

Evolutionary sequence of spacetime and intrinsic spacetime and associated sequence of geometries in metric force fields IV

Original

Research Article

Abstract

The at two-dimensional relative proper intrinsic metric spacetime ($(\tau_0; \tau_{cs} \tau_0)$) underlying the at four-dimensional relative proper metric spacetime ($(IE_{03}; c_{st0})$), which emerges at the first stage of evolutions of metric spacetimes and intrinsic metric spacetimes in long-range metric force fields, isolated in the first three parts of this paper, endures for no moment before transforming into a curved two-dimensional relative proper intrinsic metric spacetime with pseudo-orthogonal curvilinear intrinsic dimensions, τ_0 and $\tau_{cs} \tau_0$, on the vertical intrinsic metric spacetime hyperplane, on the larger spacetime and intrinsic spacetime of combined positive (or our) universe and the negative universe. It therefore possesses intrinsic Lorentzian metric tensor at every point. It projects an underlying at relativistic intrinsic metric spacetime ($(\tau; \tau_{cs} \tau)$), which is made manifested outwardly in a at four-dimensional relativistic metric spacetime ($(IE_3; c_{st})$), at the second (and final) stage of evolutions of metric spacetime and intrinsic metric spacetime in long-range metric force fields. The conclusion that the four-dimensional metric spacetime is everywhere at in every long-range metric force field is reached.

The curved 'two-dimensional' absolute intrinsic metric spacetime ($(\tau^{\wedge}; \tau^{\wedge}_{cs} \tau^{\wedge})$) with absolute intrinsic sub-Riemannian metric tensor $\tau^{\wedge} g_{ik}$, which evolves at the first stage is brought forward to the second stage. The basic aspects of the theory of relativity on the at relativistic metric spacetime, intrinsic theory of relativity on the underlying at relativistic intrinsic metric spacetime and absolute intrinsic metric theory on the curved absolute intrinsic metric spacetime, associated with the presence of a metric force field in spacetime and intrinsic metric force field in intrinsic spacetime, are developed in terms of certain derived geometrical parameters, referred to as relative proper static low speed, relative proper intrinsic static low speed and absolute intrinsic static low speed respectively. Particularization to the gravitational field will be a straight forward process, while using the results of this paper as template.

long-range metric force fields, second stage of evolutions of spacetime and intrinsic spacetime, curved proper intrinsic metric spacetime, projective at relativistic intrinsic metric spacetime, outward manifestation at relativistic metric spacetime, static low-speed

1 Introduction

This fourth and last part of this paper is devoted to the second stage of evolutions of metric spacetime and intrinsic metric spacetime in long-range metric force fields, having concluded the first stage in the preceding parts one, two and three of this paper [1{3}. The absolute intrinsic Riemannian spacetime geometry developed in the first three parts, which supports absolute intrinsic theory and absolute theory of metric force fields and the extension to the geometry of relative intrinsic metric spacetime and relative metric spacetime, which supports relative intrinsic theory and relative theory of metric force fields, in this fourth part, are pure novel effort of the author. No related work in physics or mathematics exists in the open literature, as far as can be found. This thereby limits the references in this paper to the previous papers of the author, upon which this fourth part of this paper is based essentially.

The at four-dimensional relative proper metric spacetime, denoted by $(IE_{03}; c_{st0})$ for convenience, in the first, second and third parts of this paper and this fourth part, where IE_{03} is the at three-dimensional relative proper metric space, contains the

'four-dimensional' rest masses ($m_0; m_0=c_{2s}$) of particles and objects, with the assumed

absence of strong (or relativistic) gravitational field. With this assumption, the at $(IE_{03}; c_{st0})$ supports the special theory of relativity (SR), involving the motions of the rest masses ($m_0; m_0=c_{2s}$)

of particles, which become their special-relativistic masses

$(m_0; \tau_0 = c_0 t_0)$
) relative to observers.

The introduction of a strong (or relativistic) gravitational field into the flat four-dimensional relative proper metric spacetime $(IE_{03}; c_{st0})$, will transform it into a curved four-dimensional metric spacetime $(IM_3; c_{st})$ (usually denoted by $(x_0; x_1; x_2; x_3)$), with Riemannian metric tensor g_{ij} , in the context of the general theory of relativity (GR). It is to be recalled however that, although curvature of four-dimensional spacetime in a metric force field is a well thought-out prescription, see pages 111 { 149 of [4], which has not been falsified until now, it nevertheless remains an unproven fundamental postulate of the general theory of relativity.

As for the isolation of the first stage of evolutions of spacetime and intrinsic spacetime and the associated geometry in long-range metric force fields in [1{3], on the other hand, only the 'two-dimensional' absolute intrinsic metric spacetime $(\tau^a; \tau^c s \tau^t)$, isolated in those articles and illustrated in Fig. 11 of [3], reproduced as Fig. 1 of this article, is curved with absolute intrinsic sub-Riemannian metric tensor $\tau^a g_{ik}$, while the four-dimensional relative proper metric spacetime $(IE_{03}; c_{st0})$ is at in long-range metric force fields, as Fig. 1 shows.

The developments in [1{3], which leads to the geometry of Fig. 11 of [3], reproduced as Fig. 1 of this article, is preceded by the isolation of co-existing four symmetrical universes in separate spacetimes with event horizon separations, referred to as fourworld picture in [5{8]. The four universes constitute four-world background for the special theory of relativity (SR) on flat relative proper spacetime in each universe, as developed in those articles.

ab
 ab
 c t s
 Cst Cs t
 Csabtab
 Csab tab
 y
 y
 mab,
 m,
 m,
 mab,
 mab,
 mab,

Figure 1: The proper metric spacetimes and hierarchy of intrinsic metric spacetimes that evolve at the first stage of evolutions of spacetime and intrinsic spacetime in a long-range metric field in our universe; (Fig. 11 of [3]).

By starting with the flat four-dimensional relative proper metric spacetimes, $(IE_{03}; c_{st0})$ of our universe in Fig. 1 and $(\square IE_{03}; \square c_{st0})$ of the negative universe (not shown in Fig. 1), as the spacetimes of the special theory of relativity, with the inherent assumption of the absence of strong (or relativistic) gravitational field in the respective universes in [5], the flat relative proper intrinsic metric spacetime $(\tau^a_0; \tau^c s \tau^t_0)$ that underlies $(IE_{03}; c_{st0})$ in our universe and $(\square \tau^a_0; \square \tau^c s \tau^t_0)$ that underlies $(\square IE_{03}; \square c_{st0})$ in the negative universe, were introduced as ansatz in section 4 of that article.

A new set of a_{ne} spacetime/intrinsic a_{ne} spacetime diagrams involving the rotations of straight line primed intrinsic a_{ne} spacetime coordinates, $\tau^a \sim x_0$ and $\tau^c \sim t_0$, (of the particle's primed intrinsic a_{ne} frame), relative to their projective straight line unprimed intrinsic a_{ne} coordinates, $\tau^a \sim x$ and $\tau^c \sim t$ (of the particle's unprimed intrinsic a_{ne} frame), in the positive (or our) universe, and the simultaneous

rotations of the extended straight line primed intrinsic a_{ne} coordinates, $\square? \sim x_0$ and $\square?c? \sim t_0$, of the symmetry-partner particle's primed intrinsic a_{ne} frame relative to the extended straight line unprimed intrinsic a_{ne} coordinates, $\square? \sim x$ and $\square?c? \sim t$, of the symmetry-partner particle's unprimed intrinsic a_{ne} frame in the negative universe, shown as Figs. 8a and 8b and their inverses as Figs. 9a and 9b of [5], were derived.

Intrinsic Lorentz transformation (?LT) and its inverse in terms of extended straight line primed intrinsic a_{ne} coordinates, $? \sim x_0$ and $?c? \sim t_0$, of the particle's primed intrinsic a_{ne} frame and extended straight line unprimed intrinsic a_{ne} coordinates, $? \sim x$ and $?c? \sim t$, of the particle's unprimed intrinsic a_{ne} frame, were derived from the new set of diagrams (Figs. 8a, 8b, 9a and 9b of [5]), and intrinsic Lorentz invariance (?LI) was validated from these, in the context of the twodimensional intrinsic special theory of relativity (?SR), which involves intrinsic a_{ne} spacetime coordinates embedded in the at two-dimensional proper intrinsic metric spacetime ($?_0; ?c?t_0$), with the inherent assumption of the absence of strong gravitational _eld in [5].

Lorentz transformation (LT) and its inverse in terms of extended straight line primed a_{ne} spacetime coordinates, $\sim x_0; \sim y_0; \sim z_0$ and $c \sim t_0$, of the particle's primed a_{ne} frame and extended straight line unprimed a_{ne} spacetime coordinates, $\sim x; \sim y; \sim z$ and $c \sim t$ of the particle's unprimed a_{ne} frame in the context of SR, were then written directly from the intrinsic Lorentz transformation (?LT) and its inverse in the context of ?SR; SR involving four-dimensional a_{ne} spacetime coordinates embedded on the at four-dimensional relative proper metric spacetime ($IE_{03}; c_{st_0}$), being mere outward manifestation of ?SR involving two-dimensional intrinsic a_{ne} spacetime coordinates embedded in the at two-dimensional relative proper intrinsic metric spacetime ($?_0; ?c_s?t_0$), with the inherent assumption of the absence of strong gravitational _eld.

Eventually the origin of the at two-dimensional relative proper intrinsic metric spacetime ($?_0; ?c_s?t_0$) underlying the at 4-dimensional relative proper metric spacetime ($IE_{03}; c_{st_0}$) in our universe (and indeed in every one of the other three universes of the four-world picture isolated in [5{8}], was derived formally in section 1 of [8], thereby demystifying the (non-observable or hidden) intrinsic metric dimensions, $?_0$ and $?c_s?t_0$, and validating their actual presence in nature.

The special theory of relativity (SR) cannot alter the extended at 4-dimensional relative proper metric spacetime ($IE_{03}; c_{st_0}$) on which it operates, with the assumed absence of strong (ot relativistic) gravitational _eld. The intrinsic special theory of relativity (?SR) can likewise not alter the extended at two-dimensional proper intrinsic metric spacetime ($?_0; ?c_s?t_0$) on which it operates, with the assumed absence of relativistic gravitational _eld. These, as explained under the Summary and Conclusion section of [8], is due to the fact that the spacetime/intrinsic spacetime coordinates (or spacetime/intrinsic spacetime geometry) associated with SR/?SR are a_{ne} space-time/intrinsic a_{ne} spacetime coordinates (or a_{ne} spacetime/intrinsic a_{ne} spacetime geometry) with no metric quality.

It is by introducing the source of a long-range relativistic metric force-_eld (such as a source of relativistic gravitational _eld), at a point on the at 3-dimensional relative proper metric space IE_{03} and, consequently, the source of a long-range relativistic intrinsic metric force-_eld (such as a source of a relativistic intrinsic gravitational _eld), at the same point in the straight line relative proper intrinsic metric space $?_0$ in Fig. 11 of [3], reproduced as Fig. 1 of this article, the extended at relative proper metric spacetime ($IE_0; c_{st_0}$) and its underlying at relative proper intrinsic metric spacetime ($?_0; ?c_s?t_0$) can be made to transform into four-dimensional

relativistic metric spacetime $(\tau; c_{st})$, which is underlay by two-dimensional relativistic intrinsic metric spacetime $(\tau_0; c_{st})$ in all τ -neighborhood of the source of the long-range metric force τ_{eld} . The geometry associated with this at the second stage of evolutions of spacetime/intrinsic spacetime in long range relativistic metric force- τ_{eld} s shall be developed in the rest of this article.

2 Geometrical background in the four-world picture for a new at spacetime theory of relativity associated with the presence of a long-range metric force τ_{eld}

There are the theory of relativity and theory of intrinsic relativity, which are associated with the presence of a long-range relativistic metric force τ_{eld} in the four-dimensional metric spacetime and its underlying long-range relativistic intrinsic metric force τ_{eld} in the two-dimensional relative intrinsic metric spacetime. These will convert the extended at four-dimensional relative proper metric spacetime $(IE_{03}; c_{sto})$ and its underlying at two-dimensional relative proper intrinsic metric spacetime $(\tau_0; c_{st})$ to extended four-dimensional relativistic metric spacetime $(IE_3; c_{st})$ and its underlying extended two-dimensional relativistic intrinsic metric spacetime $(\tau_0; c_{st})$, within the long-range relative metric force τ_{eld} , at the second stage of evolutions of metric spacetime and intrinsic metric spacetimes in a long-range relativistic metric force τ_{eld} , as shall be developed in the rest of this article.

Now the non-uniform absolute proper intrinsic static ow speed V_{om}

ab projected

along the projective straight absolute proper intrinsic metric spacetime `dimensions', τ_0

ab and $c_{sab} \tau_0$

ab, along the horizontal and vertical, by the non-uniform absolute intrinsic static ow speed V_m of the curved absolute intrinsic metric spacetime dimensions, τ_0 and $c_{st} \tau_0$, in Fig. 1, constitute identical non-uniform absolute proper intrinsic static ow speed V_{om}

ab along the straight line relative proper

intrinsic metric spacetime `dimensions', τ_0 and $c_{sab} \tau_0$

ab, in which τ_0

ab and

$c_{sab} \tau_0$

ab are embedded respectively in that τ_{eld} . However non-uniform absolute proper intrinsic static ow speed V_{om}

ab, cannot cause the curvature of the relative

proper intrinsic metric spacetime dimensions, τ_0 and $c_{st} \tau_0$. This is so, because

absolute proper intrinsic static ow speed, being an absolute intrinsic parameter,

cannot produce any e_ect whatever on the relative proper intrinsic metric dimensions,

τ_0 and $c_{st} \tau_0$.

It is by also establishing non-uniform relative proper intrinsic static ow speed V_{om}

along the straight line relative proper intrinsic metric space τ_0 and straight

line relative proper intrinsic metric time dimension $c_{st} \tau_0$ in Fig. 1 that τ_0 and

$c_{st} \tau_0$ can be made to evolve into curved τ_0 and curved $c_{st} \tau_0$ within a long-range

relativistic metric force- τ_{eld} , at the second stage of evolutions of metric spacetime

and intrinsic metric spacetime, as shall be developed in this section. Else, the

geometry of Fig. 1 will persist and evolution of metric spacetime/intrinsic metric

spacetime will terminate at the τ_{eld} stage within a long-range metric force- τ_{eld}

(with the geometry of Fig. 1).

