The Action of Matter: Gravitation

INTRODUCTION

This presentation of the gravitational behavior of *Spherical-Centers-of-Oscillation* is in two parts.

-The first, *The Conceptual Aspect*, deals with

[a] the defects in Einstein's General Theory of Relativity namely: that its proposed cause or mechanism of gravitation is incomplete and that its tests can validate only the tested effects not the proposed cause or mechanism, and

[b] conceptually how the *Spherical-Centers-of-Oscillation* produce a complete gravitational cause and mechanism in a manner consistent with the rest of physics.

- The second is the analytical and mathematical *Derivation of Newton's Law of Gravitation* from first principles of *Spherical-Centers-of-Oscillation* and further *Proof that Inertial Mass and Gravitational Mass Are Identical i.e. the Same.*

THE CONCEPTUAL ASPECT

The problem with generally accepted theories that are nevertheless in error lies not primarily with their error but rather that they are an impediment to the consideration of alternative more valid theories. The classic example of this is the case of Ptolemy's geocentric theory of the motion of the solar system's planets.

The Ptolemaic [Earth centered] system accounted for the observed motion of the planets by hypothesizing a motion variant in the form of cycles and epicycles imposed on the apparent general orbital path around the Earth. That system successfully accounted for the planets' motions and successfully predicted eclipses, retrograde motion, and alignments although it needed small adjustments from time to time over the approximately 1,500 years of its dominant rule.   But, it lacked a valid cause or mechanism.

A physics theory consists of known experimentally experienced behaviors or effects and a physical explanation of the cause or mechanism producing those observed effects.

- That a theory passes test predictions of its <u>*effects*</u> does not validate its proposed <u>*mechanism*</u>.

[*e.g.* Ptolemy: geocentric planetary system].

- An <u>*incomplete*</u> proposed cause or <u>*mechanism*</u> leaves its theory unvalidated.

[*e.g.* Einstein: gravitational mass curves space].

[How does it curve space, what mechanism ?]
[What is "space" that it can be "curved" ?]

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The behavior of gravitation is well known, described by Newton's Law of Gravitation. But what gravitational mass is, how gravitational behavior comes about, what in material reality produces the effects of gravitation, is little understood.

Experience shows that everything has a cause and that those causes are themselves the results of precedent causes, *ad infinitum*. Defining and comprehending the causality or mechanism operating to produce an observed behavior is essential to understanding or explaining it.

The comprehensive explanation of the cause and mechanism of gravitation as derived from the origin of the universe is the Modern Newtonian Model of Gravitation. Its development consists of the following seven steps. Each step results in new "hard" facts generated directly from prior "hard" facts. The development does not contain nor rely on opinion. Consequently, while it is deemed a "model" it is an exact factual description of what it treats.

1 – How the universe's particles of matter came into existence.

2 – How they came to be propagating an outward flow.

3 – The reservoir supply for the substance of the outward flow.

4 – The speed of the outward flow.

5 – A particle's flow encountering another particle slows its outward flow.

6 – The outward flow has momentum.

7 – Gravitation is the momentum reaction to outward flow slowing.

STEP 1 – HOW THE UNIVERSE'S PARTICLES OF MATTER CAME INTO EXISTENCE

This has been fully developed in this book's Section 1, *The Origin of Matter: Its Cause*.

STEP 2 – HOW THE MATTER PARTICLES CAME TO BE PROPAGATING AN OUTWARD FLOW

This has been fully developed in this book's Section 2, *The Behavior of Matter: Its Form*, under the heading *The Flow from the Spherical-Centers-of-Oscillation.*

STEP 3 – THE RESERVOIR SUPPLY FOR THE SUBSTANCE OF THE OUTWARD FLOW

This has been fully developed in this book's Section 2, *The Behavior of Matter: Its Form*, under the sub-heading *The Particle Core's Propagated Outward Flow.*

STEP 4 – THE SPEED OF THE OUTWARD FLOW

This has been fully developed in this book's Section 2, *The Behavior of Matter: Its Form*, under the sub-heading *The Speed of the Flow – The Speed of Light.*

STEP 5 – A PARTICLE'S FLOW ENCOUNTERING ANOTHER PARTICLE SLOWS ITS OUTWARD FLOW

In a universe of the myriad particles, *Spherical-Centers-of-Oscillation*, resulting from the Big Bang, each of those particles propagating its own *Propagated Outward*

Flow radially in all directions, there are many instances of the flow from one particle [the "source" particle] encountering, running into, the outward-flow-propagating-center core of another particle [the "encountered" particle]. Such "source" particle flows are inverse square reduced in magnitude the farther that their wave front has traveled from its "source".

