Three stages of evolutions of spacetime/intrinsic spacetime and parameters/intrinsic parameters and the associated hierarchies of spacetimes/intrinsic spacetimes and parameters/intrinsic parameters in a universe. Part II.

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The hierarchy of masses/intrinsic masses of a particle or body in a hierarchy of spacetimes/intrinsic spacetimes in a universe, isolated in the first part of this paper, is extended to the hierarchies of other physical parameters/intrinsic parameters. Spacetime and intrinsic spacetime are proposed to be composed of the ponderable (or metric) gravitational components and the non-ponderable (or affine) dynamical components, and the mass and intrinsic mass of a particle or body as composed of the ponderable (or metric) gravitational components and non-ponderable (or affine) dynamical components. The constant speed of 'signals', c = 300,000 Km/s, is separated into the constant dynamical speed of electromagnetic waves, c_γ = 300,000 Km/s in vacuo and the constant static (or gravitational) speed of gravitational waves c_g = 300,000 Km/s, where c_g being a static (or gravitational) speed, is not made manifest in actual translation through space of the massless graviton. The time dimension ct is likewise split into the metric static (or gravitational) component $c_g t$ and the affine dynamical component $c_\gamma t$. The static (or gravitational) speed of gravitational waves c_g is incorporated into the gravitational local Lorentz transformation (GLLT)in the context of the theory of gravitational relativity (TGR) on flat spacetime and the absolute intrinsic line element, absolute intrinsic metric tensor and absolute intrinsic Ricci tensor of the metric theory of absolute intrinsic gravity (MAIG) on curved 'two-dimensional' absolute intrinsic spacetime in every gravitational field of the present theory, developed in a previous paper, while the dynamical speed c_γ of electromagnetic waves should appear in local Lorentz transformation (LLT) of the special theory of relativity (SR), derived on flat spacetime in an external gravitational field in the present theory.

1 Hierarchies of parameters/intrinsic parameters in a universe

1.1 Hierarchies of gravitational parameters/intrinsic gravitational parameters associated with the hierarchies of spacetimes/intrinsic spacetimes and masses/ intrinsic masses in a universe in a universe

Some new concepts in physics added to the new spacetime/intrinsic spacetime geometries in a four-world picture for relativity, gravitation and dynamics, developed in the previous papers [1–9], started in the first part of this paper [10], is concluded in this second part.[1]

Let us consider Fig. 13(a) of the first part of this paper [10]. The non-uniform absolute-absolute intrinsic-intrinsic gravitational speeds $\phi\phi\hat{\hat{V}}_g(\phi\phi\hat{\hat{r}}) = -(2G\phi\phi\hat{\hat{M}}_0/\phi\phi\hat{\hat{r}})^{1/2}$ originating from the absolute-absolute intrinsic-intrinsic rest mass $\phi\phi\hat{\hat{M}}_0$ of a gravitational field source in absolute-absolute intrinsic-intrinsic space (or absolute-absolute nonospace) $\phi\phi\hat{\hat{\rho}}$, is made manifest outwardly in non-uniform absolute-absolute gravitational speeds $\hat{\hat{V}}_g(\hat{\hat{r}}) = -(2G\hat{\hat{M}}_0/\hat{\hat{r}})^{1/2}$ originating from the absolute-absolute rest mass $\hat{\hat{M}}_0$ of the gravitational field source in the absolute-absolute space $\hat{\hat{\Sigma}}$ at the left-hand side of that figure.

And the non-uniform absolute intrinsic gravitational speeds $\phi\hat{V}_g(\phi\hat{r}) = -(2G\phi\hat{M}_0/\phi\hat{r})^{1/2}$ originating from the absolute intrinsic rest mass $\phi\hat{M}_0$ of the gravitational field source in absolute intrinsic space $\phi\hat{\rho}$ is made manifest in non-uni-
form absolute gravitational speeds $\hat{V}_g(\hat{r}) = -(2G\hat{M}_0/\hat{r})^{1/2}$ originating from the absolute rest mass $\hat{M}_0$ of the gravitational field source in absolute space $\hat{\Sigma}$ at the right-had side in Fig. 13(a) or left-hand side in Fig. 13(b) of [10]. The non-uniform proper intrinsic gravitational speeds $\phi V_g'(\phi r') = -(2G\phi M_0/\phi r')^{1/2}$ originating from the intrinsic rest mass ϕM_0 of the gravitational field source in the proper intrinsic space $\phi\rho'$ is made manifest outwardly in non-uniform proper gravitational speeds $V_g'(r') = -(2GM_0/r')^{1/2}$ originating from the rest mass M_0 of the gravitational field source in the proper Euclidean 3-space Σ' at the right-hand side in Fig. 13(b) or left-had side in Fig. 13(c) of [10].

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On the other hand, the relativistic intrinsic mass ϕM (to be identified as the intrinsic inertial mass with further development) of a gravitational field source in the relativistic intrinsic space $\phi\rho$, is not a source of intrinsic gravitational field. That is, it is not a source of non-uniform relativistic intrinsic gravitational speed $\phi V_g(\phi r)$, non-uniform relativistic intrinsic gravitational potential $\phi\Phi(\phi r)$ or non-uniform relativistic intrinsic gravitational field $\phi g(r)$ in $\phi\rho$. Rather, what can be referred to as non-uniform relativistic intrinsic gravitational speed $\phi V_g(\phi r)$, non-uniform relativistic intrinsic gravitational potential $\phi\Phi(\phi r)$ and non-uniform relativistic intrinsic gravitational field $\phi g(\phi r)$ in the straight line relativistic intrinsic space $\phi\rho$ along the horizontal, are the projections (or transformations) of the non-uniform proper intrinsic gravitational speed $\phi V_g'(\phi r')$, non-uniform proper intrinsic gravitational potential $\phi\Phi'(\phi r')$ and non-uniform proper intrinsic gravitational field $\phi g'(\phi r')$ along the curved proper intrinsic space $\phi\rho'$ into $\phi\rho$ along the horizontal at the right-hand side in Fig. 13(c) of [10].

There are transformations of the proper intrinsic gravitational parameters $\phi V_g'(\phi r')$, $\phi\Phi'(\phi r')$ and $\phi g'(\phi r')$ along the curved $\phi\rho'$ onto their respective relativistic intrinsic gravitational parameters $\phi V_g(\phi r)$, $\phi\Phi(\phi r)$ and $\phi g(r)$ along the straight line relativistic intrinsic space $\phi\rho$ along the horizontal in Fig. 13(c) of [10], which shall be derived elsewhere with further development. It shall quickly be mentioned however that the proper intrinsic gravitational speed transforms into the relativistic intrinsic gravitational speed trivially as $\phi V_g(\phi r) = \phi V_g'(\phi r')$. This has been introduced as the invariance of intrinsic gravitational speed and expressed by Eqs. (2a) and (2b) of [9]. It means that $\phi V_g'(\phi r')$ along the curved $\phi\rho'$ is invariantly projected into $\phi\rho$ along the horizontal. On the other hand there are non-trivial transformations of $\phi\Phi'(\phi r')$ and $\phi g'(\phi r')$ into $\phi\Phi(\phi r)$ and $\phi g(r)$ respectively that shall be derived elsewhere with further development.

The projective relativistic intrinsic gravitational parameters $\phi V_g(\phi r) = \phi V_g'(\phi r')$, $\phi\Phi(\phi r)$ and $\phi g(\phi r)$ appear to originate from the base of the relativistic intrinsic mass (or intrinsic inertial mass) ϕM of the gravitational field source in $\phi\rho$. The projective relativistic intrinsic gravitational parameters in $\phi\rho$ are then made manifest in relativistic gravitational parameters $V_g(r) = V_g'(r')$, $\Phi(r)$ and $\vec{g}(r)$ that appear to originate from the centre of the relativistic (or inertial) mass M of the gravitational field source in Σ in Fig. 13(c) of [10].

Thus there is a hierarchy of gravitational speeds/intrinsic gravitational speeds due to the hierarchy of masses/intrinsic masses of a gravitational field source, in the hierarchy of spacetimes/intrinsic spacetimes in Table I of part one of this paper [10]. There are corresponding hierarchies of gravitational potentials/intrinsic gravitational potentials and gravitational fields/intrinsic gravitational fields. The hierarchies of spacetimes/intrinsic spacetimes and masses/intrinsic masses and the associated hierarchies of gravitational speeds/intrinsic gravitational speeds, gravitational potentials/intrinsic gravitational potentials and gravitational accelerations/intrinsic gravitational accelerations in a universe, at the four states of a universe, are summarized in Table I.

As noted earlier, the relativistic (or inertial) M and relativistic intrinsic mass (or intrinsic inertial mass) ϕM in column 4 are not sources of the relativistic gravitational parameters and relativistic intrinsic gravitational parameters in that column, whereas the rest mass M_0 and intrinsic rest mass ϕM_0 in column 3 are the sources of the proper gravitational parameters and proper intrinsic gravitational parameters in that column. The relativistic gravitational parameters and relativistic intrinsic gravitational parameters in column 4 must be obtained as transformations of the proper gravitational parameters and proper intrinsic gravitational parameters in column 3 as indicated.

1.2 Hierarchy of dynamical parameters/intrinsic dynamical parameters associated with the hierarchies of spacetimes/intrinsic spacetimes and masses/intrinsic masses in a universe

Like the hierarchies of gravitational (or static) speeds/intrinsic gravitational speeds and gravitational accelerations/intrinsic gravitational accelerations in Table I, there are hierarchies of dynamical speeds/intrinsic dynamical speeds and dynamical accelerations/intrinsic dynamical accelerations associated with the hierarchy of spacetimes/intrinsic spacetimes and hierarchy of masses/intrinsic masses of a particle or object in motion in a universe, at the four states of a universe, which are summarized in Table II.

1.3 Hierarchies of electromagnetic waves and speeds of electromagnetic waves and hierarchy of the associated dynamical time dimensions in a universe

Just as there is a hierarchy of masses of a material particle or object in a universe, there is a hierarchy of electromagnetic waves (or a hierarchy of photons) and a hierarchy of energy of a photon in a universe. Thus corresponding to a quantum of absolute electromagnetic wave (or absolute photon) of absolute energy $h\hat{\nu}_0$ in the absolute space $\hat{\Sigma}$, there is its quantum of absolute intrinsic electromagnetic wave (or absolute intrinsic photon) of absolute intrinsic energy $h\phi\hat{\nu}_0$ in the absolute intrinsic space (or in absolute nospace) $\phi\hat{\rho}$ and its quantum of absolute-absolute intrinsic-intrinsic electromagnetic wave (or absolute-absolute intrinsic-intrinsic photon) of absolute-absolute intrinsic-intrinsic energy $h\phi\phi\hat{\hat{\nu}}_0$ in the absolute-absolute intrinsic-intrinsic space (or absolute-absolute nonospace) $\phi\phi\hat{\hat{\rho}}$, where $h\hat{\nu}_0, h\phi\hat{\nu}_0$ and $h\phi\phi\hat{\hat{\nu}}_0$ are equal in magnitude.

Likewise corresponding to the quantum of proper (or classical) intrinsic electromagnetic wave (or proper intrinsic photon) of proper (or classical) intrinsic energy $h\phi\nu_0$ in the proper intrinsic space $\phi\rho'$, there is the proper (or classical) photon of proper (or classical) energy $h\nu_0$ in the proper physi-

Table I: Hierarchies of spacetimes/intrinsic spacetimes, masses/intrinsic masses and gravitational parameters/intrinsic gravitational parameters associated with a gravitational field source at four states of a universe.

Immaterial	Material		
State 1	State 2	State 3	State 4
$(\hat{\hat{\Sigma}}, \hat{\hat{c}}\hat{\hat{t}})$	$(\hat{\Sigma}, \hat{c}\hat{t})$	(Σ', ct')	(Σ, ct)
$\hat{\hat{M}}_0$	$\hat{M}_0$	M_0	M
$\hat{\hat{V}}_g(\hat{\hat{r}}) = -(2G\hat{\hat{M}}_0/\hat{\hat{r}})^{1/2}$	$\hat{V}_g(\hat{r}) = -(2G\hat{M}_0/\hat{r})^{1/2}$	$V_g'(r') = (2GM_0/r')^{1/2}$	$V_g(r) = V_g'(r')$
$\hat{\hat{\Phi}}(\hat{\hat{r}}) = -G\hat{\hat{M}}_0/\hat{\hat{r}}$	$\hat{\Phi}(\hat{r}) = -G\hat{M}_0/\hat{r}$	$\Phi'(r') = -GM_0/r'$	$\Phi(r) = f_\Phi(\Phi'(r'))$ [a]
$\hat{\hat{g}}(\hat{\hat{r}}) = -G\hat{\hat{M}}_0/\hat{\hat{r}}^2$	$\hat{g}(\hat{r}) = -G\hat{M}_0/\hat{r}^2$	$g'(r') = -GM_0/r'^2$	$g(r) = f_g(g'(r'))$ [a]
$(\phi\phi\hat{\hat{\rho}}, \phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}})$	$(\phi\phi\hat{\rho}, \phi\phi\hat{c}\phi\phi\hat{t})$	$(\phi\phi\rho', \phi\phi c\phi\phi t')$	$(\phi\phi\rho, \phi\phi c\phi\phi t)$
$\phi\phi\hat{\hat{M}}_0$	$\phi\phi\hat{M}_0$	$\phi\phi M_0$	$\phi\phi M$
$\phi\phi\hat{\hat{V}}_g(\phi\phi\hat{\hat{r}}) = -(2G\phi\phi\hat{\hat{M}}_0/\phi\phi\hat{\hat{r}})^{1/2}$	$\phi\phi\hat{V}_g(\phi\phi\hat{r}) = -(2G\phi\phi\hat{M}_0/\phi\phi\hat{r})^{1/2}$	$\phi\phi V_g'(\phi\phi r') = -(2G\phi\phi M_0/\phi\phi r')^{1/2}$	$\phi\phi V_g(\phi\phi r) = \phi\phi V_g'(\phi\phi r')$
$\phi\phi\hat{\hat{\Phi}}(\phi\phi\hat{\hat{r}}) = -G\phi\phi\hat{\hat{M}}_0/\phi\phi\hat{\hat{r}}$	$\phi\phi\hat{\Phi}(\phi\phi\hat{r}) = -G\phi\phi\hat{M}_0/\phi\phi\hat{r}$	$\phi\phi\Phi'(\phi\phi r') = -G\phi\phi M_0/\phi\phi r'$	$\phi\phi\Phi(\phi\phi r) = f_\Phi(\Phi'(\phi\phi r'))$
$\phi\phi\hat{\hat{g}}(\phi\phi\hat{\hat{r}}) = -G\phi\phi\hat{\hat{M}}_0/\phi\phi\hat{\hat{r}}^2$	$\phi\phi\hat{g}(\phi\phi\hat{r}) = -G\phi\phi\hat{M}_0/\phi\phi\hat{r}^2$	$\phi\phi g'(\phi\phi r') = -G\phi\phi M_0/\phi\phi r'^2$	$\phi\phi g(\phi\phi r) = f_g(\phi\phi g'(\phi\phi r'))$

[a] The transformations functions f_Φ and f_g are functions of the gravitational speed $V_g'(r')$, to be determined elsewhere with further development.