It is by introducing the source of a long-range relativistic metric force-field (such as a source of relativistic gravitational field), at a point on the relative proper metric Euclidean 3-space IE_{03} and, consequently a source of a long-range relativistic intrinsic metric force-field (such as a source of a relativistic intrinsic gravitational field), at the same point in the straight line relative proper intrinsic metric space Σ_0 in Fig. 1 that, non-uniform relative proper intrinsic static flow speed V_{om} is established

along the straight line relative proper intrinsic metric spacetime dimensions, Σ_0 and $\Sigma_{cs}t_0$ and non-uniform relative proper static flow-speed V_{om} is established in IE_{03}

and along c_{st_0} . This will cause the extended straight line Σ_0 and $\Sigma_{cs}t_0$ to become curved. projecting straight line relativistic intrinsic metric spacetime dimensions, Σ_0 and $\Sigma_{cs}t$, which are made manifested in at three-dimensional relativistic metric space IE_3 and straight line relativistic metric time dimension c_{st} respectively.

Thus the extended at relative proper metric spacetime ($IE_{03}; c_{st_0}$) and its underlying at relative proper intrinsic metric spacetime ($\Sigma_0; \Sigma_{cs}t_0$), with the assumption of the absence of a long-range relativistic metric force field, will naturally transform into at four-dimensional relativistic metric spacetime ($IE_3; c_{st}$), which is underlay by two-dimensional at relativistic intrinsic metric spacetime ($\Sigma; \Sigma_{cs}t$) in all finite neighborhood of the source of a long-range relativistic metric force field. The geometry associated with this at the second stage of evolutions of spacetime/intrinsic spacetime in a long range relativistic metric force-field shall be developed in the rest of this article.

2.1 The global curved relative proper intrinsic metric spacetime projects underlying at relativistic intrinsic metric spacetime that is made manifested outwardly in at relativistic metric spacetime in a metric force field

As follows from the preceding two paragraphs, let us introduce non-uniform relative proper intrinsic static flow speed V_{om}

along the straight line relative proper intrinsic metric space Σ_0 and of the straight line relative proper intrinsic metric time dimension $\Sigma_{cs}t_0$ in Fig. 1, which evolves at the first stage of evolutions of metric spacetime and intrinsic metric spacetimes, such that V_{om}

has its largest magnitude at a point (S, S_0) in $(\Sigma_0; \Sigma_{cs}t_0)$ and decreases continuously until it vanishes virtually at point O in $(\Sigma_0; \Sigma_{cs}t_0)$, which is far removed from point (S, S_0) . These will be made manifested outwardly in non-uniform relative proper static flow speed V_{om} in

the relative proper metric Euclidean 3-space IE_{03} and along the relative proper metric time dimension c_{st_0} , such that V_{om}

has its largest magnitude at the corresponding point (S, S_0) in $(IE_{03}; c_{st_0})$ and decreases in magnitude continuously until it vanishes virtually at point O in $(IE_{03}; c_{st_0})$, which is far removed from point (S, S_0) in that figure.

The foregoing is quite apart from the non-uniform absolute proper intrinsic static flow speed V_{om}

ab constituted along the straight line relative proper intrinsic metric space Σ_0 and the straight line relative proper intrinsic metric time dimension $\Sigma_{cs}t_0$ by the non-uniform V_{om}

ab projected along the projective absolute proper intrinsic

metric dimensions, τ_0

ab and $\tau_{csab} \tau_0$

ab, embedded in τ_0 and $\tau_{cs} \tau_0$ respectively,

and the outward manifestations of these namely, the non-uniform absolute proper static ow speed V_{0m}

ab in IE_{03} and along cst_0 in Fig. 1.

However the presence of non-uniform absolute proper intrinsic static ow speed V_{0m}

ab along the relative proper intrinsic metric space τ_0 and relative proper intrinsic metric time dimension $\tau_{cs} \tau_0$, cannot cause the curvatures of $\tau_{cs} \tau_0$ and τ_0 , or produce any other effect on them. The presence of absolute proper static ow speed V_{0m}

ab in the relative proper metric space IE_{03} and relative proper metric time dimension cst_0 can likewise produce no detectable effect on IE_{03} and cst_0 , as mentioned earlier.

Let us recall the evolution of Fig. 11 of [3], reproduced as Fig. 1 of this article, from Fig. 6 of [3], reproduced as Fig. 2 of this article. The introduction of nonuniform absolute intrinsic static ow speed V_m along the initial straight line absolute intrinsic metric space τ_0 and along the initial straight line absolute intrinsic metric time 'dimension' $\tau_{cs} \tau_0$ in Fig. 2, causes the straight line τ_0 to evolve into curved absolute intrinsic metric space τ_0 , where τ_0 will have largest curvature at the point (S, S_0) where V_m is largest and virtually zero curvature at point O, which is far removed from point (S, S_0) where V_m vanishes virtually.

cst

cs t

cs t

'3-observers'

Figure 2: Flat 'four-dimensional' absolute metric spacetime and its underlying at 'two-dimensional' absolute intrinsic metric spacetime with assumed absence of a long-range metric force field (or absence of absolute intrinsic Riemannian spacetime geometry); (Fig. 6 of [3]).

On the other hand, the absolute intrinsic metric time 'dimension' $\tau_{cs} \tau_0$ and absolute metric time dimension $\tau_{cs} \tau_0$ along the vertical are invariant (or remain unaffected) in the context of the absolute intrinsic metric phenomenon that causes the curvature of the absolute intrinsic metric spacetime 'dimensions', with respect to '3-observers' in the absolute space IE_3 in Fig. 2. Graphically, this implies that the straight line absolute intrinsic metric time 'dimension' $\tau_{cs} \tau_0$ along the vertical in that figure will remain not curved from its vertical position, thereby yielding the half-geometry of Fig. 1 of [3], reproduced as Fig. 3 of this article, which is valid with respect to 3-observers in the relative proper Euclidean 3-space IE_{03} in that figure.

ab

ab

cs t cst

Figure 3: A curved 'one-dimensional' absolute intrinsic metric space τ_0 , curving toward the absolute time/absolute intrinsic time 'dimensions' along the vertical, projects a straight line one-dimensional isotropic absolute proper intrinsic metric space τ_0

ab along the horizontal, which is made manifested in straight line absolute proper metric space τ_0

ab and, a straight line relative proper intrinsic metric space τ_0 appears, which is made manifested in at three-dimensional relative metric space IE_{03} (as a hyper-surface) along the horizontal, with respect to 3-observers in IE_{03} in

our (or positive) universe; (Fig. 1 of [3]).

The initial straight line absolute intrinsic metric time 'dimension' $c_s t$ in Fig. 2 remains not curved from the vertical, while the initial straight line absolute intrinsic metric space x in that figure becomes curved absolute intrinsic metric space x in Fig. 3, because the absolute metric time 'dimension' $c_s t$ and the absolute intrinsic metric time 'dimension' $c_s t$ are invariant (or unaffected), that is, do not evolve into the absolute proper metric time dimensions $c_{sab} t_0$

c_{ab} and absolute proper intrinsic metric time dimension $c_{sab} t_0$

c_{ab} , with respect to 3-observers in the relative proper

Euclidean 3-space IE_{03} along the horizontal in that figure, in the contexts of absolute physics and absolute intrinsic physics associated with the presence of absolute metric force f_{eld} and absolute intrinsic metric force f_{eld} .

Since there is a perfect symmetry of state between the positive (or our) universe and the positive time-universe, the half-geometry of Fig. 2 of [3], reproduced as Fig. 4 of this article, will evolve with respect to 3-observers in the relative proper Euclidean 3-space IE_{003} , within the symmetry-partner region of spacetime in the positive timeuniverse, simultaneously with the half-geometry of Fig. 1 of [3], reproduced as Fig. 3 of this article, in our universe.

The union of Figs. 1 and 2 of [3], which are Figs. 3 and 4 of this article, then gives the full geometry of Fig. 3 of [3], which is equivalent to the full geometry of Fig. 4 or Fig. 11 of that article, reproduced as Fig. 1 of this article, containing

$c_s t$

c_{st}

c_{ab}

P

d

c_{ab}

d

Figure 4: A curved 'one-dimensional' absolute intrinsic metric space x_0 , curving toward the absolute time/absolute intrinsic time 'dimensions' along the horizontal, projects a straight line one-dimensional isotropic absolute proper intrinsic metric space x_{00}

c_{ab} along the vertical, which is made manifested in straight line absolute proper metric space x_{00}

c_{ab} and, a straight line relative proper intrinsic metric space

x_{00} appears, which is made manifested in at three-dimensional relative metric space IE_{003} (as a hyper-surface) along the vertical, with respect to 3-observers in IE_{003} in the positive time-universe; (Fig. 2 of [3]).

the spacetime/intrinsic spacetime dimensions of our universe solely. This and the foregoing paragraphs are mere repetitions of what have been discussed in the process of developing the geometry of Fig. 4 (or Fig. 11) of [3], reproduced as Fig. 1 of this article, repeated here to serve as a reminder.

In the contexts of the theory of relativity and intrinsic theory of relativity associated with the presence of a long-range relative proper metric force- f_{eld} in the relative proper metric spacetime ($IE_{03}; c_{st} t_0$) and a long-range relative proper intrinsic metric force- f_{eld} in the relative proper intrinsic metric spacetime ($x_0; c_s t_0$), with the associated non-uniform relative proper static ow-speed V_{0m}

in the relative proper

metric Euclidean 3-space IE_{03} and along the relative proper metric time dimension $c_{st} t_0$ and non-uniform relative proper intrinsic static ow speed V_{0m}

along the relative proper intrinsic metric space τ_0 and relative proper intrinsic metric time dimension $\tau_{cs}t_0$, on the other hand, the relative proper time dimension $c_{st}t_0$, the relative proper Euclidean 3-space IE_{03} , as well as the relative proper intrinsic metric space τ_0 and relative proper intrinsic metric time dimension $\tau_{cs}t_0$, are all relative simultaneously (or are co-relative), with respect to 3-observers in the relative proper Euclidean 3-space IE_{03} and 1-observers in the relative proper time dimension $c_{st}t_0$. An implication of the preceding paragraph is that all the four relative proper metric coordinates, $x_{00}; x_{01}; x_{02}$ and $x_{03}; x_{00} = c_{st}t_0$, of the at relative proper metric spacetime ($IE_{03}; c_{st}t_0$) will simultaneously transform into relativistic metric coordinates, $x_0; x_1; x_2$ and $x_3; x_0 = c_{st}$, of relativistic metric spacetime ($IE_3; c_{st}$), with respect to 3-observers in the relativistic metric Euclidean 3-space IE_3 and 1-observers in the relativistic metric time dimension c_{st} . The relative proper intrinsic coordinates, τ_{x_0} and $\tau_{cs}t_0$, of the relative proper intrinsic metric spacetime ($\tau_0; \tau_{cs}t_0$), will likewise transform simultaneously into relativistic intrinsic metric coordinates, τ_x and $\tau_{cs}t$, of the two-dimensional relativistic intrinsic metric spacetime ($\tau_x; \tau_{cs}t$), with respect to 3-observers in the relativistic metric Euclidean 3-space IE_3 and 1-observers in the newly formed relativistic metric time dimension c_{st} , in the contexts of the theory of relativity and intrinsic theory of relativity associated with the presence of a long-range relative proper metric force \vec{F}_{eld} in relative proper metric spacetime and long-range relative proper intrinsic metric force- \vec{F}_{eld} in relative proper intrinsic metric spacetime.

As mentioned in section 4 of [5], a τ_0 spacetime coordinates and intrinsic τ_0 spacetime coordinates that appear in SR/ τ SR shall have over-head tilde label as, $\sim x; \sim y; \sim z; c_{d\sim}t; \sim \tau_x$ and $\tau_{cd}\sim t$, while the metric spacetime coordinates and intrinsic metric spacetime coordinates that appear in the theory of relativity and intrinsic theory of relativity associated with the presence of metric force \vec{F}_{eld} in metric spacetime and intrinsic metric force \vec{F}_{eld} in intrinsic metric spacetime, shall have no over-head tilde label, appearing as, $x_0; x_1; x_2; x_3; \tau_x$ and $\tau_{cs}t$.

An implication of the penultimate paragraph is that the introduction of nonuniform relative proper intrinsic static ω speeds τV_{0m}

identically along the straight

line relative proper intrinsic metric space τ_0 and along the straight line relative proper intrinsic metric time dimension $\tau_{cs}t_0$ in Fig. 1 of this article, will cause both τ_0 and $\tau_{cs}t_0$ to be identically curved anticlockwise simultaneously relative to the horizontal and vertical respectively, such that the curved τ_0 lying in the τ_1 st quadrant and the curved $\tau_{cs}t_0$ lying in the second quadrant on the larger spacetime hyperplane of combined positive and negative universes, constitute pseudo-orthogonal curvilinear intrinsic metric dimensions, with respect to 3-observers in the relativistic metric Euclidean 3-space IE_3 in our (or positive) universe. It is to be remembered, as mentioned earlier that, the projective non-uniform absolute proper intrinsic static ω speed τV_{0m}

ab along τ_0 and $\tau_{cs}t_0$ in Fig. 1 at the τ_1 st stage of evolutions of spacetime and intrinsic spacetime in a long-range metric force \vec{F}_{eld} cannot cause the curvature of τ_0 and $\tau_{cs}t_0$.

In symmetry, the relative proper intrinsic metric space τ_0 and the relative proper intrinsic metric time dimension $\tau_{cs}t_0$ of the negative universe are identically curved anticlockwise simultaneously relative to the horizontal and vertical respectively, such that the curved τ_0 lying in the third quadrant and the curved $\tau_{cs}t_0$ lying in the fourth quadrant, constitute pseudo-orthogonal curvilinear intrinsic metric dimensions with respect to 3-observers* in the relativistic metric Euclidean 3-space

□IE₃ in the negative universe. These curvatures of relative proper intrinsic metric spacetime dimensions and those of the preceding paragraph will take place simultaneously within symmetry-partner long-range relativistic metric force $_elds$ and their underlying long-range relativistic intrinsic metric force $_elds$ in the positive (or our) universe and the negative universe, at the second stage of evolutions of spacetime and intrinsic spacetime within symmetry-partner long-range relativistic metric force $_elds$ in the positive and negative universes.

