The Super Principle Relativity
"Hydrodynamic" Field Theory"
Ricci Curvature & Einstein Field Equations

"Part #2"

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Abstract

The Super Principle Relativity Theory is a hydrodynamic field theory, which models "Gravitation" and the "Vacuum", in the conceptual and mathematical framework of a variable density *compressible ideal gaseous fluid*. In contrast to General Relativity Theory which is a field theory, that models "Gravitation" and the "Vacuum", in the conceptual and mathematical framework of a fixed density *"frictionless incompressible fluid medium" or "incompressible liquid medium"*.

This Part #2 sets to prove the compatibility of Super Principle Relativity Theory - Hydrodynamic Gravitation Field theory, with the currently accepted General Relativity Theory - Gravitation Field Theory. This is accomplished by using the mathematical framework established in Part #1, and deriving a Ricci Curvature that is time-like. And deriving the well-established Einstein styled Gravitational Field Equations.

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Contents

1.0. Introduction ─ Part #2

In this Part #2, of the Super Principle Relativity Theory ─ "Hydrodynamic Field Theory", which models "Gravitation" and the "Vacuum", in the conceptual and mathematical framework of a variable density *compressible ideal gaseous fluid*.

In contrast to General Relativity Theory which is a field theory, that models "Gravitation" and the "Vacuum", in the conceptual and mathematical framework of a fixed density *"frictionless incompressible fluid medium" or "incompressible liquid medium"*.

In Einstein's 1916, General Relativity Theory paper mathematical; "The Foundation of the Generalized Theory of Relativity" [1], sections (15-16) equation (51), (52), (53), there he describes the "Gravitational" "Field Equation". See below.

1.1

$$\left[R_{\mu\nu} \ - \ \frac{1}{2} \cdot g_{\mu\nu} \cdot R_{Heat} \right] \ = \ -\left(\frac{8\pi \cdot G}{c_{Light}^{4}} \right) \cdot T_{\mu\nu} \quad \rightarrow \ {}^{1}\!/_{m^{2}}$$

The Einstein "Field Equation" of General Relativity Theory, is used to describe the gravitational field interacting effects of a localized distribution of mass and energy in the vacuum of space-time medium, which is a fixed density *"frictionless incompressible fluid medium" or "incompressible liquid medium"* frame of reference.

Later in 1917 Einstein modified the above Field Equation to include a "Cosmological Constant" (Λ_{Vac}) term, that acts like "anti-gravity" and prevents the universe from collapsing. Einstein called this idea, which was represented as an additional term in the mathematical equation representing his theory of gravity, the "Cosmological Constant (Λ_{Vac}) term. See below.

1.2

$$\left[R_{\mu\nu} \ - \ g_{\mu\nu} \cdot \left(\frac{1}{2} \cdot R_{Heat} \ - \ \Lambda_{Vac} \right) \right] \ = \ -\left(\frac{8\pi \cdot G}{c_{Light}^{4}} \right) \cdot T_{\mu\nu} \rightarrow \ {}^{1}\!/_{m^{2}}$$

Furthermore, the mathematics of General Relativity Theory describe a Ricci Curvature [13]. Geometrically the "Ricci Curvature" ($R_{\mu\nu}$), describes the amount by which the volume of a geodesic ball in a curved Riemannian manifold, deviates from that of the standard ball in Euclidean space.

This Part #2, Super Principle Relativity Theory ─ "Hydrodynamic Field Theory" work, introduces a General Relativity Theory, style, "Time-Like" Ricci Curvature ($\mathcal{R}(t)$) equation and Einstein "Static" and "Dynamic" Field Equations; which is derived using the mathematics of Part #1 of this work.

The Super Principle Relativity Theory, derives the Ricci Curvature ($\mathcal{R}(\mathrm{t})$) equation to be directly proportional to the "Time-Like" Energy Density ($T(\mathrm{t})$); and **Gauss's Law for Gravitation** ($\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t})$) equation.

Gauss's Law for Gravitation – "Inverse Square Time" Equation

1.1

$$\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t}) \;=\; -\nabla^2 \cdot U_{Potential}(\mathbf{A},\mathrm{t}) \;=\; -4\pi \cdot \mathrm{G} \cdot \rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) \quad \rightarrow 1/s^2$$

The theory predicts that the **Gauss's Law for Gravitation** [2] field equation is related to the Ricci Curvature ($\mathcal{R}(\mathrm{t})$), which describes time dependent gravitational effects.

In particular the Ricci Curvature ($\mathcal{R}(\mathrm{t})$), is used to describe the change in volume for a small cloud of test particles that are initially at rest, and then fall freely in a gravitational field frame of reference, and localized in the variable density *compressible ideal gaseous fluid,* vacuum of space-time speed of light ($\mathrm{c}^2_{\mathrm{Light}}$) medium.

Ricci Curvature – "Time-Like" –"Inverse Square Distance" Equation

1.3

$$\mathcal{R}(\mathrm{t}) \;=\; \left(\frac{8\pi \cdot \mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right) \cdot T(\mathrm{t}) \;=\; -\frac{2 \cdot \gamma^2(\mathbf{t})}{\mathrm{c}^2_{\mathrm{Light}}} \cdot \left[\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t})\right] \quad \rightarrow 1/m^2$$

1.4

$$\mathcal{R}(\mathrm{t}) \;=\; \left(\frac{8\pi \cdot \mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right) \cdot T(\mathrm{t}) \;=\; \frac{2 \cdot \gamma^2(\mathbf{t})}{\mathrm{c}^2_{\mathrm{Light}}} \cdot \left[\nabla^2 \cdot U_{Potential}(\mathbf{A},\mathrm{t})\right] \quad \rightarrow 1/m^2$$

The **"Time-Like" Vacuum Energy Density** ($T(\mathrm{t})$) equation was derived in Part #1, and is shown below.