Table II: Hierarchies of spacetimes/intrinsic spacetimes, masses/intrinsic masses and dynamical parameters/intrinsic dynamical parameters at four states of a universe.

Immaterial	Material		
State 1	State 2	State 3	State 4
$(\hat{\hat{\Sigma}}, \hat{\hat{c}}\hat{\hat{t}})$	$(\hat{\Sigma}, \hat{c}\hat{t})$	(Σ', ct')	(Σ, ct)
$\hat{\hat{m}}_0$	$\hat{m}_0$	m_0	m
$\hat{\hat{V}}_d$	$\hat{V}_d$	v'	v
$\hat{\hat{a}}$	$\hat{a}$	a'	a
$(\phi\phi\hat{\hat{\rho}}, \phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}})$	$(\phi\phi\hat{\rho}, \phi\phi\hat{c}\phi\phi\hat{t})$	$(\phi\phi\rho', \phi\phi c\phi\phi t')$	$(\phi\phi\rho, \phi\phi c\phi\phi t)$
$\phi\phi\hat{\hat{m}}_0$	$\phi\phi\hat{m}_0$	$\phi\phi m_0$	$\phi\phi m$
$\phi\phi\hat{\hat{V}}_d$	$\phi\phi\hat{V}_d$	$\phi\phi v'$	$\phi\phi v$
$\phi\phi\hat{\hat{a}}$	$\phi\phi\hat{a}$	$\phi\phi a'$	$\phi\phi a$

cal Euclidean 3-space Σ', where $h\phi\nu_0$ and $h\nu_0$ are equal in magnitude. And corresponding to relativistic intrinsic photon of relativistic intrinsic energy $h\phi\nu$ in the relativistic intrinsic space $\phi\rho$, there is the relativistic photon of relativistic energy $h\nu$ in the relativistic physical Euclidean 3-space Σ, where $h\phi\nu$ and $h\nu$ are equal in magnitude.

The constant speed of absolute electromagnetic waves (of absolute energy $h\hat{\nu}_0$) in the absolute space $\hat{\Sigma}$ is the absolute dynamical speed of light in vacuum to be denoted by $\hat{c}_\gamma$; note that the notation c_d was used for the dynamical speed of light in vacuum in part one of this paper [10]. The constant speed of absolute intrinsic electromagnetic waves (of absolute intrinsic energy $h\phi\hat{\nu}_0$) in absolute intrinsic space $\phi\hat{\rho}$, is the absolute intrinsic dynamical speed of light in vacuum $\phi\hat{c}_\gamma$ and the constant speed of absolute-absolute intrinsic-intrinsic electromagnetic waves (of absolute-absolute intrinsic-intrinsic energy $h\phi\phi\hat{\hat{\nu}}_0$) in absolute-absolute intrinsic-intrinsic space $\phi\phi\hat{\hat{\rho}}$ is the absolute-absolute intrinsic-intrinsic dynamical speed of light in vacuum $\phi\phi\hat{\hat{c}}_\gamma$, where $\hat{c}_\gamma$, $\phi\hat{c}_\gamma$, $\hat{\hat{c}}_\gamma$ and $\phi\phi\hat{\hat{c}}_\gamma$ are equal in magnitude (to $3 \times 10^8\, ms^{-1}$ in vacuo).

Likewise the speed of proper (or classical) intrinsic electromagnetic waves (of proper intrinsic energy $h\nu_0$) in the proper intrinsic space $\phi\rho'$ is $\phi c'_\gamma$; the speed of relativistic intrinsic electromagnetic waves (of relativistic intrinsic energy $h\phi\nu$) in the relativistic intrinsic space $\phi\rho$ is ϕc_γ, where from the invariance of the speed of light, $\phi c'_\gamma = \phi c_\gamma$. The speed of proper (or classical) electromagnetic waves (of classical energy $h\nu_0$) in the proper physical Euclidean 3-space Σ' is c'_γ, and the speed of relativistic electromagnetic waves (of relativistic energy $h\nu$) in the relativistic physical Euclidean 3-space Σ is c_γ, where, again, the invariance of speed of light implies $c'_\gamma = c_\gamma$, and where ϕc_γ and c_γ are equal in magnitude (to 3×10^8 in vacuo). The dynamical speed of light usually denoted by c in physics is what shall be uniformly denoted by c_γ in the present theory, except if otherwise stated.

Associated with the absolute speed and absolute intrinsic speeds $\hat{c}_\gamma$, $\phi\hat{c}_\gamma$ and $\phi\phi\hat{\hat{c}}_\gamma$ of absolute photon, absolute intrinsic photon and absolute-absolute intrinsic-intrinsic photon respectively, are the absolute dynamical time 'dimension' $\hat{c}_\gamma\,\hat{t}$, absolute intrinsic dynamical time 'dimension' $\phi\hat{c}_\gamma\,\phi\hat{t}$ and absolute-absolute intrinsic-intrinsic dynamical time 'dimension' $\phi\phi\hat{\hat{c}}_\gamma\,\phi\phi\hat{\hat{t}}$ respectively. Also associated with the intrinsic speed ϕc_γ are the proper intrinsic dynamical time dimension $\phi c_\gamma\,\phi t'$ and relativistic intrinsic dynamical time dimension $\phi c_\gamma\,\phi t$. And associated with the speed c_γ are the proper dynamical time dimension $c_\gamma\,t'$ and the relativistic dynamical time dimension $c_\gamma\,t$.

In Table III is summarized the hierarchies of electromagnetic wave energies/intrinsic electromagnetic wave energies, speeds/intrinsic speeds of electromagnetic waves and the associated hierarchy of dynamical time dimensions/intrinsic dynamical time dimensions in a universe.

Table III: Hierarchies of electromagnetic wave energy/intrinsic electromagnetic wave energy, speeds of light/intrinsic speeds of light and the associated dynamical time dimensions/intrinsic dynamical time dimensions at four states of a universe.

State 1	State 2	State 3	State 4
$h\hat{\hat{\nu}}_0$	$h\hat{\nu}_0$	$h\nu_0$	$h\nu$
$\hat{\hat{c}}_\gamma$	$\hat{c}_\gamma$	c_γ	c_γ
$\hat{\hat{c}}_\gamma\,\hat{\hat{t}}$	$\hat{c}_\gamma\,\hat{t}$	$c_\gamma\,t'$	$c_\gamma\,t$
$h\phi\phi\hat{\hat{\nu}}_0$	$h\phi\hat{\nu}_0$	$h\phi\nu_0$	$h\phi\nu$
$\phi\phi\hat{\hat{c}}_\gamma$	$\phi\hat{c}_\gamma$	ϕc_γ	ϕc_γ
$\phi\phi\hat{\hat{c}}_\gamma\,\phi\phi\hat{\hat{t}}$	$\phi\hat{c}_\gamma\,\phi\hat{t}$	$\phi c_\gamma\,\phi t'$	$\phi c_\gamma\,\phi t$

1.4 Hierarchies of gravitational waves/intrinsic gravitational waves, speeds/intrinsic speeds of gravitational waves and the associated gravitational (or static) time dimensions/intrinsic gravitational (or intrinsic static) time dimensions in a universe

Also as there is a hierarchy of masses of a particle or object and a hierarchy of electromagnetic waves in a universe, there is a hierarchy of gravitational waves in a universe. Thus corresponding to a quantum of absolute gravitational wave (or absolute graviton) of absolute energy $\hat{E}_{0\mathrm{graviton}}$ in the absolute space $\hat{\Sigma}$, there is a quantum of absolute intrinsic gravitational wave (or absolute intrinsic graviton) of absolute intrinsic energy $\phi\hat{E}_{0\mathrm{graviton}}$ in the absolute intrinsic space $\phi\hat{\rho}$ and a quantum of absolute-absolute intrinsic-intrinsic gravitational wave (or absolute-absolute intrinsic-intrinsic graviton) of absolute-absolute intrinsic-intrinsic energy $\phi\phi\hat{\hat{E}}_{0\mathrm{graviton}}$ in absolute-absolute intrinsic-intrinsic space $\phi\phi\hat{\hat{\rho}}$, where $\hat{E}_{0\mathrm{graviton}}$, $\phi\hat{E}_{0\mathrm{graviton}}$ and $\phi\phi\hat{\hat{E}}_{0\mathrm{graviton}}$ are equal in magnitude.

Likewise corresponding to a quantum of proper (or classical) intrinsic gravitational wave (or proper intrinsic graviton) of proper intrinsic energy $\phi E'_{0\mathrm{graviton}}$ in the proper intrinsic space $\phi\rho'$, there is a quantum of proper (or classical) gravitational wave (or proper graviton) of proper energy $E'_{0\mathrm{graviton}}$ in the proper physical Euclidean 3-space Σ', where $\phi E'_{0\mathrm{graviton}}$ and $E'_{0\mathrm{graviton}}$ are equal in magnitude. And corresponding to a quantum of relativistic intrinsic gravitational wave (or relativistic intrinsic graviton) of relativistic intrinsic energy $\phi E_{\mathrm{graviton}}$ in the relativistic intrinsic space $\phi\rho$, there is a quantum of relativistic gravitational wave (or relativistic graviton) of relativistic energy E_{graviton} in the relativistic physical Euclidean 3-space Σ, where $\phi E_{\mathrm{graviton}}$ and E_{graviton} are equal in magnitude.

The constant speed of absolute gravitational waves in the absolute space $\hat{\Sigma}$ is the absolute static speed (or absolute grav-

itational) speed to be denoted by $\hat{c}_g$; the constant speed of absolute intrinsic gravitational waves in the absolute intrinsic space $\phi\hat{\rho}$ is the absolute intrinsic static speed (or absolute intrinsic gravitational) speed to be denoted by $\phi\hat{c}_g$ and the constant speed of absolute-absolute intrinsic gravitational waves in the absolute-absolute intrinsic-intrinsic space $\phi\phi\hat{\hat{\rho}}$ is the absolute-absolute intrinsic-intrinsic static speed (or absolute-absolute intrinsic-intrinsic gravitational speed) to be denoted by $\phi\phi\hat{\hat{c}}_g$, where $\hat{c}_g$, $\phi\hat{c}_g$ and $\phi\phi\hat{\hat{c}}_g$ are equal in magnitude (to 3×10^8 m/s).

Likewise the constant speed of proper intrinsic gravitational waves in the proper intrinsic space $\phi\rho'$ is proper intrinsic static speed (or proper intrinsic gravitational speed) $\phi c'_g$, and the constant speed of relativistic intrinsic gravitational waves in the relativistic intrinsic space $\phi\rho$ is relativistic intrinsic static speed (or relativistic intrinsic gravitational speed) ϕc_g, where by virtue of the invariance of the speed of gravitational waves, $\phi c'_g = \phi c_g$. The constant speed of proper gravitational waves in the proper physical Euclidean 3-space Σ' is the proper static speed (or proper gravitational speed) c'_g and the speed of relativistic gravitational waves in the relativistic physical Euclidean 3-space Σ is the relativistic static speed (or relativistic gravitational speed) c_g, where, again, $c'_g = c_g$, and ϕc_g and c_g are equal in magnitude, (to 3×10^8 m/s).

Associated with the absolute static speed (or absolute gravitational speed) $\hat{c}_g$ of absolute gravitational waves is the absolute static time 'dimension' (or absolute gravitational time 'dimension') $\hat{c}_g\hat{t}$; associated with the absolute intrinsic static speed (or absolute intrinsic gravitational speed) $\phi\hat{c}_g$ of absolute intrinsic gravitational waves is the absolute intrinsic static time 'dimension' (or absolute intrinsic gravitational time 'dimension') $\phi\hat{c}_g\phi\hat{t}$ and associated with the absolute-absolute intrinsic-intrinsic static speed (or absolute-absolute intrinsic-intrinsic gravitational speed) $\phi\phi\hat{\hat{c}}_g$ of absolute-absolute intrinsic-intrinsic gravitational waves is the absolute-absolute intrinsic-intrinsic static time 'dimension' (or absolute-absolute intrinsic-intrinsic gravitational time 'dimension') $\phi\phi\hat{\hat{c}}_g\phi\phi\hat{\hat{t}}$.

Also associated with the intrinsic static speed (or intrinsic gravitational speed) ϕc_g of intrinsic gravitational waves are the proper intrinsic static time dimension (or proper intrinsic gravitational time dimension) $\phi c_g\phi t'$ and the relativistic intrinsic static time dimension (or relativistic intrinsic gravitational time dimension) $\phi c_g\phi t$. And associated with the static speed (or gravitational speed) c_g of gravitational waves are the proper static time dimension (or proper gravitational time dimension) $c_g t'$ and relativistic static time dimension (or relativistic gravitational time dimension) $c_g t$.

Summarized in Table IV are the hierarchies of gravitational wave energy/intrinsic gravitational wave energy; speeds of gravitational waves/intrinsic speeds of intrinsic gravitational waves and gravitational (or static) time dimensions/ intrinsic gravitational time (or intrinsic static) dimensions in a universe, at the four states of the universe.

Table IV: Hierarchies of spacetimes/intrinsic spacetimes, gravitational wave energy/intrinsic gravitational wave energy, speeds/intrinsic speeds of gravitational waves/intrinsic gravitational waves and the associated gravitational (or static) time dimensions/intrinsic gravitational time dimensions in a universe.

