point P in our proper Euclidean 3-space Σ', there are unique symmetry- partner point P^{0}, P^{*} and P^{0*} in the proper Euclidean 3-spaces $\Sigma^{0\prime}$, $-\Sigma'^{*}$ and $-\Sigma^{0\prime *}$ respectively;
2. Corresponding to every particle or object of rest mass m_0 located at a point in our proper Euclidean 3-space Σ', there are identical symmetry-partner particles or ob-

jects of rest masses to be denoted by m_0^0, $-m_0^*$ and $-m_0^{0*}$ located at the symmetry-partner points in $\Sigma^{0\prime}$, $-\Sigma'^*$ and $-\Sigma^{0\prime *}$ respectively, as illustrated in Fig. 2 already and

3. Corresponding to motion at a speed v of the rest mass m_0 of a particle or object through a point along a direction in our proper Euclidean space Σ', relative to an observer in Σ', there are identical symmetry- partner particles or objects of rest masses m_0^0, $-m_0^*$ and $-m_0^{0*}$ in simultaneous motions at equal speed v along identical directions through the symmetry-partner points in the proper Euclidean 3-spaces $\Sigma^{0\prime}$, $-\Sigma'^*$ and $-\Sigma^{0\prime *}$ respectively, relative to identical symmetry-partner observers in the respective Euclidean 3-spaces.

4. A further requirement of the symmetry of state among the four universes encompassed by Fig. 2 is that the motion at a speed v of a particle along the $X-$ axis, say, of its frame in any one of the four proper Euclidean 3-spaces, (in $\Sigma^{0\prime}$, say), relative to an observer (or frame of reference) in that proper Euclidean 3-space (or universe), is equally valid relative to the symmetry-partner observers in the three other proper Euclidean 3-spaces (or universes). Consequently the simultaneous rotations by equal intrinsic angle $\phi\psi$ of the intrinsic affine space coordinates of the symmetry-partner particles' frames $\phi\tilde{x}'$, $\phi\tilde{x}^{0\prime}$, $-\phi\tilde{x}'^*$ and $-\phi\tilde{x}^{0\prime *}$ relative to the intrinsic affine space coordinates of the symmetry-partner observers' frames $\phi\tilde{x}$, $\phi\tilde{x}^0$, $-\phi\tilde{x}^*$ and $-\phi\tilde{x}^{0*}$ respectively in the context of the intrinsic special theory of relativity (ϕSR), as developed in [1], implied by item 3, are valid relative to every one of the four symmetry-partner observers in the four proper Euclidean 3-spaces (or universes). Thus every one of the four symmetry-partner observers can validly draw the identical relative rotations of affine intrinsic spacetime coordinates of symmetry-partner frames of reference in the four universes encompassed by Fig. 2 with respect to himself and construct ϕSR and consequently SR in his universe with the diagram encompassing the four universes he obtains.

Inherent in item 4 above is the fact that the four universes with flat four-dimensional proper physical (or metric) spacetimes (Σ', ct'), $(\Sigma^{0\prime}, ct^{0\prime})$, $(-\Sigma'^*, -ct'^*)$ and $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ of classical mechanics (CM) in the universes encompassed by Fig. 2, (where the proper time dimensions have not yet appeared), are stationary dynamically relative to one another at all times. Otherwise the speed v of a particle in a universe (or in a Euclidean 3-space in Fig. 2) relative to an observer in that universe (or in that Euclidean 3-space), will be different relative to the symmetry-partner observer in another universe (or in another Euclidean 3-space), who must obtain the speed of the particle relative to himself as the resultant of the particle's speed v relative to the observer in the particle's universe and the speed V_0 of the particle's universe (or particle's Euclidean 3-space) relative to his universe (or his Euclidean 3-space). The simultaneous identical relative rotations by equal intrinsic angle of intrinsic affine spacetime coordinates of symmetry-partner frames of reference in the four universes, which symmetry of state requires to be valid with respect to every one of the four symmetry-partner observers in the four universes, will therefore be impossible in the situation where some or all the four universes (or Euclidean 3-spaces in Fig. 2) are naturally in motion relative to one another.

Now the proper intrinsic metric space $\phi\rho^{0\prime}$ along the vertical in the first quadrant is naturally rotated at an intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ relative to the proper intrinsic metric space $\phi\rho'$ of the positive (or our) universe along the horizontal in the first quadrant in Fig. 2. The proper intrinsic metric space $-\phi\rho'^*$ of the negative universe is naturally rotated at intrinsic angle $\phi\psi_0 = \pi$ relative to our proper intrinsic metric space $\phi\rho'$ and the proper intrinsic metric space $-\phi\rho^{0\prime *}$ along the vertical in the third quadrant is naturally rotated at intrinsic angle $\phi\psi_0 = \frac{3\pi}{2}$ relative to our proper intrinsic metric space $\phi\rho'$ in Fig. 2. The intrinsic angle of natural rotations of the intrinsic metric spaces $\phi\rho^{0\prime}, -\phi\rho'^*$ and $-\phi\rho^{0\prime *}$ relative to $\phi\rho'$ has been denoted by $\phi\psi_0$ in order differentiate it from the intrinsic angle of relative rotation of intrinsic affine spacetime coordinates in the context of ϕSR denoted by $\phi\psi$ in [1].

The natural rotations of the one-dimensional proper intrinsic metric spaces $\phi\rho^{0\prime}, -\phi\rho'^*$ and $-\phi\rho^{0\prime *}$ relative to our proper intrinsic metric space $\phi\rho'$ at different intrinsic angles $\phi\psi_0$ discussed in the foregoing paragraph, implies that the intrinsic metric spaces $\phi\rho^{0\prime}$, $-\phi\rho'^*$ and $-\phi\rho^{0\prime *}$ possess different intrinsic speeds, to be denoted by ϕV_0, relative to our intrinsic metric space $\phi\rho'$. This is deduced in analogy to the fact that the intrinsic speed ϕv of the intrinsic rest mass ϕm_0 of a particle relative to an observer causes the rotations of the intrinsic affine spacetime coordinates $\phi\tilde{x}'$ and $\phi c\phi\tilde{t}'$ of the particle's intrinsic frame at equal intrinsic angle $\phi\psi$ relative to the intrinsic affine spacetime coordinates $\phi\tilde{x}$ and $\phi c\phi\tilde{t}$ respectively of the observe's intrinsic frame in the context of intrinsic special relativity (ϕSR), as developed in [1] and presented graphically in Fig. 8a of that paper.

Indeed the derived relation, $\sin\phi\psi = \phi v/\phi c$, between the intrinsic angle $\phi\psi$ of inclination of the intrinsic affine space coordinate $\phi\tilde{x}'$ of the particle's intrinsic frame relative to the intrinsic affine space coordinate $\phi\tilde{x}$ of the observer's intrinsic frame in the context of ϕSR, presented as Eq. (18) of [1], is equally valid between the intrinsic angle $\phi\psi_0$ of natural rotation of a proper intrinsic metric space $\phi\rho^{0\prime}$, say, relative to our proper intrinsic metric space $\phi\rho'$ in Fig. 2 and the implied natural intrinsic speed ϕV_0 of $\phi\rho^{0\prime}$ relative to $\phi\rho'$. In other words, the following relation obtains between $\phi\psi_0$ and ϕV_0:

$$\sin\phi\psi_0 = \phi V_0/\phi c \tag{1}$$

It follows from (1) that the intrinsic metric space $\phi\rho^{0\prime}$ naturally possesses intrinsic speed $\phi V_0 = \phi c$ relative to our intrinsic metric space $\phi\rho'$, which is so since $\phi\rho^{0\prime}$ is naturally inclined at intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ relative to $\phi\rho'$; the proper intrinsic metric space $-\phi\rho'^*$ of the negative universe naturally possesses zero intrinsic speed ($\phi V_0 = 0$) relative to our proper intrinsic metric space $\phi\rho'$, since $-\phi\rho'^*$ is naturally inclined at intrinsic angle $\phi\psi_0 = \pi$ relative to $\phi\rho'$ and the intrinsic metric space $-\phi\rho^{0\prime*}$ naturally possesses intrinsic speed $\phi V_0 = -\phi c$ relative to our intrinsic metric space $\phi\rho'$, since $-\phi\rho^{0\prime*}$ is naturally inclined at $\phi\psi_0 = \frac{3\pi}{2}$ relative to $\phi\rho'$ in Fig. 2.

On the other hand, $-\phi\rho^{0\prime*}$ possesses positive intrinsic speed $\phi V_0 = \phi c$ relative to $-\phi\rho'^*$, since $-\phi\rho^{0\prime*}$ is naturally inclined at intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ relative to $-\phi\rho'^*$ and $\phi\rho^{0\prime}$ naturally possesses negative intrinsic speed $\phi V_0 = -\phi c$ relative to $-\phi\rho'^*$, since $\phi\rho^{0\prime}$ is naturally inclined at $\phi\psi_0 = \frac{3\pi}{2}$ relative to $-\phi\rho'^*$ in Fig 2. These facts have been illustrated in Figs. 10a and 10b of [1] for the concurrent open intervals $(-\frac{\pi}{2}, \frac{\pi}{2})$ and $(\frac{\pi}{2}, \frac{3\pi}{2})$ within which the intrinsic angle $\phi\psi$ could take on values with respect to 3-observers in the Euclidean 3-spaces Σ' of the positive universe and $-\Sigma'^*$ of the negative universe.

The natural intrinsic speed $\phi V_0 = \phi c$ of $\phi\rho^{0\prime}$ relative to $\phi\rho'$ will be made manifest in speed $V_0 = c$ of the Euclidean 3-space $\Sigma^{0\prime}$ relative to our Euclidean 3-space Σ'; the natural zero intrinsic speed ($\phi V_0 = 0$) of the intrinsic space $-\phi\rho'^*$ of the negative universe relative to $\phi\rho'$ will be made manifest in natural zero speed ($V_0 = 0$) of the Euclidean 3-space $-\Sigma'^*$ of the negative universe relative to our Euclidean 3-space Σ' and the natural intrinsic speed $\phi V_0 = -\phi c$ of $-\phi\rho^{0\prime*}$ relative to $\phi\rho'$ will be made manifest in natural speed $V_0 = -c$ of the Euclidean 3-space $-\Sigma^{0\prime*}$ relative to our Euclidean 3-space Σ' in Fig. 2. By incorporating the additional information in this and the foregoing two paragraphs into Fig. 2 we have Fig. 3, which is valid with respect to 3-observers in our proper Euclidean 3-spaces Σ', as indicated.

There are important differences between the speeds V_0 of the Euclidean 3-spaces that appear in Fig. 3 and speed v of relative motion of particles and objects that appear in the special theory of relativity (SR). First of all, the speed v of relative motion is a property of the particle or object in relative motion, which exists nowhere in the vast space outside the particle at any given instant. This is so because there is nothing (no action-at-a-distance) in relative motion to transmit the velocity of a particle to positions outside the particle. On the other hand, the natural speed V_0 of a Euclidean 3-space is a property of that Euclidean 3-space, which has the same magnitude at every point of the Euclidean 3-space with or without the presence of a particle or object of any rest mass.

The natural speed V_0 of a Euclidean 3-space is isotropic. This means that it has the same magnitude along every direction of the Euclidean 3-space. This is so because each dimension $x^{0j\prime}$; $j = 1, 2, 3$, of $\Sigma^{0\prime}$ is rotated at equal angle $\psi_0 = \frac{\pi}{2}$ relative to every dimension $x^{i\prime}$; $i = 1, 2, 3$, of Σ', (which implies that each dimension $x^{0j\prime}$ of $\Sigma^{0\prime}$ possesses speed $V_0 = c$ naturally relative to every dimension $x^{i\prime}$ of Σ'), thereby making $\Sigma^{0\prime}$ an orthogonal Euclidean 3-space to Σ'. What should be the natural velocity $\vec{V}_0$ of a Euclidean 3-space has components of equal magnitude V_0 along every direction and at every point in that Euclidean 3-space. On the other hand, the speed v of relative motion of a particle or object is not isotropic because the velocity $\vec{v}$ of relative motion along a direction in a Euclidean 3-space has components of different magnitudes along different directions of that Euclidean 3-space. Only the speed $v = c$ of translation of light (or photon) in space is known to be isotropic.

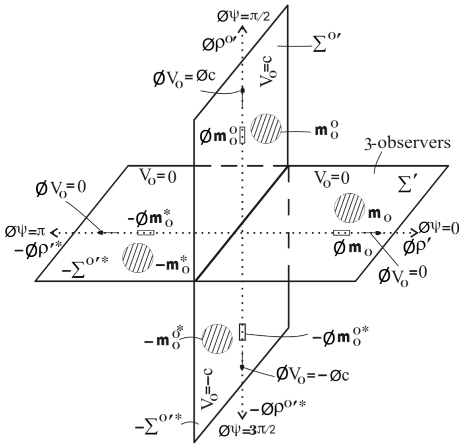

Fig. 3: Co-existing four mutually orthogonal proper Euclidean 3-spaces and their underlying isotropic one-dimensional proper intrinsic spaces, where the speeds V_0 of the Euclidean 3-spaces and the intrinsic speeds ϕV_0 of the intrinsic spaces, relative to 3-observers in our proper Euclidean 3-space (considered as a hyper-surface along the horizontal) in the first quadrant are shown.

Now a material particle or object of any magnitude of rest mass that is located at any point in a Euclidean 3-space acquires the natural speed V_0 of that Euclidean 3-space. Thus the rest mass m_0 of the particle or object located in our proper Euclidean 3-space Σ' possesses the spatially uniform natural zero speed ($V_0 = 0$) of Σ' relative to every particle, object or observer in Σ' in Fig. 3. Likewise the rest mass m_0^0 of a particle or object located at any point in the proper Euclidean 3-space $\Sigma^{0\prime}$ acquires the isotropic and spatially uniform natural speed $V_0 = c$ of $\Sigma^{0\prime}$ relative to every particle, object or observer in our Euclidean 3-space Σ'.

The rest mass $-m_0^*$ located at any point in the proper Euclidean 3-space $-\Sigma'^*$ of the negative universe acquires the spatially uniform natural zero speed ($V_0 = 0$) of $-\Sigma'^*$ relative to all particles, objects and observers in our Euclidean 3-space Σ' and the rest mass $-m_0^{0*}$ of a particle or object located at any point in the proper Euclidean 3-space $-\Sigma^{0\prime*}$ acquires the isotropic and spatially uniform natural speed $V_0 = -c$ of $-\Sigma^{0\prime*}$ relative to all particles, objects and observers in our Euclidean 3-space Σ' in Fig. 3.

However, as deduced earlier, symmetry of state among the four universes whose proper (or classical) Euclidean 3-

spaces appear in Fig. 2 or 3 requires that the four universes must be stationary relative to one another always. Then in order to resolve the paradox ensuing from this and the foregoing two paragraphs namely, all the four universes (or their proper Euclidean 3-spaces in Fig. 2 or 3) are stationary relative to one another always (as required by symmetry of state among the four universes), yet the two universes with flat proper spacetimes $(\Sigma^{0\prime}, ct^{0\prime})$ and $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ naturally possess constant speeds $V_0 = c$ and $V_0 = -c$ respectively relative to the flat spacetime (Σ', ct') of our universe, we must consider the constant speeds $V_0 = c$ and $V_0 = -c$ of the universes with the flat spacetimes $(\Sigma^{0\prime}, ct^{0\prime})$ and $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ respectively relative to our universe (or speeds $V_0 = c$ and $V_0 = -c$ of the Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ respectively relative to our Euclidean 3-space Σ' in Fig. 3) as absolute speeds of non-detectable absolute motion. This way, although the two proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ naturally possess speeds $V_0 = c$ and $V_0 = -c$ respectively relative to our proper Euclidean 3-space Σ', the four proper Euclidean 3-spaces encompassed by Fig. 2 or 3 are stationary dynamically (or translation-wise) relative to one another, as required by symmetry of state among the four universes with the four proper Euclidean 3-spaces in Fig. 2 or Fig. 3.

