Relativistic Phenomena Explained by Synthesis of Spinoza's, Leibniz' and Newton's Principles

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This paper formulates a coherent theory concerning how relativistic phenomena occur in their interconnection in a feedback loop, which no other theory has been able to achieve. This is achieved by tracing back concepts that Newton held but suppressed, when he developed his mechanics in his *Principia*. Although Newtonian mechanics was developed on the premise that everything happens within a closed system, Newton in the General Scholium at the end of Book III, pointed out that the answer lies in an open system, where 'a certain most subtle spirit' participates and directs all interactions from motion of bodies, to motion of light, to how the human brain operates. That is to say that all interactions occur in open systems. We have identified this 'most subtle spirit' as the 'universal governing field' (or governing field for short) which is non-empirical, and that no empirical interaction in this universe can occur without exchange of energy between the empirical interactants and the governing field. By analyzing the energy momentum equation, we have demonstrated that everything empirical has a non-empirical substratum, which is identified as Spinoza's primitive substance, and it is this that binds everything in the universe to the governing field and through it to one another. By recognizing the Pythagorean character of the energy-momentum equation, we have developed the 'Algorithm of Motion', which is applicable to all velocities 0<v<c. And with the application of this Algorithm, principal relativistic phenomena are explained, inclusive of accounting for time change in a GPS clock due to orbital motion. By tracing back, Leibniz' Principle of Relativity, we find the physical basis of the Lorentz transformation. How gravitation occurs is explained, and this contention is validated by accounting for the gravitational time change in a GPS clock. This theory brings the prevailing artificial schism of physics, with one theory as valid for slow motion and the other theory as valid for fast motion to an end.

1. The General Approach of this Paper

The aim of this paper is a part of an effort to develop a seamless theory to explain the following 'relativistic phenomena' (as listed in section 2) which are observed in motion of particles; and then later from these to develop the theory to embrace all physical processes including motion of light. The conceptual basis of the theory finds its origins in the ideas of Spinoza, Leibniz and Newton converging on to Maxwell's premise that all phenomena occur due to changes of states of energy [**1**, p. 72].

Hitherto all other theories have attempted to explain the six principal 'relativistic phenomena' listed below in an *ad hoc* manner, taking them singly without finding the interconnections between them. On the contrary, the present theory provides for the first time, a **coherent explanation** of how the six relativistic phenomena occur, interdependent on one another as a group and in concatenation, when a particle is set in motion at any velocity v. This is achieved by developing an **algorithm**, based on the energy momentum equation, and thereby tying all the phenomena into a **feedback loop**. The energy-momentum equation below, in turn has been discerned empirically and has been in agreement with countless experiments.

$$\left(Mc^2\right)^2 + \left(pc\right)^2 = \left(\gamma Mc^2\right)^2 \tag{1}$$

Therefore, due to the above basis, from an epistemological point of view, this is a 'theory of principles', like thermodynamics, and not a 'constructive theory', like the relativity theory which starts with arbitrary assumptions. We begin with facts (i.e. on the basis of the reality of the empirically established equation) and not with a set of unproved and unprovable assumptions. And then by analysis and deductions we move the theory forward.

2. Six Interdependent Relativistic Phenomena

This paper explains

1. Why momentum $p = \gamma_v Mv$ ($\gamma_v = 1\big/\sqrt{1 - v^2/c^2}$.) is required to set a particle of mass M and net momentum Mv in motion.
2. Why the internal processes slow down when a particle is in motion such as slowing down of an atomic clock in orbit or the delay in the decay time of a fast moving muon.
3. Why kinetic energy E_k is not $\frac{1}{2}Mv^2$ when a particle is in fast motion, but given by $E_k = Mc^2\left(\gamma_v - 1\right)$.
4. From where does the centrifugal force and Lorentz Force derive the energy that underlies them.
5. Why is it that, whereas the gamma-factor γ_v in the above four phenomena is a function of the velocity v of the particle, the gamma-factor in Lorentz transformation is $\gamma_u = 1\big/\sqrt{1 - u^2/c^2}$, where u is the velocity of the moving frame relative to the rest frame. (By the principle of relativity, which is commonly accepted by adherents and opponents of SRT, the motion of the particle is supposed to occur at velocity v with respect to the moving frame, which in turn is moving relative to the rest frame at velocity u)?