State 1	State 2	State 3	State 4
$\hat{\hat{E}}_{\text{graviton}}$	$\hat{E}_{\text{graviton}}$	E'_{graviton}	E_{graviton}
$\hat{\hat{c}}_g$	$\hat{c}_g$	c_g	c_g
$\hat{\hat{c}}_g\hat{\hat{t}}$	$\hat{c}_g\hat{t}$	$c_g t'$	$c_g t$
$\phi\phi\hat{\hat{E}}_{\text{graviton}}$	$\phi\hat{E}_{\text{graviton}}$	$\phi E'_{\text{graviton}}$	ϕE_{geaviton}
$\phi\phi\hat{\hat{c}}_g$	$\phi\hat{c}_g$	ϕc_g	ϕc_g
$\phi\phi\hat{\hat{c}}_g\phi\phi\hat{\hat{t}}$	$\phi\hat{c}_g\phi\hat{t}$	$\phi c_g\phi t'$	$\phi c_g\phi t$

We find from Tables III and IV and the discussions leading to them that electromagnetic waves possess dynamical speed c_γ in vacuum in space and therefore naturally translate at this speed in vacuum in space relative to all frames. Thus the ether of electromagnetic waves is a dynamic ether, which is constantly in motion at speed c_γ relative to all frames. On the other hand, gravitational waves possess static (or gravitational) speed c_g, which is not made manifest in actual translation in space. Hence a gravitational wave, although possesses constant speed, $c_g = 3 \times 10^8$ m/s, relative to all frames, is stationary in space always relative to all frames. (The fact that a particle that possesses gravitational speed $V_g(r') = c_g$ possesses zero dynamical speed relative to all frames shall be demonstrated elsewhere with further development). Thus the ether of gravitational waves is a static ether, which although possesses constant speed c_g, is stationary relative to all frames. The fact that gravitational waves do not propagate in spacetime is *a priori* in the present theory. This fact shall be justified formally with the development of the theory of 'propagation' of gravitational waves elsewhere with further development. The concepts of ether of electromagnetic waves and ether of gravitational waves shall likewise be isolated elsewhere with further development.

2 Spacetime/intrinsic spacetime, mass/intrinsic mass and other parameters/intrinsic parameters as composed of metric static (or gravitational) components and affine dynamical components

2.1 Spacetime/intrinsic spacetime as composed of metric static (or gravitational) components and affine dynamical components

According to Table III, the physical spacetime of dynamics including electromagnetism is $(\Sigma, c_\gamma t)$ or $(x^1, x^2, x^3, c_\gamma t)$, and according to Table VI, the physical spacetime of gravitational theories is $(\Sigma, c_g t)$ or $(x^1, x^2, x^3, c_g t)$. The dynamical time dimension $c_\gamma t$ could have been written as $c_\gamma t_\gamma$ in Table III, and the static (or gravitational) time dimension $c_g t$ could have been written as $c_g t_g$ in Table IV, connoting different kinds of time parameters t_γ for dynamics, electromagnetism and other non-gravitational dynamical laws or phenomena and t_g for the laws of gravity. This being the case, the kind of clock required to measure the times of events in dynamics, electromagnetism and non-gravitational dynamical events would be different from the kind of clock required to measure the times of events in gravitational phenomena. However the same clocks are used to measure time in dynamics, electromagnetism and gravitational phenomena. The same time t appears in mechanics, Maxwell equations and theories of gravity. The differentiation of time dimension ct into the dynamical time dimension and the static (or gravitational) time dimension must be done by differentiating the speed c into c_γ and c_g only, yielding the two dimensions $c_\gamma t$ and $c_g t$.

Now c_γ is the maximum over all dynamical speeds v of particles and bodies, where only the massless particle of electromagnetic waves namely, photon and massless non-gravitational fields propagate at speed c_γ in vacuum. In other words, c_γ is the maximum over all velocities in the special theory of relativity (SR). Hence the time dimension to appear in the special theory of relativity (or in dynamics), electromagnetism and non-gravitational dynamical laws is the dynamical time dimension $c_\gamma t$.

Likewise c_g is the maximum over all gravitational (or static) speeds $V_g'(r')$ that can be established in in the proper Euclidean 3-space Σ' or relativistic Euclidean 3-space Σ by a gravitational fields source or a combination of gravitational field sources. Therefore it is the static (or gravitational) time dimension $c_g t$ that should appear in the theories of gravity, (classical and relativistic). It is $c_g t$ that should appear in the theory of gravitational relativity (TGR) on flat four-dimensional spacetime in every gravitational field isolated in the present theory in [9].

The fact that the time dimension ct is composed of the static (or gravitational) time dimension and the dynamical time dimension shall be stated as follows

$$ct = c_g t \cup c_\gamma t \tag{1}$$

where the operation $\cup$ should be interpreted as composition or union of the two items it connects into one item.

However, as has been adequately explained at different points in the previous papers, in sub-sections 1.2 – 1.3 of [3], for instance, as well as between Fig. 1 and Fig. 2(a) of this paper, the Euclidean 3-space Σ^0 of the positive time-universe with respect to 3-observers in it, is geometrically contracted to one-dimensional space ρ^0, which further transforms into the time dimension ct relative to 3-observers in our Euclidean 3-space Σ, as happens between Fig. 2(a) and Fig. 3(a) of the first part of this paper [10] for transformation of absolute space $\hat{\Sigma}^0$ to absolute time dimension $\hat{ct}$. It then follows that ct can be replaced by ρ^0 and indeed by Σ^0 in Eq. (13) to have

$$\rho^0 = \rho_g^0 \cup \rho_d^0 \tag{2a}$$

or

$$\Sigma^0 = \Sigma_g^0 \cup \Sigma_d^0 \tag{2b}$$

Thus the fact that our time dimension is composed of the static (or gravitational) time dimension component and dynamical time dimension component, implies that the Euclidean 3-space Σ^0 of the positive time-universe is composed of the static (or gravitational) component and the dynamical component. It follows from the established perfect symmetry of state and perfect symmetry of natural laws among the four universes isolated in [1-4] that the Euclidean 3-space of our universe is composed of the static (or gravitational) component and the dynamical component as well. That is,

$$\Sigma = \Sigma_g \cup \Sigma_d \tag{3}$$

And Eqs. (2b) and (3) obtain for the Euclidean 3-spaces of the negative universe and the negative time-universe as well.

Thus let us denote the physical 3-space of dynamics, electromagnetism and other non-gravitational dynamical laws by Σ_d as already done above, with coordinates (or dimensions) to be denoted by χ^1, χ^2 and χ^3, and the physical 3-space of the theories of gravity by Σ_g, as already done above, with coordinates (or dimensions) to be denoted by x_g^1, x_g^2 and x_g^3. Thus the flat four-dimensional spacetime of special relativity, electromagnetism and other non-gravitational dynamical laws purely (i.e. when hypothetically isolated from the gravitational spacetime) is $(\Sigma_d\,,\, c_\gamma t) \equiv (\chi^1, \chi^2, \chi^3, c_\gamma t)$, while the four-dimensional spacetime of relativistic gravity purely (i.e. when hypothetically isolated from the spacetime of dynamics) in the context of the present theory is $(\Sigma_g, c_g t) \equiv (x_g^1, x_g^2, x_g^3, c_g t)$.

The fact that the physical 3-space is composed of gravitational 3-space Σ_g and dynamical 3-space Σ_d and that the physical time dimension ct is composed of the gravitational (or static) time dimension $c_g t$ and the dynamical time dimension $c_\gamma t$ shall be represented by the following

$$\Sigma(x^1, x^2, x^3) = \Sigma_g(x_g^1, x_g^2, x_g^3) \cup \Sigma_d(\chi^1, \chi^2, \chi^3) \quad (4a)$$

$$ct = c_g t \cup c_\gamma t \quad (4b)$$

where, again, the operation $\cup$ must be interpreted as composition of the two items it connects into one item.

A particle moving at a dynamical velocity $\vec{v}$ through radial distance r from the centre of a gravitational field source of inertial mass M possesses dynamical velocity $\vec{v}$ and gravitational velocity $\vec{V}_g(r)$ given by coordinate definition as follows

$$\frac{d\vec{x}}{dt} = \frac{d\vec{\chi}}{dt} \cup \frac{d\vec{x}_g}{dt} \equiv \vec{v} \cup \vec{V}_g(r) \quad (5a)$$

In a situation where the motion of a particle takes place outside a gravitational field, then

$$\frac{d\vec{x}}{dt} = \frac{d\vec{\chi}}{dt} = \vec{v} \quad (5b)$$

And in a situation where a particle is at rest relative to the observer in a gravitational field,

$$\frac{d\vec{x}}{dt} = \frac{d\vec{x}_g}{dt} = \vec{V}_g(r) \quad (5c)$$

Equation (5c) is an important relation to note, because the right-hand side is usually set to zero in this situation (of absence of motion).

Likewise a craft being accelerated by its engine away from the surface of the earth, possesses both inertial (or dynamical) acceleration $\vec{a}$ and gravitational acceleration $\vec{g}$ given by coordinate definitions as follows

$$\frac{d^2\vec{x}}{dt^2} = \frac{d^2\vec{\chi}}{dt^2} \cup \frac{d^2\vec{x}_g}{dt^2} = \vec{a} \cup \vec{g} \quad (6a)$$

If there is no gravitational field, then

$$\frac{d^2\vec{x}}{dt^2} = \frac{d^2\vec{\chi}}{dt^2} = \vec{a} \quad (6b)$$

And if there is no inertial acceleration, such as when there is no test particle at the location in the gravitational field then

$$\frac{d^2\vec{x}}{dt^2} = \frac{d^2\vec{x}_g}{dt^2} = \vec{g} \quad (6c)$$

In a nutshell, only static (or gravitational) velocity is possible in the gravitational spacetime $(\Sigma_g, c_g t)$ and only dynamical velocity is possible in the dynamical spacetime $(\Sigma_d, c_\gamma t)$, while both static (or gravitational) velocity and dynamical velocity are possible in the compound spacetime (Σ, ct).

The two-dimensional intrinsic spacetime (or nospacenotime) $(\phi\rho, \phi c\phi t)$ is likewise composed of the dynamical component to be denoted by $(\phi\chi, \phi c_\gamma \phi t)$, and the static (or gravitational) component to be denoted by $(\phi\rho_g, \phi c_g \phi t)$. This shall be represented for the hierarchy of intrinsic spacetimes as follows

$$\left.\begin{array}{rcl} \phi\rho & = & \phi\rho_g \cup \phi\chi \\ \phi\rho' & = & \phi\rho'_g \cup \phi\chi' \\ \phi\hat{\rho} & = & \phi\hat{\rho}_g \cup \phi\hat{\chi} \\ \phi\phi\hat{\hat{\rho}} & = & \phi\phi\hat{\hat{\rho}}_g \cup \phi\phi\hat{\hat{\chi}} \end{array}\right\} \quad (7)$$

2.2 The hierarchy of co-moving speeds/intrinsic co-moving speeds as composed of gravitational and dynamical components

The hierarchy of co-moving speeds/intrinsic co-moving speeds associated with the hierarchy of spacetimes/intrinsic spacetimes, shown in Fig. 12(a) and discussed in section 4 of part one of this paper [10], is likewise composed of the gravitational and dynamical components. That is,

$$\left.\begin{array}{rcl} V_0 & = & V_{0g} \cup V_{0d} \\ \phi V_0 & = & \phi V_{0g} \cup \phi V_{0d} \\ \hat{V}_0 & = & \hat{V}_{0g} \cup \hat{V}_{0d} \\ \phi\hat{V}_0 & = & \phi\hat{V}_{0g} \cup \phi\hat{V}_{0d} \\ \hat{\hat{V}}_0 & = & \hat{\hat{V}}_{0g} \cup \hat{\hat{V}}_{0d} \\ \phi\phi\hat{\hat{V}}_0 & = & \phi\phi\hat{\hat{V}}_{0g} \cup \phi\phi\hat{\hat{V}}_{0d} \end{array}\right\} \quad (8)$$

Thus for the constant co-moving speed $V_0 = c_0$ at every point along the proper and relativistic time dimensions ct' and ct; $\phi V_0 = \phi c_0$ at every point along $\phi c\phi t'$ and $\phi c\phi t$; $\hat{V}_0 = \hat{c}_0$ at every point along the absolute time 'dimension' $\hat{ct}$; $\phi\hat{V}_0 = \phi\hat{c}_0$ at every point along absolute intrinsic time 'dimension' $\phi\hat{c}\phi\hat{t}$ and $\phi\phi\hat{\hat{V}}_0 = \phi\phi\hat{\hat{c}}_0$ at every point along the absolute-absolute intrinsic-intrinsic time 'dimension' $\phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}}$ in Fig. 12(a) of [10] we have

$$\left.\begin{array}{rcl} c_0 & = & c_{0g} \cup c_{0\gamma} \\ \phi c_0 & = & \phi c_{0g} \cup \phi c_{0\gamma} \\ \hat{c}_0 & = & \hat{c}_{0g} \cup \hat{c}_{0\gamma} \\ \phi\hat{c}_0 & = & \phi\hat{c}_{0g} \cup \phi\hat{c}_{0\gamma} \\ \hat{\hat{c}}_0 & = & \hat{\hat{c}}_{0g} \cup \hat{\hat{c}}_{0\gamma} \\ \phi\phi\hat{\hat{c}}_0 & = & \phi\phi\hat{\hat{c}}_{0g} \cup \phi\phi\hat{\hat{c}}_{0\gamma} \end{array}\right\} \quad (9)$$

As deduced in section 4 of part one of this paper [10], the hierarchy of time dimensions/intrinsic time dimensions should actually be denoted in terms of the hierarchy of co-moving speeds/intrinsic co-moving speeds as $c_0 t, \phi c_0 \phi t, c_0 t', \phi c_0 \phi t', \hat{c}_0 \hat{t}, \phi\hat{c}_0\phi\hat{t}, \hat{\hat{c}}_0\hat{\hat{t}}$ and $\phi\phi\hat{\hat{c}}_0\phi\phi\hat{\hat{t}}$. It is for aesthetics and in order to be consistent with the usual notation of time dimensions as ct' and ct in physics that the hierarchy of time dimensions/intrinsic time dimensions has been retained as ct, $\phi c\phi t, ct', \phi c\phi t', \hat{ct}, \phi\hat{c}\phi\hat{t}, \hat{\hat{c}}\hat{\hat{t}}$ and $\phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}}$, as noted in section 4 of [10], while emphasizing the need to note that $c \equiv c_0$ in ct' and ct; $\phi c \equiv \phi c_0$ in $\phi c\phi t'$ and $\phi c\phi t$; $\phi\hat{c} \equiv \phi\hat{c}_0$ in