The fact that the natural speed $V_0 = c$ of the proper Euclidean 3-space $\Sigma^{0\prime}$ relative to our proper Euclidean 3-space Σ' or of the rest mass m_0^0 in $\Sigma^{0\prime}$ relative to the symmetry-partner rest mass m_0 in Σ' is an absolute speed of non-detectable absolute motion is certain. This is so since there is no relative motion involving large speed $V_0 = c$ between the rest mass of a particle in the particle's frame and the rest mass of the particle in the observer's frame, (where m_0^0 is the rest mass of the particle and $\Sigma^{0\prime}$ in which m_0^0 is in motion at speed $V_0 = c$ is the particle's frame, while m_0 is the rest mass of the particle located in the observer's frame Σ' in this analogy, knowing that m_0 and m_0^0 are equal in magnitude).

The observer's frame always contains special-relativistic (or Lorentz transformed) coordinates and parameters in special relativity. On the other hand, non-detectable absolute motion does not alter the proper (or classical) coordinates and parameters, as in the case of the non-detectable natural absolute motion at absolute speed $V_0 = c$ of m_0^0 in $\Sigma^{0\prime}$ relative to m_0 that possesses zero absolute speed ($V_0 = 0$) in Σ' in Fig. 3.

We have derived another important difference between the natural speeds V_0 of the Euclidean 3-spaces that appear in Fig. 3 and the speeds v of relative motions of material particles and objects that appear in SR. This is the fact that the isotropic and spatially uniform speed V_0 of a Euclidean 3-space is an absolute speed of non-detectable absolute motion, while speed v of particles and objects is a speed of detectable relative motion.

Thus the isotropic speed $V_0 = c$ acquired by the rest mass m_0^0 located in the proper Euclidean 3-space $\Sigma^{0\prime}$ relative to its symmetry-partner m_0 and all other particles, objects and observers in our proper Euclidean 3-space Σ' in Fig. 3 is a non-detectable absolute speed. Consequently m_0^0 in $\Sigma^{0\prime}$ does not propagate away at speed $V_0 = c$ in $\Sigma^{0\prime}$ from m_0 in Σ' but remains tied to m_0 in Σ' always, despite its isotropic absolute speed c in $\Sigma^{0\prime}$ relative to m_0 in Σ'. The speed $V_0 = -c$ acquired by the rest mass $-m_0^{0*}$ in the proper Euclidean 3-space $-\Sigma^{0\prime *}$ relative to its symmetry-partner rest mass m_0 and all other particles, objects and observers in our Euclidean 3-space Σ' in Fig. 3 is likewise an absolute speed of non-detectable absolute motion. Consequently $-m_0^{0*}$ in $-\Sigma^{0\prime *}$ does not propagate away at speed $V_0 = -c$ in $-\Sigma^{0\prime *}$ from m_0 in Σ' but remains tied to m_0 in Σ' always, despite the absolute speed $V_0 = -c$ of $-m_0^{0*}$ in $-\Sigma^{0\prime *}$ relative to m_0 in Σ'.

On the other hand, the rest mass $-m_0^{0*}$ in $-\Sigma^{0\prime *}$ possesses positive absolute speed $V_0 = c$ and rest mass m_0^0 in $\Sigma^{0\prime}$ possesses negative absolute speed $V_0 = -c$ with respect to the symmetry-partner rest mass $-m_0^*$ and all other particles, objects and observers in $-\Sigma'^*$. This is so since the proper intrinsic space $-\phi\rho^{0\prime *}$ underlying $-\Sigma^{0\prime *}$ is naturally rotated by intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ relative to the proper intrinsic space $-\phi\rho'^*$ underlying $-\Sigma'^*$ and $\phi\rho^{0\prime}$ underlying $\Sigma^{0\prime}$ is naturally rotated by intrinsic angle $\phi\psi_0 = \frac{3\pi}{2}$ relative to $-\phi\rho'^*$, as mentioned earlier. Consequently $-\phi\rho^{0\prime *}$ naturally possesses absolute intrinsic speed $\phi V_0 = \phi c$ relative to $-\phi\rho'^*$ and $\phi\rho^{0\prime}$ naturally possesses absolute intrinsic speed $\phi V_0 = -\phi c$ relative to $-\phi\rho'^*$. These are then made manifest outwardly as the absolute speed $V_0 = c$ of the Euclidean 3-space $-\Sigma^{0\prime *}$ and absolute speed $V_0 = -c$ of the Euclidean 3-space $\Sigma^{0\prime}$ respectively relative to the Euclidean 3-space $-\Sigma'^*$ of the negative universe.

Let the quartet of symmetry-partner particles or objects of rest masses m_0 in Σ', m_0^0 in $\Sigma^{0\prime}$, $-m_0^*$ in $-\Sigma'^*$ and $-m_0^{0*}$ in $-\Sigma^{0\prime *}$ be located at initial symmetry-partner positions P_i, P_i^0, P_i^* and P_i^{0*} respectively in their respective Euclidean 3-spaces. Then let the particle or object of rest mass m_0 in Σ' be in motion at constant speed v along the $\tilde{x}'$−axis of its frame in our proper Euclidean 3-space Σ' relative to a 3-observer in Σ'. The symmetry-partner particle or object of rest mass m_0^0 in $\Sigma^{0\prime}$ will be in simultaneous motion at equal speed v along the $\tilde{x}^{0\prime}$−axis of its frame in $\Sigma^{0\prime}$ relative to the symmetry-partner observer in $\Sigma^{0\prime}$; the symmetry-partner particle or object of rest mass $-m_0^*$ in $-\Sigma'^*$ will be in simultaneous motion at equal speed v along the $-\tilde{x}'^*$−axis of its frame in $-\Sigma'^*$ relative to the symmetry-partner 3-observer in $-\Sigma'^*$ and the symmetry-partner particle or object of rest mass $-m_0^{0*}$ in $-\Sigma^{0\prime *}$ will be in simultaneous motion at equal speed v along the $-\tilde{x}^{0\prime *}$−axis of its frame in $-\Sigma^{0\prime *}$ relative to the symmetry-partner 3-observer in $-\Sigma^{0\prime *}$.

Thus after a period of time of commencement of motion, the quartet of symmetry-partner particles or objects have covered equal distances along the identical directions of motion in their respective proper Euclidean 3-spaces to arrive at new symmetry-partner positions P, P^0, P^* and P^{0*} in their respective proper Euclidean 3-spaces. This is possible because the four Euclidean 3-spaces are stationary relative to one another always. The quartet of symmetry-partner particles or objects are consequently located at symmetry-partner positions in their respective proper Euclidean 3-spaces always, even when they are in motion relative to symmetry-partner frames of reference in their respective proper Euclidean 3-spaces.

The speed $V_0 = c$ of the proper Euclidean 3-space $\Sigma^{0\prime}$ relative to our proper Euclidean 3-space Σ' is the outward manifestation of the intrinsic speed $\phi V_0 = \phi c$ of the intrinsic metric space $\phi\rho^{0\prime}$ underlying $\Sigma^{0\prime}$ relative to our intrinsic metric space $\phi\rho'$ and relative to our Euclidean 3-space Σ' in Fig. 3. Then since $V_0 = c$ is absolute and is the same at every point of the Euclidean 3-space $\Sigma^{0\prime}$, the intrinsic speed $\phi V_0 = \phi c$ of $\phi\rho^{0\prime}$ relative to $\phi\rho'$ and Σ' is absolute and is the same at every point along the length of $\phi\rho^{0\prime}$. The intrinsic speed $\phi V_0 = -\phi c$ of the intrinsic metric space $-\phi\rho^{0\prime *}$ relative to our intrinsic metric space $\phi\rho'$ and relative to our Euclidean 3-space Σ' is likewise an absolute intrinsic speed and is the same at every point along the length of $-\phi\rho^{0\prime *}$. The zero intrinsic speed ($\phi V_0 = 0$) of the intrinsic metric space $-\phi\rho'^*$ of the negative universe relative to our intrinsic metric space $\phi\rho'$ and relative to our Euclidean 3-space Σ' is the same along the length of $-\phi\rho'^*$.

It follows from the foregoing paragraph that although the proper intrinsic metric spaces $\phi\rho^{0\prime}$ and $-\phi\rho^{0\prime *}$ along the vertical possess intrinsic speeds $\phi V_0 = \phi c$ and $\phi V_0 = -\phi c$ respectively, relative to our proper intrinsic metric space $\phi\rho'$ and relative to our Euclidean 3-space Σ', the four intrinsic metric spaces $\phi\rho'$, $\phi\rho^{0\prime}$, $-\phi\rho'^*$ and $-\phi\rho^{0\prime *}$ in Fig. 3 are stationery relative to one another always, since the intrinsic speeds $\phi V_0 = \phi c$ of $\phi\rho^{0\prime}$ and $\phi V_0 = -\phi c$ of $-\phi\rho'^*$ relative to our intrinsic metric space $\phi\rho'$ and our Euclidean 3-space Σ' are absolute intrinsic speeds, which are not made manifest in actual intrinsic motion.

Likewise, although the intrinsic rest mass ϕm_0^0 in $\phi\rho^{0\prime}$ acquires the intrinsic speed $\phi V_0 = \phi c$ of $\phi\rho^{0\prime}$, it is not in intrinsic motion at the intrinsic speed ϕc along $\phi\rho^{0\prime}$, since the intrinsic speed ϕc it acquires is an absolute intrinsic speed. The absolute intrinsic speed $\phi V_0 = -\phi c$ acquired by the intrinsic rest mass $-\phi m_0^{0*}$ in $-\phi\rho^{0\prime *}$ is likewise not made manifest in actual intrinsic motion of $-\phi m_0^{0*}$ along $-\phi\rho^{0\prime *}$. Consequently the quartet of intrinsic rest masses $\phi m_0, \phi m_0^0, -\phi m_0^*$ and $-\phi m_0^{0*}$ of symmetry-partner particles or objects in the quartet of intrinsic metric spaces $\phi\rho'$, $\phi\rho^{0\prime}$, $-\phi\rho'^*$ and $-\phi\rho^{0\prime *}$, are located at symmetry-partner points in their respective intrinsic spaces always, even when they are in intrinsic motions relative to symmetry-partner frames of reference in their respective Euclidean 3-spaces.

There is a complementary diagram to Fig. 3, which is valid with respect to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$ along the vertical, which must also be drawn along with Fig. 3. Now given the quartet of the proper physical (or metric) Euclidean 3-spaces and their underlying one-dimensional intrinsic metric spaces in Fig. 2, then Fig. 3 with the ab-

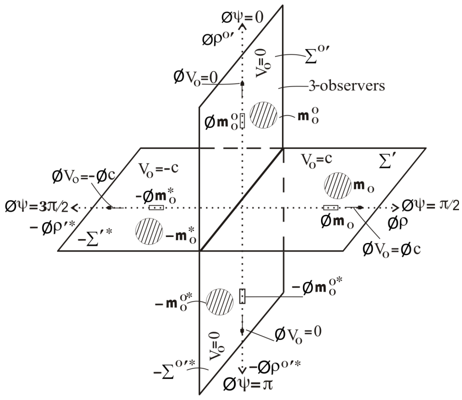

Fig. 4: Co-existing four mutually orthogonal proper Euclidean 3-spaces and their underlying isotropic one-dimensional proper intrinsic metric spaces, where the speeds V_0 of the Euclidean 3-spaces and the intrinsic speeds ϕV_0 of the intrinsic spaces, relative to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$ (considered as a hyper-surface) along the vertical in the first quadrant are shown.

solute speeds V_0 of the proper Euclidean 3-spaces and absolute intrinsic speed ϕV_0 of the proper intrinsic spaces assigned with respect to 3-observers in the proper Euclidean 3-space Σ' of the positive (or our) universe, ensues automatically.

On the other hand, the proper physical Euclidean 3-space $\Sigma^{0\prime}$ along the vertical in Fig. 2 possesses zero absolute speed ($V_0 = 0$) at every point of it and its underlying one- dimensional intrinsic space $\phi\rho^{0\prime}$ possesses zero absolute intrinsic speed ($\phi V_0 = 0$) at every point along its length with respect to 3-observers in $\Sigma^{0\prime}$. This is so since $\phi\rho^{0\prime}$ must be considered as rotated by zero intrinsic angle ($\phi\psi_0 = 0$) relative to itself (or relative to the vertical) when the observers of interest are the 3-observers in $\Sigma^{0\prime}$. Then letting $\phi\psi_0 = 0$ in (1) gives zero absolute intrinsic speed ($\phi V_0 = 0$) at every point along $\phi\rho^{0\prime}$ with respect to 3-observers in $\Sigma^{0\prime}$. The physical Euclidean 3-space $\Sigma^{0\prime}$ then possesses zero absolute speed ($V_0 = 0$) at every point of it as the outward manifestation of $\phi V_0 = 0$ at every point along $\phi\rho^{0\prime}$, with respect to 3-observers in $\Sigma^{0\prime}$. It then follows that Fig. 3 with respect to 3-observers in our Euclidean 3-space Σ' corresponds to Fig. 4 with respect to 3-observers in the Euclidean 3-space $\Sigma^{0\prime}$.

It is mandatory to consider the intrinsic metric space $\phi\rho'$ of the positive (or our) universe along the horizontal in the first quadrant as naturally rotated clockwise by a positive intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$; the intrinsic metric space $-\phi\rho^{0\prime *}$ along the vertical in the fourth quadrant as naturally rotated clockwise by a positive intrinsic angle $\phi\psi_0 = \pi$ and the intrinsic metric space $-\phi\rho'^*$ of the negative universe along the horizontal in the third quadrant as naturally rotated clockwise by a positive intrinsic angle $\phi\psi_0 = \frac{3\pi}{2}$ relative to $\phi\rho^{0\prime}$ along the vertical in the first quadrant or with respect to 3-observers in the Euclidean 3-space $\Sigma^{0\prime}$, as indicated in Fig. 4. This way, the positive signs of our proper intrinsic space $\phi\rho'$ and of the dimensions $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ of our proper Euclidean 3-space Σ', as well as the positive signs of parameters in Σ' in our (or positive) universe in Fig. 3 are preserved in Fig. 4. The negative signs of $-\phi\rho'^{*}$, $-\Sigma'^{*}$ and of parameters in $-\Sigma'^{*}$ in the negative universe in Fig. 3 are also preserved in Fig. 4, by virtue of the clockwise sense of rotation by positive intrinsic angle $\phi\psi_0$ of $-\phi\rho^{0\prime *}$ and $-\phi\rho'^{*}$ relative to $\phi\rho^{0\prime}$ or with respect to 3-observers in $\Sigma^{0\prime}$ in Fig. 4.

If the clockwise rotations of $\phi\rho'$, $-\phi\rho^{0\prime *}$ and $-\phi\rho'^{*}$ relative to $\phi\rho^{0\prime}$ or with respect to 3-observers in $\Sigma^{0\prime}$ in Fig. 4, have been considered as rotation by negative intrinsic angles $\phi\psi_0 = -\frac{\pi}{2}, \phi\psi_0 = -\pi$ and $\phi\psi_0 = -\frac{3\pi}{2}$ respectively, then the positive sign of $\phi\rho', \Sigma'$ and of parameters in Σ' of the positive (or our) universe in Fig. 3 would have become negative sign in Fig. 4 and the negative sign of $-\phi\rho'^{*}$ and $-\Sigma'^{*}$ and of parameters in $-\Sigma'^{*}$ of the negative universe in Fig. 3 would have become positive sign in Fig. 4. That is, the positions of the positive and negative universes in Fig. 3 would have been interchanged in Fig. 4, which must not be.