"Time-Like" Energy Density:

1.5

$$T(\mathrm{t}) \;=\; \gamma^2(\mathbf{t}) \cdot \rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) \cdot \mathrm{c}^2_{\mathrm{Light}} \quad \rightarrow kg/m \cdot s^2$$

1.1. Super Principle Relativity — "Time-Like" Ricci Curvature and the "Static" Einstein Field Equation

In this section, the Super Principle Relativity Theory presents a General Relativity Theory, style, "Time-Like" Ricci Curvature ($\mathcal{R}(\mathrm{t})$) equation and Einstein "Static Field Equation".

Starting with the Super Principle Relativity Theory, **Gauss's Law for Gravitation — "Inverse Square Time" Equation** ($\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t})$), and its component equation terms are given below; derived in "Part #1" of this work.

Gauss's Law for Gravitation — "Inverse Square Time" Equation

1.6

$$\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t}) = -\nabla^2 \cdot U_{Potential}(\mathbf{A},\mathrm{t}) = -4\pi \cdot \mathrm{G} \cdot \rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) \quad \rightarrow 1/s^2$$

$$\nabla \cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t}) = -\nabla^2 \cdot U_{Potential}(\mathbf{A},\mathrm{t}) = \frac{\mathrm{c}^2_{\mathrm{Light}}}{2 \cdot \gamma^2(\mathbf{t})} \cdot \left(\frac{8\pi \cdot \mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right) \cdot \begin{bmatrix} \mathcal{L}(\mathbf{A},\mathrm{t}) \\ - \quad \gamma^2(\mathbf{A}) \cdot P_{\mathbf{Vac}}(\mathbf{A}) \end{bmatrix}$$

Net Inertial Volume Mass Density of Gravitational Field:

1.7

$$\rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) = \frac{\mathrm{m}_{\mathrm{Net}}}{\mathrm{V}_{\mathrm{ol}}} = \left(\frac{3\pi}{\mathrm{G}}\right) \cdot \frac{1}{\mathbf{T}^2_{Period}} = 3 \cdot \left(\frac{\mathrm{c}^2_{\mathrm{Light}}}{8\pi \cdot \mathrm{G}}\right) \cdot \frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3} \quad \rightarrow kg/m^3$$

Electromagnetic Vacuum Energy Density

1.8

$$P_{\mathbf{Vac}}(\mathbf{A}) = \frac{\mathcal{T}_{\mathbf{A}}}{2} = \frac{1}{3} \cdot \rho_{\mathrm{Vac}}(\mathbf{A}) \cdot \mathrm{c}^2_{\mathrm{Light}} = \left(\frac{\mathrm{c}^4_{\mathrm{Light}}}{8\pi \cdot \mathrm{G}}\right) \cdot \frac{1}{\mathbf{A}^2} \quad \rightarrow kg/m^3$$

Lagrangian Hydrodynamic Field "Space-Time" "Energy Density" Equation

1.9

$$\mathcal{L}(\mathbf{A},\mathrm{t}) = -\frac{\mathbf{1}}{\mathbf{3}} \cdot \sum T(\mathbf{A},\mathrm{t}) = -\left(\frac{\mathrm{c}^4_{\mathrm{Light}}}{8\pi \cdot \mathrm{G}}\right) \cdot \begin{bmatrix} 3 \cdot \left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right) \cdot \gamma^2(\mathbf{t}) \\ - \quad \gamma^2(\mathbf{A}) \end{bmatrix} \cdot \frac{\mathbf{1}}{\mathbf{A}^2} \quad \rightarrow kg/m^3$$

Next, the mathematics above yields an Einstein style "Static Field Equation" and a General Relativity Theory, style "Time-Like" Ricci Curvature ($\mathcal{R}(\mathrm{t})$) equation.

In Super Principle Relativity Theory, the "Ricci Curvature" ($\mathcal{R}(\mathrm{t})$), describes the amount by which the volume of a geodesic ball in a curved Riemannian manifold, deviates from that of the standard ball in Euclidean space.

Likewise, the "Ricci Curvature" ($\mathcal{R}(\mathrm{t})$), is a time dependent **— "Inverse Square Distance"** equation which represents part of the curvature of space-time, that determines the degree to which mass and energy will tend to converge or diverge in "Time" ($\gamma^2(\mathbf{t})$).

The convergence takes place at the speed of light (c^2_{Light}), and in hydrodynamic gravitational field frame of reference; given by the **Gauss's Law for Gravitation Equation** ($\nabla \cdot g_{Gravity}(\mathbf{A},\mathrm{t})$).