6. If the velocity of the particle is v, as assumed in points 1 to 4, why is it that the displacement is not given by $x = vt$ as in classical mechanics, but by $x' = (x - ut)\Big/\sqrt{1 - u^2/c^2}$? That is, why is the displacement of a particle, **not only** a function of its own velocity v, **but also** a function of the velocity u of the reference frame?

3. Why the Relativistic Phenomena are beyond the Ken of Classical Mechanics

At classical velocities, the above mentioned 'relativistic effects' are so minute, that as a consequence, these phenomena remain imperceptible. Since they were imperceptible, classical mechanics has been built on the **mistaken assumption** that there are no subsidiary interactions which underlie these phenomena, in a state of change of motion of a body, beside what Newton's second law stipulates. This pre-emption of the subsidiary processes is the reason why Newtonian mechanics is incapable of providing an explanation to these phenomena. The theory developed here considers that the subsidiary interactions occur at all velocities $0 < v < c$, irrespective of whether these phenomena become perceptible or not. The phenomena concerned in points 1 to 4 above occur due to the interaction that occurs between the internal energy of the particle Mc^2, the energy of motion pc, along with an exchange of energy with the Governing Field. What this Governing Field is, is discerned later when we discuss the General Scholium of Newton which he added to *Principia* Book III in 1714, during the period in which he had heated debates with Leibniz. On the other hand, the phenomenon in point nos 5 and 6, occur due to the interaction between the net energy of motion Mvc, and the energy of the background field together with an exchange of energy with the Governing Field. We discuss these interactions in detail below.

4. New Paradigm: Open System - Interactions with the Governing and Background Fields

We revise physics by synthesizing three concepts of Newton and Leibniz which have lain hidden for three centuries, without their real significance being understood. The three concepts are:

1. Interactions of the Universal Governing Field (Newton)
2. Interactions with the immediate Background Field (Leibniz)
3. Inadequacy of Newton's Second Law of Motion (Newton)

4.1. Important Concepts Newton Held Back from the Principia

It would appear paradoxical that we are now here attempting to revise Newtonian mechanics using concepts from a text that Newton prepared, to be published as a Prefatory Note or the Conclusion to the **first edition** of *Principia*, which he had nevertheless suppressed on second thoughts, and published it as the Query 31 *(Opticks*) only 20 years later [2, p.5]. His intention to include it as a Prefatory note indicates its importance, at the same time, its suppression indicates that he did not want controversy over the second law on account of this. And on the other hand, his decision to publish it later shows that he wanted to place on record his own reservations in regard to the mechanics he built. Nevertheless, in lieu of including this text itself, he has made his misgivings about mechanics clear, briefly in general terms, in the First Preface to the *Principia* [3, p. xviii] by stating that his mechanics is only a makeshift, and that he has provisionally put it forward as an aid to the discovery or the search, for the true theory based on Corpuscular principles. The statement of inadequacy of the second law is found in the previously suppressed text (Query 31). And the idea of a universal presence (which has been identified here in this paper as the Universal Governing Field) that determines all interactions is also found in this query but only vaguely. However, this idea of the universal spirit which determines all interactions has been put forward quite clearly in the concluding paragraph, of the General Scholium that was added by Newton to the very end of Principia Book III in 1714 [3, p. 547]. In regard to the interaction with the immediate background field, Newton has made a passing reference in the *Principia* [3, p.9]. However, it is Leibniz who has stated this emphatically and formulated it as a principle, (which we take up in the last section of this paper).

4.2. The Universal Governing Field

In regard to what is identified in this paper as the Interactions of the Universal Governing Field, Newton wrote,

> "And now we might add something concerning a certain most subtle Spirit, which pervades (all space –VF) and lies hid in all gross bodies; by the force and action of which Spirit, the particles of bodies mutually attract one another at near distances, and cohere, if contiguous; and electric bodies operate to greater distances, as well repelling as attracting the neighbouring corpuscles; and light is emitted, reflected, refracted, inflected, and heats bodies; and all sensation is excited, and the members of animal bodies move at the command of the will, namely, by the vibrations of this Spirit, mutually propagated along the solid filaments of the nerves, from the outward organs of sense to the brain, and from the brain into the muscles. But these are things that cannot be explain'd in few words, nor are we furnish'd with that sufficiency of experiments which is required to an accurate determination and demonstration of the laws by which this electric and elastic spirit operates" [3, p. 547].