A consequence of the foregoing is that the geometry of Fig. 5 will evolve with respect to 3-observers in the relativistic metric Euclidean 3-spaces, IE_3 and $\square IE_3$, of the positive and negative universes, as indicated, at the second stage of evolutions of spacetime/intrinsic spacetime within symmetry-partner long-range relativistic metric force $_elds$ in the positive and negative universes. The non-uniform relative proper intrinsic static ow speed V_{om} introduced along the straight line relative proper intrinsic metric space $_o$ and straight line relative proper intrinsic metric time dimension $_cs?to$ in Fig. 1, have largest magnitude at a point (S ; So) on $(_o; _cs?to)$, due to the sources of relative proper intrinsic metric force $_eld$ located at that point (not shown) in Fig. 5, and decrease in magnitude continuously until it vanishes virtually at point O in $(_o; _cs?to)$, which is far removed from the point (S ; So) in that $_gure$.

Figure 5 has evolved from Fig. 1 upon introducing non-uniform relative proper intrinsic static ow speed along the straight line relative proper intrinsic metric space $_o$ and straight line relative proper intrinsic metric time dimension $_cs?to$ in our universe in that $_gure$, and their counterparts, $\square _o$ and $\square _cs?to$, in the negative universe (not shown in Fig. 1). Hence the curved 'two-dimensional' absolute intrinsic metric spacetime $(\^_ ; \^_cs?^t)$ in our universe in that $_gure$ and the corresponding curved 'two-dimensional' absolute intrinsic metric spacetime $(\square \^_ ; \square \^_cs?^t)$ in the negative universe (not shown in that $_gure$), have remained in Fig. 5.

A relative proper static ow speed V_{om}

is relativistic for, V_{om}

$=c_m > 0$ relative to

all observers, since V_{om}

is the same relative to all observers. A relativistic metric

force $_eld$ is one within which V_{om}

$=c_m > 0$. Thus relativistic as being used to qualify

metric force $_elds$ and metric spacetime within a relativistic metric force $_eld$, does

not connote the presence of the special theory of relativity (SR), in the context of

which 'relativistic' has usually appeared.

It is to be noted that the straight line absolute proper intrinsic metric spacetime

'dimensions', $_csab?to$

ab and $_o$

ab , which are embedded in the straight line relative

proper intrinsic metric spacetime dimensions, $_o$ and $_cs?to$, in Fig. 5, are curved

along with $_o$ and $_cs?to$ in that $_gure$. They project 'absolute relativistic'

intrinsic metric spacetime 'dimensions', $_csab$ and $_csab?tab$, (absolute proper intrinsic

3-observers

3-observers

$Cs t$

$Cst Cs t$

$Cs t$

$Cs t$

ab; □ C_sab t₋

ab),

imperceptibly embedded in them, shall be found of important relevance in determining the hierarchy of intrinsic theories and theories of a metric force $_eld$ and intrinsic metric force $_eld$ later in this article and elsewhere.

However the main interest in this article is in the formulation of the intrinsic theory of relativity and theory of relativity associated with the presence of a longrange metric force $_eld$ in metric spacetime and its underlying long-range intrinsic metric force $_eld$ in intrinsic metric spacetime. It is the curved relative proper intrinsic metric spacetimes $(?_{-0}; ?_{cs} ?_{t0})$ and $(\square ?_{-0}; \square ?_{cs} ?_{t0})$, their projective at relativistic intrinsic metric spacetimes $(?_{-}; ?_{cs} ?_{t})$ and $(\square ?_{-}; \square ?_{cs} ?_{t})$ and the outward manifestations at relativistic metric spacetimes $(IE_3; c_{st})$ and $(\square IE_{-3}; \square c_{st})$ that are relevant for doing this.

Now the curved relative proper intrinsic metric space $?_{-0}$ in the $_rst$ quadrant and the curved relative proper intrinsic metric time dimension $?_{cs} ?_{t0}$ in the second quadrant in Fig. 5, evolve simultaneously with respect to 3-observers in the relativistic Euclidean 3-space IE_3 in the $_rst$ quadrant (or in the positive universe), and the curved relative proper intrinsic metric space $\square ?_{-0}$ in the third quadrant and the curved relative proper intrinsic metric time dimension $\square ?_{cs} ?_{t0}$ in the fourth quadrant, evolve simultaneously with respect to 3-observers₋ in the relativistic metric Euclidean 3-space $\square IE_{-3}$ in the third quadrant (or in the negative universe) in that $_gure$.

The curved relative proper intrinsic metric space $?_{-0}$ in the $_rst$ quadrant projects a straight line relativistic intrinsic metric space $?_{-}$ along the horizontal, which is made manifested outwardly in the relativistic metric Euclidean 3-space IE_3 in which 3-observers are now located, as indicated. The curved relative proper intrinsic metric time dimension $?_{cs} ?_{t0}$ in the second quadrant, likewise projects straight line relativistic intrinsic metric time dimension $?_{cs} ?_{t}$ along the vertical, which is made manifested outwardly in the relativistic metric time dimension c_{s} , in which 1-observers in time dimension are now located in our universe.

The curved relative proper intrinsic metric space $\square ?_{-0}$ in the third quadrant projects relativistic intrinsic metric space $\square ?_{-}$ along the horizontal, which is made manifested outwardly in the relativistic Euclidean 3-space $\square IE_{-3}$ in which 3-observers₋ are now located in the negative universe, as indicated, and the curved relative proper intrinsic metric time dimension $\square ?_{cs} ?_{t0}$ in the fourth quadrant projects relativistic intrinsic metric time dimension $\square ?_{cs} ?_{t}$ along the vertical, which is made manifested outwardly in the relativistic metric time dimension $\square c_{st}$ in which 1-observers₋ in time dimension are now located in the negative universe.

However 1-observers are not indicated to exist in the relativistic time dimensions, c_{st} and $\square c_{st}$, in Fig. 5, because the geometry of Fig. 5 is valid with respect to 3-observers in the Euclidean 3-spaces, IE_3 and $\square IE_{-3}$, solely, as indicated. Recall from section 4 of [7] that the anti-clockwise sense of inclination (or rotation) by positive angle of the curved relative proper intrinsic metric spacetimes dimensions relative to their projective at relativistic intrinsic metric spacetimes by varying positive intrinsic angles, is valid with respect to 3-observers in the relativistic metric Euclidean 3-spaces in Fig. 5. It is in the complementary diagram to Fig. 5, to be developed shortly, which is valid with respect to 1-observers in the relativistic time dimensions that 1-observers in c_{st} and $\square c_{st}$, in which the 1-observers will be indicated along c_{st} and $\square c_{st}$.

Thus the at four-dimensional relative proper metric spacetime $(IE_{03}; c_{st0})$ and its underlying at two-dimensional relative proper intrinsic metric spacetime $(?_{-0}; ?_{cs} ?_{t0})$, which appear within a long-range metric force $_eld$ at the $_rst$ stage of evolution of

spacetime/intrinsic spacetime in our universe in Fig. 11 of [3], reproduced as Fig. 1 of this article, evolve into at four-dimensional relativistic metric spacetime ($IE_3; c_{st}$) and its underlying at two-dimensional relativistic intrinsic metric spacetime ($?_0; ?_{cs}t$) in Fig. 5, at the second stage of evolution of spacetime/intrinsic spacetime in the long-range metric force-eld.

The at 4-dimensional relative proper metric spacetime ($IE_{03}; c_{sto}$) and its underlying at relative proper intrinsic metric spacetime ($?_0; ?_{cs}t_0$), which appear within the symmetry-partner long-range metric force-eld in the negative universe (not shown in Fig. 1), at the first stage of evolutions of spacetime/intrinsic spacetime, likewise evolve into at four-dimensional relativistic metric spacetime ($IE_3; c_{st}$) and its underlying at two-dimensional relativistic intrinsic metric spacetime ($?_0; ?_{cs}t$) in Fig. 5, at the second stage of evolution of spacetime/intrinsic spacetime within the symmetry-partner long-range metric force-eld.

There are some other features of Fig. 5 that are important for remark. First, the absolute intrinsic metric space $?^0$ and the relative proper intrinsic metric space $?_0$, are shown to be identically curved relative to the relativistic intrinsic metric space $?_0$ along the horizontal. Indeed the curved $?_0$ should fall along the curved $?^0$ in Fig. 5. This means that the point P along the curved $?^0$ in Fig. 1 is the same as point P along the curved $?_0$ in Fig. 5. Consequently the absolute intrinsic angle $?^0_{m;P}$ of inclination of the curved $?^0$ to the horizontal at point P along $?^0$ in Fig. 1 and the relative proper intrinsic angle $?_{m;P}$ of inclination of the curved $?_0$ to the horizontal at point P along the curved $?_0$ in Fig. 5, are equal in magnitude. It then follows that the absolute intrinsic static ow speed $?^0 V_{mP}$ at point P along the curved $?^0$ in Fig. 1 and the relative proper intrinsic static ow speed $?V_{m;P}$ at

point P along $?_0$ in Fig. 5 are equal in magnitude. That is,

$$\sin j^0_{m;P} = \sin j_{m;P} \quad (1a)$$

or

$$j^0_{m;P} = j_{m;P}$$

$$?^0_{Cm} = ?_{Cm}$$

$$j = j$$

$$?V_{m;P} = ?V_{m;P}$$

$$?_{Cm} = ?_{Cm}$$

$$j = j \quad (1b)$$

In order for relations (1a) and (1b) to hold, it must be that the source of absolute intrinsic metric force-eld located at the point S along the curved absolute intrinsic metric space $?^0$ in Fig. 1, which establishes non-uniform absolute intrinsic static ow speed $?^0 V_{mP}$ between points S and O along the curved $?^0$ in that figure, is 'projected' as a source of absolute proper intrinsic metric force-eld of identical magnitude, into the corresponding point S along the projective absolute proper intrinsic metric space $?_0$

ab .

A source of relative proper intrinsic metric force-eld of identical magnitude then appears automatically at the corresponding point S along the straight line relative proper intrinsic metric space $?_0$, which appears along the horizontal automatically along with the projection of $?_0$

ab along the horizontal in Fig. 1. The source of relative

proper intrinsic metric force-eld that appears automatically thereby establishes nonuniform relative proper intrinsic static ow speed $?V_{0m}$

(of identical magnitudes as

the projective non-uniform absolute proper intrinsic static ow speed V_0 along the straight line τ_0 in Fig. 1 and, consequently, along the curved τ_0 in Fig. 5. The point P_0 along the curved relative proper intrinsic metric time dimension $\tau_{cs}t_0$ in the second quadrant is the symmetry-partner to point P along the curved relative proper intrinsic metric space τ_0 in the first quadrant in Fig. 2. Consequently the relative intrinsic angle θ_{P_0} of inclination of the curved $\tau_{cs}t_0$ to the vertical at point P_0 along the curved $\tau_{cs}t_0$ and the relative intrinsic angle θ_P of inclination of the curved τ_0 to the horizontal at point P along the curved τ_0 , are equal in magnitude. It then follows that the non-uniform relative proper intrinsic static ow speeds, V_0

and V_0 are equal in magnitude. That is,

$$\sin \theta_{P_0} = \sin \theta_P \quad (2a)$$

or

$$\frac{V_0}{c_m} = \frac{V_0}{c_m} \quad (2b)$$

Finally, the relative proper intrinsic static ow speed V_0 of point P along the curved relative proper intrinsic metric space τ_0 is shown to be invariantly projected as relative proper intrinsic static ow speed V_0 into the relativistic intrinsic metric space τ_0 along the horizontal, and this is made manifested in relative proper static ow speed V_0 in the relativistic metric Euclidean 3-space IE_3 in Fig. 5. The relative proper intrinsic static ow speed V_0 of point P_0 along the curved relative proper intrinsic metric time dimension $\tau_{cs}t_0$ is likewise shown to be invariantly projected as relative proper intrinsic static ow speed V_0 into the relativistic intrinsic metric time dimension $\tau_{cs}t$, which is made manifested in relative proper static ow speed V_0 along the relativistic metric time dimension cst along the vertical in Fig. 5.

On the other hand, one expects that the non-uniform relative proper intrinsic static ow speed V_{0m} along the curved relative proper intrinsic metric space τ_0 should be projected as non-uniform relativistic intrinsic static ow speed V_m (without prime label) into the projective relativistic intrinsic metric space τ_0 along the horizontal and that the non-uniform relative proper intrinsic static ow speed V_{0m} along the curved relative proper intrinsic metric time dimension $\tau_{cs}t_0$ should be projected as non-uniform relativistic intrinsic static ow speed V_m into the projective relativistic intrinsic metric time dimension $\tau_{cs}t$ along the vertical in Fig. 2.

The fact that the non-uniform relative proper intrinsic static ow speed γ_{0m} along the curved γ_{0m} and γ_{0m} along the curved $\gamma_{cs}t_0$ are invariantly projected as relative proper intrinsic static ow speed γ_{0m} into γ_{0m} along the horizontal and $\gamma_{cs}t_0$ along the vertical respectively in Fig. 5, is a graphical interpretation of the invariance of intrinsic static ow speed in the context of the intrinsic theory of relativity associated with the presence of a long-range relativistic intrinsic metric force γ_{eld} in intrinsic metric space. This invariance is stated as

$$\gamma_{0m} = \gamma_{0m}$$

; (3a)

hence,

$$\gamma_{0m} = \gamma_{0m}$$

; (3b)

where Eqs. (3a) and (3b) have been written at an arbitrary pair of symmetry-partner points along the curved γ_{0m} and $\gamma_{cs}t_0$.