$\phi\hat{c}\phi\hat{t}$, etc. Thus the fact that the hierarchy of time dimensions/intrinsic time dimensions is composed of static (or gravitational) and dynamical components should be written in the natural notations as follows

$$\left.\begin{array}{lcl} c_0t & = & c_{0g}t \cup c_{0\gamma}t \\ \phi c_0\phi t & = & \phi c_{0g}\phi t \cup \phi c_{0\gamma}\phi t \\ c_0t' & = & c_{0g}t' \cup c_{0\gamma}t' \\ \phi c_0\phi t' & = & \phi c_{0g}\phi t' \cup \phi c_{0\gamma}\phi t' \\ \hat{c}_0\hat{t} & = & \hat{c}_{0g}\hat{t} \cup \hat{c}_{0\gamma}\hat{t} \\ \phi\hat{c}_0\phi\hat{t} & = & \phi\hat{c}_{0g}\phi\hat{t} \cup \phi\hat{c}_{0\gamma}\phi\hat{t} \\ \hat{\hat{c}}_0\hat{\hat{t}} & = & \hat{\hat{c}}_{0g}\hat{\hat{t}} \cup \hat{\hat{c}}_{0\gamma}\hat{\hat{t}} \\ \phi\phi\hat{\hat{c}}_0\phi\phi\hat{\hat{t}} & = & \phi\phi\hat{\hat{c}}_{0g}\phi\phi\hat{\hat{t}} \cup \phi\phi\hat{\hat{c}}_{0\gamma}\phi\phi\hat{\hat{t}} \end{array}\right\} \quad (10)$$

where c_{0g} is a static (or gravitational) co-moving speed; $c_{0\gamma}$ is a dynamical co-moving speed; ϕc_{0g} is an intrinsic static (or gravitational) co-moving speed; $\phi c_{0\gamma}$ is an intrinsic dynamical co-moving speed; $\phi\hat{c}_{0g}$ is an absolute intrinsic static (or gravitational) co-moving speed; $\phi\phi\hat{\hat{c}}_{0\gamma}$ is an absolute-absolute intrinsic-intrinsic dynamical co-moving speed; etc.

It must also be remembered that the gravitational (or static) co-moving speed, c_{0g} ($= 3\times10^8$ m/s), is equivalent to zero gravitational speed ($V_g'(r') = 0$). Consequently the presence of c_{0g} at every point along the gravitational time dimensions $c_{0g}t'$ and $c_{0g}t$ does not lead to the presence of gravitational field and gravitational potential along $c_{0g}t'$ and $c_{0g}t$. Likewise, the dynamical co-moving speed, $c_{0\gamma}$ ($= 3\times10^8$ m/s), is equivalent to zero dynamical speed ($V_d = 0$). Consequently the presence of $c_{0\gamma}$ at every point along the dynamical time dimensions $c_{0\gamma}t'$ and $c_{0\gamma}t$ does not lead to translation (or flow) of $c_{0\gamma}t'$ and $c_{0\gamma}t$ along their positive directions.

The absolute intrinsic gravitational co-moving speed $\phi\hat{c}_{0g}$ is equivalent to zero absolute intrinsic gravitational speed ($\phi\hat{V}_g(\phi\hat{r}) = 0$). Consequently the presence of $\phi\hat{c}_{0g}$ at every point along the absolute intrinsic static (or absolute intrinsic gravitational) time dimension $\phi\hat{c}_{0g}\phi\hat{t}$ does not lead to the presence of absolute intrinsic gravitational field and absolute intrinsic gravitational potential along $\phi\hat{c}_{0g}\phi\hat{t}$. Likewise, the absolute intrinsic dynamical co-moving speed $\phi\hat{c}_{0\gamma}$ is equivalent to zero absolute intrinsic dynamical speed ($\phi\hat{V}_d = 0$). Consequently the presence of $\phi\hat{c}_{0\gamma}$ at every point along the absolute intrinsic dynamical time dimension $\phi\hat{c}_{0\gamma}\phi\hat{t}$ does not lead to absolute intrinsic translation (or absolute intrinsic flow) of $\phi\hat{c}_{0\gamma}\phi\hat{t}$ along its positive direction.

The absolute-absolute intrinsic-intrinsic gravitational co-moving speed $\phi\phi\hat{\hat{c}}_{0g}$ is equivalent to zero absolute-absolute intrinsic-intrinsic gravitational speed ($\phi\phi\hat{\hat{V}}_g(\phi\hat{r}) = 0$). Consequently the presence of $\phi\phi\hat{\hat{c}}_{0g}$ at every point along the absolute-absolute intrinsic-intrinsic static (or gravitational) time dimension $\phi\phi\hat{\hat{c}}_{0g}\phi\phi\hat{\hat{t}}$ does not lead to the presence of absolute-absolute intrinsic-intrinsic gravitational field or absolute-absolute intrinsic-intrinsic gravitational potential along the 'dimension' $\phi\phi\hat{\hat{c}}_{0g}\phi\phi\hat{\hat{t}}$. Likewise, the absolute-absolute intrinsic-intrinsic dynamical co-moving speed $\phi\phi\hat{\hat{c}}_{0\gamma}$ is equivalent to zero absolute-absolute intrinsic-intrinsic dynamical speed ($\phi\phi\hat{\hat{V}}_d = 0$). Consequently the presence of $\phi\phi\hat{\hat{c}}_{0\gamma}$ at every point along the absolute intrinsic dynamical time dimension $\phi\phi\hat{\hat{c}}_{0\gamma}\phi\phi\hat{\hat{t}}$ does not lead to absolute-absolute intrinsic-intrinsic translation (or absolute-absolute intrinsic-intrinsic flow) of $\phi\phi\hat{\hat{c}}_{0\gamma}\phi\phi\hat{\hat{t}}$ along its positive direction.

Having taken proper note of the discussions in the foregoing three paragraphs, we shall again for aesthetics and in order to be consistent with the usual notations of time dimensions simply as ct' and ct in physics, simplify the natural notations of the hierarchy of time dimensions/intrinsic time dimensions in system (10) as follows

$$\left.\begin{array}{lcl} ct & = & c_gt \cup c_\gamma t \\ \phi c\phi t & = & \phi c_g\phi t \cup \phi c_\gamma\phi t \\ ct' & = & c_gt' \cup c_\gamma t' \\ \phi c\phi t' & = & \phi c_g\phi t' \cup \phi c_\gamma\phi t' \\ \hat{c}\hat{t} & = & \hat{c}_g\hat{t} \cup \hat{c}_\gamma\hat{t} \\ \phi\hat{c}\phi\hat{t} & = & \phi\hat{c}_g\phi\hat{t} \cup \phi\hat{c}_\gamma\phi\hat{t} \\ \hat{\hat{c}}\hat{\hat{t}} & = & \hat{\hat{c}}_g\hat{\hat{t}} \cup \hat{\hat{c}}_\gamma\hat{\hat{t}} \\ \phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}} & = & \phi\phi\hat{\hat{c}}_g\phi\phi\hat{\hat{t}} \cup \phi\phi\hat{\hat{c}}_\gamma\phi\phi\hat{\hat{t}} \end{array}\right\} \quad (11)$$

The notations in system (11), which have been adopted in Tables III and IV and in Eqs. (1) and (4b) shall be adopted henceforth, except when passing reference to the natural notations in system (10) becomes necessary. It must only be remembered that system (11) is the same as system (10). Consequently the compound speed c in ct' and ct is the compound co-moving speed c_0; the speed c_g in c_gt' and c_gt is the gravitational co-moving speed c_{0g}; the speed c_γ in $c_\gamma t'$ and $c_\gamma t$ is the dynamical co-moving speed $c_{0\gamma}$; etc. These facts shall be stated explicitly by the following equivalence

$$\left.\begin{array}{lcll} ct & = & c_gt \cup c_\gamma t & \equiv \quad c_{0g}t \cup c_{0\gamma}t \\ \phi c\phi t & = & \phi c_g\phi t \cup \phi c_\gamma\phi t & \equiv \quad \phi c_{0g}\phi t \cup \phi c_{0\gamma}\phi t \\ ct' & = & c_gt' \cup c_\gamma t' & \equiv \quad c_{0g}t' \cup c_{0\gamma}t' \\ \phi c\phi t' & = & \phi c_g\phi t' \cup \phi c_\gamma\phi t' & \equiv \quad \phi c_{0g}\phi t' \cup \phi c_{0\gamma}\phi t' \\ \hat{c}\hat{t} & = & \hat{c}_g\hat{t} \cup \hat{c}_\gamma\hat{t} & \equiv \quad \hat{c}_{0g}\hat{t} \cup \hat{c}_{0\gamma}\hat{t} \\ \phi\hat{c}\phi\hat{t} & = & \phi\hat{c}_g\phi\hat{t} \cup \phi\hat{c}_\gamma\phi\hat{t} & \equiv \quad \phi\hat{c}_{0g}\phi\hat{t} \cup \phi\hat{c}_{0\gamma}\phi\hat{t} \\ \hat{\hat{c}}\hat{\hat{t}} & = & \hat{\hat{c}}_g\hat{\hat{t}} \cup \hat{\hat{c}}_\gamma\hat{\hat{t}} & \equiv \quad \hat{\hat{c}}_{0g}\hat{\hat{t}} \cup \hat{\hat{c}}_{0\gamma}\hat{\hat{t}} \\ \phi\phi\hat{\hat{c}}\phi\phi\hat{\hat{t}} & = & \phi\phi\hat{\hat{c}}_g\phi\phi\hat{\hat{t}} \cup & \equiv \quad \phi\phi\hat{\hat{c}}_{0g}\phi\phi\hat{\hat{t}} \cup \\ & & \phi\phi\hat{\hat{c}}_\gamma\phi\phi\hat{\hat{t}} & \quad\quad \phi\phi\hat{\hat{c}}_{0\gamma}\phi\phi\hat{\hat{t}} \end{array}\right\} \quad (12)$$

As a final remark in this sub-section, it is interesting to note that two distinct 'speeds' of signals namely, c_γ for electromagnetic 'signals' and c_g for gravitational 'signals', where both are numerically equal to 3×10^8 m/s (in vacuo in the case of electromagnetic 'signals'), have been deduced newly in this paper. Only one speed of 'signals', usually denoted by c, which is dynamical and hence corresponds to the speed

c_γ of electromagnetic waves in the notations adopted above, is known until now in physics. The speeds of 'signals' c_γ of electromagnetic waves and c_g of gravitational waves are quite apart from the dynamical co-moving speed $c_{0\gamma}$ and the static (or gravitational) co-moving speed c_{0g} that appear in the time dimensions $c_\gamma t\,(\equiv c_{0\gamma}t)$ and $c_g t\,(\equiv c_{0g}t)$, which are not to be referred to as speeds of 'signals', since $c_{0\gamma}$ is equivalent to zero dynamical speed and c_{0g} is equivalent to zero gravitational speed.

2.3 The mass of a particle or body as composed of static (or gravitational) mass and dynamical mass

The co-existence in nature of the spacetime of gravity and the spacetime of dynamics and electromagnetism, implies the co-existence of static (or gravitational) mass to be denoted by m_g or M_g and dynamical mass to be denoted by m_d or M_d, for every material particle or body, so that the dynamical mass of a particle or body exists in the spacetime of dynamics $(\Sigma_d, c_\gamma t)$, while its gravitational mass exists in the spacetime of the theories of gravity $(\Sigma_g, c_g t)$. The fact that the mass m is composed of the gravitational mass and dynamical mass shall be represented as follows

$$m = m_g \cup m_d \tag{13}$$

The gravitational mass m_g of a particle or body dwells in the gravitational space Σ_g. It is the actual or ponderable quantity of matter of the particle or body. If isolated in its spacetime $(\Sigma_g, c_g t)$, the gravitational mass can possess (or acquire) gravitational (or static) velocity $\vec{V}_g(r)$ and gravitational acceleration $\vec{g}$ but not dynamical velocity $\vec{v}$ and dynamical acceleration $\vec{a}$, since dynamical velocity and dynamical acceleration are impossible in $(\Sigma_g, c_g t)$. Hence m_g cannot move if isolated in $(\Sigma_g, c_g t)$. Consequently the gravitational mass cannot respond to a contact (or inertial) force (of push, pull, elastic or any other) impressed on it, by moving, if isolated in its spacetime. It therefore does not qualify to be called inertial mass when isolated in $(\Sigma_g, c_g t)$.

The gravitational mass m_g is the mass that interacts with an external gravitational field. It is therefore the "heavy mass" of a particle or body that gives the particle or body its weight in a gravitational field. However if isolated in its spacetime $(\Sigma_g, c_g t)$, the gravitational mass cannot move even if it interacts with an external gravitational field and possesses gravitational acceleration. It is the source of the gravitational potential and gravitational field of a body. It indeed qualifies to be called gravitational mass.

The dynamical mass of a particle or body, on the other hand, is not an actual or ponderable quantity of matter. It exits in the dynamical 3-space Σ_d. This implies that if isolated in its dynamical spacetime $(\Sigma_d, c_\gamma t)$, a macroscopic dynamical mass cannot be held or touched by hand. If isolated in $(\Sigma_d, c_\gamma t)$, the dynamical mass can possess dynamical velocity $\vec{v}$ and dynamical acceleration $\vec{a}$ but not static (or gravitational) velocity $\vec{V}_g(r)$ and gravitational acceleration $\vec{g}$, since gravitational velocity and gravitational acceleration are impossible in the dynamical spacetime $(\Sigma_d, c_\gamma t)$. Thus the dynamical mass of a particle or body does not interact with an external gravitational field nor is it a source of gravitational field. It is the non-ponderable "light mass" of a particle or body that has no weight in an external gravitational field. Consequently the dynamical mass does not qualify to be called gravitational mass (passive or active) [11].