The flow behavior is analogous to that of an electric transmission line where the rate of travel of an oscillation down the line is determined by the time it takes to build up the electric current for each oscillation cycle through each infinitesimal increment of the line's distributed series inductance [L_p] and to build up the electric potential for each oscillation cycle on each infinitesimal increment [C_p] of the line's distributed shunt capacitance. The transmission line speed of flow is determined by the well-established relationship

(7-1) $$\text{Speed} = \frac{1}{\sqrt{L_p \cdot C_p}}$$

For *Spherical-Centers-of-Oscillation* propagating oscillating flow the factor determining the speed of propagation is the time required to build up the flow amount for each oscillation cycle through each infinitesimal increment of the flow's μ_0 and the flow's potential for each oscillation cycle on each infinitesimal increment of the flow's ε_0. But, in radially outward propagating particle's flow, the flow amount is inverse square spread out and the potential likewise, both in exactly the same proportion as its μ_0 and ε_0. The ratio of the flow amount to its μ_0 and of its flow potential to its ε_0 remains constant, and so likewise the speed, radially outward, of its propagation, *c*.

Upon encountering another particle that arriving flow's μ and ε (scalar not vector) (much inverse square reduced) combine with the (full magnitude) μ_0 and ε_0 in the new outgoing propagation of the encountered center, the $\mu_0 + \mu$ sum and the $\varepsilon_0 + \varepsilon$ sum each being larger values. The result is that that "encountered" particle's new outward flow is slowed relative to its natural speed. That is, its speed of flow is determined by a combination of the parameters μ and ε larger than its flow's otherwise natural values. The speed of flow is determined by the well-established relationship

(7-2) $$\text{Speed} = \frac{1}{\sqrt{\mu \cdot \varepsilon}}$$

STEP 6 – *THE OUTWARD FLOW HAS MOMENTUM*

The oscillating substance, *Medium*, of each of the myriad particles is its mass. There is no other place or thing to be the mass of those particles. Therefore the propagating outward flow has momentum, the inherent effect of the product of mass, inherent in the substance of the flow, and the flow's velocity.

In the absence of other effects the outward flow is naturally radially outward. While the outward flow effectively transmits pulses of momentum outward in its *[1 - Cosine]* oscillation, the core source of that flow is experiencing radially <u>inward</u> equal but opposite pulses of momentum in accordance with Newton's third law of motion. In effect the core source is under reaction compression. Because that effect is radially uniform it produces no net affect on the particle.

STEP 7 – GRAVITATION IS THE MOMENTUM REACTION TO OUTWARD FLOW SLOWING.

The incoming flow from a distant "source" particle having the effect of slowing the speed of the "encountered" particle's outward propagated flow causes that "encountered" particle's outward flow to have less momentum than if it were not slowed, again momentum being the product of mass and velocity.

Therefore the Newton's Third Law reaction to that reduced outward flow momentum, reaction back on the "encountered" particle, is smaller than otherwise. That effect takes place on the side of the "encountered particle" facing toward the "source" particle from which the slowing - causing flow came.

[Newton's Third Law, every action has an equal opposite reaction, is valid because without it masses could self-accelerate in violation of conserving energy.]

But, on the opposite side of the "encountered" particle no such slowing of its outward propagated flow is present so that the outward flow there has the full natural momentum and the Newton's Third Law reaction on the particle on that side is the full natural amount. Consequently, the "encountered" particle experiencing its usual full momentum reaction back on itself on its side opposite that facing the incoming flow from the "source" but experiencing reduced reaction back on itself on its side facing the incoming flow from the "source", experiences a net momentum reaction toward the "source" particle from which the slowing-causing flow came.