4.3. The Inadequacy and Provisional Basis of Newton's 2nd Law of Motion

Now, to examine the statement in the Query 31 concerning the inadequacy and the **provisional basis** of his second law of motion: The statement informs that *vis inertiae* is only a **passive principle** – that is '*vis*' – the energy within the body lies inactive**.** And as a consequence, the body **will not move** (or rather, change its state of motion) solely by the body's own internal energy since this energy is inactive. (This is the first law of motion). He says some other '**active principle**' (i.e. energy in the **active mode**) is necessary for putting a body into motion. (This is the second law of motion, where the 'force' is the agency through which the energy in the active mode is delivered). And then he says that (the energy delivered by) this 'force' is also not enough, and hence yet another 'active principle' is necessary for conserving this motion that the 'force' tends to bring about.

This is what Newton states in regard to these two 'active principles' that are necessary to operate in conjunction with *vis inertia* or internal energy of a body:

> "The *vis intertiae* is a passive Principle by which Bodies persist in their Motion or Rest, receive Motion in **Proportion** to the **Force** impressing it, and resist as much as they are resisted. By this Principle alone **there never could have been any Motion** in the World. *Some other Principle was necessary for putting Bodies into Motion;* and now they are in Motion, **some other Principle is necessary for conserving the Motion**" [2, p. 51].

Newton had not described further, what these 'principles' are. However, this is a clear indication of his own admittance, that **his system of mechanics** built on the basis of the second law of motion **is a makeshift arrangement** and that the incorporation of what he calls the additional 'active principles' into his system to perfect it, is a task that must be carried out by physicists in the future, by the words, 'leave their causes to be found out'.

As for the first 'active principle', it is clear that this refers to the energy of motion Mvc, (or momentum Mv) that would get applied in proportion to the Newtonian force. But it seems that Newton had realized that this **energy of motion (hence momentum *Mv*) too has inertia.** But if this is admitted then Newtonian mechanics falls into an irresoluble, **Zeno paradox.** He knew how to calculate the inertia of a body by experiment, but there was no clue as to how the inertia of momentum was to be calculated. If he were to know the factor of proportionality for this calculation, the argument would have run as follows. In order to overcome the inertia M of the particle a quantity of momentum Mv is required, then to overcome the inertia Mv/c of this applied momentum (Mv) and keep the particle moving at velocity v, a further quantity of momentum $(Mv/c)v$ will have to be applied. But this newly applied quantity of momentum Mv^2/c too has inertia Mv^2/c^2 and to overcome this inertia, yet another quantity of momentum $\left(Mv^2/c^2\right)v$ is required and so on *ad infinitum*. Considered as an infinite algebraic series, this would be a problem for which Newton can not find a definite answer. He seems to have therefore steered his mechanics clear of this paradox, by a) by concealing the "active principle" which is energy of motion applied under the guise of the "mathematical force", and b) thereby evading the question of energy of motion in turn having inertia, demanding an infinite series of ever further increments of energy of motion. His intuition and experience would have prompted him that the solution to the problem lies in geometry, but he seems not to have been able to fathom it out. The situations of this kind that he had to dodge, for the lack of perfect geometric solutions that he preferred, could well have been the reason why he wrote in the Preface to the first edition "it comes to pass that mechanics is so distinguished from geometry, that what is **perfectly accurate** is called **geometrical**; and what is less so is called mechanical" [3, p. xvii]. This is a clear indication that he knew for good reasons that what he is giving us as "mechanics" is an inferior product, under the expediency of not being able to solve the Zeno paradox.