We have thus been led to an important conclusion that natural rotations of intrinsic metric spaces by positive absolute intrinsic angle $\phi\psi_0$ (and consequently the relative rotations of intrinsic affine space coordinates in the context of intrinsic special relativity (ϕSR) by positive relative intrinsic angles, $\phi\psi$), are clockwise rotations with respect to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ along the vertical (in Fig. 4). Whereas rotation of intrinsic metric spaces (and intrinsic affine space coordinates in the context of ϕSR) by positive intrinsic angles are anti-clockwise rotations with respect to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ of the positive and negative universes along the horizontal in Fig. 3.

The origin of the natural isotropic absolute speeds V_0 of every point of the proper Euclidean 3-spaces and of the natural absolute intrinsic speeds ϕV_0 of every point along the lengths of the one-dimensional proper intrinsic spaces with respect to the indicated observers in Fig. 3 and Fig. 4, cannot be exposed in this paper. It must be regarded as an outstanding issue to be resolved elsewhere with further development. Nevertheless, a preemptive statement about their origin is appropriate at this point: They are the outward manifestations in the proper physical Euclidean 3-spaces and proper intrinsic spaces of the absolute speeds with respect to the indicated observers, of homogeneous and isotropic absolute spaces (distinguished co-moving coordinate systems) that underlie the proper physical Euclidean 3-spaces and their underlying proper intrinsic spaces in nature, which have not yet appeared in Figs. 3 and Fig. 4.

Leibnitz pointed out that Newtonian mechanics prescribes a distinguished coordinate system (the Newtonian absolute space) in which it is valid [3, see p. 2]. Albert Einstein said, "Newton might no less well have called his absolute space ether..." [4] and argued that the proper (or classical) physical Euclidean 3-space (of Newtonian mechanics) will be impossible without such ether. He also pointed out the existence of ether of general relativity as a necessary requirement for the possibility of that theory, just as the existence of luminiferous ether was postulated to support the propagation of electromagnetic waves. Every dynamical or gravitational law (including Newtonian mechanics) requires (or has) an ether. It is the non-detectable absolute speeds of the ethers of classical mechanics (known to Newton as absolute spaces), which underlie the proper physical Euclidean 3-spaces with respect to the indicated observers in Fig. 3 and 4, that are made manifest in the non-detectable absolute speeds V_0 of the proper Euclidean 3-spaces with respect to the indicated observers in those figures. However this a matter to be formally derived elsewhere, as mentioned above.

1.2 Geometrical contraction of the vertical Euclidean 3-spaces to one-dimensional spaces relative to 3-observers in the horizontal Euclidean 3-spaces and conversely

Let us consider the $x'y'$−plane of our proper Euclidean 3-space Σ' in Fig. 3: Corresponding to the $x'y'$−plane of Σ' is the $x^{0\prime}y^{0\prime}$−plane of the Euclidean 3-space $\Sigma^{0\prime}$. However since Σ' and $\Sigma^{0\prime}$ are orthogonal Euclidean 3-spaces, following the operational definition of orthogonal Euclidean 3-spaces at the beginning of the preceding sub-section, the dimensions $x^{0\prime}$ and $y^{0\prime}$ of the $x^{0\prime}y^{0\prime}$−plane of $\Sigma^{0\prime}$ are both perpendicular to each of the dimensions x' and y' of Σ'. Hence $x^{0\prime}$ and $y^{0\prime}$ are effectively parallel dimensions normal to the $x'y'$− plane of Σ' with respect to 3-observers in Σ'. Symbolically:

$$x^{0\prime} \perp x' \text{ and } y^{0\prime} \perp x';\ x^{0\prime} \perp y' \text{ and } y^{0\prime} \perp y' \ \Rightarrow x^{0\prime} \| y^{0\prime} \quad (*)$$

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

$$x^{0\prime} \perp x' \text{ and } z^{0\prime} \perp x';\ x^{0\prime} \perp z' \text{ and } z^{0\prime} \perp z' \ \Rightarrow x^{0\prime} \| z^{0\prime} \quad (**)$$

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

$$y^{0\prime} \perp y' \text{ and } z^{0\prime} \perp y';\ y^{0\prime} \perp z' \text{ and } z^{0\prime} \perp z' \ \Rightarrow y^{0\prime} \| z^{0\prime} \quad (***)$$

Indeed $x^{0\prime} \| y^{0\prime}$ and $x^{0\prime} \| z^{0\prime}$ in $(*)$ and $(**)$ already implies $y^{0\prime} \| z^{0\prime}$ in $(***)$.

The combination of $(*)$, $(**)$ and $(***)$ give $x^{0\prime} \| y^{0\prime} \| z^{0\prime}$ with respect to 3-observers in Σ', which says that the mutually perpendicular dimensions $x^{0\prime}$, $y^{0\prime}$ and $z^{0\prime}$ of $\Sigma^{0\prime}$ with

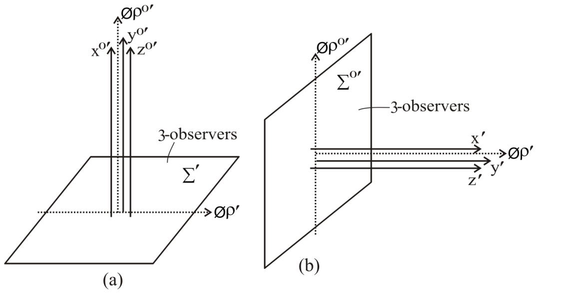

Fig. 5: Given the two orthogonal proper Euclidean 3-spaces $\Sigma^{0\prime}$ and Σ' of Fig. 1 then, (a) the mutually perpendicular dimensions of the proper Euclidean 3-space $\Sigma^{0\prime}$ with respect to 3-observers in it, are naturally "bundle" into parallel dimensions relative to 3-observers in our proper Euclidean 3-space Σ' and (b) the mutually perpendicular dimensions of our proper Euclidean 3-space Σ' with respect to 3-observer in it are naturally "bundled" into parallel dimensions relative to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$.

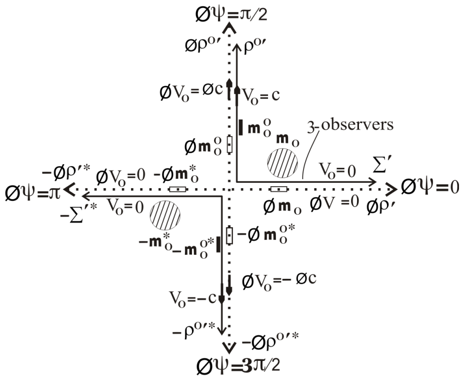

Fig. 6: (a) The proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ along the vertical in Fig. 3, are naturally contracted to one-dimensional proper spaces $\rho^{0\prime}$ and $-\rho^{0\prime *}$ respectively relative to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ along the horizontal.

respect to 3-observers in $\Sigma^{0\prime}$ are effectively parallel dimensions with respect to 3-observers in our Euclidean 3-space Σ'. In other words, the dimensions $x^{0\prime}$, $y^{0\prime}$ and $z^{0\prime}$ of $\Sigma^{0\prime}$ effectively form a "bundle", which is perpendicular to each of the dimensions x', y' and z' of Σ' with respect to 3-observers in Σ' in Fig. 3. The "bundle" must lie along a fourth dimension with respect to 3-observers in Σ' consequently, as illustrated in Fig. 5a, where the proper Euclidean 3-space Σ' is considered as a hyper-surface represented by a horizontal plane surface.

Conversely, the mutually perpendicular dimensions x', y' and z' of our Euclidean 3-space Σ' with respect to 3-observers in Σ' are effectively parallel dimensions with respect to 3-observers in the Euclidean 3-space $\Sigma^{0\prime}$ in Fig. 4. In other words, the dimensions x', y' and z' of Σ' effectively form a "bundle", which is perpendicular to each of the dimensions $x^{0\prime}$, $y^{0\prime}$ and $z^{0\prime}$ of $\Sigma^{0\prime}$ with respect to 3-observers in $\Sigma^{0\prime}$ in Fig. 4. The "bundle" of x', y' and z' must lie along a fourth dimension with respect to 3-observers in $\Sigma^{0\prime}$ consequently, as illustrated in Fig. 5b, where the proper Euclidean 3-space $\Sigma^{0\prime}$ is considered as a hyper-surface represented by a vertical plane surface.

The three dimensions $x^{0\prime}$, $y^{0\prime}$ and $z^{0\prime}$ that are shown as separated parallel dimensions, thereby constituting a "bundle" along the vertical with respect to 3-observers in Σ' in Fig. 5a, are not actually separated. Rather they lie along the singular fourth dimension, thereby constituting a one-dimensional space to be denoted by $\rho^{0\prime}$ with respect to 3-observers in Σ' in Fig. 5a. 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 $\Sigma^{0\prime}$ in Fig. 5b. Thus Fig. 5a shall be replaced with the fuller diagram of Fig. 6a, which is valid with respect to 3-observers in the Euclidean 3-space Σ', while Fig. 5b shall be replaced with the fuller diagram of Fig. 6b, which is valid with respect to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$.

Representation of the Euclidean spaces Σ', $-\Sigma'^{*}$, $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ by plane surfaces in the previous diagrams in this paper has temporarily been changed to lines in Figs. 6a and 6b for convenience. The three-dimensional rest masses m_0 and $-m_0^{*}$ in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ and m_0^0 and $-m_0^{0*}$ in $\Sigma^{0\prime}$and $-\Sigma^{0\prime *}$ have been represented by circles to remind us of their three-dimensionality, while the one-dimensional intrinsic rest masses in the one-dimensional intrinsic spaces $\phi\rho^{0\prime}$, $-\phi\rho^{0\prime *}$, $\phi\rho'$ and $-\phi\rho'^{*}$ and the one-dimensional rest masses in the one-dimensional spaces $\rho^{0\prime}$, $-\rho^{0\prime *}$, ρ' and $-\rho'^{*}$ have been represented by short line segments in Figs. 6a and 6b.

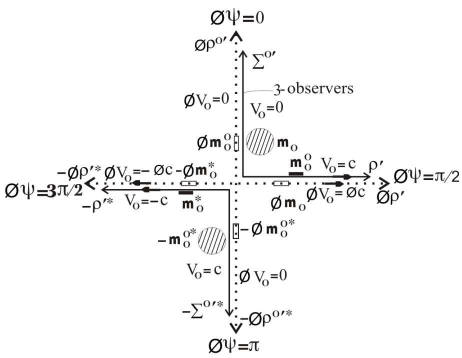

Fig. 6: (b) The proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ along the horizontal in Fig. 4, are naturally contracted to one-dimensional proper spaces ρ' and $-\rho'^{*}$ respectively relative to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ along the vertical.

Fig. 3 naturally simplifies as Fig. 6a with respect to 3-observers in the proper Euclidean 3-space Σ' of the positive (or our) universe, while Fig. 4 naturally simplifies as Fig. 6b with respect to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$ along the vertical. The vertical Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ in Fig. 3 have been geometrically contracted to one-dimensional proper spaces $\rho^{0\prime}$ and $-\rho^{0\prime *}$ respectively with respect to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ of the positive and negative universes and the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ of the positive and negative universes along the horizontal in Fig. 4, have been geometrically contracted to one-dimensional proper spaces ρ' and $-\rho'^{*}$ respectively with respect to 3-observers in the vertical proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ in Fig. 6b, as actualization of the topic of this sub-section.

The isotropic absolute speed $V_0 = c$ of every point of the Euclidean 3-space $\Sigma^{0\prime}$ with respect to 3-observers in the Euclidean 3-space Σ' in Fig. 3 is now absolute speed $V_0 = c$ of every point along the one-dimensional space $\rho^{0\prime}$ with respect to 3-observers in Σ' in Fig. 6a. The isotropic absolute speed $V_0 = -c$ of every point of the Euclidean 3-space $-\Sigma^{0\prime *}$ with respect to 3-observers in Σ' in Fig. 3 is likewise absolute speed $V_0 = -c$ of every point along the one-dimensional space $-\rho^{0\prime *}$ with respect to 3-observers in Σ' in Fig. 6a.

Just as the absolute speed $V_0 = c$ of every point along $\rho^{0\prime}$ and the absolute intrinsic speed $\phi V_0 = \phi c$ of every point along the intrinsic space $\phi\rho^{0\prime}$ with respect to 3-observers in Σ' in Fig. 6a are isotropic, that is, without unique orientation in the Euclidean 3-space $\Sigma^{0\prime}$ that contracts to $\rho^{0\prime}$, with respect to 3-observers in Σ' and $-\Sigma'^{*}$, so are the one-dimensional space $\rho^{0\prime}$ and the one-dimensional intrinsic space $\phi\rho^{0\prime}$ isotropic dimension and isotropic intrinsic dimension respectively with no unique orientation in the Euclidean 3-space $\Sigma^{0\prime}$, with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$. The one-dimensional space $-\rho^{0\prime *}$ and one-dimensional intrinsic space $-\phi\rho^{0\prime *}$ are likewise isotropic dimension and isotropic intrinsic dimension respectively with no unique orientation in the Euclidean 3-space $-\Sigma^{0\prime *}$ with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ in Fig. 6a.

The isotropic absolute speed $V_0 = c$ of every point of the Euclidean 3-space Σ' and the isotropic absolute speed $V_0 = -c$ of every point of the Euclidean 3-space $-\Sigma'^{*}$ with respect to 3-observers in $\Sigma^{0\prime}$ in Fig. 4 are now absolute speed $V_0 = c$ of every point along the one-dimensional space ρ' and absolute speed $V_0 = -c$ of every point along the one-dimensional space $-\rho'^{*}$ with respect to 3-observers in $\Sigma^{0\prime}$ Fig. 6b. Again the one-dimensional metric spaces ρ' and $-\rho'^{*}$ and the one-dimensional intrinsic metric spaces $\phi\rho'$ and $-\phi\rho'^{*}$ are isotropic dimensions and isotropic intrinsic dimensions respectively with no unique orientations in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ that contract to ρ' and $-\rho'^{*}$ respectively, with respect to 3-observers in the vertical Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ in Fig. 6b.

1.3 The vertical proper Euclidean 3-spaces as proper time dimensions relative to 3-observers in the horizontal proper Euclidean 3-spaces and conversely

Figs. 6a and 6b are intermediate diagrams. It shall be shown finally in this section that the one-dimensional proper spaces $\rho^{0\prime}$ and $-\rho^{0\prime *}$ in Fig. 6a naturally transform into the proper time dimensions ct' and $-ct'^{*}$ respectively and their underlying one-dimensional proper intrinsic spaces $\phi\rho^{0\prime}$ and $-\phi\rho^{0\prime *}$ naturally transform into the proper intrinsic time dimensions $\phi c\phi t'$ and $-\phi c\phi t'^{*}$ respectively with respect to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ in that figure. It shall also be shown that the one-dimensional proper spaces ρ' and $-\rho'^{*}$ in Fig. 6b naturally transform into the proper time dimensions $ct^{0\prime}$ and $-ct^{0\prime *}$ respectively and their underlying proper intrinsic spaces $\phi\rho'$ and $-\phi\rho'^{*}$ naturally transform into proper intrinsic time dimensions $\phi c\phi t^{0\prime}$ and $-\phi c\phi t^{0\prime *}$ respectively with respect to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ in that figure.