Ricci Curvature — "Time-Like" —"Inverse Square Distance" Equation

1.10

$$\mathcal{R}(\mathrm{t}) = -\frac{2\cdot\gamma^2(\mathbf{t})}{c^2_{\mathrm{Light}}}\cdot\left[\nabla\cdot g_{Gravity}(\mathbf{A},\mathrm{t})\right] = \frac{2\cdot\gamma^2(\mathbf{t})}{c^2_{\mathrm{Light}}}\cdot\left[\nabla^2\cdot U_{Potential}(\mathbf{A},\mathrm{t})\right] \rightarrow 1/m^2$$

$$\mathcal{R}(\mathrm{t}) = \gamma^2(\mathbf{t})\cdot\left(\frac{8\pi\cdot G}{c^4_{\mathrm{Light}}}\right)\cdot\left(\rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t})\cdot c^2_{\mathrm{Light}}\right) \rightarrow 1/m^2$$

1.11

$$\mathcal{R}(\mathrm{t}) = \gamma^2(\mathbf{t})\cdot\left(\frac{8\pi\cdot G}{c^2_{\mathrm{Light}}}\right)\cdot\rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) = 3\cdot\left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) \rightarrow 1/m^2$$

$$\mathcal{R}(\mathrm{t}) = \left(\frac{8\pi\cdot G}{c^4_{\mathrm{Light}}}\right)\cdot T(\mathrm{t}) = -\left(\frac{8\pi\cdot G}{c^4_{\mathrm{Light}}}\right)\cdot\left[\mathcal{L}(\mathbf{A},\mathrm{t}) - \gamma^2(\mathbf{A})\cdot P_{\mathbf{Vac}}(\mathbf{A})\right] \rightarrow 1/m^2$$

In Einstein's 1916, General Relativity Theory paper mathematical; "The Foundation of the Generalized Theory of Relativity" [2], sections (15-16) equation (51), (52), (53), there he describes the "Gravitational" "Static Field Equation".

Next, after making the substitution ($P_{\mathbf{Vac}}(\mathbf{A}) = \frac{\mathcal{T}_{\mathbf{A}}}{2}$), into the above equation, the Super Principle Relativity Theory, presents its version of the Ricci Curvature ($\mathcal{R}(\mathrm{t})$) Time-Like equation, and the "Einstein - Static Field Equation" shown below.

Ricci Curvature — "Time-Like" —"Inverse Square Distance" Equation

1.12

$$\mathcal{R}(\mathrm{t}) = \left(\frac{8\pi \cdot \mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right) \cdot T(\mathrm{t}) = -\left(\frac{8\pi \cdot \mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right) \cdot \left[\mathcal{L}(\mathbf{A},\mathrm{t}) - \frac{1}{2} \cdot \gamma^2(\mathbf{A}) \cdot \mathcal{T}_{\mathbf{A}}\right] \rightarrow 1/m^2$$

Super Principle Relativity Theory — Einstein "Static" Field Equation — "Inverse Square Distance" Relation

1.13

$$\left[\mathcal{R}(t) - \frac{1}{2} \cdot \gamma^2(\mathbf{A}) \cdot \mathcal{R}(\mathbf{A})\right] = -\left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right) \cdot \mathcal{L}(\mathbf{A}, t) \rightarrow 1/m^2$$

1.14

$$\left[\frac{1}{2} \cdot \gamma^2(\mathbf{A}) \cdot \mathcal{R}(\mathbf{A})\right] = \left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right)\left[\frac{1}{2} \cdot \gamma^2(\mathbf{A}) \cdot \mathcal{T}_{\mathbf{A}}\right] = \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2} \rightarrow 1/m^2$$

1.15

$$\mathcal{R}(\mathbf{A}) = \left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right) \cdot \mathcal{T}_{\mathbf{A}} \rightarrow 1/m^2$$

1.16

$$\left[\mathcal{R}(t) - \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] = -\left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right) \cdot \mathcal{L}(\mathbf{A}, t) \rightarrow 1/m^2$$

Super Principle Relativity Theory — Einstein "Static" Field Equation — "Inverse Square Distance" Relation

1.17

$$\left[\frac{2 \cdot \gamma^2(t)}{c^2_{Light}} \cdot [\nabla^2 \cdot U_{Potential}(\mathbf{A}, t)] - \frac{1}{2} \cdot \gamma^2(\mathbf{A}) \cdot \mathcal{R}(\mathbf{A})\right] = -\left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right) \cdot \mathcal{L}(\mathbf{A}, t)$$

1.18

$$\left[\frac{2 \cdot \gamma^2(t)}{c^2_{Light}} \cdot [\nabla^2 \cdot U_{Potential}(\mathbf{A}, t)] - \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] = -\left(\frac{8\pi \cdot \mathrm{G}}{c^4_{Light}}\right) \cdot \mathcal{L}(\mathbf{A}, t) \rightarrow 1/m^2$$

Super Principle Relativity Theory — Einstein "Static" Field Equation — "Inverse Square Distance" Relation

1.19

$$\left[\frac{2\cdot\gamma^2(t)}{c_{Light}^2}\cdot\left[\nabla\cdot g_{Gravity}(\mathbf{A},t)\right] \quad + \quad \frac{1}{2}\cdot\gamma^2(\mathbf{A})\cdot\mathcal{R}(\mathbf{A})\right] \quad = \quad \left(\frac{8\pi\cdot \mathrm{G}}{c_{Light}^4}\right)\cdot\mathcal{L}(\mathbf{A},t)$$

1.20

$$\left[\frac{2\cdot\gamma^2(t)}{c_{Light}^2}\cdot\left[\nabla\cdot g_{Gravity}(\mathbf{A},t)\right] \quad + \quad \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] \quad = \quad \left(\frac{8\pi\cdot \mathrm{G}}{c_{Light}^4}\right)\cdot\mathcal{L}(\mathbf{A},t) \quad \rightarrow {}^{1}\!/_{m^2}$$