4.4. Solution of Zeno's Paradox: Gamma-Factor Revealed

We show below the secret of the gamma-factor by considering the infinite series, geometrically. If we consider the ratio between applied momentum of the body and the internal momentum of the body $Mv/Mc = v/c$ as equal to $\sin\phi$, then we have the following diagram (see Fig. 1). In order to overcome the inertia of $\mathrm{AD} = Mc$ and move at velocity v, it requires momentum $\mathrm{DE} = Mv(= Mc\sin\phi)$. Then in order to order overcome the inertia of $\mathrm{DE} = Mc\sin\phi$ and move at velocity v, it requires momentum $\mathrm{ED}' = Mv\sin\phi$. Similarly for ED′ it requires $\mathrm{D'E'} = Mv\sin^2\phi$, and so on.

We now consider the first two increments of momentum as a pair whose resultant is $\mathrm{EE}' = \mathrm{ED}'\cos\phi = Mv\sin\phi\cos\phi$. Then we find an infinite number of such pairs, (ED′+D′E′) + (E′D″+D″E″) + (E″D‴+D‴E‴) + ... The resultant of the series of these pairs is: (ED′+D′E′)+(E′D″+D″E″)+(E″D‴+D‴E‴)+...= EE′+E′E″+E″E‴+ $\ldots = Mv\cos\phi\left(\sin\phi + \sin^3\phi + \sin^5\phi + \ldots\right) = Mv\cos\phi\left(\sin\phi/\cos^2\phi\right) = Mv\tan\phi$, $(\mathrm{EC} = Mv\tan\phi$, as the diagram indicates$)$.

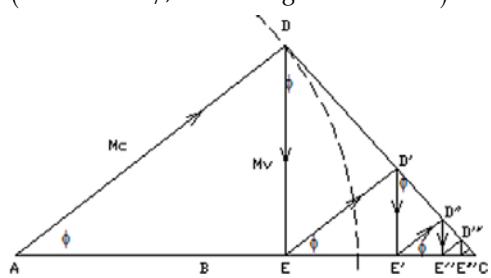

Fig. 1. Inertia of momentum as an infinite geometric series

But this $Mv\tan\phi$ is obtained from an infinite series, and consequently, this quantity can never be supplied externally to escape the Zeno paradox and set the particle in motion.

A simplistic—mechanistic—answer would be the following. Since $v/c = \sin\phi$, then $\sec\phi = 1\Big/\sqrt{1 - v^2/c^2}$. Let $\sec\phi = \gamma$, then $\mathrm{DC} = Mv\sec\phi = \gamma Mv$. Then the simplistic answer one could offer is that when $\mathrm{DC} = \gamma Mv$ is applied (instead of the Newtonian Mv) it resolves into two perpendicular components, DE = Mv and EC = $Mv\tan\phi$, and it suggest that the paradox gets solved this way. However, if we consider it that way, then we cannot account for both the slowing down of internal processes when in motion and the centrifugal force. Also we cannot account for the binding energy between the particle and the energy of motion. Hence the answer must lie elsewhere. We shall demonstrate how the Governing Field supplies this in one leap, and with this all the above phenomena find a way to be accounted for.

5. The Algorithm of Motion

5.1. Change of State occurs by Fusion of Particle Energy and Energy of Motion

Consider the energy momentum equation.

$$\left(Mc^2\right)^2 + \left(pc\right)^2 = \left(\gamma Mc^2\right)^2 \tag{1}$$

This equation is represented in the algorithm depicted in Fig. 2, where $\mathrm{AD} = Mc^2$, $\mathrm{DC} = pc = \gamma Mvc$, and $\mathrm{AC} = \gamma Mc^2$.

When energy of motion $\mathrm{DC} = \gamma Mvc$, is applied to the particle energy $\mathrm{AD} = Mc^2$, they form a sub-system, by fusing together. The interaction is similar to what occurs when an electron and a positron fuse, where fractions of their energy is usurped as 'bonding energy'. In the present interaction, from the quantities of energy $\mathrm{DC} = \gamma Mvc$, and $\mathrm{AD} = Mc^2$, fractions proportional to $(1-\cos\phi)$ of each quantity is usurped. Thus $\mathrm{DC} = \gamma Mvc$ loses CF $= \gamma Mvc(1-\cos\phi)$ and what is left is $\gamma Mvc\cos\phi$ = DF = DE = Mvc (since $\cos\phi = 1/\gamma$). And at the same time $AD = Mc^2$ loses ED = $Mc^2(1-\cos\phi)$ and what is left is $Mc^2\cos\phi$ = AE′ = DE = Mc^2/γ.