The invariance of relative proper intrinsic static ow speed and relative proper static ow speed (3a) and (3b), in the context of the theory of relativity and theory of intrinsic relativity associated with the presence of a relative proper metric force γ_{eld} in relative proper metric spacetime and relative proper intrinsic metric force γ_{eld} in relative proper intrinsic metric spacetime, which involve relative proper static ow speed and relative proper intrinsic static ow speed respectively, established in spacetime and intrinsic spacetime by the source of a long-range relative proper metric force γ_{eld} , at the second stage of evolutions of spacetimes and intrinsic spacetimes within the metric force γ_{eld} , shall be given formal proof elsewhere, upon particularizing to the gravitational γ_{eld} .

The corresponding invariance of absolute intrinsic static ow speed and absolute static ow speed,

$$\gamma_{0m}$$

$$ab = \gamma_{0m} \text{ and } \gamma_{0m}$$

$$ab = \gamma_{0m};$$

deduced and presented as Eqs. (83a) and (83b) of [3], in the context of absolute intrinsic metric theory of physics and absolute metric theory of physics, involving absolute intrinsic static ow speeds and absolute static ow speed respectively, established in absolute spacetime and absolute intrinsic spacetime by the source of a long-range absolute metric force- γ_{eld} , at the γ_{eld} stage of evolution of spacetime/intrinsic spacetime within the metric force γ_{eld} , shall likewise be given formal proofs elsewhere upon particularizing to the gravitational γ_{eld} .

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dimensions in our universe and the negative universe.
 uniform relative proper intrinsic static ow speed, established in spacetimes and
 intrinsic spacetimes by symmetry-partner relative proper metric force _elds and
 relative proper intrinsic metric force _elds in our universe and the negative universe,
 correspond to the geometry of Fig. 8a of of [5] and its complementary geometry of
 Fig. 8b of that article, of the theory of relativity and intrinsic theory of relativity
 associated with uniform relative dynamical speeds and uniform relative intrinsic
 dynamical speeds namely, the special theory of relativity and intrinsic special theory
 of relativity (SR/?SR), associated with the motions of symmetry-partner particles
 relative to symmetry-partner `stationary' observers in our universe and the negative
 universe. Figures 8a and 8b of [5] are reproduced as Fig. 8a and Fig. 8b respectively
 of this article, for convenience of reading.

Just as Fig. 8a and Fig. 8b of [5] of SR/?SR, reproduced as Fig. 8a and Fig. 8b
 of this article, have Fig. 9a and Fig. 9b of that article as their inverses, there are
 inverses to Fig. 5 and Fig. 7 of this article for the theory of relativity and intrinsic
 theory of relativity associated with the presence of symmetry-partner long-range
 metric force _elds in our universe and negative universe. Figures 9a and 9b of [5],
 which are the inverse diagrams to Fig.8 a and Fig. 8b of this article, are reproduced
 as Fig. 9a and Fig. _9b of this article, for convenience of reading. The derivations of

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Figure 8: a The a_ne spacetime/intrinsic a_ne spacetime diagram of the special
 theory of relativity and intrinsic special theory of relativity with respect to
 symmetry-partner 3-observers in the metric Euclidean 3-spaces of our universe and

the negative universe; (Fig. 8a of [5]).

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Figure 8: b The a_{ne} spacetime/intrinsic a_{ne} spacetime diagram of the special theory of relativity and intrinsic special theory of relativity with respect to symmetry-partner 1-observers in the metric time dimensions of our universe and the negative universe; the complementary diagram to Fig. 8a; (Fig. 8b of [5]). the inverses to Fig. 5 and Fig. 7 of this article are done below.

Now the extended curved relative proper intrinsic metric space τ_0 and the extended curved relative proper intrinsic metric time dimension τ_{cs} to possess varying positive relative proper intrinsic static ow speed V_{0m} along their lengths, relative to all 3-observers in the relativistic metric Euclidean 3-space IE_3 in Fig. 5. Consequently τ_0 is curved anticlockwise at varying positive relative intrinsic angles

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Figure 9: b The inverse diagram of Fig. 8b of this article with respect to symmetry partner 3-observers in the metric Euclidean 3-spaces of our universe and the negative universe; the complementary diagram to Fig. 9a; (Fig. 8b of [5]).

θ relative to the straight line θ_0 along the horizontal and $\theta_{cs}t_0$ is identically curved anticlockwise (into the second quadrant) at varying positive relative intrinsic angle θ relative to the straight line $\theta_{cs}t_0$ along the vertical in Fig. 5.

In obtaining the inverse of Fig. 5, one could, at first thought, consider the projective extended relativistic intrinsic metric space θ_0 and extended projective straight line relativistic intrinsic metric time dimension $\theta_{cs}t_0$ to possess varying negative relative proper intrinsic static ω speed $\omega = V_{om}$ along their lengths, relative

to the curved relative proper intrinsic metric space θ_0 and curved relative proper intrinsic metric time dimension $\theta_{cs}t_0$ respectively. One could then further consider the relativistic intrinsic metric space θ_0 to be curved into the first quadrant at varying negative intrinsic angle θ relative to straight line relative proper intrinsic metric space θ_0 along the horizontal and the relativistic intrinsic metric time dimension $\theta_{cs}t_0$ to be curved into the second quadrant at varying negative intrinsic angle θ relative to straight line relative proper intrinsic metric time dimension $\theta_{cs}t_0$ along the vertical. The straight line θ_0 along the horizontal and the straight line $\theta_{cs}t_0$ along the vertical so formed, will then be made manifested outwardly in three-dimensional relative proper Euclidean space IE_{03} as hyper-surface along the horizontal and straight line relative proper metric time dimension c_{st_0} along the vertical.

The inverse of Fig. 5 derived as explained in the preceding paragraph is invalid for two major reasons. First, it brings back the at four-dimensional relative proper metric spacetime ($IE_{03}; c_{st_0}$) and its underlying at two-dimensional relative proper intrinsic metric spacetime ($\theta_0; \theta_{cs}t_0$) at the second stage of evolutions of metric spacetimes and intrinsic metric spacetimes in a long range metric force field, which cannot be, since the at relative proper metric spacetime ($IE_{03}; c_{st_0}$) and its underlying at relative proper intrinsic metric spacetime ($\theta_0; \theta_{cs}t_0$), have evolved into at relativistic metric spacetime ($IE_3; c_{st}$) and its underlying at relativistic intrinsic metric spacetime ($\theta; \theta_{cs}t$) permanently at the second stage.

Secondly, projective negative non-uniform relative proper intrinsic static ω speed $\omega = V_{om}$

along the length of the relativistic intrinsic metric spacetime dimensions, x_0 and ct , cannot give rise to curvature of x_0 and ct . Rather it is nonuniform negative relativistic intrinsic static ow speed (without prime label) ΔV_m along the lengths of the relativistic intrinsic metric dimensions, x_0 and ct , that can give rise to their curvature relative to straight line x_0 and ct . In other words, contrary to the inverse of Fig. 5 described in the penultimate paragraph, the relativistic intrinsic metric spacetime $(x_0; ct)$ cannot be curved relative to at relative proper intrinsic metric spacetime $(x_0; ct)$ by virtue of non-uniform negative relative proper intrinsic static ow speed ΔV_{0m} along the lengths of x_0 and ct .

The curvature of the relative proper intrinsic metric spacetime $(x_0; ct)$ relative to its projective at relativistic intrinsic metric spacetime $(x_0; ct)$ underlying a at relativistic metric spacetime (IE3; ct) in Fig. 5, must be retained in the inverse of Fig. 5. However the straight line relativistic intrinsic metric space x_0 with varying positive relative proper intrinsic static ow speeds ΔV_{0m} along its length along the horizontal in Fig. 5, must be considered to possess varying negative relative proper intrinsic static ow speed ΔV_{0m} along its length along the horizontal and to be inclined clockwise by varying negative intrinsic angle $\Delta \theta$ relative to the curved x_0 in the inverse diagram, where the curved x_0 also possesses non-uniform relative 1-observers

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Figure 10: The inverse of the global metric spacetime/intrinsic metric spacetime diagram of Fig. 5; is valid with respect to 1-observers in the relativistic time dimensions cs and Δcst_0 in the positive and negative universes.

proper intrinsic static ow speed ΔV_{0m}

along its length.

The straight line relativistic intrinsic metric time dimension ct with varying positive relative proper intrinsic static ow ΔV_{0m}

speed along its length along the vertical in Fig. 5, must likewise be considered to possess varying negative relative proper intrinsic static ow speed $\square?V_{om}$ along its length along the vertical and to be inclined clockwise by varying negative relative intrinsic angle $\square?$ relative to the curved $?_{cs}?_{to}$ in the inverse diagram, where the curved $?_{cs}?_{to}$ also possesses non-uniform relative proper intrinsic static ow speed $\square?V_{om}$ along its length.

The valid inverse of Fig. 5 that follows from the preceding paragraph is depicted in Fig. 10. It is to be observed that the straight line relativistic intrinsic metric space $?_?$ along the horizontal is rotated clockwise by negative relative intrinsic angle $\square?_{m;P}$ relative to the tangent to the curved relative proper intrinsic metric space $?_{?_0}$ at the point P along the curved $?_{?_0}$ and the straight line relativistic intrinsic metric time dimension $?_{cs}?_t$ along the vertical is rotated clockwise by equal negative relative intrinsic angle $\square?_{P_0}$ relative to the tangent to the curved relative proper intrinsic time dimension $?_{cs}?_{to}$, at the symmetry-partner point P_0 along the curved $?_{cs}?_{to}$ in Fig. 10. The negative relative proper intrinsic static ow speed $\square?V_{om}$

and negative relative intrinsic angle $\square?$ vary along the curved $?_{?_0}$ and curved $?_{cs}?_{to}$ in Fig. 10.

Now the clockwise sense of inclination of the relativistic intrinsic metric time dimension $?_{cs}?_t$ along the vertical relative to the curved relative proper intrinsic metric time dimension $?_{cs}?_{to}$ in the second quadrant, by varying negative relative intrinsic angles $\square?$ along the curved $?_{cs}?_{to}$, due to varying negative relative proper intrinsic static ow speed $\square?V_{om}$

along $?_{cs}?_t$, is valid with respect to 1-

observers in the relativistic time dimensions, c_{st} and $\square c_{st}_?$ of the positive and negative universes as indicated. The clockwise sense of inclination of the straight line relativistic intrinsic metric space $?_?$ along the horizontal relative to the curved relative proper intrinsic metric space $?_{?_0}$ in the $_{rst}$ quadrant, by varying negative intrinsic angles, $\square?$ along the curved $?_{?_0}$, due to varying negative relative proper intrinsic static ow speed $\square?V_{om}$

along $?_{?_0}$ in Fig. 10, is likewise valid with respect

to 1-observers in the relativistic time dimensions, c_{st} and $\square c_{st}_?$, of the positive and negative universes as indicated.

The Fig. 10 is valid with respect to 1-observers in the relativistic time dimensions, c_{st} and $\square c_{st}_?$, because the clockwise rotations (or inclinations) of the curved relative proper intrinsic metric dimensions, $?_{cs}?_{to}$ and $?_{?_0}$, relative to their projective straight line relativistic intrinsic metric dimensions, $?_?$ and $?_{cs}?_t$, respectively, by varying positive intrinsic angle $?_{}$ in Fig. 7, are equivalent to clockwise rotations (or inclinations) of the straight line relativistic intrinsic metric dimensions, $?_?$ and $?_{cs}?_t$, relative to the curved relative proper intrinsic metric dimensions, $?_{?_0}$ and $?_{cs}?_{to}$, respectively, by varying negative intrinsic angle $\square?$ in Fig. 10. Consequently, Fig. 10, like Fig. 7, is valid with respect to 1-observers in the relativistic time dimensions c_{st} and $\square c_{st}_?$.

The inverse of Fig. 7, which can be derived from that $_{gure}$ by following the derivation of Fig. 10 from Fig. 5 is depicted in Fig. 11.

Again the curved relative proper intrinsic metric spacetime $(?_{?_0};?_{cs}?_{to})$ relative to its projective at relativistic intrinsic metric spacetime $(?_{?_?};?_{cs}?_t)$ underlying the at relativistic metric spacetime $(IE_3; c_{st})$ in Fig. 7, is retained in the inverse diagram of Fig. 11. However the straight line relativistic intrinsic metric space $?_?$

constant relative positive intrinsic dynamical speed and positive dynamical speed, v and v (in Figs. 8a and 8b) and constant relative negative intrinsic dynamical speed and negative dynamical speed, $-v$ and $-v$ (in Figs. 9a and 9b), in the context of the intrinsic special theory of relativity and special theory of relativity (SR/SR), as developed in [5].

On the other hand, Figs. 5 and 7 and their inverses, Figs. 10 and 11, of this article, involve extended inclined curved pseudo-orthogonal curvilinear relative proper intrinsic metric spacetime dimensions, $(t_0; c_s t_0)$ and $(t; c_s t)$, which are curved relative to their projective extended straight line pseudo-orthogonal relativistic intrinsic metric spacetime dimensions, $(t_0; c_s t_0)$ and $(t; c_s t)$. They involve non-uniform positive relative proper intrinsic static ow speed v_{0m}

along the curved and straight line intrinsic metric spacetime dimensions (in Figs. 5 and 7), and non-uniform negative relative proper intrinsic static ow speed $-v_{0m}$

along the curved and straight line intrinsic metric spacetime dimensions (in Figs. 10 and 11), in the context of the intrinsic theory of relativity and theory of relativity associated with the presence of symmetry-partner long-range relative proper metric force F_{eld} in metric spacetimes and symmetry-partner longrange relative proper intrinsic metric force F_{eld} in the underlying intrinsic metric spacetimes in our universe and the negative universe.

From the point of view of the absolute intrinsic metric theory on the curved 'twodimensional' absolute intrinsic metric spacetime $(t_0; c_s t_0)$, involving non-uniform absolute intrinsic static ow speed v_m along the curved $(t_0; c_s t_0)$ and $(t; c_s t)$, developed in the preceding three parts of this paper [1-3], at the first stage of evolutions of spacetime and intrinsic spacetime within a long-range metric force F_{eld} , on the other hand, there is only one diagram namely, the curved absolute intrinsic spacetime $(t_0; c_s t_0)$ relative to its projective at absolute proper intrinsic metric spacetime $(t_0; c_s t_0)$

and the relative proper intrinsic metric spacetime $(t_0; c_s t_0)$, which appears automatically alongside the projection of $(t_0; c_s t_0)$ along the

horizontal, as well as the outward manifestation of $(t_0; c_s t_0)$ namely, the at four-dimensional relative proper metric spacetime IE_3 in Fig. 1.