Now let us re-present the generalized forms of the intrinsic Lorentz transformations and its inverse derived and presented as systems (44) and (45) of [1] respectively as follows

$$\left.\begin{aligned} \phi c\,\phi\tilde{t}' &= \sec\phi\psi(\phi c\phi\tilde{t} - \phi\tilde{x}\sin\phi\psi);\\ &\quad (\text{w.r.t. } 1-\text{observer in } c\tilde{t});\\ \phi\tilde{x}' &= \sec\phi\psi(\phi\tilde{x} - \phi c\phi\tilde{t}\sin\phi\psi);\\ &\quad (\text{w.r.t. } 3-\text{observer in } \tilde{\Sigma}) \end{aligned}\right\} \tag{2}$$

and

$$\left.\begin{aligned} \phi c\phi\tilde{t} &= \sec\phi\psi(\phi c\phi\tilde{t}' + \phi\tilde{x}'\sin\phi\psi);\\ &\quad (\text{w.r.t. } 3-\text{observer in } \tilde{\Sigma}');\\ \phi\tilde{x} &= \sec\phi\psi(\phi\tilde{x}' + \phi c\phi\tilde{t}'\sin\phi\psi);\\ &\quad (\text{w.r.t. } 1-\text{observer in } c\tilde{t}') \end{aligned}\right\}. \tag{3}$$

As explained in [1], systems (2) and (3) can be applied for all values of the intrinsic angle $\phi\psi$ in the first cycle, $0 \le \phi\psi \le 2\pi$, except that $\phi\psi = \frac{\pi}{2}$ and $\phi\psi = \frac{3\pi}{2}$ must be avoided.

One observes from system (2) that the pure intrinsic affine time coordinate $\phi c\phi\tilde{t}'$ of the primed (or particle's) intrinsic frame with respect to an observer at rest relative to the particle's frame, transforms into an admixture of intrinsic affine time and intrinsic affine space coordinates of the unprimed (or observer's) intrinsic frame. The pure intrinsic affine space coordinate $\phi\tilde{x}'$ of the primed (or particle's) frame likewise transforms into an admixture of intrinsic affine space and intrinsic affine time coordinates of the unprimed (or particle's) intrinsic frame, when the particle's frame is in motion relative to the observer's frame. The inverses of these observations obtain from system (3), which is the inverse to system (2).

The observations made from system (2) and system (3) described in the foregoing paragraph make the concept of intrinsic affine spacetime induction relevant in relative intrinsic motion of two intrinsic spacetime frames of reference. In order to make this more explicit, let us re-write systems (2) and

(3) respectively as follows

$$\left.\begin{array}{rcl} \phi c\phi\tilde{t}' & = & \sec\phi\psi(\phi c\phi\tilde{t} + \phi c\phi\tilde{t}_i); \\ & & \text{(w.r.t. 1 − observer in } c\tilde{t}\text{);} \\ \phi\tilde{x}' & = & \sec\phi\psi(\phi\tilde{x} + \phi\tilde{x}_i); \\ & & \text{(w.r.t. 3 − observer in } \tilde{\Sigma}\text{)} \end{array}\right\} \quad (4)$$

and

$$\left.\begin{array}{rcl} \phi c\phi\tilde{t} & = & \sec\phi\psi(\phi c\phi\tilde{t}' + \phi c\phi\tilde{t}'_i); \\ & & \text{(w.r.t. 3 − observer in } \tilde{\Sigma}'\text{);} \\ \phi\tilde{x} & = & \sec\phi\psi(\phi\tilde{x}' + \phi\tilde{x}'_i); \\ & & \text{(w.r.t. 1 − observer in } c\tilde{t}'\text{)} \end{array}\right\}. \quad (5)$$

A comparison of systems (4) and (2) gives the relations for the induced unprimed intrinsic affine spacetime coordinates $\phi c\phi\tilde{t}_i$ and $\phi\tilde{x}_i$ as follows

$$\phi c\phi\tilde{t}_i = \phi\tilde{x}\sin(-\phi\psi) = -\phi\tilde{x}\sin\phi\psi = -\frac{\phi v}{\phi c}\phi\tilde{x}; \quad (6)$$

w.r.t. 1 − observer in $c\tilde{t}$ and

$$\begin{array}{rcl} \phi\tilde{x}_i & = & \phi c\phi\tilde{t}\sin(-\phi\psi) = -\phi c\phi\tilde{t}\sin\phi\psi = \\ & & -\dfrac{\phi v}{\phi c}\phi c\phi\tilde{t} = -\phi v\phi\tilde{t}; \end{array} \quad (7)$$

w.r.t 3 − observer in $\tilde{\Sigma}$.

Diagrammatically, the induced unprimed intrinsic affine time coordinate, $\phi c\phi\tilde{t}_i = \phi\tilde{x}\sin(-\phi\psi)$ in (6), appears in the fourth quadrant in Fig. 9a of [1] as $\phi\tilde{x}^*\sin(-\phi\psi)$ and the induced unprimed intrinsic affine space coordinate, $\phi\tilde{x}_i = \phi c\phi\tilde{t}$ $\sin(-\phi\psi)$ in (7), appears in the second quadrant in Fig. 9b of [1] as $\phi c\phi\tilde{t}^*\sin(-\phi\psi)$.

And a comparison of systems (5) and (3) gives the relations for the induced primed intrinsic affine spacetime coordinates $\phi c\phi\tilde{t}'_i$ and $\phi\tilde{x}'_i$ as follows

$$\phi c\phi\tilde{t}'_i = \phi\tilde{x}'\sin\phi\psi = \frac{\phi v}{\phi c}\phi\tilde{x}'; \quad (8)$$

w.r.t. 3 − observer in $\tilde{\Sigma}'$ and

$$\phi\tilde{x}'_i = \phi c\phi\tilde{t}'\sin\phi\psi = \frac{\phi v}{\phi c}\phi c\phi\tilde{t}' = \phi v\phi\tilde{t}'; \quad (9)$$

w.r.t. 1 − observer in $c\tilde{t}'$.

Diagrammatically, the induced primed intrinsic affine time coordinate, $\phi c\phi\tilde{t}'_i = \phi\tilde{x}'\sin\phi\psi$ in Eq. (8), appears in the fourth quadrant in Fig. 8b of [1], where it is written as $\phi\tilde{x}'^*\sin\phi\psi$ and the induced primed intrinsic affine space coordinate, $\phi\tilde{x}'_i = \phi c\phi\tilde{t}'\sin\phi\psi$ in (9), appears in the second quadrant in Fig. 8a of [1], where it is written as $\phi c\phi\tilde{t}'^*\sin\phi\psi$.

The intrinsic affine time induction relation (6) states that an intrinsic affine space coordinate $\phi\tilde{x}$ of the unprimed intrinsic frame, which is inclined at negative intrinsic angle $-\phi\psi$ relative to the intrinsic affine space coordinate $\phi\tilde{x}'$ of the primed intrinsic frame, due to the negative intrinsic speed $-\phi v$ of the unprimed intrinsic frame relative to the primed intrinsic frame, projects (or induces) a negative unprimed intrinsic affine time coordinate, $\phi c\phi\tilde{t}_i = \phi\tilde{x}\sin(-\phi\psi) = -\phi\tilde{x}\sin\phi\psi$, along the vertical relative to the 1-observer in $c\tilde{t}$.

The intrinsic affine space induction relation (7) states that an intrinsic affine time coordinate $\phi c\phi\tilde{t}$ of the observer's (or unprimed) intrinsic frame, which is inclined at negative intrinsic angle $-\phi\psi$ relative to the intrinsic affine time coordinate $\phi c\phi\tilde{t}'$ of the particle's (or primed) intrinsic frame along the vertical, due to the negative intrinsic speed $-\phi v$ of the intrinsic observer's frame relative to the intrinsic particle's frame, induces a negative unprimed intrinsic affine space coordinate, $\phi\tilde{x}_i = \phi c\phi\tilde{t}\sin(-\phi\psi) = -\phi c\phi\tilde{t}\sin\phi\psi$, along the horizontal relative to 3-observer in $\tilde{\Sigma}$.

The intrinsic affine time induction relation (8) states that an intrinsic affine space coordinate $\phi\tilde{x}'$ of the particle's (or primed) intrinsic frame, which is inclined relative to the intrinsic affine space coordinate $\phi\tilde{x}$ of the observer's (or unprimed) intrinsic frame at a positive intrinsic angle $\phi\psi$, due to the intrinsic motion of the particle's (or primed) intrinsic frame at positive intrinsic speed ϕv relative to the observer's (or unprimed) intrinsic frame, induces positive primed intrinsic affine time coordinate, $\phi c\phi\tilde{t}'_i = \phi\tilde{x}'\sin\phi\psi$, along the vertical relative to the 3-observer in $\tilde{\Sigma}'$.

Finally the intrinsic affine space induction relation (9) states that an intrinsic affine time coordinate $\phi c\phi\tilde{t}'$ of the primed intrinsic frame, which is inclined at positive intrinsic angle $\phi\psi$ relative to the intrinsic affine time coordinate $\phi c\phi\tilde{t}$ along the vertical of the primed intrinsic frame, due to the intrinsic motion of the primed intrinsic frame at positive intrinsic speed ϕv relative to the unprimed intrinsic frame, induces positive primed intrinsic affine space coordinate, $\phi\tilde{x}'_i = \phi c\phi\tilde{t}'\sin\phi\psi$, along the horizontal relative to the 1-observer in $c\tilde{t}'$.

The outward manifestations on flat four-dimensional affine spacetime of the intrinsic affine spacetime induction relations (6)–(9) are given by simply removing the symbol ϕ from those relations respectively as follows

$$c\tilde{t}_i = \tilde{x}\sin(-\psi) = -\tilde{x}\sin\psi = -\frac{v}{c}\tilde{x}; \quad (10)$$

w.r.t. 1 − observer in $c\tilde{t}$;

$$\tilde{x}_i = c\tilde{t}\sin(-\psi) = -c\tilde{t}\sin\psi = -\frac{v}{c}c\tilde{t} = -v\tilde{t}; \quad (11)$$

w.r.t. 3 − observer in $\tilde{\Sigma}$;

$$c\tilde{t}'_i = \tilde{x}'\sin\psi = \frac{v}{c}\tilde{x}'; \quad (12)$$

w.r.t. 3 − observer in $\tilde{\Sigma}'$ and

$$\tilde{x}'_i = c\tilde{t}'\sin\psi = \frac{v}{c}c\tilde{t}' = v\tilde{t}'; \quad (13)$$

w.r.t. 1 − observer in $c\tilde{t}'$.

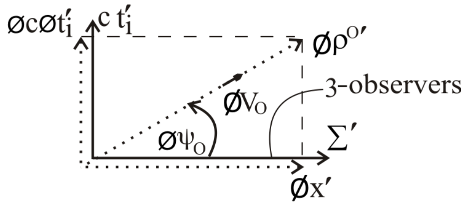

Fig. 7: Proper intrinsic metric time dimension and proper metric time dimension are induced along the vertical with respect to 3-observers in the proper Euclidean 3-space Σ' (as a hyper-surface represented by a line) along the horizontal, by a proper intrinsic metric space that is inclined to the horizontal.

However the derivation of the intrinsic affine spacetime induction relations (6)–(9) in the context of ϕSR and their outward manifestations namely, the affine spacetime induction relations (10)–(13) in the context of SR, are merely to demonstrate explicitly the concept of intrinsic affine spacetime induction that is implicit in intrinsic Lorentz transformation (ϕLT) and its inverse in the context of ϕSR and affine spacetime induction that is implicit in Lorentz transformation (LT) and its inverse in the context of SR.

On the other hand, our interest in this sub-section is in intrinsic metric time induction that arises by virtue of possession of absolute intrinsic speed ϕV_0 naturally at every point along the length of a proper intrinsic metric space, $\phi\rho^{0\prime}$, say, relative to another proper intrinsic metric space, $\phi\rho'$, say, in Fig. 3. Let us assume, for the purpose of illustration, that a proper intrinsic metric space $\phi\rho^{0\prime}$ possesses an absolute intrinsic speed $\phi V_0 < \phi c$ naturally at every point along its length relative to our proper intrinsic metric space $\phi\rho'$ along the horizontal, instead of the absolute intrinsic speed $\phi V_0 = \phi c$ of every point along the length of $\phi\rho^{0\prime}$ relative to $\phi\rho'$ in Fig. 3. Then $\phi\rho^{0\prime}$ will be inclined at an absolute intrinsic angle $\phi\psi_0 < \frac{\pi}{2}$ relative to $\phi\rho'$ along the horizontal, as illustrated in Fig. 7, instead of inclination of $\phi\rho^{0\prime}$ to the horizontal by absolute intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ in Fig. 3.

As shown in Fig. 7, the inclined proper intrinsic metric space $\phi\rho^{0\prime}$ induces proper intrinsic metric time dimension $\phi c\phi t'_i$ along the vertical with respect to 3-observers in our proper Euclidean 3-space Σ' along the horizontal. The intrinsic metric time induction relation with respect to 3-observers in Σ' in Fig. 7, takes the form of the primed intrinsic affine time induction relation (8) with respect to 3-observer in $\tilde{\Sigma}'$ in the context of ϕSR. We must simply replace the primed intrinsic affine spacetime coordinates $\phi c\phi\tilde{t}'_i$ and $\phi\tilde{x}'$ by proper intrinsic metric spacetime dimensions $\phi c\phi t'_i$ and $\phi\rho^{0\prime}$ respectively and the relative intrinsic angle $\phi\psi$ and relative intrinsic speed ϕv by absolute intrinsic angle $\phi\psi_0$ and absolute intrinsic speed ϕV_0 in (8) to have as follows

$$\phi c\phi t'_i = \phi\rho^{0\prime}\sin\phi\psi_0 = \frac{\phi V_0}{\phi c}\phi\rho^{0\prime}; \tag{14}$$

w.r.t. all 3 − observers in Σ'. And the outward manifestation of (14) is

$$ct'_i = \rho^{0\prime}\sin\psi_0 = \frac{V_0}{c}\rho^{0\prime}; \tag{15}$$

w.r.t. all 3 − observers in Σ'.

The induced proper intrinsic metric time dimension $\phi c\phi t'_i$ along the vertical in (14) is made manifest in induced proper metric time dimension ct'_i in (15) along the vertical, as shown in Fig. 7. As indicated, relations (14) and (15) are valid with respect to all 3-observers in our proper Euclidean 3-space Σ' overlying our proper intrinsic metric space $\phi\rho'$ along the horizontal in Fig. 7.

As abundantly stated in [1] and under systems (2) and (3) earlier in this paper, the relative intrinsic angle $\phi\psi = \frac{\pi}{2}$ corresponding to relative intrinsic speed $\phi v = \phi c$, is prohibited by the intrinsic Lorentz transformation (2) and its inverse (3) in ϕSR and consequently $\phi\psi = \frac{\pi}{2}$ or $\phi v = \phi c$ is prohibited in the intrinsic affine time and intrinsic affine space induction relations (6) and (7) and their inverses (8) and (9) in ϕSR. Correspondingly, the angle $\psi = \frac{\pi}{2}$ or speed $v = c$ is prohibited in the affine time and affine space induction relations (10) and (11) and their inverses (12) and (13) in SR.

On the other hand, the absolute intrinsic speed ϕV_0 can be set equal to ϕc and hence the absolute intrinsic angle $\phi\psi_0$ can be set equal to $\frac{\pi}{2}$ in (14). This is so since, as prescribed earlier in this paper, the proper intrinsic metric space $\phi\rho^{0\prime}$ exists naturally along the vertical as in Fig. 3, corresponding to $\phi V_0 = \phi c$ and $\phi\psi_0 = \frac{\pi}{2}$ naturally in (14) with respect to 3-observers in Σ'. More over, as mentioned at the end of subsection 1.1 and as shall be developed fully elsewhere, the absolute intrinsic speed ϕV_0 of every point of the inclined $\phi\rho^{0\prime}$ with respect to all 3-observers in Σ' in Fig. 7, being the outward manifestation in $\phi\rho^{0\prime}$ of the absolute speed of the Newtonian absolute space (the ether of classical mechanics), it can take on values in the range $0 \le \phi V_0 \le \infty$, since the maximum speed of objects in classical mechanics is infinite speed. Thus by letting $\phi V_0 = \phi c$ and $\phi\psi_0 = \frac{\pi}{2}$ in (14) we have

$$\phi c\phi t'_i \equiv \phi c\phi t' = \phi\rho^{0\prime};$$
$$\text{for } \phi V_0 = \phi c \text{ or } \phi\psi_0 = \frac{\pi}{2} \text{ in Fig. 7}; \tag{16}$$

w.r.t. all 3 − observers in Σ'.