1.21

$$\left[\mathcal{R}(\mathrm{t}) \quad - \quad \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] \quad = \quad -\left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^4}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t}) \quad \rightarrow {}^{1}\!/_{m^2}$$

Super Principle Relativity Theory — Einstein "Static" Field Equation — "Inverse Square Distance" Exact Solution

1.22

$$\left[3\cdot\left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) \quad - \quad \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] \quad = \quad -\left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^4}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t})$$

1.2. Super Principle Relativity ─ Derivation of the Einstein "Dynamic" Field Equation with Space-Time Volume Expansion Term

This section, will use the mathematics of the **Super Principle Relativity Theory** to derive the currently accepted, modern formulation of the General Relativity Theory ─ Einstein "Dynamic" Field Equation; which includes the "Local Volume Expansion of Space-Time" term; shown below.

Next, the **Super Principle Relativity Theory** list a set of energy density equations and a volume expansion equation.

Isotopic Electromagnetic Energy Density Equation

1.23

$$P_{\mathbf{Vac}}(\mathbf{A}) = \frac{\mathcal{T}_{\mathbf{A}}}{2} = \begin{bmatrix} \frac{1}{3} \cdot \rho_{\text{Net}}(\mathbf{A},\text{t}) \cdot \text{c}^2_{\text{Light}} \\ + \quad P_{\mathbf{Vac}}(\mathbf{B}) \end{bmatrix} = \left(\frac{\text{c}^4_{\text{Light}}}{8\pi \cdot \text{G}}\right) \cdot \frac{1}{\mathbf{A}^2} \quad \rightarrow \quad kg/_{m \cdot s^2}$$

Local Volume Expansion of Space-Time ─ Energy Density Equation

1.24

$$P_{\mathbf{Vac}}(\mathbf{B}) = \frac{\mathcal{T}_{\mathbf{B}}}{2} = \begin{bmatrix} P_{\mathbf{Vac}}(\mathbf{A}) \\ - \quad \frac{1}{3} \cdot \rho_{\text{Net}}(\mathbf{A},\text{t}) \cdot \text{c}^2_{\text{Light}} \end{bmatrix} = \left(\frac{\text{c}^4_{\text{Light}}}{8\pi \cdot \text{G}}\right) \cdot \frac{1}{\mathbf{B}^2} \quad \rightarrow \quad kg/_{m \cdot s^2}$$

Local Volume Expansion of Space-Time in a Gravitational Field ─ Inverse Square Distance

1.25

$$\frac{\mathbf{1}}{\mathbf{B}^2} = \left(\frac{1}{2} \cdot R_{Heat} - \Lambda_{\text{Vac}}\right) = \frac{\mathbf{1}}{\mathbf{A}^2} \cdot \left(\mathbf{1} - \frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right) \rightarrow 1/_{m^2}$$

Starting with the Einstein "Static" Field Equation, shown below.

Einstein "Static" Field Equation ─ "Inverse Square Distance" Equation

1.26

$$\left[\mathcal{R}(\text{t}) - \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] = -\left(\frac{8\pi \cdot \text{G}}{\text{c}^4_{\text{Light}}}\right) \cdot \mathcal{L}(\mathbf{A},\text{t}) \rightarrow 1/_{m^2}$$

Next, adding the following equation, to both sides of the above equation is demonstrated below.

1.27

$$\gamma^2(\mathbf{A}) \cdot \frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3} = -\gamma^2(\mathbf{A}) \cdot \left(\frac{\mathbf{1}}{\mathbf{B}^2} - \frac{\mathbf{1}}{\mathbf{A}^2}\right) \rightarrow 1/_{m^2}$$

1.28

$$\left[\begin{array}{l} \mathcal{R}(\mathrm{t}) \;-\; \dfrac{\gamma^2(\mathbf{A})}{\mathbf{A}^2} \\ \quad +\; \gamma^2(\mathbf{A})\cdot\dfrac{\alpha_{\text{Constant}}}{\mathbf{A}^3} \end{array}\right] = -\left[\begin{array}{l} \left(\dfrac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t}) \\ \quad -\; \gamma^2(\mathbf{A})\cdot\dfrac{\alpha_{\text{Constant}}}{\mathbf{A}^3} \end{array}\right] = \left(\dfrac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t})$$

The above equation, yields the modern version of the Einstein "Dynamic" Field Equation; which includes the "Local Volume Expansion of Space-Time" term.

The "right side" of the above equation is given below.

Einstein "Dynamic" Field Equation – Local Volume Expansion of Space-Time Equation — "Inverse Square Distance" Equation

1.29

$$\left[-\left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t}) \;+\; \gamma^2(\mathbf{A})\cdot\left(\frac{\alpha_{\text{Constant}}}{\mathbf{A}^3}\right)\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t}) \;\rightarrow\; 1/m^2$$

The "left side" of the above equation is given below has the same mathematical form as the General Relativity — Einstein "Dynamic" Field Equation.