Inverse diagrams and inverse coordinate transformations exist in relativity only and not in the context of the absolute intrinsic metric theory. Consequently the curved $(t_0; c_s t_0)$ in the first quadrant and the curved $(-t_0; -c_s t_0)$ in the third quadrant in Figs. 2 and 4 are retained in the inverse diagrams of Fig. 7 and Fig. 11.

2.2 Deriving intrinsic local lorentz transformation and local lorentz transformation and their inverses within long-range metric force

F_{eld} in terms of intrinsic static ow speed and static ow speed

Let us consider an elementary interval d_0 of the curved relative proper intrinsic metric space $(t_0; c_s t_0)$ about point P along the curved $(t_0; c_s t_0)$ in the first quadrant in Fig. 5. The interval d_0 possesses positive relative proper intrinsic static ow speed $v_{0m;P}$

and is inclined anticlockwise to the horizontal at intrinsic angle θ_P . It projects relativistic intrinsic metric space interval d_0 along the horizontal that also possesses relative proper intrinsic static speed $v_{0m;P}$, with respect to all 3-observers in the

relativistic Euclidean 3-space IE_3 in Fig. 5.

The corresponding elementary interval $d_{cs}^?$ of the curved relative proper intrinsic metric time dimension $?_{cs}^?$ about the symmetry-partner point P_0 along the curved $?_{cs}^?$ in the second quadrant in Fig. 5, possesses intrinsic static ow speed $?V_0$

$_{m;P_0}$ and is inclined anticlockwise at intrinsic angle $?_{P_0}$ to the vertical.

It projects interval $d^?$ of relativistic intrinsic metric time dimension along the vertical that also possesses proper intrinsic static ow speed $?V_0$

$_{m;P_0}$, with respect

to all 3-observers in IE_3 in that figure.

The elementary interval $d^?_{_0}$ of the curved relative proper intrinsic metric space $?_{_0}$ about the symmetry-partner point $P_{_0}$ along $?_{_0}$, in the third quadrant in Fig. 5, possesses positive relative proper intrinsic static ow speed $?V_0$

$_{m;P}$ and is

inclined anticlockwise at intrinsic angle $?_P$ to the horizontal. It projects relativistic intrinsic metric space interval $d^?_{_0}$ along the horizontal that also possesses relative proper intrinsic static ow speed $?V_0$

$_{m;P}$, with respect to all 3-observers* in the

relativistic Euclidean 3-space IE_3 in that figure. The corresponding elementary interval $d^?_{cs}^?$ of the curved relative proper intrinsic metric time dimension

$?_{cs}^?$, about the symmetry-partner point $P_{0_}$ along $?_{cs}^?$ in the fourth quadrant in Fig. 5, possesses positive relative intrinsic static ow speed $?V_0$

$_{m;P_0}$

and it is inclined anticlockwise at intrinsic angle $?_{P_0}$ to the vertical. It projects interval $d^?_{cs}^?$ of relativistic intrinsic metric time dimension along the vertical that also possesses positive relative intrinsic static ow speed $?V_0$

$_{m;P_0}$, with respect

to all 3-observers* in IE_3 in Fig. 5.

The elementary intervals of curved relative proper intrinsic metric spaces and curved relative proper intrinsic metric time dimensions, $d^?_{_0}$; $d^?_{_0}$; $d^?_{cs}^?$ and $d^?_{cs}^?$, shall be considered to be indefinitely short so that they are short straight line segments within which relative proper intrinsic static ow speed has a constant value. Then since the points, P_0 and $P_{0_}$, along the curved $?_{cs}^?$ and $?_{cs}^?$ and points, P and P^* , along the curved $?_{_0}$ and $?_{_0}$ are symmetry-partner points in Fig. 5, the intrinsic angle $?_{P_0}$ of inclinations of intervals, $d^?_{cs}^?$ and $d^?_{cs}^?$, to the vertical and the intrinsic angle $?_{m;P}$ of inclinations of intervals, $d^?_{_0}$ and $d^?_{_0}$, to the horizontal are equal, that is, $?_{P_0} = ?_{m;P}$ in Fig. 5.

By making use of the information in the preceding two paragraphs and drawing the inclined elementary intervals, $d^?_{_0}$, $d^?_{cs}^?$, $d^?_{_0}$ and $d^?_{cs}^?$, relative to their projections, $d^?_{_0}$, $d^?_{cs}^?$, $d^?_{_0}$ and $d^?_{cs}^?$, respectively, at the symmetry-partner points, P along the curved $?_{_0}$, P_0 along the curved $?_{cs}^?$, $P_{_0}$ along the curved $?_{_0}$ and $P_{0_}$ along the curved $?_{cs}^?$ in Fig. 5, we have Fig. 12. The local geometry of Fig. 12, derived from the global geometry of Fig. 5, is valid with respect to all 3-observers in the relativistic metric Euclidean 3-spaces, IE_3 and IE_3 , as is the case with Fig. 5.

Figure 12 has been drawn at the symmetry-partner points P , P_0 , P^* and P_{0^*} along the curved relative proper intrinsic metric dimensions $?_{_0}$; $?_{cs}^?$; $?_{_0}$ and $?_{cs}^?$ respectively in Fig. 5, as mentioned above. Hence the appearance of intrinsic angle of inclination $?_{m;P}$ (where $?_{m;P} = ?_{P_0}$) in Fig. 7. The inclined elementary intervals of proper intrinsic metric spacetime $d^?_{_0}$, $d^?_{cs}^?$, $d^?_{_0}$ and $d^?_{cs}^?$, possess equal positive relative proper intrinsic static ow speed

$d_{?_0}$, then $d_{?_0} = d_{?_0} \cos \theta_{m;P}$. Hence we must express the rotated $d_{?_0}$ in terms of its projection $d_{?_0}$ along the horizontal with respect to all 3-observers in IE_3 and write

$$d_{?_0} = d_{?_0} \sec \theta_{m;P} :$$

This is all the intrinsic metric spacetime interval transformation that should have been possible along the horizontal in the 1st quadrant, with respect to 3-observers in the relativistic Euclidean 3-space IE_3 in Fig. 12, except that the inclined interval of negative relative proper intrinsic metric time dimension $\square c_{sd} t_0$ in the fourth quadrant also projects interval $\square c_{sd} t_0 \sin \theta_{m;P}$ (with the star label removed for the reason given above) along the horizontal, which must be added to the right-hand side of the last displayed equation to have

$$d_{?_0} = d_{?_0} \sec \theta_{m;P} + \square c_{sd} t_0 \sin \theta_{m;P} :$$

But the inclined interval $\square c_{sd} t_0$ is related to its projection $\square c_{sd} t$ along the vertical in the same Fig. 12 as, $\square c_{sd} t = \square c_{sd} t_0 \cos \theta_{m;P}$, hence $\square c_{sd} t_0 = \square c_{sd} t \sec \theta_{m;P}$. Using this in the last displayed equation gives

$$d_{?_0} = d_{?_0} \sec \theta_{m;P} + \square c_{sd} t \tan \theta_{m;P} ;$$

(with respect to 3 \square observers in IE_3) :

(5)

Equation (5) is the partial transformation of elementary intrinsic metric spacetime coordinate intervals in terms of the intrinsic angle $\theta_{m;P}$, which can be derived along the horizontal in the 1st quadrant, with respect to 3-observers in IE_3 in Fig. 12.

The complementary diagram to Fig. 12 that can be drawn at the symmetry partner points, P, P₀, P* and P₀*, along the curved relative proper intrinsic metric spacetimes dimensions, $\theta_{?_0}; c_{s} t_0; \square \theta_{?_0}$ and $\square c_{s} t_0$, in Fig. 7; Fig. 7 being the complementary diagram to Fig. 5, is depicted in Fig. 13. The local geometry of Fig. 13 derived from the global geometry of Fig. 7 is valid with respect to 1-observers in the relativistic metric time dimensions, c_{st} and $\square c_{st}$, as is the case with Fig. 7.

Now $\square c_{sd} t$ being the projective component along the vertical of the inclined $\square c_{sd} t_0$ in the 1st quadrant in Fig. 13, then $\square c_{sd} t = \square c_{sd} t_0 \cos \theta_{m;P}$. We must express the rotated $\square c_{sd} t_0$ in terms of its projection $\square c_{sd} t$ along the vertical with respect to 1-observers in c_{st} and write,

$$\square c_{sd} t_0 = \square c_{sd} t \sec \theta_{m;P} :$$

This is all the transformation of intrinsic metric spacetime intervals that should have been possible along the vertical in the 1st quadrant, with respect to 1-observers in the relativistic time dimension c_{st} in Fig. 13, except that the inclined negative relative proper intrinsic metric space interval $\square d_{?_0}$ in the second quadrant also

$c_{sd} t$
 $c_{sd} t$
 $c_{sd} t$
 $c_{sd} t$
 $c_{sd} t$
 $c_{st} t_{sd}$
 d
 d
 d
 d
 d
 d
 d
 d
 $m,$
 $m, m,$
 $m,$
 $m,$

d
d
d
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,
m,

Figure 14: The inverse of the local diagram of Fig. 12 drawn from the global diagram of Fig. 10, for deriving partial inverse transformations of elementary intrinsic metric coordinate intervals in terms of relative proper intrinsic static ow speed with respect to 1-observers in the relativistic time dimensions c_{st} and $\square c_{st}$ in the positive and negative universes.

The clockwise rotation of the relative proper (or primed) intrinsic local metric frame $(d?_0; ?c_{sd}?t_0)$ relative to its projective relativistic (or unprimed) intrinsic local metric frame $(d?_; ?c_{sd}?t)$, by a positive intrinsic angle $?_{m;P}$ in Fig. 13, is equivalent to the clockwise rotation of the relativistic (or unprimed) intrinsic local metric frame $(d?_; ?c_{sd}?t)$ relative to the relative proper (or primed) intrinsic local metric frame $(d?_0; ?c_{sd}?t_0)$, by negative intrinsic angle $\square ?_{m;P}$ in Fig. 14. Consequently Fig. 13 and Fig. 14 are both valid with respect to 1-observers in the relativistic metric time dimensions, c_{st} and $\square c_{st}$, in our universe and the negative universe.

Figure 14 as the inverse of Fig. 12 in a long-range metric force $_eld$ and an intrinsic long-range metric force $_eld$, corresponds to Fig. 9a as the inverse of Fig. 8a [5], reproduced as Figs. 8a and 9a of the article in the context of SR/?SR. Consequently the procedure applied in deriving partial inverse intrinsic a_ne coordinate transformation from Fig. 9(a) of this article in [5] shall be applied in deriving partial inverse transformation of elementary intrinsic metric spacetime coordinate intervals from Fig. 14 here.

Now the interval of inclined relative proper intrinsic metric space $d?_0$ in the $_rst$ quadrant in Fig. 14 is the projection of the non-inclined interval of relativistic intrinsic metric space $d?_$ in the $_rst$ quadrant in that $_gure$. That is, $d?_0 = d?_ \cos(\square ?_{m;P}) = d?_ \cos(?_{m;P})$. The non-inclined $d?_$ must be expressed in terms of its projective $?_{?_0}$ with respect to 1-observers in c_{st} in the inverse diagram of Fig. 14 as

$$d?_ = d?_0 \sec ?_{m;P} :$$

This is all the elementary intrinsic metric spacetime coordinate interval transformation that should have been possible along the inclined path AB_0 , with respect to 1-observers in the relativistic time dimension c_{st} in the $_rst$ quadrant in Fig. 14, except that the interval $?c_{sd}?t$ of relativistic intrinsic metric time dimension along the vertical projects a component, $?c_{sd}?t \cos ?_$ along the inclined path AB_0 , where $?_ + ?_{m;P} = ?_ = 2$, or $?_ = ?_ = 2 \square ?_{m;P}$. Hence, $?c_{sd}?t \cos ?_ = ?c_{sd}?t \sin ?_{m;P}$. This component must be added to the right-hand side of the last displayed equation to have

$$d?_ = d?_0 \sec ?_{m;P} + ?c_{sd}?t \sin ?_{m;P} ;$$

(w:r:t: 1 \square observers in c_{st}) : However, $?c_{sd}?t_0 = ?c_{sd}?t \cos(\square ?_{m;P}) = ?c_{sd}?t \cos ?_{m;P}$; hence, $?c_{sd}?t = ?c_{sd}?t_0 \sec ?_{m;P}$; along the vertical in the $_rst$ quadrant in Fig. 14. Using this in the last displayed equation gives

$$d?_ = d?_0 \sec ?_{m;P} + ?c_{sd}?t_0 \tan ?_{m;P} ;$$

(w:r:t: 1 \square observers in c_{st}) : (8)

This is the partial inverse transformation of elementary intrinsic metric spacetime coordinate intervals that can be derived along the inclined path AB_0 with respect

to have

$$\Delta t = \Delta t_0 \sec \theta + \frac{d}{c} \sin \theta$$

(w.r.t: 3 observers in IE_3)

However, $d \cos \theta = d_0$; hence, $d \sin \theta = d_0 \tan \theta$; along the horizontal in the 1st quadrant in Fig. 15. Using this in the last displayed equation gives

$$\Delta t = \Delta t_0 \sec \theta + \frac{d_0}{c} \tan \theta$$

(w.r.t: 3 observers in IE_3) : (9)

This is the partial inverse transformation of elementary intrinsic metric spacetime coordinate intervals that can be derived along the inclined path AC_0 with respect to 3-observers in the relativistic Euclidean 3-space IE_3 in the 1st quadrant (or in our universe) in Fig. 15. Collecting Eqs. (8) and (9) gives

$$\Delta t = \Delta t_0 \sec \theta + \frac{d_0}{c} \tan \theta$$

(w.r.t 3 observers in IE_3) ;

$$\frac{d}{c} = \frac{d_0}{c} \sec \theta + \Delta t \tan \theta$$

(w.r.t 1 observer in Cst) :

System (10) derived from the local diagrams of Figs. 14 and 15 is the inverse of system (7) derived from the local diagrams of Figs. 12 and 13.