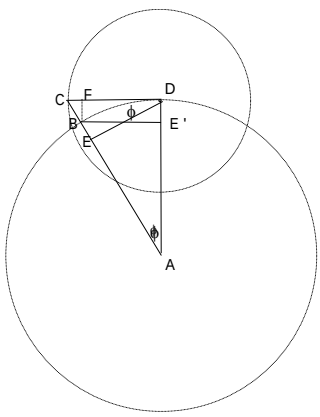

Fig. 2. Relationship between binding energy and gamma-factor

What happens is that bonding of the two quantities of energy Mc^2 and γMvc occurs by means of losing fractions of themselves as shown above. But there is no 'binding energy' *as such* that remains in the system. Rather it is **their loss,** their **absence** from the system, that brings about their bonding or their cohesion. These fractions of energy get transferred to the governing field, and in return the governing field provides the quantity of energy CF = $\mathrm{DE}\tan\phi$. Thereby Nature solves the Zeno paradox we confronted in the previous section. Instead of an infinite series of fractions of energy EE′+E′E″+E″E‴+…, being supplied *ad infinitum*, as required in Fig. 1 above, in one leap the governing field supplies $\mathrm{EC} = Mv\tan\phi$.

After the subsystem has transferred the 'binding energy' to the governing field and in return for it the latter has supplied energy $\mathrm{EC} = Mv\tan\phi$ to the subsystem, we get the algorithm of motion as shown in Fig 3.

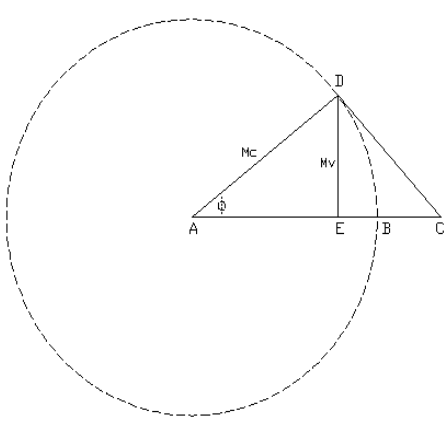

Fig. 3. Algorithm of Motion

6. Phenomena due to Interaction between Particle Energy and Energy of Motion

There is no interaction in the universe that can occur without the mediation of the governing field. Therefore the interaction between particle energy and the energy of motion too is guided and mediated by the governing field. Upon having shown in the previous section that the exchange of energy that occurs between the subsystem and the governing field we are in a position to provide answers to the following four, out of the six questions framed at the beginning of this paper:

1) Why is gross momentum $p = \gamma Mv$ ($\gamma = 1/\sqrt{1-v^2/c^2}$) required to set a particle of mass M with net momentum Mv in motion?

This is because, in order to achieve the cohesion required to form the subsystem, a fraction of energy has to be transferred to the governing field. For this reason DC, scales down to DE = Mv.

2) Why the internal processes slow down when a particle is in motion such as slowing down of an atomic clock in orbit or the delay in the decay time of a fast moving muon?

Referring to Fig. 3, the original internal energy is AD = AB $= Mc^2$. In order to achieve cohesion, the particle energy transfers EB to the governing field. The energy that is left for internal vibrations is $\mathrm{AE} = \mathrm{AD}\cos\phi = Mc^2\cos\phi$. We shall demonstrate this with the following two examples.

6.1. Clock Rate Decrease Due to Orbital Motion of the GPS Clock

Referring to Fig. 3, if the clock were at rest at on earth the atomic frequency would have been proportional to AD. When the clock is in orbit the atomic frequency is proportional to $\mathrm{AE} = \mathrm{AD}\cos\phi$. Therefore the atomic frequency would slow down when in orbit by the fraction $\mathrm{AD}(1-\cos\phi)/\mathrm{AD} = 1-\cos\phi$.