While relation (14) states that a proper intrinsic metric space $\phi\rho^{0\prime}$, which is inclined to $\phi\rho'$ along the horizontal at absolute intrinsic angle $\phi\psi_0 < \frac{\pi}{2}$, induces proper intrinsic metric time dimension $\phi c\phi t'_i$ along the vertical, whose length is a fraction $\phi V_0/\phi c$ or $\sin\phi\psi_0$ times the length of $\phi\rho^{0\prime}$, with respect to all 3-observers in our proper Euclidean 3-space Σ' along the horizontal, relation (16) states that a proper intrinsic metric space $\phi\rho^{0\prime}$, which is naturally inclined at intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ relative to $\phi\rho'$ along the horizontal, thereby lying along the vertical, induces proper intrinsic metric time dimension $\phi c\phi t'_i \equiv \phi c\phi t'$ along the vertical, whose length is the length of $\phi\rho^{0\prime}$, with respect to all 3-observers in our proper Euclidean 3-space Σ' along the horizontal.

The preceding paragraph implies that a proper intrinsic metric space $\phi\rho^{0\prime}$ that is naturally rotated along the vertical is wholly converted (or wholly transformed) into proper intrinsic metric time dimension $\phi c\phi t'$ relative to all observers in our Euclidean 3-space Σ' (along the horizontal). Eq. (16) can therefore be re-written as the transformation of proper intrinsic metric space into proper intrinsic metric time dimension:

$$\phi\rho^{0\prime} \rightarrow \phi c\phi t'; \quad \text{for } \phi V_0 = \phi c \text{ or } \phi\psi_0 = \pi/2 \text{ in Fig. 7;} \quad (17)$$

w.r.t. all 3 – observers in Σ' and the outward manifestation of Eq. (17) is the transformation of the one-dimensional proper metric space $\rho^{0\prime}$ into proper metric time dimension ct':

$$\rho^{0\prime} \rightarrow ct'; \quad \text{for } V_0 = c \text{ or } \psi_0 = \pi/2 \text{ in Eq.(15);} \quad (18)$$

w.r.t. all 3 – observers in Σ'.

The condition required for the transformations (17) and (18) to obtain are naturally met by $\phi\rho^{0\prime}$ and $\rho^{0\prime}$ in Fig. 6a. This is the fact that they are naturally inclined at absolute intrinsic angle $\phi\psi_0 = \frac{\pi}{2}$ and absolute angle $\psi_0 = \frac{\pi}{2}$ respectively relative to our proper intrinsic space $\phi\rho'$ along the horizontal and consequently they naturally possess absolute intrinsic speed $\phi V_0 = \phi c$ and absolute speed $V_0 = c$ respectively at every point along their lengths with respect to all 3-observers in our proper Euclidean 3-space Σ' in that diagram.

The transformations (17) and (18) with respect to 3-observers in our proper Euclidean 3-space Σ' correspond to the following with respect to 3-observers in the proper Euclidean 3-space $-\Sigma'^*$ of the negative universe in Fig. 6a:

$$-\phi\rho^{0\prime *} \rightarrow -\phi c\phi t'^*; \quad \text{for } \phi V_0 = \phi c \text{ or } \phi\psi_0 = \pi/2; \quad (19)$$

w.r.t. all 3 – observers in $-\Sigma'^*$ and

$$-\rho^{0\prime *} \rightarrow -ct'^*; \quad \text{for } V_0 = c \text{ or } \psi_0 = \pi/2; \quad (20)$$

w.r.t. all 3 – observers in $-\Sigma'^*$.

The counterparts of transformations (17) and (18), which are valid with respect to 3-observers in the proper Euclidean 3-space $\Sigma^{0\prime}$ in Fig. 6b are the following

$$\phi\rho' \rightarrow \phi c\phi t^{0\prime}; \quad \text{for } \phi V_0 = \phi c \text{ or } \phi\psi_0 = \pi/2; \quad (21)$$

w.r.t. all 3 – observers in $\Sigma^{0\prime}$ and

$$\rho' \rightarrow ct^{0\prime}; \quad \text{for } V_0 = c \text{ or } \psi_0 = \pi/2; \quad (22)$$

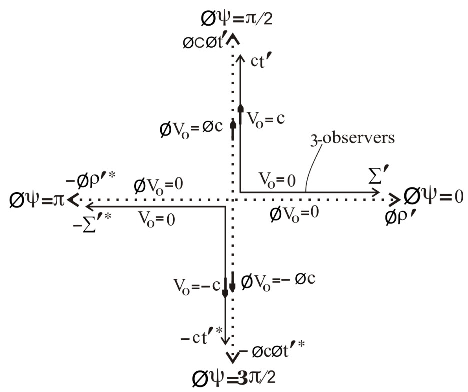

Fig. 8: a) The one-dimensional proper spaces $\rho^{0\prime}$ and $-\rho^{0\prime *}$ in Fig. 6a transform into proper time dimensions ct' and $-ct'^*$ respectively and the proper intrinsic spaces $\phi\rho^{0\prime}$ and $-\phi\rho^{0\prime *}$ in Fig. 6a transform into proper intrinsic time dimensions $\phi c\phi t'$ and $-\phi c\phi t'^*$ respectively, relative to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^*$ (represented by lines) along the horizontal.

w.r.t. all 3 – observers in $\Sigma^{0\prime}$ and the counterparts of transformations (19) and (20), which are valid with respect to 3-observers in the proper Euclidean 3-space $-\Sigma^{0\prime *}$ in Fig. 6b are the following

$$-\phi\rho'^* \rightarrow -\phi c\phi t^{0\prime *}; \quad \text{for } V_0 = c \text{ or } \psi_0 = \pi/2; \quad (23)$$

w.r.t. all 3 – observers in $-\Sigma^{0\prime *}$ and

$$-\rho'^* \rightarrow -ct^{0\prime *}; \quad \text{for } V_0 = c \text{ or } \psi_0 = \pi/2; \quad (24)$$

w.r.t. all 3 – observers in $-\Sigma^{0\prime *}$.

Application of transformations (17)–(20) on Fig. 6a gives Fig. 8a and application of transformation (21)–(24) on Fig. 6b gives Fig. 8b. Again representation of Euclidean 3-spaces by plane surfaces in the previous diagrams in this paper has temporarily been changed to lines in Figs. 8a and 8b, as done in Figs. 6a and 6b, for convenience.

The three-dimensional rest masses of the symmetry-partner particles or objects in the proper Euclidean 3-spaces and the one-dimensional rest masses in the proper time dimensions, as well as their underlying one-dimensional intrinsic rest masses in the proper intrinsic spaces and proper intrinsic time dimensions have been deliberately left out in Figs. 8a and 8b, unlike in Figs. 6a and 6b where they are shown. This is necessary because of further discussion required in locating the one-dimensional particles or objects in the time dimensions, which shall be done later in this paper. As indicated in Figs. 8a and 8b, the proper time dimensions ct' and $ct^{0\prime}$ possess absolute speed $V_0 = c$ at every point along their lengths, relative to 3-observers in the proper Euclidean 3-spaces Σ' and $\Sigma^{0\prime}$ respectively, like the one-dimensional

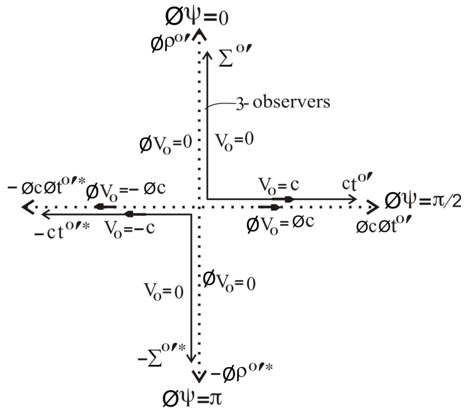

Fig. 8: b) The one-dimensional proper spaces ρ' and $-\rho'^{*}$ in Fig. 6b transform into proper time dimensions $ct^{0\prime}$ and $-ct^{0\prime *}$ respectively and the proper intrinsic spaces $\phi\rho'$ and $-\phi\rho'^{*}$ in Fig. 6b transform into proper intrinsic time dimensions $\phi c\phi t^{0\prime}$ and $-\phi c\phi t^{0\prime *}$ respectively relative to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ (represented by lines) along the vertical.

spaces $\rho^{0\prime}$ and ρ' in Figs. 6a and 6b that transform into ct' and $ct^{0\prime}$ respectively in Figs. 8a and 8b. As also indicated in Figs. 8a and 8b, the proper intrinsic time dimensions $\phi c\phi t'$ and $\phi c\phi t^{0\prime}$ possess absolute intrinsic speed $\phi V_0 = \phi c$ at every point along their lengths relative to 3-observers in the proper Euclidean 3-spaces Σ' and $\Sigma^{0\prime}$ respectively, like the intrinsic spaces $\phi\rho^{0\prime}$ and $\phi\rho'$ in Figs. 6a and 6b that transform into $\phi c\phi t'$ and $\phi c\phi t^{0\prime}$ respectively in Figs. 8a and 8b. The time dimensions ct' and $ct^{0\prime}$ and the intrinsic time dimensions $\phi c\phi t'$ and $\phi c\phi t^{0\prime}$ are isotropic dimensions (with no unique orientations in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and Σ' that transform into ct' and $ct^{0\prime}$ respectively). These follow from the isotropy of the one-dimensional spaces $\rho^{0\prime}$ and ρ' in the Euclidean 3-spaces $\Sigma^{0\prime}$ and Σ' respectively in Figs. 6a and 6b that transform into ct' and $ct^{0\prime}$ respectively in Figs. 8a and 8b and from the isotropy of the one-dimensional intrinsic spaces $\phi\rho^{0\prime}$ and $\phi\rho'$ in the Euclidean 3-spaces $\Sigma^{0\prime}$ and Σ' respectively in Figs. 6a and 6b that transform into $\phi c\phi t'$ and $\phi c\phi t^{0\prime}$ respectively in Figs. 8a and 8b.

Fig. 8a is the final form to which the quartet of mutually orthogonal proper Euclidean 3-spaces and underlying one-dimensional proper intrinsic spaces in Fig. 2 naturally simplify with respect to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ of the positive (or our) universe and the negative universe and Fig. 8b is the final form to which the quartet of proper Euclidean 3-spaces and underlying one-dimensional proper intrinsic spaces in Fig. 2 naturally simplify with respect to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime *}$ of the positive and negative time-universes.

It follows from the natural simplification of Fig. 2 to Figs. 8a and 8b that the concept of time is secondary to the concept of space. Indeed the concept of time had evolved from the concept of space and the concept of intrinsic time had evolved from the concept of intrinsic space. This is so since given the quartet of mutually orthogonal proper metric Euclidean 3-spaces/underlying one-dimensional proper intrinsic metric spaces in Fig. 2, then the straight line one-dimensional proper metric time manifolds (or proper metric time dimensions) evolve automatically relative to 3-observers in the proper Euclidean 3-spaces, as illustrated in Figs. 8a and 8b. Thus one could ask for the origin of space without at the same time asking for the origin of time in the present picture. The origin of time and intrinsic time dimensions, which we seek in this section, has been achieved.

2 Perfect symmetry of natural laws among the isolated four universes

The four universes encompassed by Figs. 8a and 8b are the positive (or our) universe with flat proper spacetime (Σ', ct') of SR and its underlying flat two-dimensional proper intrinsic spacetime $(\phi\rho', \phi c\phi t')$ of ϕSR in Fig. 8a and the negative universe with flat proper spacetime $(-\Sigma'^{*}, -ct'^{*})$ of SR and its underlying two-dimensional flat proper intrinsic spacetime $(-\phi\rho'^{*}, -\phi c\phi t'^{*})$ of ϕSR in Fig. 8a.

The third universe is the one with flat proper spacetime $(\Sigma^{0\prime}, ct^{0\prime})$ of SR and its underlying flat proper intrinsic spacetime $(\phi\rho^{0\prime}, \phi c\phi t^{0\prime})$ of ϕSR in Fig. 8b. This third universe shall be referred to as the positive time-universe, since its proper Euclidean 3-space $\Sigma^{0\prime}$ and its proper intrinsic space $\phi\rho^{0\prime}$ are the proper time dimension ct' and proper intrinsic time dimension $\phi c\phi t'$ respectively of the positive (or our) universe.

The fourth universe is the one with flat proper spacetime $(-\Sigma^{0\prime *}, -ct^{0\prime *})$ of SR and its underlying flat proper intrinsic spacetime $(-\phi\rho^{0\prime *}, -\phi c\phi t^{0\prime *})$ of ϕSR in Fig. 8b. This fourth universe shall be referred to as the negative time-universe, since its proper Euclidean 3-space $-\Sigma^{0\prime *}$ and its proper intrinsic space $-\phi\rho^{0\prime *}$ are the proper time dimension $-ct'^{*}$ and proper intrinsic time dimension $-\phi c\phi t'^{*}$ respectively of the negative universe.

As prescribed earlier in this paper, the four worlds (or universes) encompassed by Figs. 8a and 8b, listed above, coexist in nature and exhibit perfect symmetry of natural laws and perfect symmetry of state among themselves. Perfect symmetry of laws among the four universes shall be demonstrated hereunder, while perfect symmetry of state among the universes shall be be demonstrated in the second part of this paper.

Demonstration of perfect symmetry of natural laws between the positive (or our) universe and the negative universe in [1] and [2] involves three steps. In the first step, the affine spacetime/intrinsic affine spacetime diagrams of Figs. 8a and 8b and Figs. 9a and 9b of [1] are derived upon the metric spacetimes/intrinsic metric spacetimes of the positive (or our) universe and the negative universe of Fig. 8a above, (which was prescribed to exist in nature and constitute a two-world background of SR in [1]).

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	$d\phi x^0$ or ϕx^0	+	−
Interval (or dimension) of time	dt^0 or t^0	$d\phi t^0$ or ϕt^0	+	−
Mass	m^0	ϕm^0	+	−
Electric charge	q	q	+ or −	− or +
Absolute entropy	S^0	ϕS^0	+	−
Absolute temperature	T	T	+	+
Energy (total, kinetic)	E^0	ϕE^0	+	−
Potential energy	U^0	ϕU^0	+ or −	− or +
Radiation energy	$h\nu^0$	$h\phi\nu^0$	+	−
Electrostatic potential	Φ_E^0	$\phi\Phi_E^0$	+ or −	+ or −
Gravitational potential	Φ^0	$\phi\Phi^0$	−	−
Electric field	$\vec{E}^0$	ϕE^0	+ or −	− or +
Magnetic field	$\vec{B}^0$	ϕB^0	+ or −	− or +
Planck constant	h	h	+	+
Boltzmann constant	k	ϕk	+	−
Thermal conductivity	k	ϕk	+	−
Specific heat capacity	c_p	ϕc_p	+	+
velocity	$\vec{v}$	ϕv	+ or −	+ or −
speeds of particles	v	ϕv	+	+
Speed of light	c	ϕc	+	+
Electric permittivity	ϵ_o^o	$\phi\epsilon_o^o$	+	+
Magnetic permeability	μ_o^o	$\phi\mu_o^o$	+	+
Angular measure	θ, φ	$\phi\theta, \phi\varphi$	+ or −	+ or −
Parity	Π	$\phi\Pi$	+ or −	− or +
⋮	⋮	⋮	⋮	⋮

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

The intrinsic Lorentz transformation/Lorentz transformation (ϕLT/LT) was then derived from those diagrams in the positive and negative universes, thereby establishing intrinsic Lorentz invariance (ϕLI) 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. 8a of this paper described above, applies directly between the positive time-universe and the negative time-universe. The counterparts of Figs. 8a, 8b, 9a and 9b of [1], drawn upon the metric spacetimes/intrinsic metric spacetimes of the positive and negative universes of Fig. 8a of this paper in that paper, can be drawn upon the metric spacetimes/intrinsic spacetimes of the positive time-universe and negative time-universe in Figs. 8b of this paper and intrinsic Lorentz transformations/Lorentz transformation (ϕLT/LT) derived from them in the positive time-universe and the negative time-universe, as shall not be done here in order to conserve space. Intrinsic Lorentz invariance (ϕLI) on flat two-dimensional intrinsic spacetimes and Lorentz invariance (LI) on flat four-dimensional spacetimes in the positive and negative time-universes then follow with respect to observers in those universes.