Let us consider an intrinsic event that involves interval Δt_0 of relative proper intrinsic metric time dimension but zero interval of relative proper intrinsic metric space ($d_0 = 0$). This reduces system (10) as

$$\Delta t = \Delta t_0 \sec \theta$$

$$\frac{d}{c} = \Delta t \tan \theta$$

Dividing the second into the 1st equation of system (11) gives

$$\frac{d}{c} = \Delta t \tan \theta$$

$$\frac{d}{c} = \Delta t \tan \theta$$

$$= \sin \theta$$

$$\text{But } \frac{d}{c} = \frac{V}{c}$$

V , is the positive relative proper intrinsic ow speed of the primed intrinsic local metric frame ($d_0; \Delta t_0$) and its projective unprimed intrinsic local metric frame ($d; \Delta t$), knowing that intrinsic dynamical speed is absent, since no particle is in motion.

Let us also recall the definition of $\sin \theta$ in Eq. (80) of the preceding third part of this paper [3] and the discussion following it. The corresponding definition of $\sin \theta$ in the present context is, $\sin \theta = \frac{d}{c} = \frac{d_0}{c} = \frac{V}{c}$

$V = c \sin \theta$. As discussed in converting Eq. (80) to Eqs. (81) and (82) of the preceding article, the ratio, $\sin \theta = \frac{V}{c}$

$V = c \sin \theta$ (where c , with magnitude

$3 \times 10^8 \text{ ms}^{-1}$, is the maximum over all relative proper intrinsic static-ow speeds V_m

that can be established in intrinsic metric spacetime), is the appropriate ratio. The ratio, $\sin \theta = \frac{V}{c}$

$V = c \sin \theta$, where c is the maximum intrinsic

static geodesic ow-speed that appears in the time dimensions, c and c_0 (introduced in sub-section 2.1 of [7]), is inappropriate. Indeed c is equivalent to zero magnitude of V_m

. The speed V_m

and c_m shall referred to as gravitational

ow-speed and re-denoted upon particularizing the results of this paper to the

gravitational field elsewhere. Then the difference between c and c_m shall become

clari_ed. Hence,

$$\sin \theta_{m;P} = \frac{v}{c} \quad (13a)$$

$$\sec \theta_{m;P} = \frac{1}{\cos \theta_{m;P}} = \frac{c}{v} \quad (13b)$$

Using Eqs. (13a) and (13b) in systems (7) and (10) gives the following respectively

$$d\tau = \frac{dt}{\gamma} \quad (14)$$

(w.r.t: 1 observers in cst);

$$d\tau_0 = \frac{dt}{\gamma} \quad (15)$$

(w.r.t: 3 observers in IE3)

and

$$d\tau = \frac{dt}{\gamma} \quad (16)$$

(w.r.t: 3 observers in IE3);

$$d\tau_0 = \frac{dt}{\gamma} \quad (17)$$

(w.r.t: 1 observers in cst) :

Systems (14) and (15) in terms of intrinsic static ow speed v

γ , take on the

forms of intrinsic Lorentz transformation (LT) and its inverse respectively in terms of relative intrinsic dynamical speed v , in the context of intrinsic special theory of relativity (SR), presented as systems (20) and (21) of [5]. Hence systems (14) and (15) shall be referred to as intrinsic local Lorentz transformation (LLT) and its inverse (in terms of intrinsic static ow speed), in the context of the intrinsic theory of relativity associated with the presence of intrinsic metric force \vec{f}_m in intrinsic metric spacetime

Either system (10) or its inverse (7), or the explicit form in terms of relative proper intrinsic static ow speed (14) or (15), leads to intrinsic local Lorentz invariance

$$d\tau^2 = d\tau_0^2 = c^2 ds^2$$

space interval with intrinsic laboratory rod and as intrinsic time interval with intrinsic laboratory clock by 'intrinsic 1-observers' in the intrinsic space Σ , the terms

$$\begin{aligned} & \frac{1}{c} \frac{d\tau}{dt} \text{ and } \frac{1}{c} \frac{d\tau}{dt} \\ & \frac{1}{c} \frac{d\tau}{dt} \end{aligned}$$

must be set to zero in system (17), thereby reducing that system as follows from the point of view of what can be measured with intrinsic laboratory rod and clock by hypothetical intrinsic 1-observers in Σ

$$\begin{aligned} d\tau &= \frac{1}{c} \frac{d\tau}{dt} \\ \frac{1}{c} \frac{d\tau}{dt} &= \frac{1}{c} \frac{d\tau}{dt} \left(1 - \frac{v^2}{c^2} \right)^{1/2} \end{aligned} \quad (18)$$

and

$$\begin{aligned} \frac{d\tau}{dt} &= \frac{1}{c} \frac{d\tau}{dt} \\ \frac{d\tau}{dt} &= \frac{d\tau}{dt} \left(1 - \frac{v^2}{c^2} \right)^{-1/2} \end{aligned} \quad (19)$$

Equations (18) and (19) give intrinsic metric space contraction and intrinsic metric time dilation formulae with respect to 3-observers in the relativistic Euclidean 3-space IE_3 , explicitly in terms of relative proper intrinsic static flow speed at point P along the curved Σ and the symmetry-partner point O_0 along the curved Σ in the global diagrams. These are intrinsic length contraction and intrinsic time dilation formulae in the context of the intrinsic theory of relativity associated with the presence of a long-range intrinsic metric force \vec{F}_{eld} in intrinsic metric spacetime. Now the intrinsic theory of relativity on the at two-dimensional relativistic intrinsic metric spacetime $(\Sigma; \tau)$ associated with the presence of a long-range relativistic intrinsic metric force \vec{F}_{eld} on $(\Sigma; \tau)$, will be made manifested outwardly in the theory of relativity on the at four-dimensional relativistic metric spacetime $(IE_3; ct)$, due to the presence of a long-range relativistic metric force \vec{F}_{eld} in $(IE_3; ct)$. Consequently the intrinsic local Lorentz transformation (LLT) of system (7) and its inverse of system (10) in the two-dimensional intrinsic metric spacetime, will be made manifested outwardly in local Lorentz transformation (LLT) and its inverse in the four-dimensional metric spacetime respectively as

$$\begin{aligned} c\tau_0 &= c\tau \sec \alpha + dx_1 \tan \alpha; \\ (\text{w.r.t: } 1 \text{ observers in } ct) &; \\ dx_0 &= dx_1 \sec \alpha + c\tau \tan \alpha; dx_2 = dx_2; dx_3 = dx_3; \\ (\text{w.r.t: } 3 \text{ observers in } IE_3) &; \end{aligned} \quad (20)$$

and

$$\begin{aligned} c\tau &= c\tau_0 \sec \alpha + dx_0 \tan \alpha; \\ (\text{w.r.t: } 3 \text{ observers in } IE_3) &; \\ dx_1 &= dx_0 \sec \alpha + c\tau_0 \tan \alpha; dx_2 = dx_2; dx_3 = dx_3; \\ (\text{w.r.t: } 1 \text{ observers in } ct) &: \end{aligned}$$

(21)

The explicit forms of LLT (14) and its inverse (15) in the two-dimensional intrinsic metric spacetime are likewise made manifested in LLT and its inverse on the at four-dimensional metric spacetime respectively as

$$\begin{aligned}
dt_0 &= \frac{1}{\gamma} \left(dt + \frac{V_0}{c^2} dx_1 \right); \\
dx_0 &= \gamma \left(dx_1 + V_0 dt \right); \\
dx_2 &= dx_2; \\
dx_3 &= dx_3;
\end{aligned}$$

(w.r.t: 1 observers in cst)

(22)

$$\begin{aligned}
dt &= \frac{1}{\gamma} \left(dt_0 + \frac{V_0}{c^2} dx_0 \right); \\
dx_1 &= \gamma \left(dx_0 + V_0 dt_0 \right); \\
dx_2 &= dx_2; \\
dx_3 &= dx_3;
\end{aligned}$$

(w.r.t: 3 observers in IE3)

(23)

$$\begin{aligned}
\gamma &= \frac{1}{\sqrt{1 - \frac{V_0^2}{c^2}}}; \\
\gamma_0 &= \frac{1}{\sqrt{1 - \frac{V_0^2}{c^2}}};
\end{aligned}$$

where

The dimension x_1 of the relativistic Euclidean 3-space IE_3 is considered to be orientated along the isotropic relativistic intrinsic metric space \mathbb{R}^1 , while the dimensions x_2 and x_3 of IE_3 are orientated along other directions in IE_3 . It then follows that the dimension x_{01} of the relative proper Euclidean 3-space IE_{03} was orientated along the isotropic relative proper intrinsic metric space \mathbb{R}^1_0 , while the dimensions x_{02} and x_{03} of IE_{03} were orientated along other directions in IE_{03} in Fig. 4 or Fig. 11 of [3], reproduced as Fig. 1 of this article, at the $_rst$ stage of evolutions of spacetimes and intrinsic spacetimes in a long-range metric force $_eld$, prior to the evolutions of Figs. 5, 7, 10 and 11 at the second stage.

Now the intrinsic static low speed V_0 lies along the isotropic proper intrinsic metric space \mathbb{R}^1_0 underlying IE_{03} (in Fig. 1) at the $_rst$ stage and along \mathbb{R}^1 underlying IE_3 at the second stage. Consequently the static low velocity $\sim V_0$

$m;P$ lies along x_0

in IE_3 and along x_1 in IE_3 . It has no component along the coordinate x_2 or x_3 in IE_3 and no component along coordinate x_2 or x_3 in IE_3 . These make systems (20) through (23) to take on their forms, in which the intervals dx_2 and dx_3 transform into intervals dx_2 and dx_3 trivially as, $dx_2 = dx_2$ and $dx_3 = dx_3$. A robust explanation of why systems (20) { (25) take on their forms in all long-ranged metric force-elds|spherically symmetric or not|shall be given when we fully make connection to the gravitational _eld elsewhere.

Either the LLT (20) or its inverse (21), or the explicit form (22) or (23), leads to local Lorentz invariance (LLI)

c_2s

$$dt^2 - (dx_1)^2 - (dx_2)^2 - (dx_3)^2 = c_2s^2$$

$$dt_0^2 - (dx_0)^2 - (dx_2)^2 - (dx_3)^2 : (25)$$

This is the outward manifestation in the four-dimensional metric spacetime of the intrinsic local Lorentz invariance (?LLI) (16) in the two-dimensional intrinsic metric spacetime. The local Lorentz invariance (25) is valid at every point on the fourdimensional spacetime, implying atness everywhere in a long-range metric force _eld of the four-dimensional relativistic metric spacetime ($IE_3; c_{st}$).

The intrinsic length contraction formula (18) and intrinsic time dilation (19) on the at two-dimensional intrinsic metric spacetime are likewise made manifested outwardly in length contraction and time dilation formulae on the at four-dimensional metric spacetime as

$$dx_1 = m;P(V_0$$

$$m;P)dx_0 = (1 -$$

$$V_0^2$$

$$m;P$$

$$c_2$$

$$m$$

$$)^{-1}dx_0; dx_2 = dx_2; dx_3 = dx_3 (26)$$

and

$$dt = m;P(V_0$$

$$m;P)dt_0 = (1 -$$

$$V_0^2$$

$$m;P$$

$$c_2$$

$$m$$

$$)^{-1}dt_0 : (27)$$

As a summary of this section, we have derived the global curved intrinsic metric spacetime/global at metric spacetime geometries of Figs. 5 { 11 and the associated local spacetime/intrinsic spacetime geometries of Figs. 12 { 15 in the four-world picture. We have derived the intrinsic local Lorentz transformation (?LLT) and its inverse of systems (7) and (10), or systems (14) and (15); we have validated intrinsic local Lorentz invariance (?LLI) and have derived the intrinsic length contraction and intrinsic time dilation formulas (18) and (19), at an arbitrary point in spacetime within a long range metric force _eld, with the aid of Figs. 12 { 15 (as must be done at every point in spacetime) in every long-range metric force _eld. These are results in the context of the intrinsic theory of relativity associated with the presence of an intrinsic metric force _eld in intrinsic metric spacetime.

The theory of relativity in the metric spacetime due to the presence of a longrange metric force _eld in the metric spacetime, being mere outward manifestation of the intrinsic theory of relativity in intrinsic metric spacetime, due to the presence of intrinsic metric force _eld in the intrinsic metric spacetime; the results of the theory

of relativity in spacetime have been written directly from the corresponding results of intrinsic theory of relativity in intrinsic metric spacetime. These are the local Lorentz transformation (LLT) and its inverse of system (20) and (21) or system (22) and (23); local Lorentz invariance (25) and the length contraction and time dilation formulae (26) and (27), all of which have been written at an arbitrary point in spacetime in a long-range metric force \mathcal{E} .

The central purpose of this article is to develop a new geometrical background for the theory of relativity associated with the presence of a long-range metric force \mathcal{E} in the metric spacetime within the four-world picture, in which the four-dimensional metric spacetime is underlay by a hidden two-dimensional intrinsic metric spacetime in each universe, derived in [5{8]. We deem the results derived in this section and summarized in the foregoing two paragraphs as adequate for this purpose. It is to be recalled from the derivation of the concept of intrinsic static ow speed and static ow speed in part three of this paper [3] that, the intrinsic static ow speed and static ow speed, which appear in the intrinsic theory of relativity and theory of relativity associated with the presence of a long-range metric force \mathcal{E} in spacetime in this article are pure geometrical parameters. Nevertheless, they will not arise in the absence of a source of a metric force \mathcal{E} and a source of intrinsic metric force \mathcal{E} .

2.3 Clari_cations of the concepts of relative static ow-speed, relativity associated with static ow-speed and relative metric force \mathcal{E} s

It is appropriate to shine some light on the new concepts in the topic of this subsection that are introduced in this article. Let us start with the familiar concept (or parameter) in physics namely, the dynamical velocity $\sim v$ (or speed v). It is an observable and measurable property of a particle or object in motion. The dynamical velocity is a relative parameter because its magnitude varies with the observer or frame of reference relative to which the particle is in motion. The relativity of dynamical velocity is the origin of the relativity of motion of material particles and objects described by the special theory of relativity.