Since in an atomic clock, the clock rate is directly connected to the frequency, when the frequency decreases the clock rate diminishes by the same proportion. From the algorithm (Fig. 3) it will be seen that: $\sin\phi = v/c$ = energy of motion/internal energy of the atom $= \sqrt{GM_E/R}/c$, where R = 26,600 km is the orbital radius. Therefore the fraction $\Delta t/t$ by which the clock rate diminishes is given by:

$$\Delta t/t = 1-\cos\phi = 1-\sqrt{1-GM_E/Rc^2} \text{ per-unit change.}$$

Knowing the values of GM_E, R, and c, the clock rate diminution per day due to orbit is:

$$\Delta t/t = \left[1-\sqrt{1-GM/R_Ec^2}\right]\times 86400 = -7.202766\ \mu\text{s/day}.$$

This is the same as 7200±200 ns/day in Van Flandern's paper [4].

6.2. The Delay in Decay Time of Fast moving Muons.

In a laboratory on Earth, the disintegration of a muon occurs in a time $t = 2.2\times10^{-6}$ sec.

By the estimated distances traveled by muons in cosmic rays moving at velocities near 0.9c, the decay time is found to be 5.047 $\times10^{-6}$ sec, as recorded by Feynman. It is proposed that the half-life period of the muon is determined by a definite number N of

cycles of internal processes. At rest N cycles are completed in $t = 2.2 \times 10^{-6}$ sec.

When in motion (ref Fig. 3) the internal energy gets scaled down from AD to $\mathrm{AD}\cos\phi$. This causes the internal processes to slow down, and it takes a time $t' = t\sec\phi$ to complete N cycles.

$t' = t\sec\phi$, i.e., $t' = t\Big/\sqrt{1-v^2/c^2} = 5.047\,\mu\mathrm{sec}$, assmuming $v = 0.9c$.

In contrast to the above, SRT's "explanation" given by Feynman is pathetic and farcical: "We **do not know why the meson disintegrates** or what its machinery is, but we do know its behavior satisfies the principle of relativity. That is the utility of principle of relativity—it permits us to make predictions, even about things that otherwise we do not know much about. For example, **before we have any idea at all about what makes the meson disintegrate**, we can still predict that when it is moving at nine-tenths of the speed of light, the apparent length of time that it last is $2.2 \times 10^{-6}\Big/\sqrt{1-0.9^2}$ sec; and our prediction works—that is the good thing about it." [5, Vol. 1 ch 15 -4].

3) Why kinetic energy E_k is not $\frac{1}{2}Mv^2$ when a particle is in fast motion, but given by $E_k = Mc^2(\gamma - 1)$?

The kinetic energy is represented in the Fig 3, by E_k = BC. As explained in order to achieve cohesion, the particle has transferred the fraction of energy EB to the governing field, and the latter has transferred EC to the subsystem. Therefore BC = (EC – EB), which is the balance energy (momentum) gained by the subsystem along AC. Also we have BC = AC – AB.

Since $\mathrm{AC} = \mathrm{AD}\sec\phi$, $E_k = \mathrm{BC} = Mc^2(\sec\phi - 1) = Mc^2(\gamma - 1)$.

3a) Why $E_k = \frac{1}{2}Mv^2$ when $v \ll c$. Consider the equation

$$\left(Mc^2\right)^2 + \left(pc\right)^2 = \left(\gamma Mc^2\right)^2 \tag{1}$$

Rearranging Eq. (1) and recognizing that $E_k = Mc^2(\gamma - 1)$ we get:

$$\begin{aligned}(\gamma Mvc)^2 &= \left(\gamma Mc^2\right)^2 - \left(Mc^2\right)^2 = \left(Mc^2\right)^2(\gamma-1)(\gamma+1)\\ &= E_k Mc^2(\gamma+1)\end{aligned}$$

Therefore $E_k = \left(\gamma Mv^2\right)\left(\gamma Mc^2\right)\Big/\left[Mc^2(\gamma+1)\right] = Mv^2\left[\gamma^2\Big/(\gamma+1)\right]$

When $v \ll c$, $\gamma = 1\Big/\sqrt{1-v^2/c^2} \to 1$.

Therefore when $v \ll c$, $\gamma^2\Big/(\gamma+1) \to \frac{1}{2}$. Hence, $E_k \to \frac{1}{2}Mv^2$.

4) From where does Centrifugal Force/Lorentz Force derive its energy that underlies it?