Einstein "Dynamic" Field Equation – Local Volume Expansion of Space-Time Equation — "Inverse Square Distance" Equation

1.30

$$\left[\mathcal{R}(\mathrm{t}) \;-\; \gamma^2(\mathbf{A})\cdot\left(\frac{1}{\mathbf{A}^2} \;-\; \frac{\alpha_{\text{Constant}}}{\mathbf{A}^3}\right)\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t}) \;\rightarrow\; 1/m^2$$

1.31

$$\left[\mathcal{R}(\mathrm{t}) \;-\; \frac{\gamma^2(\mathbf{A})}{\mathbf{B}^2}\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t})$$

1.32

$$\left[\mathcal{R}(\mathrm{t}) \;-\; \gamma^2(\mathbf{A})\cdot\left(\frac{1}{2}\cdot R_{Heat} \;-\; \Lambda_{\text{Vac}}\right)\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t}) \;\rightarrow\; 1/m^2$$

Einstein "Dynamic" Field Equation — "Inverse Square Distance" Equation — Exact Solution

1.33

$$\left[3\cdot\left(\frac{\alpha_{\text{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) \;-\; \gamma^2(\mathbf{A})\cdot\left(\frac{1}{\mathbf{A}^2} \;-\; \frac{\alpha_{\text{Constant}}}{\mathbf{A}^3}\right)\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\mathrm{t})$$

1.3. Super Principle Relativity ─ Local Volume Expansion of Space-time Component Terms

Next, the **Super Principle Relativity Theory** list the various component terms of the **Local Volume Expansion of Space-Time in a Gravitational Field ─ Inverse Square Distance** ($\frac{\mathbf{1}}{\mathbf{B}^2}$) equation. The following are also component terms in the Einstein "Dynamic" Field Equation.

Local Volume Expansion of Space-Time in a Gravitational Field ─ Inverse Square Distance

1.34

$$\frac{\mathbf{1}}{\mathbf{B}^2} = \left(\frac{1}{2}\cdot R_{Heat} - \Lambda_{\mathrm{Vac}}\right) = \frac{\mathbf{1}}{\mathbf{A}^2}\cdot\left(\mathbf{1} - \frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right) \rightarrow 1/m^2$$

Gradient Gravity Field Coefficient

1.35

$$\gamma_{\mathbf{GG}}^{\mathbf{2}} = \frac{\mathbf{B}^2}{\mathbf{A}^2} = \frac{\mathbf{1}}{\left(\mathbf{1} - \frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right)} = \frac{1}{\left(1 - \left(\frac{2\cdot \mathrm{m}_{\mathrm{Net}}\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^2}\right)\cdot\frac{1}{\mathbf{A}}\right)} \rightarrow Unitless$$

Inverse Square Distance ─ Heat Radiation Energy Density

1.36

$$\frac{1}{2}\cdot R_{Heat} = 8\pi\cdot\left(\frac{4\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^4}\right)\cdot\left[\left(\frac{\sigma_{Stephan}}{\mathrm{c}_{\mathrm{Light}}}\right)\cdot\left(T_{Temp}\right)^4\right] = \left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^2}\right)\cdot\rho_{\mathrm{Heat}} \rightarrow 1/m^2$$

Heat Radiation Energy Density Temperature

1.37

$$\left(T_{Temp}\right)^4 = \frac{1}{16\pi}\cdot\left[\left(\frac{\mathrm{c}_{\mathrm{Light}}^4}{4\cdot \mathrm{G}}\right)\cdot\left(\frac{\mathrm{c}_{\mathrm{Light}}}{\sigma_{Stephan}}\right)\right]\cdot R_{Heat} \rightarrow K$$

The **Einstein "Cosmological Constant"** (Λ_{Vac}) term is given in the following.

Inverse Square Distance ─ "Dark Matter - Cosmic" Vacuum Density

1.38

$$\Lambda_{\mathrm{Vac}} = \frac{1}{4}\cdot\left(\frac{\mathrm{c}_{\mathrm{Light}}^2}{\mathrm{m}_{\mathrm{Net}}\cdot \mathrm{G}}\right)\cdot\left(\frac{1}{\mathbf{A}}\right) = \frac{1}{3}\cdot\left(\frac{8\pi\cdot \mathrm{G}}{\mathrm{c}_{\mathrm{Light}}^2}\right)\cdot\rho_{\mathrm{Dark}} \rightarrow 1/m^2$$

Below is a figure of the "Hydrodynamic Field Gravitational Vortex" model and is used to visually describe the mathematics of the **Local Volume Expansion of Space-Time in a Gravitational Field – Inverse Square Distance** ($\frac{1}{B^2}$) and the normal Invers Square Distance ($\frac{1}{A^2}$) equations above.