On the other hand, the dynamical mass will respond to an inertial force or an inertial acceleration by moving if isolated in its spacetime $(\Sigma_d, c_\gamma t)$. The dynamical mass in its spacetime therefore qualifies to be called the inertial mass. A dynamical mass with net electric charge, which is isolated in its spacetime $(\Sigma_d, c_\gamma t)$, will move in an external electromagnetic field, since $(\Sigma_d, c_\gamma t)$ is the spacetime of electromagnetism. The dynamical mass may be said to also possess electromagnetic inertia in this situation.

The gravitational mass m_g and the dynamical mass m_d of a particle or body, (each with unit of kilogramme), are equal in magnitude and volume and have the same shape. However while the magnitude of the gravitational mass translates into the weight of the particle or body in an external gravitational field, its dynamical mass does not translate into weight, as mentioned earlier. The gravitational mass of a particle or body occupies a volume of the gravitational 3-space Σ_g, which is equal to the volume of the dynamical 3-space Σ_d occupied by its dynamical mass. They are always tied together but in their respective spaces (or it can be said that the dynamical mass m_d in the dynamical space Σ_d is embedded in the gravitational mass m_g in the gravitational space Σ_g always), the two thereby constituting the observed compound mass m in the compound 3-space Σ.

The compound mass m in the compound 3-space Σ combines the properties of the gravitational mass m_g isolated in the gravitational spacetime $(\Sigma_g, c_g t)$ and the dynamical mass m_d isolated in the dynamical spacetime $(\Sigma_d, c_\gamma t)$. It is the observed mass of a particle or body, which can be touched or held by hand, (in the case of macroscopic object) $-$ by virtue of its material (or ponderable) gravitational mass component.

The inertial force of push, pull, elastic or any other can be impressed on the compound mass, which will move in response by virtue of its dynamical mass component in the dynamical spacetime. The compound mass therefore qualifies to be called inertial mass. The compound mass in the compound proper spacetime is the source of the gravitational field of a body and will interact with an external gravitational field by virtue of its gravitational mass component in the gravitational spacetime. The compound mass in the compound spacetime again qualifies to be called gravitational mass. Thus the observed compound mass m of a particle or body in the compound 3-space Σ is both the gravitational mass and the inertial mass of the particle or body, as known from experience [11].

Now relation (13) shows that the mass of a particle or

body is purely a dynamical mass in the absence of gravitational mass. The electron (and its anti-particle) is one particle that possesses dynamical mass, usually denoted by m_{e}, but zero gravitational mass. This is so since the electronic rest mass satisfies the following exact relation classically,

$$m_{0\mathrm{e}}c_{\gamma}^{2} = e^{2}/4\pi\epsilon_{\circ}r_{0\mathrm{e}} \tag{14}$$

This exact classical relation implies that the energy stored in electromagnetic field within the rest mass of the electron is equal to the rest-mass-energy of the electron classically. This implies that the rest mass of the electron $m_{0\mathrm{e}}$ is pure electromagnetic mass, which is a dynamical rest mass resident in the proper (or classical) dynamical Euclidean 3-space Σ_{d}'. If energy was also stored in gravitational field and in the other fundamental force-fields within the electron, (in which case the electron possesses not purely electromagnetic rest mass), then the classical relation (14) would be inexact. We can conclude from this that the electron is non-ponderable (or 'immaterial') classically.

In the light of the foregoing, the equivalent masses m_{eq} of electrical energy stored in an electrostatic or uniform electric field and magnetic energy stores in a magnetic field are equivalent dynamical masses, which shall be referred to as equivalent electromagnetic masses because of their origin from electromagnetic field. The electronic mass m_{e} shall be referred to as equivalent electromagnetic mass that resides in the dynamical 3-space Σ_{d}, since it arises from energy stored in electrostatic field within the electron. The electron (and its anti-particle) is a state of pure equivalent electromagnetic mass, (i.e. not attached to other material particle with compound mass) which, all the same, possesses the properties of a particle namely, spin, magnetic moment, etc. The electron and its anti-particle are the only particulate states of equivalent electromagnetic mass. Other states of equivalent electromagnetic mass are not pure (or are not particulate states) because they are always attached to particles and bodies with compound mass.

On the other hand, the black hole is one macroscopic object with pure gravitational mass. The rest mass M_{0b} of a black hole of radius r_{0b} satisfies the following exact relation,

$$M_{0b}c_{g}^{2} = 2GM_{0b}^{2}/r_{0b} \tag{15}$$

Again this relation states that the energy stored in gravitational field within the rest mass of a black hole is equal to the rest-mass-energy of the black hole, which means that the rest mass of a black hole is pure gravitational mass. This is not true for other macroscopic objects that possess both gravitational mass and dynamical mass.

The fact that photon possesses zero rest mass implies that it possesses both zero dynamical rest mass and zero gravitational rest mass. Consequently the photon is purely immaterial with zero inertial and zero gravitational attributes and

Table V: Hierarchies of gravitational spacetimes/intrinsic gravitational spacetimes and gravitational masses/intrinsic gravitational masses in parallel with the hierarchies of dynamical spacetimes/intrinsic dynamical spacetimes and dynamical masses/intrinsic dynamical masses in a universe.

Hierarchy	Static or gravitational component	Dynamical component
Absolute-absolute	$(\hat{\hat{\Sigma}}_{g}, \hat{\hat{c}}_{g}\hat{\hat{t}}; \hat{\hat{m}}_{0g})$ $(\phi\phi\hat{\hat{\rho}}_{g}, \phi\phi\hat{\hat{c}}_{g}\phi\phi\hat{\hat{t}}; \phi\phi\hat{\hat{m}}_{0g})$	$(\hat{\hat{\Sigma}}_{d}, \hat{\hat{c}}_{\gamma}\hat{\hat{t}}; \hat{\hat{m}}_{0d})$ $(\phi\phi\hat{\hat{\chi}}, \phi\phi\hat{\hat{c}}_{\gamma}\phi\phi\hat{\hat{t}}; \phi\phi\hat{\hat{m}}_{0d})$
Absolute	$(\hat{\Sigma}_{g}, \hat{c}_{g}\hat{t}; \hat{m}_{0g})$ $(\phi\hat{\rho}_{g}, \phi\hat{c}_{g}\phi\hat{t}; \phi\hat{m}_{0g})$	$(\hat{\Sigma}_{d}, \hat{c}_{\gamma}\hat{t}; \hat{m}_{0d})$ $(\phi\hat{\chi}, \phi\hat{c}_{\gamma}\phi\hat{t}; \phi\hat{m}_{0d})$
Proper	$(\Sigma_{g}', c_{g}t'; m_{0g})$ $(\phi\rho_{g}', \phi c_{g}\phi t'; \phi m_{0g})$	$(\Sigma_{d}', c_{\gamma}t'; m_{0d})$ $(\phi\chi', \phi c_{\gamma}\phi t'; \phi m_{0d})$
Relativistic	$(\Sigma_{g}, c_{g}t; m_{g})$ $(\phi\rho_{g}, \phi c_{g}\phi t; \phi m_{g})$	$(\Sigma_{d}, c_{\gamma}t; m_{d})$ $(\phi\chi, \phi c_{\gamma}\phi t; \phi m_{d})$

likewise for graviton:

$$\begin{aligned} m_{0\mathrm{photon}} &\equiv (\text{zero grav. rest mass} \cup \text{zero dynamical rest mass}) \\ m_{0\mathrm{graviton}} &\equiv (\text{zero grav. rest mass} \cup \text{zero dynamical rest mass}) \end{aligned}$$

There is in nature a hierarchy of dynamical spacetimes and the associated hierarchy of dynamical masses of every particle or body, which co-exists with (or which is embedded in) the hierarchy of gravitational spacetimes and the associated hierarchy of gravitational masses of every material particle or body, (except the electron with pure equivalent electromagnetic mass, black hole with pure equivalent gravitational mass and photon and graviton with zero gravitational mass and zero electromagnetic (dynamical) mass), as summarized in Table V. The electron, black holes, the photon and the graviton are not encompassed by Table V.

Finally, just as the natural notations for the hierarchy of time dimensions/intrinsic time dimensions are as contained in system (10), the natural notations for the hierarchy of equivalent mass/equivalent intrinsic mass of material particles and bodies in the hierarchy of time dimensions/intrinsic time di-

mensions are the the following

$$\left.\begin{array}{lcl} E/c_0^2 & = & E_g/c_{0g}^2 \cup E_d/c_{0\gamma}^2 \\ & & (\text{in } c_{0g}t \cup c_{0\gamma}t) \\ \phi E/\phi c_0^2 & = & \phi E_g/\phi c_{0g}^2 \cup \phi E_d/\phi c_{0\gamma}^2 \\ & & (\text{in } \phi c_{0g}\phi t \cup \phi c_{0\gamma}\phi t) \\ E'/c_0^2 & = & E'_g/c_{0g}^2 \cup E'_d/c_{0\gamma}^2 \\ & & (\text{in } c_{0g}t' \cup c_{0\gamma}t') \\ \phi E'/\phi c_0^2 & = & \phi E'_g/\phi c_{0g}^2 \cup \phi E'_d/\phi c_{0\gamma}^2 \\ & & (\text{in } \phi c_{0g}\phi t' \cup \phi c_{0\gamma}\phi t') \\ \hat{E}/\hat{c}_0^2 & = & \hat{E}_g/\hat{c}_{0g}^2 \cup \hat{E}_d/\hat{c}_{0\gamma}^2 \\ & & (\text{in } \hat{c}_{0g}\hat{t} \cup \hat{c}_{0\gamma}\hat{t}) \\ \phi\hat{E}/\phi\hat{c}_0^2 & = & \phi\hat{E}_g/\phi\hat{c}_{0g}^2 \cup \phi\hat{E}_d\phi\hat{c}_{0\gamma}^2 \\ & & (\text{in } \phi\hat{c}_{0g}\phi\hat{t} \cup \phi\hat{c}_{0\gamma}\phi\hat{t}) \\ \hat{\hat{E}}/\hat{\hat{c}}_0^2 & = & \hat{\hat{E}}_g/\hat{\hat{c}}_{0g}^2 \cup \hat{\hat{E}}_d/\hat{\hat{c}}_{0\gamma}^2 \\ & & (\text{in } \hat{\hat{c}}_{0g}\hat{\hat{t}} \cup \hat{\hat{c}}_{0\gamma}\hat{\hat{t}}) \\ \phi\phi\hat{\hat{E}}/\phi\phi\hat{\hat{c}}_0^2 & = & \phi\phi\hat{\hat{E}}_g/\phi\phi\hat{\hat{c}}_{0g}^2 \cup \phi\phi\hat{\hat{E}}_d/\phi\phi\hat{\hat{c}}_{0\gamma}^2 \\ & & (\text{in } \phi\phi\hat{\hat{c}}_{0g}\phi\phi\hat{\hat{t}} \cup \phi\phi\hat{\hat{c}}_{0\gamma}\phi\phi\hat{\hat{t}}) \end{array}\right\} \quad (16)$$

where c_{0g} is a static (or gravitational) co-moving speed; $c_{0\gamma}$ is a dynamical co-moving speed; ϕc_{0g} is an intrinsic static (or gravitational) co-moving speed; $\phi c_{0\gamma}$ is an intrinsic dynamical co-moving speed; $\phi\hat{c}_{0g}$ is an absolute intrinsic static (or gravitational) co-moving speed; $\phi\phi\hat{\hat{c}}_{0\gamma}$ is an absolute-absolute intrinsic-intrinsic dynamical co-moving speed; etc and $E = mc_0^2$; $E_g = m_g c_{0g}^2$; $E_d = m_d c_{0\gamma}^2$; $\phi E = \phi m \phi c_0^2$; $\phi\phi\hat{\hat{E}} = \phi\phi\hat{\hat{m}}_0\phi\phi\hat{\hat{c}}_0^2$; $\phi\phi\hat{\hat{E}}_g = \phi\phi\hat{\hat{m}}_{0g}\phi\phi\hat{\hat{c}}_{0g}^2$; etc.

The notations in system (16) are the natural notations. However just as the natural notations in system (10) for the hierarchies of time dimensions/intrinsic time dimensions are replaced by those in system (11) for aesthetics and in order to be consistent with the usual notations ct' and ct for the time dimensions in physics, the natural notations in system (16) shall be simplified as follows for the same reasons

$$\left.\begin{array}{lcl} E/c^2 & = & E_g/c_g^2 \cup E_d/c_\gamma^2 \quad (\text{in } c_g t \cup c_\gamma t) \\ \phi E/\phi c^2 & = & \phi E_g/\phi c_g^2 \cup \phi E_d/\phi c_\gamma^2 \\ & & (\text{in } \phi c_g \phi t \cup \phi c_\gamma \phi t) \\ E'/c^2 & = & E'_g/c_g^2 \cup E'_d/c_\gamma^2 \quad (\text{in } c_g t' \cup c_\gamma t') \\ \phi E'/\phi c^2 & = & \phi E'_g/\phi c_g^2 \cup \phi E'_d/\phi c_\gamma^2 \\ & & (\text{in } \phi c_g \phi t' \cup \phi c_\gamma \phi t') \\ \hat{E}/\hat{c}^2 & = & \hat{E}_g/\hat{c}_g^2 \cup \hat{E}_d/\hat{c}_\gamma^2 (\text{in } \hat{c}_g\hat{t} \cup \hat{c}_\gamma\hat{t}) \\ \phi\hat{E}/\phi\hat{c}^2 & = & \phi\hat{E}_g/\phi\hat{c}_g^2 \cup \phi\hat{E}_d/\phi\hat{c}_\gamma^2 \\ & & (\text{in } \phi\hat{c}_g\phi\hat{t} \cup \phi\hat{c}_\gamma\phi\hat{t}) \\ \hat{\hat{E}}/\hat{\hat{c}}^2 & = & \hat{\hat{E}}_g/\hat{\hat{c}}_g^2 \cup \hat{\hat{E}}_d/\hat{\hat{c}}_\gamma^2 \quad (\text{in } \hat{\hat{c}}_g\hat{\hat{t}} \cup \hat{\hat{c}}_\gamma\hat{\hat{t}}) \\ \phi\phi\hat{\hat{E}}/\phi\phi\hat{\hat{c}}^2 & = & \phi\phi\hat{\hat{E}}_g/\phi\phi\hat{\hat{c}}_g^2 \cup \phi\phi\hat{\hat{E}}_d/\phi\phi\hat{\hat{c}}_\gamma^2 \\ & & (\text{in } \phi\phi\hat{\hat{c}}_g\phi\phi\hat{\hat{t}} \cup \phi\phi\hat{\hat{c}}_\gamma\phi\phi\hat{\hat{t}}) \end{array}\right\} \quad (17)$$

2.4 Compound spacetime and compound mass and gravitational spacetime and gravitational mass as metric spacetimes and metric masses and dynamical spacetime and dynamical mass as affine spacetime and affine mass

The terms 'metric' and 'affine' shall also be used loosely or literally to describe the compound spacetime and its constituents and the compound mass and its constituents. In this regard, the compound four-dimensional spacetime $(\Sigma\,,\,ct)$ is a metric spacetime, as well known. The four-dimensional gravitational spacetime $(\Sigma_g\,,\,c_g t)$ component of $(\Sigma\,,\,ct)$ is likewise a metric spacetime, while the four-dimensional dynamical spacetime $(\Sigma_d\,,\,c_\gamma\, t)$ component of $(\Sigma\,,\,ct)$ is an affine spacetime, where, as used here, 'metric' has the literal meaning of ponderable with respect to observers in the metric spacetime, while 'affine' has the loose meaning of non-ponderable with respect to these observers.