It was pointed out earlier with reference to Fig. 1, that Nature solves the Zeno paradox of the infinite series of fractions of energy (momentum) required to keep the body in motion, by the governing field by supplying this in one leap as $EC = Mvc\tan\phi$. But we did not discuss the teleological meaning of this action by Nature. We discern this by way of accounting for the change of time due to the gravitational effect in an atomic clock in orbit in a GPS satellite.

The satellite (and the clock) cannot conserve its position wrt Earth's centre and remain in orbit if it does not possess a centrifugal force equal and opposite to the gravitational force acting on it. It would be seen from the algorithm (Fig. 3) that no matter what the velocity v of motion is, the governing field provides energy $Mvc\tan\phi$. This seems to us as a 'chance occurrence' which has no purpose. We realize the necessity that resides within this 'chance' only when the object's velocity v is equal the square root of the gravitational potential GM_E/R at a given position R from the centre. Then this velocity matches the orbital velocity at that position. But having a matching velocity alone is not enough, because for the object to remain in orbit, it requires a centrifugal force equal to the gravitational force. In this situation $Mv\tan\phi/R$ must equal the gravitational force. For this the governing field endows the energy $Mvc\tan\phi$, that underlies the centrifugal force.

Here is how it works. $Mvc\tan\phi = \left(Mvc\tan\phi/R\right)\times R$.

(Force = Energy/R; hence Energy = Force $\times R$).

Now $\tan\phi = \sec\phi\,\sin\phi = \gamma\sin\phi = \gamma v/c$. Since for the satellite, the orbital velocity $v \ll c$, then $\gamma \to 1$. Hence $\tan\phi \to v/c$. Therefore $Mvc\tan\phi \to Mv^2$. Therefore the centrifugal force = $Mvc\tan\phi/R = Mv^2/R$.

Since the gravitational potential equals gravitational acceleration multiplied by R, and the gravitational potential GM_E/R is equal to v^2, the square of the orbital velocity. Hence the gravitational energy is numerically equal to Mv^2 = EC. What this means is that the governing field has supplied centrifugal energy Mv^2 which is numerically equal to the gravitational energy.

I explained in my NPA-16 paper [6] that the gravitational energy of a body is a part of that body's total energy. That is, **the source of gravitational energy is body's internal energy** (**and the source of this energy is not the gravitational field as it is commonly believed**). I can now explain how it works. We saw that for cohesion of an electron and a positron, or in our case of the cohesion of the particle energy Mc^2 and the energy of motion pc, fractions of their energies are withdrawn to the governing field. It is the negativity (deficiency) created by this withdrawal, that causes the two entities to seek to make up for this deficiency, by **sharing energy** from one another. And in sharing each other's energy, there occurs cohesion. Gravitational "attraction" too can be looked at through the same 'lens', as a **tendency** towards cohesion.

6.3. How Gravitation Occurs

Briefly, this is how two-body gravitation operates. If the body in question were hypothetically at an infinite distance away from the earth, then the body's energy will totally be dedicated to its internal processes. At any other intermediate position, the omnipresent governing field provides the body with the necessary information about the earth (and *vice-versa*). Upon having this information, and depending on whether the body in question has moved towards or away from the centre, a fraction of the total intrinsic energy of the body is exuded to, or absorbed from, the governing field. And to the extent the energy is exuded or absorbed, energy available for internal processes is scaled down or scaled up, and to the same extent the internal vibrations are de-

creased or increased. In general when a body is in a gravitational field, the body is **always in a state of negativity**, where a fraction of its energy has been withdrawn to the governing field. And it is this negativity or the deficiency of energy that creates the urge for sharing energy of the other body (the earth). This then tends the body towards the earth seeking coherence with the earth. This creates the impression that an external gravitational force acts on the body tending the body towards the earth, whereas it is an internal 'negative force' originating within the body by virtue of the mutual suction-like action that occurs between the two bodies due to the requirement of having to share their energy. If the body is moved from the surface of the earth to a higher altitude, energy from the governing field (in the form of kinetic energy) is drawn into the body and this intensifies the internal vibrations. We demonstrate the validity of the above contention by accounting for the time change of an atomic clock due to change of altitude in a GPS satellite.