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

Table 1 here is the same as Table 1 in [2]. The superscript "0" that appears on dimensions/intrinsic dimensions and some parameters/intrinsic parameters and constants/intrinsic constants in Table 1 here is used to differentiate the dimensions/intrinsic dimensions, parameters/intrinsic parameters and constants/intrinsic constants of the positive time-universe and negative time-universe from those of the positive (or our) universe and the negative universe in Table 1 of [2].

The third and final step in demonstrating the symmetry of natural laws between the positive (or our) universe and the negative universe in [1] and [2], consists in replacing the positive spacetime dimensions and the physical parameters and physical constants that appear in (the instantaneous differential) natural laws in the positive universe by the negative spacetime dimensions and physical parameters and physical constants of the negative universe (with the appropriate signs in Table 1 of [2]), and showing that these operations leave all natural laws unchanged in the negative universe, as done in section 5 of [2].

The third step in the demonstration of the perfect symmetry of natural laws between the positive and negative universes described in the foregoing 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 negative time-universe at the first step, it is straight forward to use Table 1 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.

Symmetry of natural laws must be considered to have been established between the positive time-universe and the negative time-universe. A more detailed presentation than done above will amount to a repetition of the demonstration of symmetry of natural laws between the positive and negative universes in [1] and [2].

Finally the established validity of Lorentz invariance in the four universes encompassed by Figs. 8a and 8b, 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, physical constants in the negative universe and negative time-universe in Table 1 of [2] and Table 1 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. This 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, guarantees invariance of natural laws among the four universes.

Symmetry of natural laws among the four universes encompassed by Figs. 8a and 8b of this paper namely, the positive (or our) universe and the negative universe (in Fig. 8a), the positive time-universe and the negative time-universe (in Fig. 8b), has thus been shown. Perfect symmetry of state among the universes shall be demonstrated in the second part of this paper, as mentioned earlier.

3 Origin of one-dimensional particles, objects and observers in the time dimension and (3+1)-dimensionality of particles, objects and observers in special relativity

An implication of the geometrical contraction of the three dimensions $x^{01\prime}$, $x^{02\prime}$ and $x^{03\prime}$ of the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe in Fig. 2 or Fig. 3 into a one-dimensional space $\rho^{0\prime}$ relative to 3-observers in our proper Euclidean 3-space Σ' in Fig. 6a, which ultimately transforms into the proper time dimension ct' relative to 3-observers in Σ' in Fig. 8a, is that the dimensions of a particle or object, such as a box of rest mass m_0^0 and proper (or classical) dimensions $\Delta x^{0\prime}$, $\Delta y^{0\prime}$ and $\Delta z^{0\prime}$ in $\Sigma^{0\prime}$ with respect to 3-observers in $\Sigma^{0\prime}$, are geometrically "bundled" parallel to one another, thereby effectively becoming a one-dimensional box of equal rest mass m_0^0 and proper (or classical) length $\Delta\rho^{0\prime}$ along $\rho^{0\prime}$ in Fig. 6a, which transforms into an interval $c\Delta t'$ containing rest mass m_0^0 along the proper time dimension ct' in Fig. 8a, relative to 3-observers in our Euclidean 3-space Σ', where $c\Delta t' = \Delta\rho^{0\prime} = \sqrt{(\Delta x^{0\prime})^2 + (\Delta y^{0\prime})^2 + (\Delta z^{0\prime})^2}$.

Likewise all radial directions of a spherical particle or object of rest mass m_0^0 and proper (or classical) radius $r^{0\prime}$ in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe, with respect to 3-observers in $\Sigma^{0\prime}$, are "bundled" parallel to one another, thereby becoming a one-dimensional particle or object of proper (or classical) length, $\Delta\rho^{0\prime} = r^{0\prime}$, along $\rho^{0\prime}$ in Fig. 6a, which ultimately transforms into interval $c\Delta t'$ ($= r^{0\prime}$) containing rest mass m_0^0 along the proper time dimension ct' in Fig. 8a, with respect to 3-observers in our proper Euclidean 3-space Σ'.

A particle or object of rest mass m_0^0 with arbitrary shape located in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe with respect to 3-observers in $\Sigma^{0\prime}$, will have the lengths (or dimensions) from its centroid to its boundary along all directions geometrically "bundled" parallel to one another, thereby effectively becoming a one-dimensional particle or object of equal rest mass m_0^0 along the proper time dimension ct' with respect to 3-observers in Σ' in Fig. 8a.

The one-dimensional rest mass m_0^0 of proper length $c\Delta t'$ of a particle, object or observer in our proper time dimension ct' with respect to 3-observers in our Euclidean 3-space Σ' in Fig. 8a, will acquire the absolute speed $V_0 = c$, which the proper time dimension possesses at every point along its length with respect to 3-observers in Σ'. Consequently it will possess energy $m_0^0 V_0^2 = m_0^0 c^2 = E'$ in ct' with respect to 3-observers in Σ'. Indeed the one-dimensional rest mass m_0^0 in ct' will be made manifest in the state of energy $E' = m_0^0 c^2$ by virtue of its absolute speed c in ct' and not in the state of rest mass m_0^0. In other words, instead of locating one-dimensional rest mass m_0^0 along the proper time dimension ct' in Fig. 8a, as done along the one-dimensional space $\rho^{0\prime}$ in Fig. 6a, we must locate one-dimensional equivalent rest mass E'/c^2 ($= m_0$) along ct' with respect to 3-observers in Σ', as the symmetry-partner in ct' to the three-dimensional rest mass m_0 in Σ'.

It follows from the foregoing that as the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe in Fig. 2 or 3 is geometrically contracted to one-dimensional space $\rho^{0\prime}$ with respect to 3-observers in our proper Euclidean 3-space Σ' in Fig. 6a, the three-dimensional rest mass m_0^0 in $\Sigma^{0\prime}$ with respect to 3-observers in $\Sigma^{0\prime}$ in Fig. 2 or Fig. 3, contracts to one-dimensional rest mass m_0^0 located in the one-dimensional space $\rho^{0\prime}$ with respect to 3-observers in our proper Euclidean 3-space Σ' in Fig. 6a. And as the one-dimensional proper space $\rho^{0\prime}$ in Fig. 6a ultimately transforms into the proper time dimension ct' with respect to 3-observers in our Euclidean 3-space Σ', the one-dimensional rest mass m_0^0 in $\rho^{0\prime}$ transforms into one-dimensional equivalent rest mass E'/c^2, (i.e. $m_0^0 \rightarrow E'/c^2$), located in the proper time dimension ct' in Fig. 8a with respect to 3-observers in our Euclidean 3-space Σ', (although E'/c^2 has not been shown in ct' in Fig. 8a).

It must be noted however that since the speed $V_0 = c$ acquired by the rest mass m_0^0 in the proper time dimension ct' is an absolute speed, which is not made manifest in actual motion (or translation) of m_0^0 along ct', the energy $m_0^0 c^2 = E'$ possessed by m_0^0 in ct' is a non-detectable energy in the proper time dimension. Important to note also is the fact that the equivalent rest mass E'/c^2 of a particle or object in the proper time dimension ct' is not an immaterial equivalent rest mass. Rather it is a quantity of matter that possesses inertia (like the rest mass m_0^0) along the proper time dimension. This is so because the speed c in $m_0^0 c^2 = E'$, being an absolute speed, is not made manifest in motion of m_0^0 along ct', as mentioned above. On the other hand, the equivalent mass, $m_{0\gamma} = E'_\gamma/c^2 = h\nu_0/c^2$, of a photon is purely immaterial, since the speed c in $m_{0\gamma}c^2 = h\nu_0$ is the speed of actual translation through space of photons and only a purely immaterial particle can attain speed c of actual translation in space or along the time dimension. While the material equivalent rest mass $E'/c^2 (\equiv m_0^0)$ in ct' can appear as rest mass in SR, the immaterial equivalent mass $E'_{0\gamma}/c^2$ ($\equiv m_{0\gamma}$) of photon cannot appear in SR.

Illustrated in Fig. 9a are the three-dimensional rest mass m_0 of a particle or object at a point of distance d' from a point of reference or origin in our proper Euclidean 3-space Σ' and the symmetry-partner one-dimensional equivalent rest mass E'/c^2 at the symmetry-partner point of distance $d^{0\prime}$ along the proper time dimension ct' from the point of reference or origin, where the distances d' and $d^{0\prime}$ are equal. The three-dimensional rest mass m_0 in Σ' is underlied by its one-dimensional intrinsic rest mass ϕm_0 in the one-dimensional proper intrinsic space $\phi\rho'$ and the one-dimensional equivalent rest mass E'/c^2 in ct' is underlied by its one-dimensional equivalent intrinsic rest mass $\phi E'/\phi c^2$ in the proper intrinsic time dimension $\phi c\phi t'$ in Fig. 9a.

Fig. 9a pertains to a situation where the three-dimensional rest mass m_0 of the particle or object is at rest relative to the 3-observer in the proper Euclidean 3-space Σ' and consequently its one-dimensional equivalent rest mass E'/c^2 is at rest in the proper time dimension ct' relative to the 3-observer in Σ'. On the other hand, Fig. 9b pertains to a situation where the three-dimensional rest mass m_0 of the particle or object is in motion at a velocity $\vec{v}$ relative to the 3-observer in Σ', thereby becoming the special-relativistic mass, $m = \gamma m_0$ in Σ', relative to the 3-observer in Σ' and consequently the one-dimensional equivalent rest mass E'/c^2 of the particle or object is in motion at speed $v = |\vec{v}|$ in the proper time dimension ct' relative to the 3-observer in Σ', thereby becoming the special-relativistic equivalent mass $E/c^2 = \gamma E'/c^2$ in ct' relative to the 3-observer in Σ'.

The one-dimensional equivalent rest mass E'/c^2 of proper (or classical) length $c\Delta t' = d^{0\prime}$ located at a point in the proper time dimension ct' with respect to 3-observers in the proper Euclidean 3-space Σ' in Fig. 9a, acquires the absolute speed $V_0 = c$ of ct'. However, since the absolute speed $V_0 = c$ of ct' is not made manifest in the flow of ct' with respect to 3-observers in Σ', it is not made manifest in translation of E'/c^2 along ct' with respect to the 3-observers in Σ'. Moreover the equivalent rest mass E'/c^2 possesses zero speed ($v = 0$) of motion in ct' relative to the 3-observer in Σ', just as the rest mass m_0 possesses zero speed of motion in the Euclidean 3-space Σ' relative to the 3-observer in Σ'. Consequently m_0 and E'/c^2 remain stationary at their symmetry-partner locations in Σ' and ct' respectively relative to the 3-observer in Σ' in Fig. 9a.

Likewise the equivalent intrinsic rest mass $\phi E'/\phi c^2$ of proper intrinsic length $\phi c\Delta\phi t' = \phi d^{0\prime}$ located at a point in the proper intrinsic time dimension $\phi c\phi t'$ with respect to 3-observers in the proper Euclidean 3-space Σ' in Fig. 9a, acquires the absolute intrinsic speed $\phi V_0 = \phi c$ of $\phi c\phi t'$. However, since the absolute intrinsic speed ϕc of $\phi c\phi t'$ is not made manifest in the intrinsic flow of $\phi c\phi t'$ with respect to 3-observers in Σ', it is not made manifest in intrinsic translation of $\phi E'/\phi c^2$ along $\phi c\phi t'$ with respect to the 3-observers in Σ'. Moreover the equivalent intrinsic rest mass $\phi E'/\phi c^2$ possesses zero intrinsic speed ($\phi v = 0$) of intrinsic translation in $\phi c\phi t'$ relative to the 3-observer in Σ', just as the intrinsic rest mass ϕm_0 possesses zero intrinsic speed of intrinsic translation in the proper intrinsic space $\phi\rho'$ underlying Σ' relative to the 3-observer in Σ'. Consequently ϕm_0 and $\phi E'/\phi c^2$ remain stationary at their symmetry-partner locations in $\phi\rho'$ and $\phi c\phi t'$ respectively relative to the 3-observer in Σ' in Fig. 9a.

In a situation where the rest mass m_0 of the particle or object is in motion at a velocity $\vec{v}$ in the proper Euclidean 3-space Σ' and the one-dimensional equivalent rest mass E'/c^2

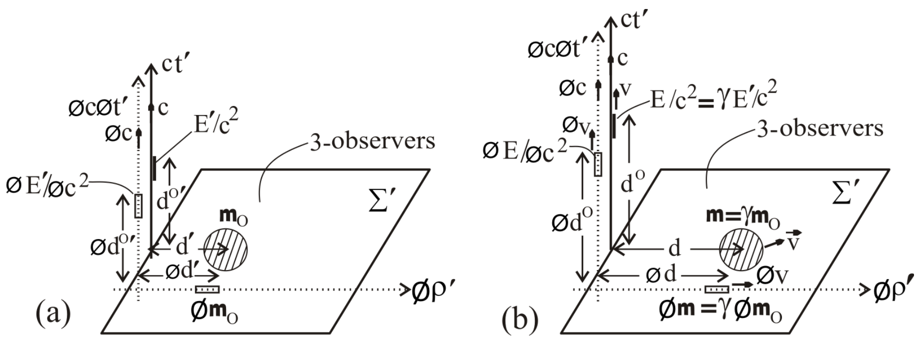

Fig. 9: The three-dimensional mass of an object at a position in the Euclidean 3-space and its one-dimensional equivalent mass at the symmetry-partner position in the time dimension, along with the underlying one-dimensional intrinsic mass of the object in intrinsic space and its equivalent intrinsic mass in the intrinsic time dimension, in the situations where (a) the object is stationary relative to the observer and (b) the object is in motion relative to the observer.

is in motion at speed $v = |\vec{v}|$ in the proper time dimension ct' relative to the 3-observer in Σ' in Fig. 9b, on the other hand, the special-relativistic equivalent mass $E/c^2 = \gamma E'/c^2$, acquires the absolute speed $V_0 = c$ of the proper time dimension ct', which is not made manifest in motion of $\gamma E'/c^2$ along ct' and as well possesses speed v of translation along ct' relative to the 3-observer in Σ'.

During a given period of time, the relativistic equivalent mass $\gamma E'/c^2$ has translated at constant speed v from an initial position P_1^0 to another position P_2^0 along the proper time dimension ct', while covering an interval $P_1^0 P_2^0$ of ct'. During the same period of time, the special-relativistic mass $m = \gamma m_0$, has translated at equal constant speed $v = |\vec{v}|$ from an initial position P_1 to another position P_2 in the proper Euclidean 3-space Σ', while covering a distance $P_1 P_2$ in Σ', where the interval $P_1^0 P_2^0$ covered along ct' by $\gamma E'/c^2$ is equal to the distance $P_1 P_2$ covered in Σ' by γm_0 and positions P_1 and P_2 in Σ' are symmetry-partner positions to positions P_1^0 and P_2^0 respectively in ct'. Consequently γm_0 and $\gamma E'/c^2$ are always located at symmetry-partner positions in Σ' and ct' respectively in the situation where they are in motion at any speed v in their respective domains relative to the 3-observer in Σ' in Fig. 9b.