On the other hand, the relative proper static ow speed V_{0m} is a property of space, established in space by the source of a long-range relative proper (or classical) metric force \mathcal{E} , irrespective of whether a particle or object is present in space or not. A particle or object of any mass located at a point P in space where the relative proper static ow speed is V_0
 $m;P$, will acquire V_0
 $m;P$ but will not move relative to any observer or frame of reference at this speed. If it also possesses dynamical velocity $\sim v$ relative to an observer while moving through point P, then it will be observed to move at the velocity $\sim v$ only relative to the observer, despite the static ow speed V_0
 $m;P$ it has acquired.

The static ow speed established at a point in space cannot be observed or measured. It does not give rise to ow of space and, consequently, it does not give rise to translation in space of a material particle or object that acquired it, as mentioned above. Further more, the static ow speed of a point in space is the same with respect to all observers of frames of reference. It is hence an absolute parameter from the point of view of dynamical relativity (or the special theory of relativity). Then how come the concepts of relative static ow speed and relativity associated with static ow speed?

In order to answer the question ending the preceding paragraph, let us revisit the

length contraction and time dilation formulae (26) and (27). Although the relative proper static low speed V_{0m} of a point in space cannot be observed or measured and, although its square V_{02}

cannot be observed or measured, the quantities $(1 - \frac{V_{02}}{c^2})$

cannot

be

observed and measured, $(1 - \frac{V_{02}}{c^2})$

can

be

observed and measured. This follows

from the fact to be formally derived upon making connection to gravity elsewhere that V_{02}

is related to the classical potential ϕ_0

of the metric force field that

establishes V_{0m}

in space as, ϕ_0

$= -\frac{1}{2}$

$\frac{V_{02}}{c^2}$

(for an attractive metric force field).

The quantity $\frac{V_{02}}{c^2}$

, like the potential ϕ_0

at a point in space, cannot be observed

or measured (as is the case with gravitational potential in particular).

Now the quantities,

$(1 - \frac{V_{02}}{c^2})$

cannot

be

observed and measured, $(1 - \frac{V_{02}}{c^2})$

can

be

observed

and

$(1 - \frac{V_{02}}{c^2})$

can

be

observed and measured, $(1 - \frac{V_{02}}{c^2})$

can

be

observed

and

measured, since, $\frac{V_{02}}{c^2}$

cannot

be observed and measured, $\frac{V_{02}}{c^2}$, being equivalent to difference of potentials, can

be measured. It then follows that the length contraction and time dilation formulae (26) and (27) can be observed and measured.

Thus by allowing an event that involves proper time interval dt_0 and proper space intervals, dx_{01} ; dx_{02} and dx_{03} , to occur at different positions in space within a long-range metric force field, the observed (or relativistic) time interval dt and the

observed (or relativistic) interval dx_1 of the relativistic Euclidean 3-space IE_3 (in Fig. 5) involved in the same event, will vary with position in IE_3 , while the observed intervals, dx_2 and dx_3 , of IE_3 involved in the event will be the same at all positions within the metric force $_eld$, according to systems (26) and (27). The variations with the magnitude of the relative proper static ow speed V_{om} and, consequently,

with position in space within a long-range metric force $_eld$, of the observed (or relativistic) time interval dt and the observed (or relativistic) interval dx_1 of the Euclidean 3-space IE_3 , of an event, is the concept of relativity associated with relative proper static ow-speed, or with the presence of a long-range metric force $_eld$ in spacetime.

In brief, the relativity associated with relative proper static ow speed in a longrange metric force $_eld$ is relativity with position in space within the $_eld$ (and not relativity with observer or frame of reference). Relativity of relative proper static ow speed likewise refers to variation of magnitude of relative proper static ow speed with position in space within a long-range metric force $_eld$. In other words, it refers to the fact that the relative proper static ow speeds, V_0

$m;P$ and V_0

$m;Q$, of

two positions P and Q of di_erent distances, x_{01}

P and x_{01Q}

, respectively, from the

origin of the long-range metric force $_eld$, have di_erent magnitudes. It does not refer to variation of the magnitude of a static ow speed with observers or frames of reference. As mentioned earlier, the relative proper static ow speed at a point in space is the same relative to all observers or frames of reference.

In the light of the foregoing, a relative (or relativistic) metric force $_eld$ is the one that establishes non-zero relative proper static ow speed in space. That is, one that establishes relative proper static ow speeds of di_erent magnitudes (no matter how small in magnitudes in a strict sense), at di_erent positions in the relative proper metric Euclidean 3-space IE_{03} , which transforms invariantly as relative proper static ow speeds in the relativistic metric Euclidean 3-space IE_3 within the metric force $_eld$. The possibility of the relativity of other physical parameters, such as mass, electric and magnetic $_elds$, energy, uxes, temperature, entropy, potentials, etc, in the sense of the variations of their observed (or relativistic) magnitudes with relative proper static ow speed and, consequently, with position in space within a long-range metric force $_eld$, on the at four-dimensional relativistic metric spacetime ($IE_3; cst$) (in Fig. 5), now isolated, shall be investigated upon applying the results of this article to the gravitational $_eld$ elsewhere.

Expectedly, it will be possible to derive the transformations of physical parameters and physical constants, classical and special-relativistic non-gravitational laws, as well as classical gravitational laws, on at spacetime within a long-range metric force $_eld$, with the aid of the local Lorentz transformation and its inverse in terms of relative proper static ow speed of systems (22) and (23), in the context of the theory of relativity associated with the presence of a long-range metric force $_eld$ in metric spacetime and, in particular, in the gravitational $_eld$. This will be analogous to the Lorentz transformations of parameters and natural laws on at spacetime in the context of the special theory of relativity.

3 Absolute intrinsic Riemann geometry on curved 'two-dimensional' absolute intrinsic metric spacetime at

the second stage of evolutions of spacetime/intrinsic spacetime in a metric force \mathcal{E}

The 'two-dimensional' absolute intrinsic metric spacetime $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ is curved relative to its projective at '2-dimensional' absolute proper intrinsic metric spacetime $(\mathcal{A}_0; \mathcal{C}_{sab} \mathcal{A}_0^t)$, which is imperceptibly embedded in the at relative proper intrinsic metric spacetime $(\mathcal{A}_0; \mathcal{C}_s \mathcal{A}_0^t)$ in Fig. 1, at the first stage of evolutions of spacetimes and intrinsic spacetimes within a long-range metric force \mathcal{E} . Consequently the absolute intrinsic Riemann geometry has been formulated on the curved $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ with respect to 3-observers in the relative proper Euclidean 3-space IE_03 that overlies \mathcal{A}_0 in [3].

On the other hand, the 'two-dimensional' absolute intrinsic metric spacetime $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ is curved relative to the at two-dimensional relativistic intrinsic metric spacetime $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ in Fig. 5, at the second stage of evolution of spacetime/intrinsic spacetime in a long-range metric force \mathcal{E} . It then follows that absolute intrinsic Riemann geometry must be formulated on the curved $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ with respect to 3-observers in the relativistic Euclidean 3-space IE_3 that overlies \mathcal{A} in Fig. 5, at the second stage of evolutions of spacetime and intrinsic spacetime.

In order to show that absolute intrinsic Riemann geometry on the curved absolute intrinsic metric spacetime $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$ takes on the same form with respect to 3-observers in the relative proper Euclidean 3-space IE_03 solely in Fig. 4 or Fig. 11 of [3], reproduced as in Fig. 1 of this article, and with respect to 3-observers in the relativistic Euclidean 3-space IE_3 solely in Fig. 5 of this article, let us revisit the derivation of the absolute intrinsic metric tensor without star label with the aid of Fig. 7 of [3], reproduced as Fig. 16 of this article, from Eq. (48a-b) through Eq. (64) of [3].

Let us re-write Eq. (53) of that article as follows

$$\begin{aligned}
 (d\mathcal{A}_0)_{ab}^2 &= \mathcal{C}_s^2 \mathcal{A}_0^2 \\
 (d\mathcal{A}_0)_{ab}^2 &= \cos^2 \mathcal{A}^m;P + \sin^2 \mathcal{A}^m;P \\
 &= (d\mathcal{A}_0)_{ab}^2 \\
 &= \sec^2 \mathcal{A}^m;P \square \tan^2 \mathcal{A}^m;P \\
 &: (28)
 \end{aligned}$$

Equation (28) gives the absolute intrinsic line element on the curved 'two-dimensional' absolute intrinsic spacetime $(\mathcal{A}; \mathcal{C}_s \mathcal{A}^t)$, written in terms of the intervals of the absolute proper intrinsic metric spacetime $(\mathcal{A}_0$

$\mathcal{A}_0; \mathcal{C}_{sab} \mathcal{A}_0^t$) in Fig. 16, which is valid with respect to 3-observers in the relative proper Euclidean 3-space IE_03 in that figure.

Then the established invariance of intrinsic line element (or absolute intrinsic local Lorentz invariance (A?LLI)) is derived between the curved $(\mathcal{A}; \mathcal{C}_{sab} \mathcal{A}^t)$

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 h
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 :

Figure 16:
and its projective at (?_0

$ab; \text{?}^{\wedge}c_s \text{?}^{\wedge}t$) in Fig. 7 of [3], reproduced as Fig. 16 of this article and expressed by Eq. (54) of that article. It shall be reproduced here as $\text{?}^{\wedge}c_{2s}$

$$(d\text{?}^{\wedge}t)_2 \square (d\text{?}^{\wedge}_0)_2 = \text{?}c_{2s}$$

$ab(d\text{?}t_0$

$$ab)_2 \square (d\text{?}_0$$

$ab)_2 : (29)$

The $(d\text{?}_0$

$ab)_2$ and $\text{?}c_{2s}$

$ab(d\text{?}t_0$

$ab)_2$ in this equation are replaced with $(d\text{?}^{\wedge}_0)_2$ and

$\text{?}^{\wedge}c_2(d\text{?}^{\wedge}t)_2$ respectively, yielding Eq. (56) of [3], reproduced here as

$$(d\text{?}^{\wedge}s)_2 = \text{?}^{\wedge}c_{2s}$$

$$(d\text{?}^{\wedge}t)_2 (\cos^2 \text{?}^{\wedge} m;P + \sin^2 \text{?}^{\wedge} m;P)$$

$$\square (d\text{?}^{\wedge}_0)_2 (\sec^2 \text{?}^{\wedge} m;P \square \tan^2 \text{?}^{\wedge} m;P) : (30)$$

The absolute intrinsic metric tensor without star label of Eq. (63) or Eq. (64) of [3] and the absolute intrinsic Ricci tensor without star label of Eq. (67) or Eq. (68) of that article, were then derived with respect to 3-observers in the relative proper Euclidean 3-space IE_{03} solely in Fig. 16, from Eq. (30) above (or Eq. (56) of [3]), between Eqs. (58) and (68) of that article.

Now the absolutism of the absolute intrinsic metric spacetime $(\text{?}^{\wedge}_0; \text{?}^{\wedge}c_s \text{?}^{\wedge}t)$ and absolute proper intrinsic metric spacetime $(\text{?}_0$

$ab; \text{?}c_{sab} \text{?}t_0$

$ab)$, implies that they are

invariant with intrinsic local Lorentz transformation (14) and its inverse (15) in the context of the theory of relativity associated with the presence of a long-range metric

force $_eld$ in spacetime. In other words, we can write as follows

$$(d\text{?}_0)_{ab})_2 \square \text{?}c_{2s}$$

$$ab(d\text{?}t_{ab})_2 = (d\text{?}_0$$

$$ab)_2 \square \text{?}c_{2s}$$

$ab(d\text{?}t_0$

$ab)_2 : (31)$

$c_s t$

$c_s t$

$c_s t$

$c_s t$

$c_s t$

$c_s t$

$ab ab$

$c_{sab} t_{ab}$

ab

ab

ab

$c_{sab} t_{ab}$

3

Figure 17: The curved 'two-dimensional' absolute intrinsic metric spacetime made valid with respect to 3-observers in the lat relative proper metric 3-space solely; the correct diagram for absolute intrinsic Riemannian metric spacetime geometry in our universe; (Fig. 7 of [3]).

Just as the at absolute proper intrinsic metric spacetime $(\text{?}_0$

$ab; \text{?}c_{sab} \text{?}t_0$

$ab)$

is imperceptibly embedded in the at relative proper intrinsic metric spacetime

$(\text{?}_0; \text{?}c_s \text{?}t_0)$ in Fig. 1, at the $_rst$ stage of evolutions of metric spacetimes and

intrinsic metric spacetimes in a long-range metric force \vec{e}_{ld} , the at 'absolute relativistic' intrinsic metric spacetime $(\tau_{ab}; c_{sab} \tau_{tab})$ is imperceptibly embedded in the at relativistic intrinsic metric spacetime $(\tau; c_s \tau)$ in Fig. 5, at the second stage of evolutions of metric spacetimes and intrinsic metric spacetimes in a longrange metric force \vec{e}_{ld} , and the invariance (31) obtains between $(d\tau_{ab})^2$

$$(\tau_{ab}; c_{sab} \tau_{tab})^2 = (\tau; c_s \tau)^2$$

and its projective $(d\tau_{ab})^2$

$$(\tau_{ab}; c_{sab} \tau_{tab})^2 = (\tau; c_s \tau)^2$$

ab). This allows us to replace c_{sab}

$$(\tau_{ab}; c_{sab} \tau_{tab})^2 = (\tau; c_s \tau)^2$$

$(d\tau_{ab})^2$ and

$$(d\tau_{ab})^2 = c_{sab}^2 (d\tau_{tab})^2$$

with c_{sab} and $(d\tau_{ab})^2$ respectively in Eq. (28) to have

$$(d\tau_{ab})^2 = c_{sab}^2 (d\tau_{tab})^2$$

$$(d\tau_{ab})^2 = c_{sab}^2 (d\tau_{tab})^2$$

$$\cos^2 \theta_{m;P} + \sin^2 \theta_{m;P}$$

$$\square (d\tau_{ab})^2$$

$$\sec^2 \theta_{m;P} \square \tan^2 \theta_{m;P}$$

: (32)

While the primed absolute intrinsic line element $d\tau_{s0}$ in Eq. (28) on relative proper intrinsic metric spacetime $(\tau_{ab}; c_{sab} \tau_{tab})$

$$(\tau_{ab}; c_{sab} \tau_{tab})$$

ab) is valid with respect to 3-observers

in the relative proper Euclidean 3-space IE_{03} solely in Fig. 1, at the first stage

of evolutions of metric spacetimes and intrinsic metric spacetimes in a long-range

metric force \vec{e}_{ld} , the unprimed absolute intrinsic line element $d\tau_s$ in Eq. (32) on the

'absolute relativistic' (or absolute unprimed) intrinsic metric spacetime $(\tau_{ab}; c_{sab} \tau_{tab})$,

is valid with respect to 3-observers in the relativistic Euclidean 3-space IE_3 solely in

Fig. 5 of this article at the second stage.