Thus the particle experiences *[1 - Cosine]* pulses of momentum increase toward the "source" gravitationally attracting particle which constitute the gravitational acceleration.

DERIVATION OF NEWTON'S LAW OF GRAVITATION

In Section 2 a statement of the derived gravitational acceleration was obtained as equation *2-17*, repeated below.

(2-17)
$$\Delta v = c \cdot \frac{\delta^2}{d^2} \quad \text{per cycle of } f_{source}$$

a quite pure, precise and direct statement of the operation of gravitation. It states that gravitation is a function of the speed of light, *c,* and the inverse square law, in the context of the oscillation frequency, f_S, corresponding to the attracting, source body's mass. It should be noted that equation *2-17* is exact without involving a constant of proportionality such as *G*.

The equation *2-17* result can also be obtained directly from consideration of solely how slowing is caused by μ and ε, which demonstrates that the cause of gravitation is the slowing of wave propagation presented just above. That is as follows.

For the *Medium* of the *Propagated Outward Flow* at the instant of its propagation from its source center responding to its own μ_0 and ε_0, the value of those two are constant at what we term their free space values. Those values are inverse square reduced as the medium carrying them propagates outward from their source center-of-oscillation. (As discussed in the prior section, the speed of wave propagation remains the same because the waves are also inverse square reduced in amplitude.)

(7-3) (1) At distance δ from the center of the source center,
the first place where the propagated medium
appears and where its concentration is greatest,
the values of μ and ε are the free space values:

$$\mu = \mu_0 \qquad \text{and} \qquad \varepsilon = \varepsilon_0$$

(2) Per the inverse square law, the values at distance *"d"*
from the center of the source center are:

$$\mu(d) = \mu_0 \cdot \frac{\delta^2}{d^2} \qquad \text{and} \qquad \varepsilon(d) = \varepsilon_0 \cdot \frac{\delta^2}{d^2}$$

Then, the overall net effective values when flowing medium from a distant center passes through the outward propagation of an encountered center are

(7-4)

$$\mu_{net} = \left[\mu_0 + \mu_0 \cdot \frac{\delta^2}{d^2} \right] = \mu_0 \cdot \left[1 + \frac{\delta^2}{d^2} \right]$$

$$\varepsilon_{net} = \left[\varepsilon_0 + \varepsilon_0 \cdot \frac{\delta^2}{d^2} \right] = \varepsilon_0 \cdot \left[1 + \frac{\delta^2}{d^2} \right]$$

The resulting net speed of propagation is, then

(7-5)

$$c_{net} = \frac{1}{\left[\mu_{net} \cdot \varepsilon_{net} \right]^{\frac{1}{2}}} = \frac{1}{\left[1 + \frac{\delta^2}{d^2} \right] \cdot \left[\mu_0 \cdot \varepsilon_0 \right]^{\frac{1}{2}}}$$

$$= \frac{c}{\left[1 + \frac{\delta^2}{d^2} \right]} = \frac{d^2}{d^2 + \delta^2} \cdot c$$

and the amount of the slowing is

(7-6) $\Delta c = c - c_{net}$

$$= c \cdot \left[1 - \frac{d^2}{d^2 + \delta^2} \right]$$

$$= c \cdot \frac{\delta^2}{d^2 + \delta^2}$$

$$= c \cdot \frac{\delta^2}{d^2} \qquad \text{[d^2 is much greater than δ^2]}$$

so that

(7-7)

$$\Delta v = c \cdot \frac{\delta^2}{d^2} \qquad \text{[the slowing, Δc, equals} \\ \text{the velocity change, Δv]}$$

which is identical to equation *2-17*, above.

Equation *(2-17)*, above, gives the gravitationally caused velocity change per cycle of the incoming gravitational wave field. The time rate of those velocity change increments, i.e. the gravitational acceleration, a_g, is Δv times the incoming wave's frequency, which is the source center's frequency, f_s.