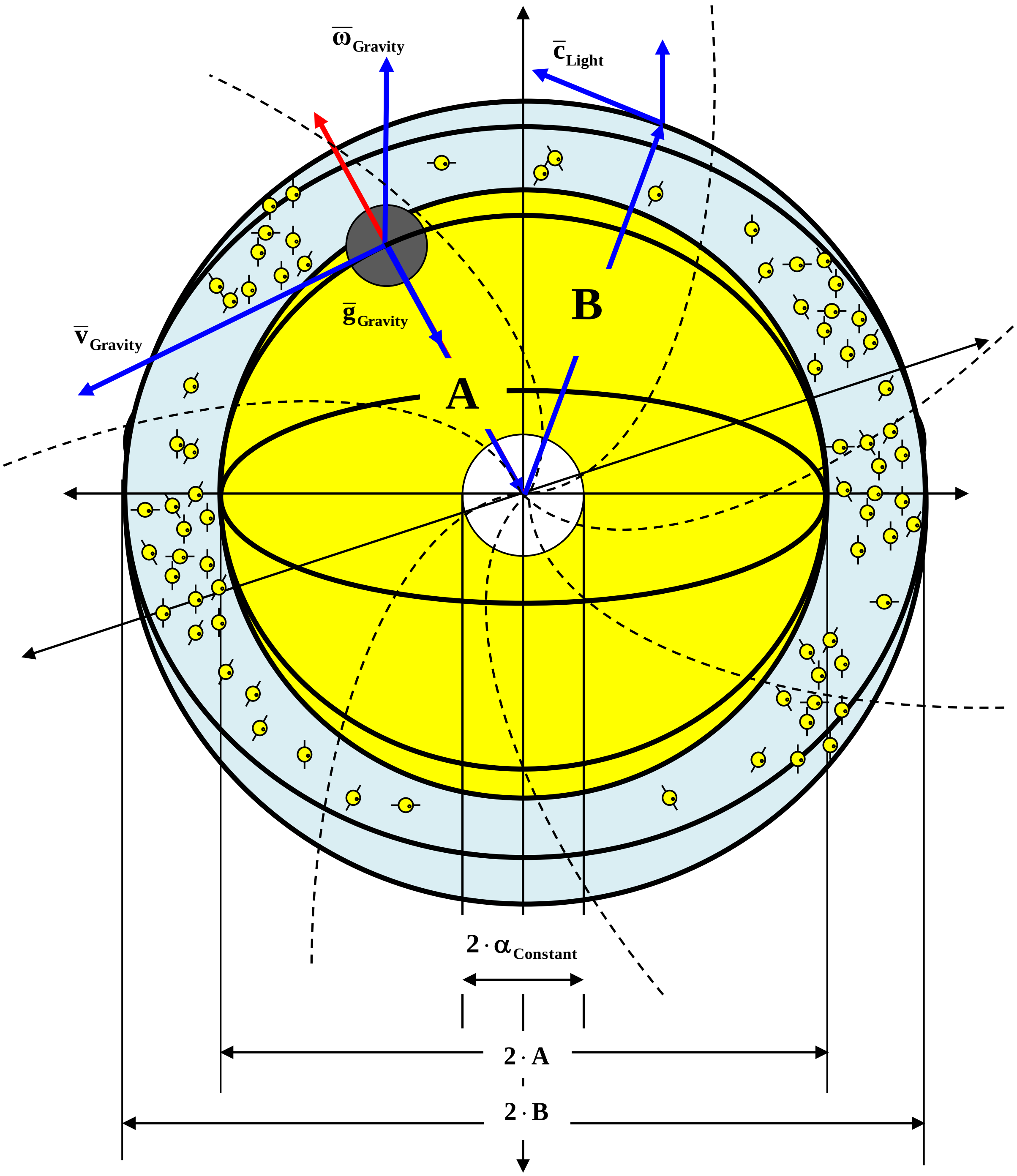

Figure 1.1: Compressible Ideal Aether Gas – Hydrodynamic Field – Inverse Square Distance Equations

1.4. Summary of "Time-Like" Ricci Curvature and the Einstein "Static" and "Dynamic" Field Equations

Below is a summary of the, **Super Principle Relativity Theory** "Time-Like" Ricci Curvature and the Einstein "Static" and "Dynamic" Field Equations with exact solutions; shown below.

Ricci Curvature — "Inverse Square Distance" Equation

1.39

$$\mathcal{R}(\mathrm{t}) \;=\; -\frac{2\cdot\gamma^2(\mathbf{t})}{\mathrm{c}^2_{\mathrm{Light}}}\cdot\left[\nabla\cdot \mathrm{g}_{Gravity}(\mathbf{A},\mathrm{t})\right] \;=\; \frac{2\cdot\gamma^2(\mathbf{t})}{\mathrm{c}^2_{\mathrm{Light}}}\cdot\left[\nabla^2\cdot U_{Potential}(\mathbf{A},\mathrm{t})\right] \;\rightarrow 1/m^2$$

1.40

$$\mathcal{R}(\mathrm{t}) \;=\; \gamma^2(\mathbf{t})\cdot\left(\frac{8\pi\cdot\mathrm{G}}{\mathrm{c}^2_{\mathrm{Light}}}\right)\cdot\rho_{\mathrm{Net}}(\mathbf{A},\mathrm{t}) \;=\; 3\cdot\left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) \;\rightarrow 1/m^2$$

Isotopic Electromagnetic Energy Density Equation

1.41

$$P_{\mathbf{Vac}}(\mathbf{A}) \;=\; \frac{\mathcal{T}_{\mathbf{A}}}{2} \;=\; \left(\frac{\mathrm{c}^4_{\mathrm{Light}}}{8\pi\cdot\mathrm{G}}\right)\cdot\frac{1}{\mathbf{A}^2} \;\rightarrow kg/m\cdot s^2$$

Ricci Curvature and Einstein "Static" Field Equation — "Inverse Square Distance" Equation

1.42

$$\mathcal{R}(\mathrm{t}) \;=\; -\left(\frac{8\pi\cdot\mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right)\cdot\left[\mathcal{L}(\mathbf{A},\mathrm{t}) \;-\; \frac{\gamma^2(\mathbf{A})}{2}\cdot\mathcal{T}_{\mathbf{A}}\right] \;\rightarrow 1/m^2$$