Combining the absolute intrinsic local Lorentz invariance (A?LLI) (29) and (31)

we have

$$c_{sab}^2$$

$$(d\tau_{ab})^2 \square (d\tau_{ab})^2 = c_{sab}^2$$

$$(d\tau_{ab})^2$$

$$(d\tau_{ab})^2 \square (d\tau_{ab})^2$$

$$(d\tau_{ab})^2 =$$

$$c_{sab}^2$$

$$(d\tau_{ab})^2 \square (d\tau_{ab})^2 : (33)$$

Equation (33) allows us to replace c_{sab}

$$(d\tau_{ab})^2 \text{ and } (d\tau_{ab})^2 \text{ by } c_{sab}^2$$

$$(d\tau_{ab})^2 \text{ and}$$

$$(d\tau_{ab})^2 \text{ respectively in Eq. (32) to have Eq. (30) again.}$$

It then follows that the absolute intrinsic metric tensor of Eq. (63) or (64) and

absolute intrinsic Ricci tensor of Eq. (67) or (68) of [3], derived from Eq. (30) of this article, with respect to 3-observers in the relative proper Euclidean 3-space IE_{03} solely in Fig. 4 or Fig. 11 of [3], reproduced as Fig. 1 of this article, but with the aid of Fig. 7 of that article, reproduced as Fig. 16 of this article, at the first stage of evolutions of metric spacetimes and intrinsic metric spacetimes in a long-range metric force field, are equally valid with respect to 3-observers in the relativistic Euclidean 3-space IE_3 solely in Fig. 5 of this article at the second stage.

The starred absolute intrinsic line element $d\hat{s}_*$, the starred absolute intrinsic metric tensor \hat{g}_{ij}

and the starred absolute intrinsic Ricci tensor \hat{R}_{ij} on the curved

'two-dimensional' absolute intrinsic metric spacetime $(\hat{t}; \hat{c}_s \hat{t})$ in Fig. 1, given by Eqs. (31), (33) and (39) respectively of [3], which are valid partially with respect to 3-observers in the at relative proper metric 3-space IE_{03} and partially with respect to 1-observers in the relative proper metric time dimension cst_0 in that figure, as explained in that article, are equally valid on the curved $(\hat{t}; \hat{c}_s \hat{t})$ in Fig. 5 of this article, partially with respect to 3-observers on the at relativistic metric 3-space IE_3 and partially with respect to 1-observers in the relativistic metric time dimension cst in that figure.

Thus the formulation of absolute intrinsic Riemann geometry on the curved 'two-dimensional' absolute intrinsic metric spacetime $(\hat{t}; \hat{c}_s \hat{t})$ with respect to 3-observers in the relativistic metric Euclidean 3-space IE_3 solely in Fig. 5 of this article, at the second stage of evolutions of metric spacetimes and intrinsic metric spacetimes within a long-range metric force field, follows the same procedure used to formulate absolute intrinsic Riemann geometry on the curved $(\hat{t}; \hat{c}_s \hat{t})$, with respect to 3-observers in the relative proper Euclidean 3-space IE_{03} , with the aid of Fig. 7 of [3], reproduced as Fig. 16 of this article, in [3] at the first stage.

The preceding paragraph means that just as done at the first stage of evolutions of metric spacetimes/intrinsic metric spacetimes, one must write the pair of absolute intrinsic tensor equations involving starred absolute intrinsic tensors \hat{g}_{ij}

and \hat{R}_{ij} ,

ij,

derived on the curved $(\hat{t}; \hat{c}_s \hat{t})$ in [3], and presented as Eqs. (34) and (38) of that article. One must then solve those equations algebraically to obtain \hat{g}_{ij}

ij and

\hat{R}_{ij}

ij in terms of the square of the absolute intrinsic curvature parameter \hat{k}_2 as Eqs. (64) and (68), or in terms of absolute intrinsic static low speed as Eqs. (81) and (82) of [3]. The starred absolute intrinsic tensors so derived are valid partially with respect to 3-observers in the relativistic Euclidean 3-space IE_3 and partially with respect to 1-observers in the relativistic time dimension ct in Fig. 5 of this article.

Then in order to obtain the absolute intrinsic metric tensor without star label \hat{g}_{ij} , which is valid with respect to 3-observers in the relativistic Euclidean 3-space IE_3 solely, one must use the relations among the components of the starred absolute intrinsic metric tensor \hat{g}_{ij}

ij and the components of the absolute intrinsic metric

tensor without star label \hat{g}_{ij} in systems (65a) and (65b) of [3]. Once \hat{g}_{ij} has been obtained, one must apply the tensorial statement of intrinsic local Lorentz invariance (66) of [3] to derive the absolute intrinsic Ricci tensor without star label \hat{R}_{ij} , which is valid with respect to 3-observers in IE_3 solely.

The superposition procedure developed in absolute intrinsic Riemann geometry

at the first stage of evolutions of spacetimes and intrinsic spacetimes in [3], when two or a larger number of curved absolute intrinsic metric spacetimes co-exist, is equally applicable at the second stage. The clarifications of the concepts of absolute intrinsic static flow speed, absolute proper intrinsic static flow speed, absolute intrinsic metric tensor and absolute intrinsic metric theory of physics associated with them, introduced in [3] and this section, shall be done upon making connection to gravity in the next article and elsewhere.

4 Summary, conclusion and direction for further investigation

The summary in brief of the four parts of this paper is that metric spacetime and its underlying intrinsic metric spacetime follow two stages of evolution in the sequence of absolute metric spacetime/absolute intrinsic metric space ! proper metric spacetime/proper intrinsic metric spacetime ! relativistic metric spacetime/relativistic intrinsic metric spacetime in every long-range metric field. The proper metric spacetime is comprised of 'two-dimensional' absolute proper metric spacetime (\mathcal{M}_{ab} ;

\mathcal{C}_{sabt0}

\mathcal{M}_{ab}) and the 4-dimensional relative proper metric spacetime

($\mathcal{I}E_{03}$; \mathcal{C}_s

\mathcal{M}_{ab}), where (\mathcal{M}_{ab}

\mathcal{M}_{ab} ; \mathcal{C}_{sabt0}

\mathcal{M}_{ab}) is imperceptibly embedded in ($\mathcal{I}E_{03}$; \mathcal{C}_{st0}), as illustrated

in Fig. 1. The proper intrinsic metric spacetime is likewise comprised of 'twodimensional' of absolute proper intrinsic metric spacetime (\mathcal{M}_{ab} ;

$\mathcal{C}_{sab?to}$

\mathcal{M}_{ab}) and

the two-dimensional relative proper intrinsic metric spacetime (\mathcal{M}_{ab} ; $\mathcal{C}_{s?to}$), where

(\mathcal{M}_{ab}

\mathcal{M}_{ab} ; \mathcal{C}_{sabt0}

\mathcal{M}_{ab}) is embedded in (\mathcal{M}_{ab} ; $\mathcal{C}_{s?to}$), as also illustrated in Fig. 1, at the first

stage of evolutions of metric spacetimes and intrinsic metric spacetimes in a longrange metric field.

The relativistic metric spacetime is comprised 'two-dimensional' 'absolute relativistic' metric spacetime (\mathcal{M}_{ab} ; \mathcal{C}_{sabtab}) and the four-dimensional 'relative relativistic' (simply referred to as relativistic) metric spacetime ($\mathcal{I}E_3$; $\mathcal{C}_s t$), where (\mathcal{M}_{ab} ; \mathcal{C}_{sabtab}) is imperceptibly embedded in ($\mathcal{I}E_3$; $\mathcal{C}_s t$) in Fig. 5. The relativistic intrinsic metric spacetime is likewise comprised of 'two-dimensional' 'absolute relativistic' intrinsic metric spacetime (\mathcal{M}_{ab} ; $\mathcal{C}_{sab?tab}$) and two-dimensional relativistic intrinsic metric spacetime (\mathcal{M}_{ab} ; $\mathcal{C}_s?t$), where (\mathcal{M}_{ab} ; \mathcal{C}_{sabtab}) is embedded in (\mathcal{M}_{ab} ; $\mathcal{C}_s?t$) in Fig. 5, at the second stage of evolutions of metric spacetimes and intrinsic metric spacetimes in long-range metric fields. It shall be shown elsewhere that the second stage of evolutions of metric spacetimes and intrinsic metric spacetimes in a long-range metric field is the final stage.

The theories and intrinsic theories of a given long-range metric field encompassed by the geometry of Fig. 1 at the first stage of evolutions of spacetime and intrinsic spacetime in a long-range metric field and those encompassed by the geometries of Figs. 2 and 7 and their inverses of Figs. 10 and 11, at the second stage, shall be formulated upon particularizing to the gravitational field elsewhere.

The spacetime/intrinsic spacetime geometry of Fig.1 and the associated theories and intrinsic theories of a given metric force field, which evolve at the first stage of evolutions of spacetime and intrinsic spacetime in the long-range metric field, endure for no moment before transforming into the enduring spacetime/intrinsic

spacetime geometries of Figs. 5, 7, 10 and 11 and the associated theories and intrinsic theories of the given metric force \mathcal{F} at the second (and \mathcal{F}) stage. Indeed the \mathcal{F} and second stages commence simultaneously and progress together, as shall be demonstrated upon particularizing to the gravitational \mathcal{F} elsewhere. It is therefore the theories and intrinsic theories encompassed by Figs. 5 and 7 and their inverses of Figs. 10 and 11, at the second stage that exist in every long-range metric force \mathcal{F} in the universe.

A crucial conclusion is that the four-dimensional (relativistic) metric spacetime ($IE_3; c_{st}$) and its underlying two-dimensional (relativistic) intrinsic metric spacetime (${}_{\mathcal{F}}; {}_{\mathcal{F}}c_{st}$) are everywhere at in long-range metric force \mathcal{F} s; the only curved spacetime with Riemannian metric tensor, so to speak, with respect to 3-observers in the at (or Euclidean) three-dimensional metric space IE_3 , being the 'two-dimensional' absolute intrinsic metric spacetime (${}_{\mathcal{F}}; {}_{\mathcal{F}}c_{st}$) with absolute intrinsic sub-Riemannian metric tensor ${}_{\mathcal{F}}g_{ik}$, isolated progressively in the \mathcal{F} three parts of this paper [1]{3}. The next natural step is to particularize the newly derived spacetime/intrinsic spacetime geometries of Figs. 5 and 7 and their inverses of Figs. 10 and 11, in longrange metric force \mathcal{F} s and the associated at spacetime theory of metric force \mathcal{F} on the at four-dimensional metric spacetime ($IE_3; c_{st}$) and hierarchy of theories of intrinsic metric force \mathcal{F} on the hierarchy of intrinsic metric spacetimes namely, the at relativistic intrinsic metric spacetime (${}_{\mathcal{F}}; {}_{\mathcal{F}}c_{st}$), the curved relative proper intrinsic metric spacetime (${}_{\mathcal{F}}; {}_{\mathcal{F}}c_{st}$) with intrinsic Lorentzian metric tensor and the curved absolute intrinsic metric spacetime (${}_{\mathcal{F}}; {}_{\mathcal{F}}c_{st}$), with absolute intrinsic sub-Riemannian metric tensor, to the gravitational \mathcal{F} . This will yield the corresponding at spacetime theory of gravity and hierarchy of theories of intrinsic gravity in the gravitational \mathcal{F} . Particularization to the gravitational \mathcal{F} shall be done elsewhere.

COMPETING INTERESTS

No competing interests are involved in this work.

References

- [1] Joseph, O. A. A. (2021) Evolutionary sequence of spacetime/intrinsic spacetime and associated sequence of geometries in metric force \mathcal{F} s I. physical science international journal, 25(10), 1-20. Available at: <https://doi.org/10.9734/psij/2021/v25i1030284>.
- [2] Joseph, O. A. A. (2021) Evolutionary sequence of spacetime/intrinsic spacetime and associated sequence of geometries in metric force \mathcal{F} s II. Physical Science International Journal, 25(10), 39-77. Available at: <https://doi.org/10.9734/psij/2021/v25i1030287>
- [3] Joseph, O. A. A. Evolutionary sequence of spacetime/intrinsic spacetime and associated sequence of geometries in a metric force \mathcal{F} III. Physical Science International Journal, 25(10), 78-112. Available at: <https://doi.org/10.9734/psij/2021/v25i1030288>.
- [4] Einstein A The Principle of Relativity. (London: Methuen; reprints by Dover Publications); 1923.
- [5] Joseph, O. A. A. (2020) Reformulating special relativity on a two-world background. Physical Science International Journal, 24(8) 44-87. Available at: <https://doi.org/10.9734/psij/2020/v24i830209>.
- [6] Joseph, O. A. A. (2020) Reformulating special relativity on a two-world background II. Physical Science International Journal. 24(9) 34-67. Available at: <https://doi.org/10.9734/psij/2020/v24i930215>.
- [7] Joseph, O. A. A. (2020) Re-interpretation of the two-world background of special relativity as four-world background I. Physical Science International Journal, 24(12), 10-38. Available at: <https://doi.org/10.9734/psij/2020/v24i1230229>.
- [8] Joseph, O. A. A. (2021) Re-interpretation of the two-world background of special relativity as four-world background II. 25(2), 37-57. Available at: <https://doi.org/10.9734/psij/2021/v25i230243>.

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