The compound absolute intrinsic spacetme (or absolute nospace-notime) $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ and the gravitational absolute intrinsic spacetime (or gravitational absolute nospace-notime) $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ are metric absolute intrinsic spacetimes (or metric absolute nospace-notimes), whereas the dynamical absolute intrinsic spacetime (or dynamical absolute nospace-notime) $(\phi\hat{\chi}\,,\,\phi\hat{c}_\gamma\,\phi\hat{t})$ is an affine absolute intrinsic spacetime (or affine absolute nospace-notime). Again 'metric' has the literal meaning of ponderable with respect to hypothetical absolute-intrinsic-rest-mass-observers in the metric absolute intrinsic spacetime, while 'affine' has the loose meaning of non-ponderable with respect to these hypothetical absolute-intrinsic-rest-mass-observers.

An absolute intrinsic metric theory with absolute intrinsic Riemannian spacetime geometry (Fig. 4 of Fig. 11 of [7] that becomes Fig. 5 of [9] in a gravitational field), can be formulated in terms of the absolute intrinsic coordinates of curved

metric compound absolute intrinsic spacetime $(\phi\hat{\rho}\,,\ \phi\hat{c}\phi\hat{t})$ and the coordinates of curved metric absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g\,,\ \phi\hat{c}_g\phi\hat{t})$, but not in terms of absolute intrinsic coordinates of the affine absolute intrinsic dynamical spacetime $(\phi\hat{\chi}\,,\ \phi\hat{c}_\gamma\,\phi\hat{t})$.

The compound proper intrinsic spacetime $(\phi\rho', \phi c\phi t')$ and the proper intrinsic gravitational spacetime $(\phi\rho'_g, \phi c_g\phi t')$ are metric intrinsic spacetimes, whereas the proper intrinsic dynamical spacetime $(\phi\chi', \phi c_\gamma\,\phi t')$ is an affine intrinsic spacetime. The compound relativistic intrinsic spacetime $(\phi\rho, \phi c\phi t)$ and the relativistic intrinsic gravitational spacetime $(\phi\rho_g, \phi c_g\phi t)$ are metric intrinsic spacetimes, whereas the relativistic intrinsic dynamical spacetime $(\phi\chi, \phi c_\gamma\,\phi t)$ is an affine intrinsic spacetime.

The compound mass m in the metric compound Euclidean 3-space Σ and the gravitational mass component m_g in the metric gravitational 3-space Σ_g are metric masses, (that is, ponderable mass with respect to observers in the metric spaces Σ or Σ_g), while the dynamical mass m_d and the equivalent electromagnetic mass m_{em} in the case of the equivalent mass of electrostatic energy stored within a macroscopic object with net electric charge and m_{e} in the case of the electron with unit electric charge, in the affine dynamical 3-space Σ_d are affine masses, (that is, non-ponderable mass with respect to observers in the metric space Σ).

The compound absolute intrinsic rest mass (or compound absolute nomass) $\phi\hat{m}_0$ in the metric compound absolute intrinsic space $\phi\hat{\rho}$ and its absolute intrinsic gravitational rest mass component $\phi\hat{m}_{0g}$ in the metric absolute intrinsic gravitational space $\phi\hat{\rho}_g$, are metric absolute intrinsic rest masses, whereas the absolute intrinsic dynamical rest mass $\phi\hat{m}_{0d}$ and equivalent absolute intrinsic electromagnetic rest mass $\phi\hat{m}_{0\mathsf{em}}$ and $\phi\hat{m}_{0\mathsf{e}}$ in the case of the electron, in the affine absolute intrinsic dynamical space $\phi\hat{\chi}$, are affine absolute intrinsic rest masses.

The compound intrinsic rest mass (or compound proper nomass) ϕm_0 in the metric compound proper intrinsic space $\phi\rho'$ and its intrinsic gravitational rest mass component ϕm_{0g} in the metric proper gravitational intrinsic space $\phi\rho'_g$, are metric intrinsic rest masses, whereas the intrinsic dynamical rest mass ϕm_{0d}, $\phi m_{0\mathsf{em}}$ and $\phi m_{0\mathsf{e}}$ in the case of the electron, in the affine proper intrinsic dynamical space (or affine proper dynamical nospace) $\phi\chi'$, are affine intrinsic rest masses.

The compound relativistic intrinsic mass ϕm in the metric compound relativistic intrinsic space $\phi\rho$ and its intrinsic gravitational relativistic mass component ϕm_g in the metric relativistic gravitational intrinsic space $\phi\rho_g$, are metric intrinsic masses, whereas the dynamical relativistic intrinsic mass ϕm_d and relativistic equivalent intrinsic electromagnetic mass ϕm_{em} and ϕm_{e} in the case of the electron, in the affine dynamical relativistic intrinsic space, are affine intrinsic masses.

Although the special theory of relativity involves the affine dynamical mass m_d of a particle in the affine dynamical spacetime $(\Sigma_d, c_\gamma\,t)$ naturally, the motion of m_d in Σ_d drags the gravitational mass m_g of the particle in Σ_g along. Consequently the special theory of relativity (SR) is observed as motion of the metric compound mass m in the mixed spacetime $(\Sigma, c_\gamma\,t)$, the static (or gravitational) time dimension $c_g t$ being absolute (and hence not a dimension) in the context of SR. Likewise the theory of gravitational relativity (TGR) on flat four-dimensional spacetime, started within a long range metric force field in [8] and adapted to the gravitational field in [9], which shall be revisited elsewhere, involves the metric compound mass in the mixed spacetime $(\Sigma, c_g t)$, the dynamical time dimension $c_\gamma t$ being absolute (and hence not a dimension) in the context of TGR.

Electric and magnetic fields exist and propagate in the affine dynamical spacetime $(\Sigma_d, c_\gamma\,t)$ naturally. However as electric field and magnetic field propagate in Σ_d, they are observed in the compound 3-space Σ. Hence electromagnetism and the theory of propagation of electromagnetic waves involve the mixed spacetime $(\Sigma, c_\gamma\,t)$. Likewise gravitational field $\vec{g}$ exists in the gravitational spacetime $(\Sigma_g, c_g t)$ naturally, but is observed in the mixed spacetime $(\Sigma, c_g t)$.

Thus the splitting of the compound time dimension ct into the dynamical time dimension $c_\gamma\,t$ and the static (or gravitational) time dimension $c_g t$ is all that shall be required in the non-gravitational and gravitational laws. All the laws involve the compound 3-space Σ, the compound masses m of particles and bodies and other compound physical parameters. The validity of this fact shall with further development of the present evolving theory.

Now let the metric gravitational mass m_g of a given shape of a body occupy a volume V of the metric gravitational Euclidean 3-space Σ_g. Then the affine dynamical mass m_d of the same magnitude and shape as the gravitational mass m_g of the body, occupies equal volume V of affine dynamical Euclidean 3-space Σ_d. However any magnitude of affine dynamical mass m_d in affine dynamical space Σ_d is equivalent to zero magnitude of metric gravitational mass m_g in the metric gravitational space Σ_g. Moreover any volume V of the affine dynamical Euclidean 3-space Σ_d corresponds to zero volume of the metric gravitational Euclidean 3-space Σ_g. It then follows that the affine dynamical mass m_d of any shape occupying any volume V of affine dynamical space Σ_d of a body is effectively a mass-point of zero metric mass at the centroid of the metric gravitational mass m_g of the body in the metric gravitational Euclidean 3-space Σ_g. The body thereby possesses a composite mass $m = m_g \cup m_d$, in the compound Euclidean 3-space Σ with respect to 3-observers in Σ, as illustrated in Fig. 1(a).

Alternatively the affine dynamical mass m_d occupying volume V of affine dynamical space Σ_d can be considered as wholly embedded in the metric gravitational mass m_g occupying equal volume of the metric gravitational space Σ_g, so that m_d and m_g become two-in-one entity in a volume V of the compound Euclidean 3-space Σ, as illustrated in Fig. 1(b).

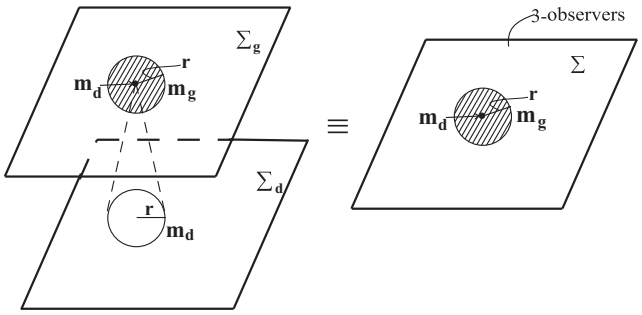

Fig. 1: (a)

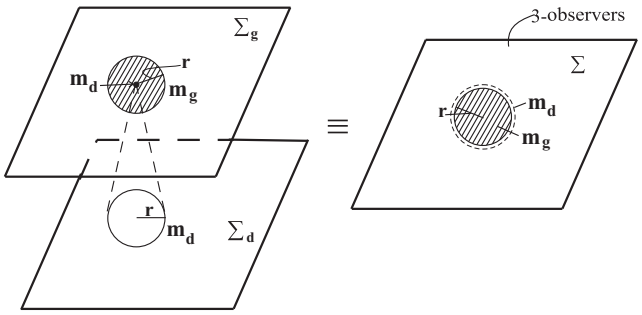

Fig. 1: (b)

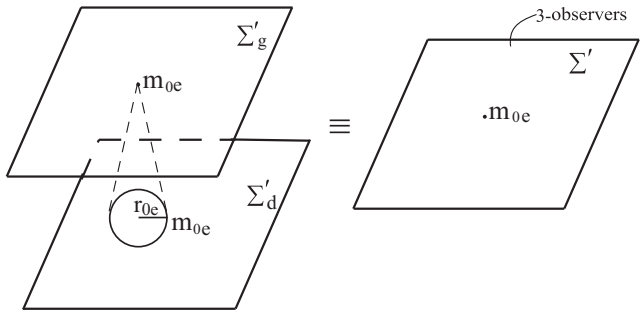

Fig. 1: (c)

The fact that m_g and m_d have equal density is clear from Fig. 1(b), but not from the effective Fig. 1(a).

It is important to note that the weight of the compound mass $m = m_g \cup m_d$ in an external gravitational field is the weight of its metric gravitational mass (the "heavy mass") m_g solely, since its affine dynamical mass (the "light mass") m_d does not interact with gravitational field and hence does not translate into weight of the body in an external gravitational field, as mentioned earlier.

The affine dynamical mass is not a source of metric gravitational field. Thus a particle with dynamical rest mass but zero gravitational rest mass is not a gravitational field source. A particle with this attribute is the electron (and its anti-particle). As discussed earlier (in the paragraph leading to Eq. (14)), the electron (and its anti-particle) possesses equivalent electromagnetic rest mass $m_{0\mathrm{e}} = \mathrm{e}^2/4\pi\epsilon_\circ r_{0\mathrm{e}} c_\gamma^2$, but zero gravitational rest mass. The electron and its anti-particle are therefore not gravitational field sources. They are however electrostatic field sources by virtue of their unit electric charge $-$e and $+$e.

Although the electron possesses equivalent electromagnetic rest mass $m_{0\mathrm{e}} \approx 1.09 \times 10^{-31}\,\mathrm{kg}$ (0.511 MeV), and occupies a sphere of radius $r_{0\mathrm{e}} \approx 2.8 \times 10^{-15}\,\mathrm{m}$ of the affine proper dynamical Euclidean 3-space Σ'_d, it is a point particle (of zero extension), possessing zero metric rest mass (thereby being structure-less) in the metric compound proper Euclidean 3-space Σ', as illustrated in Fig. 1(c). Associated with the point-particle electron (occupying a point of zero extension) of the metric compound proper Euclidean 3-space Σ' are unit electric charge $-$e, intrinsic classical radius $r_{0\mathrm{e}}$, intrinsic rest mass $m_{0\mathrm{e}}$, intrinsic spin $\pm\hbar/2$ and other intrinsic particle properties.

Now a macroscopic electric charge Q, which is hypothetically dissociated from a material particle or object, possesses zero metric gravitational mass. It therefore possesses zero gravitational attribute and zero inertial attribute. Being an aggregate number of electrons, it will occupy a volume V of affine dynamical space Σ_d but zero volume of metric compound space Σ. Consequently it will occupy a point of zero extension in Σ like the electron. However it does not possess the attributes of a particle like the electron. A macroscopic charge assumed not attached to a material particle or object possesses zero passive gravitational mass and cannot interact with an external gravitational field. It is yet to be settled however whether the electron with unit electric charge not attached to a metric mass will, by virtue of its particulate nature, interact with an external gravitational field, and thereby possess weight in an external gravitational field and be attracted radially towards a central body.