It shall be reiterated for emphasis that the equivalent mass E'/c^2 or $\gamma E'/c^2$ in our proper metric time dimension ct' with respect to 3-observers in our proper Euclidean 3-space Σ', of a particle, object or observer in Figs. 9a and 9b, is actually the three-dimensional mass m_0^0 or γm_0^0 of the symmetry-partner particle, object or observer in the proper Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe with respect to 3-observers in $\Sigma^{0\prime}$. This is the origin of the the one-dimensional particle, object or observer (or 1-particle, 1-object or 1-observer) in the time dimension to every 3-dimensional particle, object or observers (or 3-particle, 3-object or 3-observer) in 3-space in our universe.

Just as the proper time dimension $ct'(\equiv x^{0\prime})$ is added to the three dimensions $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ of the proper Euclidean 3-space Σ' to have the four dimensions $x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ of the flat four-dimensional proper metric spacetime, the one-dimensional equivalent rest mass E'/c^2 of a particle, object or observer in the proper time dimension ct' must be added to the three-dimensional rest mass m_0 of its symmetry-partner particle, object or observer in the proper Euclidean 3-space Σ' to have a 4-dimensional particle, object or observer of rest mass $(m_0, E'/c^2)$ on the flat four-dimensional proper spacetime (Σ', ct') in our notation.

However it is more appropriate to refer to 4-dimensional particles, objects and observers on flat 4-dimensional spacetime as (3+1)-dimensional particles, objects and observers, because the one-dimensional particles, objects and observers (or 1-particles, 1-objects and 1-observers) in the time dimension ct' are themselves distinct particles, objects and observers, (which are geometrically contracted from three-dimensional particles, objects and observers in the Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe), which are separated in the time dimension ct' from their symmetry-partner three-dimensional continuum particles, objects and observers (or 3-particles, 3-objects and 3-observers) in the continuum Euclidean 3-space Σ'.

The 1-particle, 1-object or 1-observer in the time dimension can be thought of as weakly bonded to the 3-particle, 3-object or 3-observer in the Euclidean 3-space to form a (3+1)-dimensional particle, object or observer in spacetime and a (3+1)-dimensional particle, object or observer can be decomposed into its component 1-particle, 1-object or 1-observer in the time dimension and 3-particle, 3-object or 3-observer in the Euclidean 3-space. On the other hand, what should be referred to as a continuum 4-dimensional particle, object or observer (or 4-particle, 4-object or 4-observer) on four-dimensional spacetime continuum should be non-decomposable into its component dimensions, just as a continuum 3-dimensional particle, object or observer in the Euclidean 3-space continuum cannot be decomposed into its component dimensions.

There are no continuum non-decomposable four-dimensional particles, objects and observers on four-dimensional spacetime in the context of the present theory. Rather there are (3+1)-dimensional particles, objects and observers that can be decomposed into one-dimensional particles, objects and observers in the time dimension and three-dimensional particles, objects and observers in the Euclidean 3-space. Relativistic physics must be formulated partially with respect to 1-observers in the time dimension as distinct from relativistic physics formulated partially with respect to 3-observers in the Euclidean 3-space. The partial physics formulated with respect to 1-observer in the time dimension and 3-observer in the Euclidean 3-space must then be composed into the full relativistic physics on four-dimensional spacetime.

It is also important to note that it is the partial physics formulated with respect to 1-observers in the time dimension, which, of course, contains component of physics projected from the Euclidean 3-space in relativistic physics, is what the 1-observers in the time dimension could observe. It is likewise the partial physics formulated with respect to 3-observers in the Euclidean 3-space, which, of course, contains component of physics projected from the time dimension in relativistic physics, that the 3-observers in the Euclidean 3-space could observe.

The foregoing paragraph has been well illustrated with the derivation of the intrinsic Lorentz transformation of system (13) of [1] as combination of partial intrinsic Lorentz transformation (11) derived from Fig. 8a with respect to the 3-observer (Peter) in the Euclidean 3-space $\tilde{\Sigma}$ and partial intrinsic Lorentz transformation (12) derived from Fig. 8b with respect to the 1-observer ($\tilde{\text{P}}$eter) in the time dimension $c\tilde{t}$ in that paper. The Lorentz transformation of system (28) of [1], as the outward manifestation on flat four-dimensional spacetime of the intrinsic Lorentz transformation (11) in that paper, has likewise been composed from partial Lorentz transformation with respect to the 3-observer in $\tilde{\Sigma}$ and partial Lorentz transformation with respect to the 1-observer in the time dimension $c\tilde{t}$.

Let us collect the partial Lorentz transformations derived with respect to the 1-observer in $c\tilde{t}$ in the LT and its inverse of systems (28) and (29) of [1] to have as follows

$$\left.\begin{array}{rcl} c\tilde{t}' &=& c\tilde{t}\sec\psi - \tilde{x}\tan\psi; \\ \tilde{x} &=& \tilde{x}'\sec\psi + c\tilde{t}\tan\psi;\ \tilde{y} = \tilde{y}';\ \tilde{z} = \tilde{z}'; \\ && (\text{w.r.t. } 1-\text{observer in } c\tilde{t}) \end{array}\right\}. \quad (25)$$

These coordinate transformations simplify as follows from the point of view of what can be measured with laboratory rod and clock discussed in detail in sub-section 4.5 of [1]:

$$\tilde{t} = \tilde{t}'\cos\psi;\ \tilde{x} = \tilde{x}'\sec\psi;\ \tilde{y} = \tilde{y}';\ \tilde{z} = \tilde{z}' \quad (26)$$

w.r.t. 1 − observer in $c\tilde{t}$.

System (26) derived with respect to the 1-observer in $c\tilde{t}$, corresponds to system (42) of [1], derived with respect to 3-observer in $\tilde{\Sigma}$ in that paper, which shall be re-presented here as follows

$$\tilde{t} = \tilde{t}'\sec\psi;\ \tilde{x} = \tilde{x}'\cos\psi;\ \tilde{y} = \tilde{y}';\ \tilde{z} = \tilde{z}' \quad (27)$$

w.r.t. 3 − observer in $\tilde{\Sigma}$.

We find from systems (26) and (27) that while 3-observers in the Euclidean 3-space observe length contraction and time dilation of relativistic events, their symmetry-partner 1-observers in the time dimension observe length dilation and time contraction of relativistic events.

It is clear from all the foregoing that a 3-observer in the Euclidean 3-space and his symmetry-partner 1-observer in the time dimension are distinct observers who can be composed (or "weakly bonded") into a (3+1)-dimensional observer that can be decomposed back into its component 3-observer and 1-observer for the purpose of formulating relativistic physics, which is composed from partial relativistic physics formulated separately with respect to 3-observers in the Euclidean 3-space and 1-observers in the time dimension.

Every parameter in the Euclidean 3-space has its counterpart (or symmetry-partner) in the time dimension. We have seen the case of rest mass m_0 in the proper Euclidean 3-space Σ' and its symmetry-partner one-dimensional equivalent rest mass E'/c^2 in the proper time dimension ct', as illustrated in Figs. 9a and 9b. A classical three-vector quantity $\vec{q}\,'$ in the proper Euclidean 3-space Σ' has its symmetry-partner classical scalar quantity $q^{0\prime}$ in the proper time dimension ct'. The composition of the two yields what is usually referred to as four-vector quantity denoted by $q'_\lambda = (q^{0\prime}, \vec{q}\,')$ or $q'_\lambda = (q^{0\prime}, q^{1\prime}, q^{2\prime}, q^{3\prime})$. We now know that the scalar components $q^{0\prime}$ in the time dimension ct' of four-vector quantities in the positive (or our) universe are themselves three-vector quantities $\vec{q}^{\,0\prime}$ in the Euclidean 3-space $\Sigma^{0\prime}$ of the positive time-universe with respect to 3-observers in $\Sigma^{0\prime}$. The three-vector quantities $\vec{q}^{\,0\prime}$ in $\Sigma^{0\prime}$, (which are identical symmetry-partners to the three-vector quantities $\vec{q}\,'$ in our Euclidean 3-space Σ'), become contracted to one-dimensional scalar quantities $q^{0\prime} = |\vec{q}^{\,0\prime}|$ in the time dimension ct' relative to 3-observers in Σ', even as the proper Euclidean 3-space $\Sigma^{0\prime}$ containing $\vec{q}^{\,0\prime}$ becomes contracted to the proper time dimension ct' relative to 3-observers in Σ'.

4 Final justification for the new spacetime/intrinsic spacetime diagrams for Lorentz transformation/intrinsic Lorentz transformation in the four-world picture

New geometrical representations of Lorentz transformation and intrinsic Lorentz transformation (LT/ϕLT) and their inverses were derived and presented as Figs. 8a and 8b and Figs. 9a and 9b within the two-world picture isolated in [1]. However at least two outstanding issues about those diagrams remain to be resolved in order to finally justify them. The first issue is the unexplained origin of Fig. 8b that must necessarily be drawn to complement Fig. 8a of [1] in deriving ϕLT/LT.

The second issue is the unspecified reason why anticlockwise relative rotations of intrinsic affine spacetime coordinates are positive rotations (involving positive intrinsic angles $\phi\psi$) with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^*$ in Fig. 8a of [1], while, at the same time, clockwise relative rotations of intrinsic affine spacetime coordinates are positive rotations (involving positive intrinsic angles $\phi\psi$) with respect to 1-observers in the time dimensions ct' and $-ct'^*$ in Fig. 8b of [1]. These two issues shall be resolved within the four-world picture encompassed by Figs. 8a and 8b of this paper in this section.

Let us as done in deriving Figs. 8a and 8b and their inverses Figs. 9a and 9b of [1] towards the derivation of intrinsic Lorentz transformation/Lorentz transformation (ϕLT/LT) and their inverses in the positive and negative universes in [1], prescribe particle's (or primed) frame and observer's (or unprimed) frame in terms of extended affine spacetime coordinates in the positive (or our) universe as $(\tilde{x}', \tilde{y}', \tilde{z}', c\tilde{t}')$ and $(\tilde{x}, \tilde{y}, \tilde{z}, c\tilde{t})$ respectively. They are underlied by intrinsic particle's frame and intrinsic observer's frame in terms of extended intrinsic affine coordinates $(\phi\tilde{x}', \phi c\phi\tilde{t}')$ and $(\phi\tilde{x}, \phi c\phi\tilde{t})$ respectively.

The prescribed perfect symmetry of state between the positive and negative universes in [1] implies that there are identical symmetry-partner particle's frame and observer's frame $(-\tilde{x}'^*, -\tilde{y}'^*, -\tilde{z}'^*, -c\tilde{t}'^*)$ and $(-\tilde{x}^*, -\tilde{y}^*, -\tilde{z}^*, -c\tilde{t}^*)$ respectively, as well as their underlying identical symmetry-partner intrinsic particle's frame and symmetry-partner intrinsic observer's frame $(-\phi\tilde{x}'^*, -\phi c\phi\tilde{t}'^*)$ and $(-\phi\tilde{x}^*, -\phi c\phi\tilde{t}^*)$ respectively in the negative universe.

Let us consider the motion at a constant speed v of the rest mass m_0 of the particle along the $\tilde{x}'$−axis of its frame and the underlying intrinsic motion at constant intrinsic speed ϕv of the intrinsic rest mass ϕm_0 of the particle along the intrinsic space coordinate $\phi\tilde{x}'$ of its frame relative to a 3-observer in the positive universe. Again the prescribed perfect symmetry of state between the positive and negative universes implies that the rest mass $-m_0^*$ of the symmetry-partner particle is in simultaneous motion at equal constant speed v along the $-\tilde{x}'^*$−axis of its frame of reference and its intrinsic rest mass $-\phi m_0^*$ is in simultaneous intrinsic motion at equal intrinsic speed ϕv along the intrinsic space coordinate $-\phi\tilde{x}'^*$−axis of its frame relative to the symmetry-partner 3-observer in the negative universe.

As developed in sub-section 4.4 of [1], the simultaneous identical motions of the symmetry-partner particles' frames relative to the symmetry-partner observers' frames in the positive and negative universes, described in the foregoing paragraph, give rise to Fig. 8a of [1] with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^*$, which shall be reproduced here as Fig. 10a.

The diagram of Fig. 10a involving relative rotations of extended intrinsic affine spacetime coordinates, has been drawn upon the flat four-dimensional proper metric spacetime of classical mechanics (CM) and its underlying flat two-dimensional proper intrinsic metric spacetime of intrinsic classical mechanics (ϕCM) of the positive (or our) universe and the negative universe contained in Fig. 8a of this paper. The prescribed symmetry of state among the four universes encompassed by Figs. 8a and 8b of this paper, implies that identical symmetry-partner particles undergo identical motions simultaneously relative to identical symmetry-partner observers (or frames of reference) in the four universes. It follows from this that Fig. 10b drawn upon the flat four-dimensional proper metric spacetime of CM and its underlying flat two-dimensional proper intrinsic metric spacetime of ϕCM of the positive time-universe and the negative time-universe contained in Fig. 8b of this paper, co-exists with Fig. 10a in nature.

Fig. 10b is valid with respect to 3-observers in the Euclidean 3-spaces $\Sigma^{0\prime}$ of the positive time-universe and $-\Sigma^{0\prime*}$ of the negative time-universe as indicated. It must be noted that the anti-clockwise rotations of primed intrinsic coordinates $\phi\tilde{x}'$ and $\phi c\phi\tilde{t}'$ relative to the unprimed intrinsic coordinates $\phi\tilde{x}$ and $\phi c\phi\tilde{t}$ respectively by positive intrinsic angle $\phi\psi$ with respect to 3-observers in the Euclidean 3-space Σ' and $-\Sigma'^*$ in Fig. 10a, correspond to clockwise rotations of the primed intrinsic coordinates $\phi\tilde{x}^{0\prime}$ and $\phi c\phi\tilde{t}^{0\prime}$ relative to the unprimed intrinsic coordinates $\phi\tilde{x}^0$ and $\phi c\phi\tilde{t}^0$ respectively by positive intrinsic angle $\phi\psi$ with respect to 3-observers in $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ in Fig. 10b.

Fig. 10b co-exists with Fig. 10a in nature and must complement Fig. 10a towards deriving intrinsic Lorentz transformation/Lorentz transformation (ϕLT/LT) graphically in the positive (or our) universe and the negative universe by physicists in our universe and the negative universe. However Fig. 10b in its present form cannot serve a complementary role to Fig. 10a, because it contains the spacetime and intrinsic spacetime coordinates of the positive time-universe and the negative time-universe, which are elusive to observers in our (or positive) universe and the negative universe, or which cannot appear in physics in the positive and negative universes.

In order for Fig. 10b to be able to serve a complementary role to Fig. 10a towards deriving the ϕLT/LT in the positive and negative universes, it must be appropriately modified. As found earlier in this paper, the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ of the positive and negative time-universes with respect to 3-observers in them, are proper time dimensions ct' and $-ct'^*$ respectively with respect to 3-observers in the proper Euclidean 3-spaces Σ' and $-\Sigma'^*$ of our universe and the negative universe and the proper time dimensions $ct^{0\prime}$ and $-ct^{0\prime*}$ of the positive and negative time-universes with respect to 3-observers in the proper Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ of the positive and negative time-universes, are the proper Euclidean 3-spaces Σ' and $-\Sigma'^*$ of our universe and the negative universes respectively with respect to 3-observers in Σ' and $-\Sigma'^*$.