1.43

$$\mathcal{R}(\mathrm{t}) \;=\; -\left(\frac{8\pi\cdot\mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right)\cdot\left[\mathcal{L}(\mathbf{A},\mathrm{t}) \;-\; \gamma^2(\mathbf{A})\cdot P_{\mathbf{Vac}}(\mathbf{A})\right]$$

1.44

$$\mathcal{R}(\mathrm{t}) \;=\; -\left[\left(\frac{8\pi\cdot\mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t}) \;-\; \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] \;\rightarrow 1/m^2$$

Einstein "Static" Field Equation — "Inverse Square Distance" Equation — Exact Solution

1.45

$$\left[3\cdot\left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) \;-\; \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\right] \;=\; -\left(\frac{8\pi\cdot\mathrm{G}}{\mathrm{c}^4_{\mathrm{Light}}}\right)\cdot\mathcal{L}(\mathbf{A},\mathrm{t}) \;\rightarrow 1/m^2$$

Local Volume Expansion of Space-Time — Energy Density Equation

1.46

$$P_{\mathbf{Vac}}(\mathbf{B}) = \frac{\mathcal{T}_{\mathbf{B}}}{2} = \left(\frac{c^4_{\text{Light}}}{8\pi\cdot G}\right)\cdot\left(\frac{1}{2}\cdot R_{Heat} - \Lambda_{\text{Vac}}\right) \rightarrow {}^{kg}\!/_{m^3}$$

$$P_{\mathbf{Vac}}(\mathbf{B}) = \frac{\mathcal{T}_{\mathbf{B}}}{2} = \left(\frac{c^4_{\text{Light}}}{8\pi\cdot G}\right)\cdot\frac{\mathbf{1}}{\mathbf{B}^2} = \left(\frac{c^4_{\text{Light}}}{8\pi\cdot G}\right)\cdot\left(\mathbf{1} - \frac{\boldsymbol{\alpha}_{\textbf{Constant}}}{\mathbf{A}}\right)\cdot\frac{\mathbf{1}}{\mathbf{A}^2}$$

Ricci Curvature and Einstein "Dynamic" Field Equation — "Inverse Square Distance" Relation

1.47

$$\mathcal{R}(\text{t}) = \left(\frac{8\pi\cdot G}{c^4_{\text{Light}}}\right)\cdot\left[\mathcal{T}(\mathbf{A},\text{t}) - \gamma^2(\mathbf{A})\cdot P_{\mathbf{Vac}}(\mathbf{B})\right] \rightarrow {}^{1}\!/_{m^2}$$

1.48

$$\mathcal{R}(\text{t}) = \left(\frac{8\pi\cdot G}{c^4_{\text{Light}}}\right)\cdot\left[\mathcal{T}(\mathbf{A},\text{t}) - \frac{\gamma^2(\mathbf{A})}{2}\cdot\mathcal{T}_{\mathbf{B}}\right]$$

1.49

$$\mathcal{R}(\text{t}) = \left[\left(\frac{8\pi\cdot G}{c^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\text{t}) - \frac{\gamma^2(\mathbf{A})}{\mathbf{A}^2}\cdot\left(\mathbf{1} - \frac{\boldsymbol{\alpha}_{\textbf{Constant}}}{\mathbf{A}}\right)\right]$$

1.50

$$\mathcal{R}(\text{t}) = \left[\left(\frac{8\pi\cdot G}{c^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\text{t}) - \gamma^2(\mathbf{A})\cdot\left(\frac{1}{2}\cdot R_{Heat} - \Lambda_{\text{Vac}}\right)\right] \rightarrow {}^{1}\!/_{m^2}$$

The equation above has the same mathematical form as the modern version of the General Relativity Theory - Einstein "Dynamic" Field Equation.

Next, substituting the **Ricci Curvature** ($\mathcal{R}(\text{t}) = 3\cdot\left(\frac{\boldsymbol{\alpha}_{\textbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t})$) equation into the above equation, yields an exact solution below.

Einstein "Dynamic" Field Equation — "Inverse Square Distance" Equation — Exact Solution

1.51

$$\left[3\cdot\left(\frac{\boldsymbol{\alpha}_{\textbf{Constant}}}{\mathbf{A}^3}\right)\cdot\gamma^2(\mathbf{t}) - \gamma^2(\mathbf{A})\cdot\left(\frac{1}{\mathbf{A}^2} - \frac{\boldsymbol{\alpha}_{\textbf{Constant}}}{\mathbf{A}^3}\right)\right] = \left(\frac{8\pi\cdot G}{c^4_{\text{Light}}}\right)\cdot\mathcal{T}(\mathbf{A},\text{t}) \rightarrow {}^{1}\!/_{m^2}$$

1.5. Conclusion ─ Part # 2

The Super Principle Relativity Theory predicts that the vacuum is not empty, but is a hydrodynamic compressible "aether" gaseous fluid medium made of "electromagnetic", "gravitational", and "hydrodynamic sink" and "hydrodynamic source" field **"Vacuum Energy Density" ─ "Frames of Reference"**.

In this Part #2, it was proven that General Relativity Theory, the Einstein Field Equations, and the Ricci Curvature, concepts fits within the mathematical framework of the Super Principle Relativity Theory.