(7-8) $\quad a_g = \Delta v \cdot f_s$

$$= c \cdot \frac{\delta 2}{d2} \cdot f_s$$

$$= c \cdot \frac{\delta 2}{d2} \cdot \frac{m_s \cdot c^2}{h} \qquad [m_s = \text{the source center's mass;}$$

$$= G \cdot \frac{m_s}{d2} \qquad \qquad \begin{array}{l} \text{[substituting } G \text{ per equation } \textit{2-14} \text{ re} \\ \text{the definition of the Planck Length} \\ \text{and equation 2-16 re definition of } \delta] \end{array}$$

(7-9) $\quad F_g = a_g \cdot m_e$

$$= G \cdot \frac{m_s \cdot m_s}{d2} \qquad \qquad [m_e \text{ is the encountered center's mass.}]$$

which is Newton's Law of Gravitation.

As with Coulomb's Law and inertial mass, as developed in Section 3, here gravitation, gravitational mass, and Newton's Law of gravitation cease to be mere empirically valid observations becoming instead requisite behavior aspects of natural reality derived from *Spherical-Centers-of-Oscillation* fundamentals.

INERTIAL MASS AND GRAVITATIONAL MASS ARE IDENTICAL i.e. THE SAME

From equation *(7-8)* it is clear that only m_s operates in the process of gravitation. That is, m_s in equation *(7-8)* is a gravitational mass and the gravitational acceleration is independent of m_e. Equation *(7-9)* on the other hand is merely a statement of Newton's 2nd Law. The new [relative to equation *(7-8)*] mass in equation *(7-9)*, m_e, is the inertial mass of Newton's law.

But, the overall action is mutual. The "encountered" center gravitationally attracts the "source" center at the same time as the "source" center gravitationally attracts the "encountered" center. Therefore, the quantities, m_s and m_e, are, and operate simultaneously, in both roles – "source" and "encountered", as both types of mass – inertial and gravitational. That means that inertial mass and gravitational mass are identical as follows.

Given two gravitationally attracting bodies, *#1* and *#2,* the force with which *#1* attracts *#2* must equal that with which *#2* attracts *#1* [Newton's 3rd Law of Motion]. That is

(7-10) $\quad$ Using: "Grav" = the gravitation constant [normally "G"]
$\qquad\qquad$ Body #1 has inertial mass = i
$\qquad\qquad\quad$ and gravitational mass = g
$\qquad\qquad$ Body #2 has inertial mass = I
$\qquad\qquad\quad$ and gravitational mass = G
$\qquad$ Then:
$\qquad\qquad$ Force$_{grav}$ #1⇨#2 = Force$_{grav}$ #2⇨#1

$$\text{"Grav"} \cdot \frac{g \cdot I}{d2} = \text{"Grav"} \cdot \frac{G \cdot i}{d2}$$

$$g \cdot I = G \cdot i$$

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(7-11)  If:     Inertial Mass ≡ Gravitational Mass

                I = G   and   i = g

     Then:            g·I = G·i     [of equation 7-10 above]

     Can Be:  g·G = G·g  and   i·I = I·i

     Which is obviously true.
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whereby proving that:

The inertial mass and the gravitational mass are identical.

[That conclusion, has long been thought by modern physicists to be the case, and has been indicated by the most sophisticated measurements, but has been beyond proof because of the lack of understanding of gravitation.]

CONCLUSION

The physical effects that we refer to as gravitational mass and gravitation and their behavior in Newton's Law of Gravitation are all properly understood as actions of *Spherical-Centers-of-Oscillation* via their *Propagated Outward Flow.*

The comprehensive development and set of derivations and proofs of:

- The Origin of Matter.
- Coulomb's Law
- The Lorentz Transforms
- Ampere's Law
- Matter Waves
- Orbital Electrons Behavior
- Gravitation

demonstrate the overall validity of the *Spherical-Centers-of-Oscillation* and their *Propagated Outward Flow* description of material reality which must replace the various "field" theories of modern physics as well as Einstein's General Theory of Relativity treatment of gravitation all of which fail because of their lack of developed causes and mechanisms.