As follows from the foregoing paragraph, Fig. 10b will contain the spacetime and intrinsic spacetime coordinates of

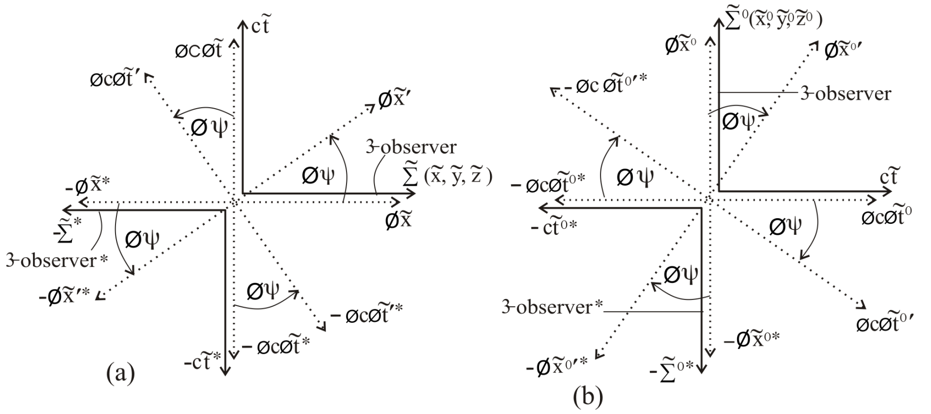

Fig. 10: a) Relative rotations of intrinsic affine spacetime coordinates of a pair of frames in the positive (or our) universe and of the symmetry-partner pair of frames in the negative universe, which are valid relative to symmetry-partner 3-observers in the Euclidean 3-spaces in the positive and negative universes. b) Relative rotations of intrinsic affine spacetime coordinates of a pair of frames in the positive time-universe and of the symmetry-partner pair of frames in the negative time-universe, which are valid relative to symmetry-partner 3-observers in the Euclidean 3-spaces in the positive and negative time-universes.

our (or positive) universe and the negative universe solely by performing the following transformations of spacetime and intrinsic spacetime coordinates on it with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ of our universe and the negative universe:

$$\left.\begin{array}{lll} \tilde{\Sigma}^{0} & \to & c\tilde{t};\ c\tilde{t}^{0} \to \tilde{\Sigma};\ -\tilde{\Sigma}^{0*} \to -c\tilde{t}^{*}; \\ & & -c\tilde{t}^{0*} \to -\tilde{\Sigma}^{*}. \\ \phi\tilde{x}^{0} & \to & \phi c\phi\tilde{t};\ \phi c\phi\tilde{t}^{0} \to \phi\tilde{x}; \\ & & -\phi\tilde{x}^{0*} \to -\phi c\phi\tilde{t}^{*}; \\ & & -\phi c\phi\tilde{t}^{0*} \to -\phi\tilde{x}^{*}. \\ \phi\tilde{x}^{0\prime} & \to & \phi c\phi\tilde{t}';\ \phi c\phi\tilde{t}^{0\prime} \to \phi\tilde{x}'; \\ & & -\phi\tilde{x}^{0\prime*} \to -\phi c\phi\tilde{t}'^{*}; \\ & & -\phi c\phi\tilde{t}^{0\prime*} \to -\phi\tilde{x}'^{*}. \end{array}\right\} \quad (28)$$

By implementing the coordinate/intrinsic coordinate transformations of systems (28) on Fig. 10b we have Fig. 11a.

Fig. 11a is valid with respect to 1-observers in the proper time dimensions ct' and $-ct'^{*}$ of the positive and negative universes as indicated, where these 1-observers are the 3-observers in the Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ in Fig. 10b. Since Fig. 11a contains the spacetime/intrinsic spacetime coordinates of the positive (or our) universe and the negative universe solely, it can serve as a complementary diagram to Fig. 10a towards the deriving ϕLT/LT in the positive (or our) universe and the negative universe. Indeed Fig. 10a and Fig. 11a are the same as Figs. 8a and 8b of [1], with which the ϕLT/LT were derived in the positive (or our) universe and the negative universe in that paper, except for intrinsic spacetime projections in Figs. 8a and 8b of [1], which are not shown in Figs. 10a and Fig. 11a here.

On the other hand, Fig. 10a will contain the spacetime/intrinsic spacetime coordinates of the positive time-universe and the negative time-universe solely, as shown in Fig. 11b, by performing the inverses of the transformations of spacetime and intrinsic spacetime coordinates of system (28), (that is, by reversing the directions of the arrows in system (28)) on Fig. 10a. Just as Fig. 11a must complement Fig. 10a for the purpose of deriving the ϕLT/LT in the positive (or our) universe and the negative universe, as presented in sub-section 4.4 of [1], Fig. 11b must complement Fig. 10b for the purpose of deriving the ϕLT/LT in the positive time-universe and the negative time-universe.

The clockwise sense of relative rotations of intrinsic affine spacetime coordinates by positive intrinsic angles $\phi\psi$ with respect to 1-observers in the time dimension $c\tilde{t}$ and $-c\tilde{t}^{*}$ in Fig. 11a follows from the validity of the clockwise sense of relative rotations of intrinsic affine spacetime coordinates by positive intrinsic angle $\phi\psi$ with respect to 3-observers in the Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ in Fig. 10b. The 1-observers in $c\tilde{t}$ and $-c\tilde{t}^{*}$ in Fig. 11a are what the 3-observers in $\tilde{\Sigma}^{0}$ and $-\tilde{\Sigma}^{0*}$ in Fig. 10b transform into, as noted above.

Thus the second outstanding issue about the diagrams of Figs. 8a and 8b of [1], mentioned at the beginning of this section namely, the unexplained reason why anti-clockwise relative rotations of intrinsic affine spacetime coordinates with respect to 3-observers in the Euclidean 3-spaces Σ' and $-\Sigma'^{*}$ are positive rotations involving positive intrinsic angles $\phi\psi$ in Fig. 8a of [1], while, at the same time, clockwise relative rotations of intrinsic affine spacetime coordinates with respect to 1-observers in the time dimensions ct' and $-ct'^{*}$ are positive rotations involving positive intrinsic angles $\phi\psi$ in Fig. 8b of [1], has now been resolved.

Since Fig. 8b of [1] or Fig. 11a of this paper has been shown to originate from Fig. 10b of this paper, which is valid with respect to 3-observers in the Euclidean 3-spaces $\Sigma^{0\prime}$ and $-\Sigma^{0\prime*}$ of the positive and negative time-universes, the origin

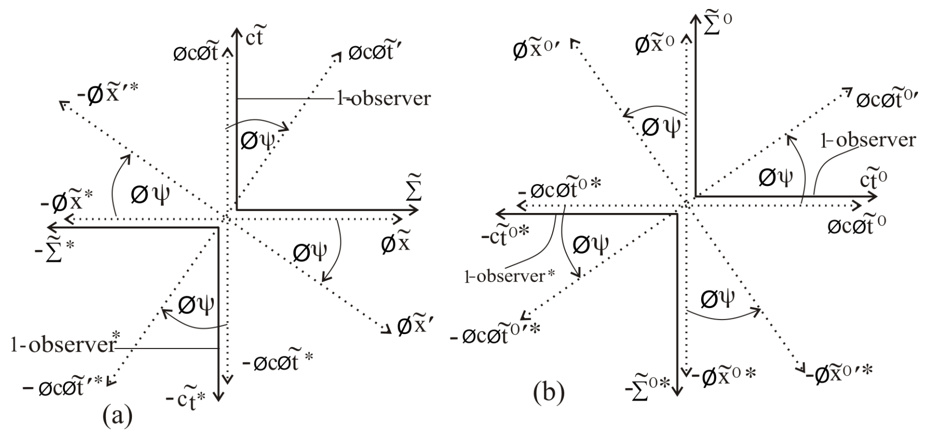

Fig. 11: a) Complementary diagram to Fig. 10a obtained by transforming the spacetime/intrinsic spacetime coordinates of the positive time-universe and the negative time-universe in Fig. 10b into the spacetime/intrinsic spacetime coordinates of the positive (or our) universe and the negative universe; is valid with respect to 1-observers in the time dimensions of our universe and the negative universe. b) Complementary diagram to Fig. 10b obtained by transforming the spacetime/intrinsic spacetime coordinates of the positive (or our) universe and the negative universe in Fig. 10a into the spacetime/intrinsic spacetime coordinates of the positive time-universe and the negative time-universe; is valid with respect to 1-observers in the time dimensions of the positive time-universe and the negative time-universe.

from the positive time-universe and negative time-universe of Fig. 8b of [1] (or Fig. 11a of this paper), which must necessarily be drawn to complement Fig. 8a of [1] (or Fig. 10a of this paper) in deriving the ϕLT/LT in our (or positive) universe and the negative universe, has been shown. Thus the first outstanding issue about Figs. 8a and 8b of [1], which was unresolved in [1], mentioned at the beginning of this section, namely the unexplained origin of Fig. 8b that must always be drawn to complement Fig. 8a in [1] in deriving the ϕLT/LT, has now been resolved. The four-world background of Figs. 8a and its complementary diagram of Fig. 8b in [1] (or Fig. 10a and Fig. 11a of this paper), has thus been demonstrated.

The new geometrical representation of the intrinsic Lorentz transformation/Lorentz transformation (ϕLT/LT) of Figs. 8a and 8b in [1] (or Fig. 10a and Fig. 11a of this paper), which was said to rest on a two-world background in [1] and [2], because those diagrams contain the spacetime/intrinsic spacetime coordinates of the positive (or our) universe and the negative universe solely and the origin of Fig. 8b in [1] (or Fig. 11a of this paper) from the diagram of Fig. 10b of this paper in the positive time-universe and the negative time-universe was unknown in [1]. The ϕLT/LT and consequently the intrinsic special theory of relativity/special theory of relativity (ϕSR/SR) shall be said to rest on a four-world background henceforth.

5 Invariance of the flat four-dimensional proper (or classical) metric spacetime in the context of special relativity

The flat four-dimensional proper physical (or metric) spacetime, which is composed of the proper Euclidean 3-space Σ' and the proper time dimension ct' in the first quadrant in Fig. 8a of this paper, is the flat four-dimensional proper metric spacetime of classical mechanics (including classical gravitation), of the positive (or our) universe, usually denoted by $(x^{0\prime}, x^{1\prime}, x^{2\prime}, x^{3\prime})$, where the dimension $x^{0\prime}$ is along the one-dimensional proper space $\rho^{0\prime}$ in Fig. 6a, which transforms into the proper time dimension ct' in Fig. 8a; hence $x^{0\prime} = ct'$ and $x^{1\prime}$, $x^{2\prime}$ and $x^{3\prime}$ are the dimensions of the proper Euclidean 3-space Σ'. The notation (Σ', ct') for the flat four-dimensional proper physical (or metric) spacetime adopted in [1] and [2], (although the prime label on Σ' and ct' did not appear in those papers), is being adhered to in this paper for convenience.

When the special theory of relativity operates on the flat four-dimensional proper metric spacetime $(x^{0\prime}, x^{1\prime}, x^{2\prime}, x^{3\prime})$; $x^{0\prime} = ct'$ (or (Σ', ct') in our notation), it is the extended intrinsic affine spacetime coordinates $\phi\tilde{x}'$ and $\phi c\phi\tilde{t}'$ of the primed (or particle's) frame that are rotated relative to their projective extended affine intrinsic spacetime coordinates $\phi\tilde{x}$ and $\phi c\phi\tilde{t}$ of the unprimed (or observer's) frame. It is consequently the primed intrinsic affine coordinates $\phi\tilde{x}'$ and $\phi c\phi\tilde{t}'$ that transform into the unprimed intrinsic affine coordinates $\phi\tilde{x}$ and $\phi c\phi\tilde{t}$ in intrinsic Lorentz transformation (ϕLT) in the context of intrinsic special theory of relativity (ϕSR).

It is the extended affine spacetime coordinates $c\tilde{t}'$, $\tilde{x}'$, $\tilde{y}'$ and $\tilde{z}'$ of the primed frame on the flat four-dimensional proper physical (or metric) spacetime $(x^{0\prime}, x^{1\prime}, x^{2\prime}, x^{3\prime})$ (or (Σ', ct') in our notation) that transform into the extended affine spacetime coordinates $c\tilde{t}$, $\tilde{x}$, $\tilde{y}$ and $\tilde{z}$ of the unprimed frame, also on the flat four-dimensional proper physical (or metric) spacetime $(x^{0\prime}, x^{1\prime}, x^{2\prime}, x^{3\prime})$ (or (Σ', ct') in our notation) 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 ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct') in our notation) on which it operates, to an extended flat relativistic metric spacetime (x^0, x^1, x^2, x^3) (or (Σ, ct) in our notation), because SR involves the transformation of extended affine spacetime coordinates with no physical (or metric) quality. Or because the spacetime geometry associated with SR is affine spacetime geometry. A re-visit to the discussion of affine and metric spacetimes in sub-section 4.4 of [1] may be useful here. The primed coordinates $\tilde{x}'$, $\tilde{y}'$, $\tilde{z}'$ and $c\tilde{t}'$ of the particle's frame and the unprimed coordinates $\tilde{x}$, $\tilde{y}$, $\tilde{z}$ and $c\tilde{t}$ of the observer's frame in the context of SR are affine coordinates with no metric quality, both of which exist on the flat proper (or classical) metric spacetime ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct') in our notation).

It is gravity (a metric phenomenon) that can transform extended flat four-dimensional proper (or classical) metric spacetime (with prime label) ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct') in our notation) into extended four-dimensional "relativistic" spacetime (x^0, x^1, x^2, x^3) (or (Σ, ct)), (without prime label), where (x^0, x^1, x^2, x^3) (or (Σ, ct)) is known to be curved in all finite neighborhood of a gravitation field source 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 ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct')) is also known to transform into the inertial mass m on the curved "relativistic" physical (or metric) spacetime (x^0, x^1, x^2, x^3) (or (Σ, ct)) in the context of GR, where m is known to be trivially related to m_0 as $m = m_0$, by virtue of the principle of equivalence of Albert Einstein [5].

However our interest in [1] and [2] and in the two parts of this paper is not in the metric phenomenon of gravity, but in the special theory of relativity (with affine spacetime geometry), as an isolated subject from gravity. We have inherently assumed the absence of gravity by restricting to the extended flat four-dimensional proper (or classical) metric spacetime ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct') in our notation), as the metric spacetime that supports SR in the absence of relativistic gravity in [1] and [2] and up to this point in this paper. The transformation of the flat proper (or classical) metric spacetime ($x^{0\prime}$, $x^{1\prime}$, $x^{2\prime}$, $x^{3\prime}$) (or (Σ', ct')) into "relativistic" metric spacetime (x^0, x^1, x^2, x^3) (or (Σ, ct)) in the context of a theory of gravity, shall be investigated with further development within the present four-world picture, in which four-dimensional spacetime is underlined by two-dimensional intrinsic spacetime in each of the four symmetrical worlds (or universes).

This first part of this paper shall be ended at this point, while justifications for the co-existence in nature of the four symmetrical worlds (or universes) in Figs. 8a and 8b of this paper, as the actual background of the special theory of relativity in each universe, shall be concluded in the second part.

Submitted on January 26, 2010 / Accepted on March 01, 2010

References

1. Adekugbe A. O. J. Two-world background of special relativity. Part I. *Progress in Physics*, 2010, v. 1, 30–48.
2. Adekugbe A. O. J. Two-world background of special relativity. Part II. *Progress in Physics*, 2010, v. 1, 49–61.
3. Adler R., Bazin M., Schiffer M. Introduction to general relativity. Second Edition. McGraw-Hill Book Company, New York, 1975.
4. Einstein A. Sidelights on relativity. Methuen, 1922.
5. Bonnor W. B. Negative mass in general relativity. *Gen. Relat. Grav.*, 1989, v. 21, 1143–1157.