It shall be shown elsewhere with further development that the Lorentz-Einstein-Minkowski special theory of relativity (LEM), being a theory in the affine dynamical spacetime $(\Sigma_d,\ c_\gamma t)$ naturally, is valid, in a strict sense, for the relative motion in a spacetime that is devoid of the metric gravitational field, of a particle that is not a gravitational field source. In other words, LEM shall be shown to be valid for the electron (and its anti-particle) in a gravity-free space. The modified for of LEM when the electron is in relative motion in an external gravitational field and when a material particle or body with metric compound mass, which is hence a gravitational field source, is in relative motion within and outside an external gravitational field shall be derived elsewhere with further development.

Finally, the gravitational potential $\Phi(r)$ and gravitational field $\vec{g}$ are metric gravitational parameters resident in the metric gravitational space Σ_g, which are but observed in the metric compound space Σ. The energy stored in gravitational field $-2GM_0^2/r'$ within a spherical region of Σ' of radius r'

that is concentric with the rest mass M_0 of a gravitational field source, is likewise a metric energy in the metric gravitational Euclidean 3-space Σ'_g. Consequently the mass-equivalent of the gravitational energy $M_0\text{eq} = 2GM_0/r'c_g^2$ is a metric equivalent mass in Σ'_g and Σ'.

On the other hand, the electric field $\vec{E}$ and the magnetic field $\vec{B}$ are affine force fields resident in the affine dynamical space Σ_d, which are but observed in the metric compound Euclidean 3-space Σ. The energy stored in electrostatic field $q^2/4\pi\epsilon_\circ r'$ or in uniform electric field $\epsilon_\circ|\vec{E}'|^2V'$ and uniform magnetic field $|\vec{B}'|^2V'/\mu_\circ$ are affine energy in Σ_d. The mass-equivalent $m_0\text{eq} = q^2/4\pi\epsilon_\circ r'c_\gamma^2$, or $m_0\text{eq} = \epsilon_\circ|\vec{E}|^2V'/c_\gamma^2$ and $m_0\text{eq} = |\vec{B}'|^2V'/\mu_\circ c_\gamma^2$ are affine equivalent masses in Σ_d.

3 Incorporating the maximum gravitational speed (of gravitational waves) into the theory of gravitational relativity (TGR) and metric theory of absolute intrinsic gravity (ϕMAG)

The factors $\gamma_g(r')$ and $\beta_g(r')$ that appear in the theory of gravitational relativity (TGR) have been written in terms of gravitational speed $V_g(r')$ and the only known speed of signals in physics until now, which is the speed of light in vacuo c as, $\gamma_g(r') = (1 - V_g(r')^2/c^2)^{-1/2}$ and $\beta_g(r') = V_g(r')/c$, in section 2 of [9] and the components of the absolute intrinsic metric tensor $\phi\hat{g}_{ij}$ of the metric theory of absolute intrinsic gravity (ϕMAG) on curved 'two-dimensional' absolute intrinsic metric spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ with respect to 3-observers in the underlying Euclidean 3-space Σ', have been written in terms of absolute intrinsic gravitational speed $\phi\hat{V}_g(\phi\hat{r})$ and absolute intrinsic speed of light $\phi\hat{c}$ as, $\phi\hat{g}_{00} = -1/\phi\hat{g}_{11} = (1 - \phi\hat{V}_g(\phi\hat{r})^2/\phi\hat{c}^2)$, in section 3 of that paper. These are the best that could be done in [9], since the fact that the speed c is composed of the gravitational speed c_g (of gravitational waves) and dynamical speed c_γ (of electromagnetic waves), found in this paper was yet unknown in [9].

It shall now be shown that it is the gravitational speed c_g that must appear in the factors $\gamma_g(r')$ and $\beta_g(r')$ as, $\gamma_g(r') = (1 - V_g(r')^2/c_g^2)^{-1/2}$ and $\beta_g(r') = V_g(r')/c_g$ and it is the absolute intrinsic gravitational speed $\phi\hat{c}_g$ that must appear in $\phi\hat{g}_{ij}$ as, $\phi\hat{g}_{00} = -1/\phi\hat{g}_{11} = (1 - \phi\hat{V}_g(\phi\hat{r})^2/\phi\hat{c}_g^2)$. The fact that the numerator and denominator in $V_g(r')/c_g$ are homogeneous in gravitational speeds is to be expected.

Let us assume that the flat absolute gravitational spacetime $(\hat{\Sigma}_g, \hat{c}_g\hat{t})$ containing the absolute gravitational rest mass $(\hat{M}_{0g}, \hat{E}_g/\hat{c}_g^2)$; $\hat{E}_g = \hat{M}_{0g}\hat{c}_g^2$, of a gravitational field source and the underlying flat absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ containing the absolute intrinsic gravitational rest mass $(\phi\hat{M}_{0g}, \phi\hat{E}_g/\phi\hat{c}_g^2)$; $\phi\hat{E}_g = \phi\hat{M}_{0g}\phi\hat{c}_g^2$ of the gravitational field source, are separated from the flat absolute dynamical spacetime $(\hat{\Sigma}_d, c_\gamma\,\hat{t})$ containing the absolute dynamical rest mass $(\hat{M}_{0d}, \hat{E}_d/\hat{c}_\gamma^2)$; $\hat{E}_d = \hat{M}_{0d}\hat{c}_\gamma^2$, of the gravitational field source and its underlying flat absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\phi\hat{t})$ containing the absolute intrinsic dynamical rest mass $(\phi\hat{M}_{0d}, \phi\hat{E}_d/\phi\hat{c}_\gamma^2)$; $\phi\hat{E}_d = \phi\hat{M}_{0d}\phi\hat{c}_\gamma^2$ of the field source, as illustrated in Figs. 2(a) and 2(b).

The absolute gravitational field source establishes non-uniform absolute gravitational speeds $\hat{V}_g(\hat{r})$ in both the absolute gravitational spacetime $(\hat{\Sigma}_g, \hat{c}_g\hat{t})$ and the absolute dynamical spacetime $(\hat{\Sigma}_d, c_\gamma\,\hat{t})$. It also establishes non-uniform absolute intrinsic gravitational speeds $\phi\hat{V}_g(\phi\hat{r})$ in the absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ and absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\phi\hat{t})$, as also illustrated in Fig. 2(a) and 2(b).

The artificially separated Figs. 2(a) and 2(b) will exist just at the instant the absolute gravitational field source is introduced into the otherwise empty flat absolute spacetime and its underlying empty flat absolute intrinsic spacetime. However after this instant, the non-uniform absolute intrinsic gravitational speeds $\phi\hat{V}_g(\phi\hat{r})$ established on the flat absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ in Fig. 2(a) will cause $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ to become curved, thereby converting Fig. 2(a) to Fig. 3(a), in the context of the theory of absolute intrinsic gravity (ϕAG) in absolute intrinsic spacetime, a theory that is yet to be fully developed. Never the less the evolution of the geometry of Fig. 3(a) from the reference geometry of Fig. 2(a) has been explained within a long-range metric force field in general in [8] and adapted to the gravitational field in [9].

On the other hand, the establishment of non-uniform absolute intrinsic gravitational speeds $\phi\hat{V}_g(\phi\hat{r})$ on the flat affine absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\phi\hat{t})$ in Fig. 2(b) cannot give rise to curvature of $(\phi\hat{\chi}, \phi\hat{c}_\gamma\phi\hat{t})$. Only absolute intrinsic dynamical speed $\phi\hat{V}_d$ can cause the curvature of the absolute intrinsic dynamical spacetime (with uniform curvature in the case of a uniform $\phi\hat{V}_d$), in the context of the theory of absolute intrinsic motion (ϕAM) in absolute intrinsic spacetime, yet to be developed.

If indeed the metric gravitational spacetime/intrinsic gravitational spacetime and metric gravitational mass/intrinsic gravitational mass were decoupled from the affine dynamical spacetime/intrinsic dynamical spacetime and affine dynamical mass/intrinsic dynamical mass in nature, as illustrated in Figs. 2(a) and 2(b), then the reference geometry of Fig. 2(a) will endure for no moment before evolving into the geometry of Fig. 3(a) at the first stage of evolutions of spacetime/intrinsic spacetime and mass/intrinsic mass in a gravitational field, while the reference geometry of Fig. 2(b) will remain unchanged, as illustrated between figs. 2(b) and Fig. 3(b).

However the gravitational spacetime/intrinsic gravitational spacetime and gravitational mass/intrinsic gravitational mass are never separated from the dynamical spacetime/intrinsic dynamical spacetime and dynamical mass/intrinsic

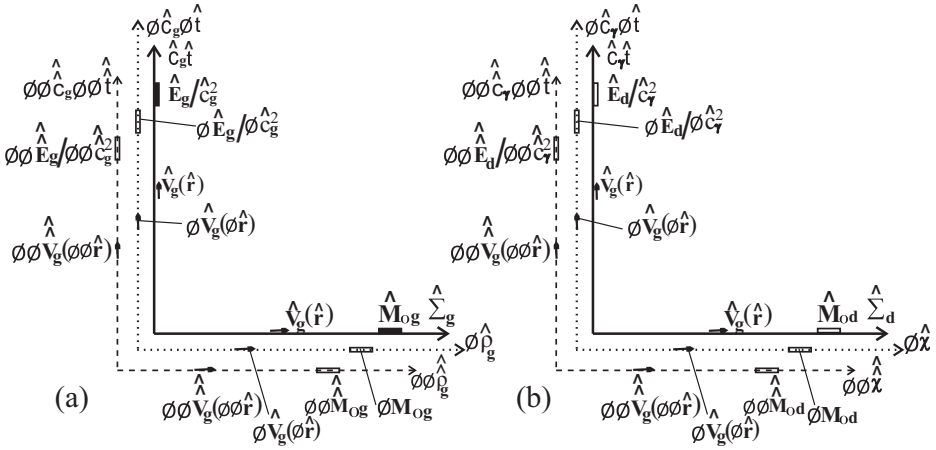

Fig. 2:

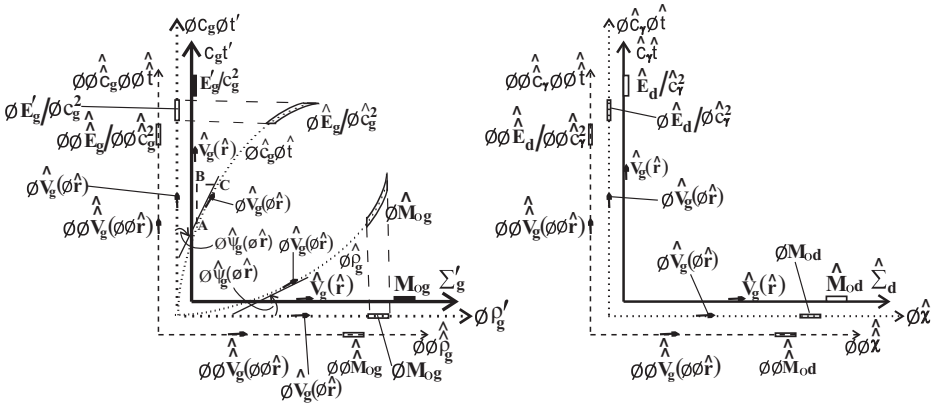

Fig. 3:

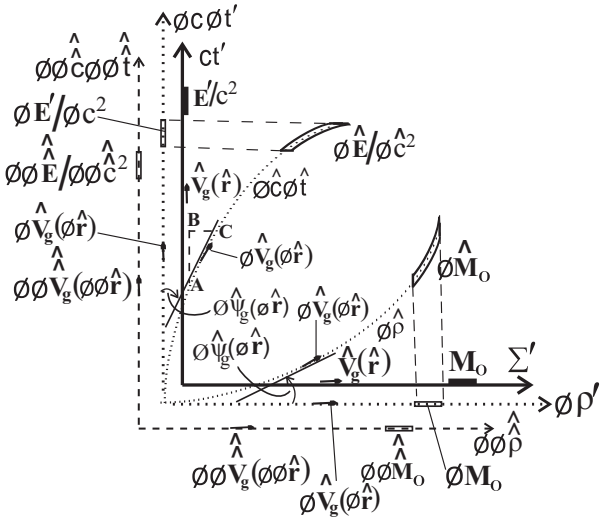

Fig. 4:

mass in nature. Rather the dynamical is inseparably embedded in the gravitational always. A consequence of this is that the affine absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\phi\hat{t})$ is curved along with the metric absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$, thereby yielding a curved 'two-dimensional' metric compound absolute intrinsic spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$, containing the metric compound absolute intrinsic rest mass $(\phi\hat{M}_0, \phi\hat{E}/\phi\hat{c}^2)$; $\phi\hat{E} = \phi\hat{M}_0\phi\hat{c}^2$, at the first stage of evolutions of spacetime/intrinsic spacetime and mass/intrinsic mass in a gravitational field, as illustrated in Fig. 4.

Although the curved metric compound absolute intrinsic spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ containing the metric compound absolute intrinsic rest mass $(\phi\hat{M}_0, \phi\hat{E}/\phi\hat{c}^2)$ of the gravitational field source and the flat metric compound proper intrinsic spacetime $(\phi\rho', \phi c\phi t')$ containing the metric compound intrinsic rest mass $(\phi M_0, \phi E'/\phi c^2)$ and the flat metric compound proper spacetime (Σ', ct') containing the metric compound rest mass $(M_0, E'/c^2)$ of the gravitational field source, evolve at the first stage of evolutions of spacetime/intrinsic spacetime and mass/intrinsic mass in a gravitational field in the geometry of Fig. 4, as has been the case in all such diagrams in the previous papers [7-9] and up to this point in this paper, it must now be known that it is the metric absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ that is actually curved due to the establishment of non-uniform absolute gravitational speeds $\hat{V}_g(\hat{r})$ in absolute spacetime and non-uniform absolute intrinsic gravitational speeds $\phi\hat{V}_g(\phi\hat{r})$ in absolute intrinsic spacetime in gravitational field and not the affine absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$. It is due to the fact that $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$ is inseparably embedded in $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ that $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$ is curved along with $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$, thereby constituting curved compound absolute intrinsic spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ in Fig. 4.