Consequently, the "Super Principle Relativity Theory" predicts seven (7) different **"Hydrodynamic Vacuum Energy Density Field ─ Frames of Reference"**: gravitational, electromagnetic, isotropic space-time world line, gravitational sink, gravitational source, electromagnetic sink, and electromagnetic source **"energy density frames of reference"**.

In order to distinguish between the (7) different **"energy density frames of reference"**, the "Super Principle Relativity Theory" hydrodynamic field vacuum energy density equations uses the **"frame of reference"** variant terms:

- **"Space-Like" Hydrodynamic Coefficient** ($\gamma^2(\mathbf{A})$), and
- **"Time-Like" Hydrodynamic Coefficient** ($\gamma^2(\mathbf{t})$).

Thus far, in this part of the work, the values for the different **"Space-Like"** ($\gamma^2(\mathbf{A})$) and **"Time-Like"** ($\gamma^2(\mathbf{t})$) **Hydrodynamic Coefficients** have not been presented; however the values will be given in the next part of this work.

Once the "Space-Like" and "Time-Lime" Hydrodynamic Coefficients are substituted into the above equations, a whole host of new revelations about the material world become apparent.

The table below, "lets the cat out of the bag early", and is the key, to the solutions for all of equations derived in Part #1, and Part #2 of this work.

The table below lists the various Hydrodynamic **“Space-Like”** ($\gamma^2(\mathbf{A})$) and **“Time-Like”** ($\gamma^2(\mathbf{A})$) Coefficients for the different “Hydrodynamic Field Vacuum Energy Density” Frames of Reference (ψ).

“Space-Like” & “Time-Like” Hydrodynamic Coefficients ($\gamma^2(\mathbf{A})_{\psi}$) , ($\gamma^2(\mathbf{t})_{\psi}$)			
Field Type	ψ	**“Space-Like”** ($\gamma^2(\mathbf{A})_{\psi}$)	**“Time-Like”** ($\gamma^2(\mathbf{t})_{\psi}$)
Electromagnetic Field	$\psi \; = \; \mathrm{Vac}$	$\gamma^2(\mathbf{A})_{Vac} = -\left[1 - 3 \cdot \left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right)\right]$	$\gamma^2(\mathbf{t})_{Vac} \; = \; 0$
Gravitational Field	$\psi \; = \; Gravity$	$\gamma^2(\mathbf{A})_{Gravity} = \left[3 \cdot \left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right) - \frac{1}{2} \cdot \left(\frac{\boldsymbol{\alpha}^2_{\mathbf{Constant}}}{\mathbf{A}^2}\right)\right]$	$\gamma^2(\mathbf{t})_{Gravity} \; = \; 0$
Isotropic Coordinate Chart Space-Time “World-Line”	$\psi \; = \; Time$	$\gamma^2(\mathbf{A})_{Time} \; = \; 0$	$\gamma^2(\mathbf{t})_{Time} \; = \; 1$
“Electromagnetic Source” Field	$\psi \; = \; \mathrm{Source}$	$\gamma^2(\mathbf{A})_{\mathrm{Source}} \; = \; 1$	$\gamma^2(\mathbf{t})_{\mathrm{Source}} = 1$
“Electromagnetic Sink” Field	$\psi \; = \; Sink$	$\gamma^2(\mathbf{A})_{\mathrm{Sink}} = \left[1 + 2 \cdot \left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right)\right]$	$\gamma^2(\mathbf{t})_{\mathrm{Sink}} \; = \; 1$
“Gravitational Source” Field	$\psi \; = \; \mathrm{G}\text{-}Source$	$\gamma^2(\mathbf{A})_{G-Source} \; = \; \left(\frac{\boldsymbol{\alpha}^2_{\mathbf{Constant}}}{\mathbf{A}^2}\right)$	$\gamma^2(\mathbf{t})_{G-Source} = 1$
“Gravitational Sink” Field	$\psi \; = \; \mathrm{G}\text{-}Sink$	$\gamma^2(\mathbf{A})_{G-Sink} \; = \left[2 \cdot \left(\frac{\boldsymbol{\alpha}_{\mathbf{Constant}}}{\mathbf{A}}\right) + \frac{\boldsymbol{\alpha}^2_{\mathbf{Constant}}}{\mathbf{A}^2}\right]$	$\gamma^2(\mathbf{t})_{G-Sink} \; = \; 1$

Table 1

1.6. Appendix – 1 — Table of Universal Constants

Table of Universal Constants

Table of Universal Constants			
Constant's Name	**Symbol**	**Constant Value**	**Units**
Stephan Boltzmann's Constant	$\sigma_{Stephan}$	**5.670400474E-08**	$kg/s^3 \cdot K^4$
Boltzmann's Energy Constant	$\mathrm{k_B}$	**1.380650400E-23**	$kg \cdot m^2/s^2 \cdot K$
Speed of Light	$\mathrm{c_{Light}}$	**2.997924580E+08**	m/s
Planck's Constant	h_{Planck}	**6.626068960E-34**	$kg \cdot m^2/s$
Universal Gravitational Constant	**G**	**6.6742800E-11**	$m^3/kg \cdot s^2$
Black Hole Linear Mass Density	$\boldsymbol{\mu}_{\mathbf{L\_Density_{BH}}}$	**6.73297478332358E+26**	kg/m
Dark Vacuum Force	$\mathrm{F_{Dark\_Force}}$	**3.0256479774082E+43**	$kg \cdot m/s^2$

Table 2

1.7. References

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