Recalling the isolation of the concept of absolute intrinsic static speed $\phi\hat{V}_s$ from Figs. 10(a) and 10(b) of [7], which is the absolute intrinsic gravitational speed $\phi\hat{V}_g(\phi\hat{r})$ in Fig. 5 of [9] and Figs. 2(a), 3(a) and 4 here, the sine of the absolute intrinsic angle $\phi\hat{\psi}_g(\phi\hat{r})$ is related to the hypothenuse AC and opposite side BC of the absolute intrinsic angle $\phi\hat{\psi}_g(\phi\hat{r})$ in the triangle ABC in Fig. 3(a) as follows

$$\sin\phi\hat{\psi}_g(\phi\hat{r}) = \frac{d\phi\hat{\rho}}{\phi\hat{c}_g d\phi\hat{t}} = \frac{\phi\hat{V}_g(\phi\hat{r})}{\phi\hat{c}_g} \tag{18}$$

where

$$\frac{d\phi\hat{\rho}}{d\phi\hat{t}} = \phi\hat{V}_g(\phi\hat{r}) \tag{19}$$

As mentioned in the penultimate paragraph, the geometry of Fig. 3(a) is established by virtue of non-uniform absolute intrinsic gravitational speeds in absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$, assumed decoupled from the absolute intrinsic dynamical spacetime $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$ and relation (18) holds for Fig. 3(a). Even when $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$ is allowed to be curved along with $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ in Fig. 4, as happens naturally, relation (18) holds as well. This is so because the curvature of $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ in Fig. 3(a) is unchanged in Fig. 4 upon incorporating the curved $(\phi\hat{\chi}, \phi\hat{c}_\gamma\hat{t})$.

Having shown that relation (18) derived for curved metric absolute intrinsic gravitational spacetime $(\phi\hat{\rho}_g, \phi\hat{c}_g\phi\hat{t})$ in Fig. 3(a) is equally valid for the curved metric compound absolute intrinsic spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ in Fig. 4, then the factor $\cos^2\phi\hat{\psi}_g(\phi\hat{r}) = 1 - \phi\hat{V}_g(\phi\hat{r})^2/\phi\hat{c}^2$, which appears in the absolute intrinsic line element of the metric theory of absolute intrinsic gravity (ϕMAG) in section 3 of [9], must be corrected as $\cos^2\phi\hat{\psi}_g(\phi\hat{r}) = 1 - \phi\hat{V}_g(\phi\hat{r})^2/\phi\hat{c}_g^2$. Thus the absolute intrinsic line element of ϕMAG in empty space at the exterior of one gravitational field source derived in section 3 of [9] must be corrected as follows

$$\begin{aligned} d\phi\hat{s}^2 &= (1 - \frac{\phi\hat{V}_g(\phi\hat{r})}{\phi\hat{c}_g^2})\phi\hat{c}^2 d\phi\hat{t}^2 \\ &\quad -(1 - \frac{\phi\hat{V}_g(\phi\hat{r})}{\phi\hat{c}_g^2})^{-1} d\phi\hat{\rho}^2 \end{aligned} \tag{20}$$

or

$$\begin{aligned} d\phi\hat{s}^2 &= (1 - \frac{2G\phi\hat{M}_0}{\phi\hat{r}\phi\hat{c}_g^2})\phi\hat{c}^2 d\phi\hat{t}^2 \\ &\quad -(1 - \frac{2G\phi\hat{M}_0}{\phi\hat{r}\phi\hat{c}_g^2})^{-1} d\phi\hat{\rho}^2 \end{aligned} \tag{21}$$

The metric compound elementary absolute intrinsic spacetime coordinate intervals $d\phi\hat{\rho}$ and $\phi\hat{c}d\phi\hat{t}$ have appeared in the absolute intrinsic line element because it is the compound absolute intrinsic spacetime $(\phi\hat{\rho}, \phi\hat{c}\phi\hat{t})$ that is curved (in the final geometry of Fig. 4) in a gravitational field. If the gravitational spacetime/intrinsic spacetime and the dynamical spacetime/intrinsic spacetime were separated in nature, so that Fig. 3(a) obtained, then it is $d\phi\hat{\rho}_g$ and $\phi\hat{c}_g d\phi\hat{t}$ that should have appeared in the absolute intrinsic line element of ϕMAG (20) or (21).

The absolute intrinsic metric tensor and absolute intrinsic Ricci tensor of ϕMAG must likewise be corrected as follows

$$\phi\hat{g}_{ij} = \begin{pmatrix} 1 - \frac{\phi\hat{V}_g(\phi\hat{r})^2}{\phi\hat{c}_g^2} & 0 \\ 0 & -(1 - \frac{\phi\hat{V}_g(\phi\hat{r})^2}{\phi\hat{c}_g^2})^{-1} \end{pmatrix} \tag{22}$$

$$= \begin{pmatrix} 1 - \frac{2G\phi\hat{M}_0}{\phi\hat{r}\phi\hat{c}_g^2} & 0 \\ 0 & -(1 - \frac{2G\phi\hat{M}_0}{\phi\hat{r}\phi\hat{c}_g^2})^{-1} \end{pmatrix} \tag{23}$$

and

$$\phi\hat{R}_{ij} = \begin{pmatrix} -\frac{\phi\hat{V}_g(\phi\hat{r})^2}{\phi\hat{c}_g^2} & 0 \\ 0 & -\frac{\phi\hat{V}_g(\phi\hat{r})^2/\phi\hat{c}_g^2}{1-\frac{\phi\hat{V}_g(\phi\hat{r})^2}{\phi\hat{c}_g^2}} \end{pmatrix} \quad (24)$$

$$= \begin{pmatrix} -\frac{2G\phi\hat{M}_0}{\phi\hat{r}\phi\hat{c}_g^2} & 0 \\ 0 & -\frac{2G\phi\hat{M}_0/\phi\hat{r}\phi\hat{c}_g^2}{1-2G\phi\hat{M}_0/\phi\hat{r}\phi\hat{c}_g^2} \end{pmatrix} \quad (25)$$

The absolute intrinsic line element, absolute intrinsic metric tensor and absolute intrinsic Ricci tensor of ϕMAG are in their final forms in Eqs. (20) – (25), except that the absolute intrinsic rest mass $\phi\hat{M}_0$ that appears in them shall be replaced by absolute intrinsic active gravitational mass, to be denoted by $\phi\hat{M}_{0\mathsf{a}}$ elsewhere with further development.

It is likewise the metric gravitational proper intrinsic spacetime $(\phi\rho_g', \phi c_g \phi t')$ that is actually curved due to the establishment of non-uniform proper intrinsic gravitational speeds $\phi V_g'(\phi r')$ on an initially flat compound proper intrinsic metric spacetime $(\phi\rho', \phi c\phi t')$ in a gravitational field. It is due to the fact that gravitational spacetime/intrinsic spacetime and dynamical spacetime/intrinsic spacetime cannot be separated that the affine dynamical proper intrinsic spacetime $(\phi\chi', \phi c_\gamma \phi t')$ is curved along with $(\phi\rho_g', \phi c_g\phi t')$, thereby yielding a curved metric compound proper intrinsic spacetime $(\phi\rho', \phi c\phi t')$ in Figs. 7 and 8 of [9] (or in the partial diagram at the right-hand side in Fig. 13(c) of part one of this paper [10]), at the second stage of evolutions of spacetime/intrinsic spacetime and mass/intrinsic mass in a gravitational field. It thus follows that the sine of the intrinsic angle $\phi\psi_g(\phi r')$ in Figs. 7 and 8 of [9] must be expressed in terms of intrinsic gravitational speeds $\phi V_g'(\phi r')$ and ϕc_g as $\sin\phi\psi_g(\phi r') = \phi V_g'(\phi r')/\phi c_g$.

Thus the intrinsic curvature parameter $\phi V_g'(\phi r')/\phi c$ that appears in the gravitational intrinsic local Lorentz transformation (ϕGLLT) and its inverse and in gravitational intrinsic time dilation and gravitational intrinsic length contraction formulae in the context of intrinsic theory of gravitational relativity (ϕTGR) in section 2 of [9], must be replaced by $\phi V_g'(\phi r')/\phi c_g$. The ϕGLLT and its inverse and intrinsic gravitational time dilation and intrinsic gravitational length contraction formulae of ϕTGR shall be re-written while implementing this correction respectively as follows

$$\left.\begin{aligned} d\phi t' &= \phi\gamma_g(\phi r')(d\phi t - \frac{\phi V_g(\phi r')}{\phi c_g^2}\, d\phi\rho) \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \\ d\phi\rho' &= \phi\gamma_g(\phi r')(d\phi\rho - \phi V_g(\phi r')\, d\phi t) \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \end{aligned}\right\} \quad (26)$$

and

$$\left.\begin{aligned} d\phi t &= \phi\gamma_g(\phi r')(d\phi t' + \frac{\phi V_g(\phi r')}{\phi c_g^2}\, d\phi\rho') \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \\ d\phi\rho &= \phi\gamma_g(\phi r')(d\phi\rho' + \phi V_g(\phi r')\, d\phi t') \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \end{aligned}\right\} \quad (27)$$

$$d\phi t = \phi\gamma_g(\phi r')d\phi t' = (1-\frac{\phi V_g'(\phi r')^2}{\phi c_g^2})^{-1/2} d\phi t' \quad (28)$$

and

$$d\phi\rho = \phi\gamma_g(\phi r')^{-1} d\phi\rho' = (1-\frac{\phi V_g'(\phi r')^2}{\phi c_g^2})^{1/2} d\phi\rho' \quad (29)$$

And by using the relation $\phi V_g'(\phi r')^2 = 2G\phi M_0/\phi r'$, established in [9], Eqs. (26)– (29) become the following respectively

$$\left.\begin{aligned} d\phi t' &= \phi\gamma_g(\phi r')(d\phi t - \sqrt{\frac{2G\phi M_0}{\phi r'\phi c_g^4}}\, d\phi\rho) \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \\ d\phi\rho' &= \phi\gamma_g(\phi r')(d\phi\rho - \sqrt{\frac{2G\phi M_0}{\phi r'}}\, d\phi t) \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \end{aligned}\right\} \quad (30)$$

and

$$\left.\begin{aligned} d\phi t &= \phi\gamma_g(\phi r')(d\phi t' + \sqrt{\frac{2G\phi M_0}{\phi r'\phi c_g^4}}\, d\phi\rho') \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \\ d\phi\rho &= \phi\gamma_g(\phi r')(d\phi\rho' + \sqrt{\frac{2G\phi M_0}{\phi r'}}\, d\phi t') \\ &\quad (\text{w.r.t. } 3-\text{observers in } ct) \end{aligned}\right\} \quad (31)$$

$$d\phi t = d\phi t'(1-\frac{2G\phi M_0}{\phi r'\phi c_g^2})^{-1/2} \quad (32)$$

and

$$d\phi\rho = d\phi\rho'(1-\frac{2G\phi M_0}{\phi r'\phi c_g^2})^{1/2} \quad (33)$$

Equations (26) – (33) obtain in the context of the intrinsic theory of gravitational relativity (ϕTGR) on flat two-dimensional relativistic intrinsic metric spacetime $(\phi\rho, \phi c\phi t)$. Their outward manifestations on flat relativistic four-dimensional spacetime in the context of the theory of gravitational relativity (TGR) are given by removing the symbol ϕ as follows

$$\left.\begin{aligned} dt' &= \gamma_g(r')(dt - \frac{V_g(r')}{c_g^2}\, dr); \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \\ dr' &= \gamma_g(r')(dr - V_g(r')\, dt); \\ &\quad r'd\theta' = rd\theta;\ r'\sin\theta' d\varphi' = r\sin\theta d\varphi; \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \end{aligned}\right\} \quad (34)$$

$$\left.\begin{aligned} dt &= \gamma_g(r')(dt' + \frac{V_g(r')}{c_g^2}\,dr'); \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \\ dr &= \gamma_g(r')(dr' + V_g(r')\,dt'); \\ &\quad r d\theta = r' d\theta';\ r\sin\theta d\varphi = r'\sin\theta' d\varphi'; \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \end{aligned}\right\} \quad (35)$$

and

$$dt = (1 - \frac{V_g'(r')^2}{c_g^2})^{-1/2}\,dt' \quad (36)$$

$$dr = (1 - \frac{V_g'(r')^2}{c_g^2})^{1/2}\,dr';\ r d\theta = r' d\theta';\ r\sin\theta d\varphi = r'\sin\theta' d\varphi' \quad (37)$$

or

$$\left.\begin{aligned} dt' &= \gamma_g(r')(dt - \sqrt{\frac{2GM_0}{r' c_g^4}}\,dr); \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \\ dr' &= \gamma_g(r')(dr - \sqrt{\frac{2GM_0}{r'}}\,dt); \\ &\quad r' d\theta' = r d\theta;\ r'\sin\theta' d\varphi' = r\sin\theta d\varphi; \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \end{aligned}\right\} \quad (38)$$

$$\left.\begin{aligned} dt &= \gamma_g(r')(dt' + \sqrt{\frac{2GM_0}{r' c_g^4}}\,dr'); \\ &\quad (\text{w.r.t. } 3-\text{observers in } \Sigma) \\ dr &= \gamma_g(r')(dr' + \sqrt{\frac{2GM_0}{r'}}\,dt'); \\ &\quad r d\theta = r' d\theta';\ r\sin\theta d\varphi = r'\sin\theta' d\varphi'; \\ &\quad (\text{w.r.t. } 1-\text{observers in } ct) \end{aligned}\right\} \quad (39)$$

and

$$dt = (1 - \frac{2GM_0}{r' c_g^2})^{-1/2}\,dt' \quad (40)$$

$$dr = (1 - \frac{2GM_0}{r' c_g^2})^{1/2}\,dr';\ r d\theta = r' d\theta';\ r\sin\theta d\varphi = r'\sin\theta' d\varphi' \quad (41)$$

Equations (26) – (41) are in their final forms, except that the intrinsic rest mass ϕM_0 that appears in the definition $\phi V_g'(\phi r')^2 = 2G\phi M_0/\phi r'$ in Eqs. (30) – (33) shall be replaced by active gravitational intrinsic mass, to be denoted by $\phi M_{0\mathsf{a}}$ and the rest mass that appears in the definition $V_g'(r')^2 = 2GM_0/r'$ in Eqs. (38) – (41) shall be replaced by the active gravitational mass $M_{0\mathsf{a}}$ elsewhere with further development.

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