6.4. Gravitational Time Change in a GPS Clock

Let us now consider the equation governing the motion of the caesium atom in orbit. Again consider the equation

$$\left(Mc^2\right)^2 + \left(pc\right)^2 = \left(\gamma Mc^2\right)^2 \tag{1}$$

Divide Eq. (1) by γMc^2. This operation indicates to us that out of the total energy γMc^2 of the subsystem, what fraction is available for internal vibrations, and (indirectly by the equivalence of the gravitational and centrifugal forces) what fraction of it is converted to gravitational energy. By this operation Eq. (1) becomes (when the atomic clock is in orbit):

Net internal energy + equiv. grav. energy = Total energy

$$\frac{Mc^2}{\gamma} \quad + \quad \gamma Mv^2 \quad = \quad \gamma Mc^2 \tag{2}$$

When the atomic clock was at rest on earth before the launch:

Net internal energy + equiv. grav. energy = Total energy

$$Mc^2 \quad + \quad \frac{MGM_{\mathrm{E}}}{R_{\mathrm{E}}} \quad = E' \text{ (rest energy)} \tag{3}$$

Since, (as discussed) the source of gravitational energy is the body, and since this energy (considering it here as **positive** disregarding the prevailing convention) is greater when the clock is on earth, than when it is in orbit, the difference in gravitational energy $\Delta E = MGM_{\mathrm{E}}/R_{\mathrm{E}} - \gamma Mv^2$ must return to the body as internal energy and must increase the internal vibrations.

For this reason we correct Eq. (2) to (2a):

Net internal energy + equiv. grav. energy = Total energy

$$\frac{Mc^2}{\gamma} + \Delta E \quad + \quad \gamma Mv^2 \quad = \quad \gamma Mc^2 + \Delta E \tag{2a}$$

Let's now calculate the increase of frequency occuring due to the inflow of ΔE and the resulting augmentation of internal energy.

$$\Delta E = MGM_{\mathrm{E}}/R_{\mathrm{E}} - \gamma Mv^2 = MGM_{\mathrm{E}}/R_{\mathrm{E}} - MGM_{\mathrm{E}}/R$$

$$R = 26{,}600 \text{ km} \quad GM_{\mathrm{E}} = 3.986 \times 10^5 \text{ km}^3/\text{sec}^2$$

$$R_{\mathrm{E}} = 6378 \text{ km} \quad c = 2.99792 \times 10^5 \text{ km/sec}$$

When at rest on earth the frequency was proportional to the internal energy Mc^2. Therefore, the proportionate increase of frequency due to inflow of ΔE is:

$$\Delta f/f = \Delta E/Mc^2 = \left(MGM_{\mathrm{E}}/R_{\mathrm{E}} - MGM_{\mathrm{E}}/R\right)/Mc^2 .$$

We note that in GPS clocks time is determined by the number of cycles of atomic vibrations. Since the number of cycles increase with the increase in internal energy ΔE, and since time is the reciprocal of frequency, the fractional time loss $\Delta t/t$ is directly proportional to the fractional energy gain $\Delta E/Mc^2$. Hence

$$\Delta t/t = \Delta E/Mc^2 = \left(MGM_{\mathrm{E}}/R_{\mathrm{E}} - MGM_{\mathrm{E}}/R\right)/Mc^2 .$$

Hence the time increase per day

$$= 86{,}400 \times \frac{GM_{\mathrm{E}}}{\mathrm{c}^2} \frac{R - R_{\mathrm{E}}}{R\,R_{\mathrm{E}}} \text{ seconds/day}$$

The gain in time due to increase of altitude = 4.5674 x 10^{-5} sec per day = 45,674 ns/day. This result is very close to the observed result of 45,900 ± 200 ns/day in Van Flandern's paper [4].

Under point no. 2 we found that the clock rate decreases by 7.2027 μs/day. Therefore the net change in the clock rate = 45.6739 – 7.2027 = + 38.4712 μs/day. (I leave out the demonstration of the Lorentz Force due to the lack of space in this paper).

7. Philosophical Differences on Matter between Spinoza, Leibnitz and Newton

The quest of this discussion is to arrive at the fundamental requirement of finding a theory of matter based on **most general properties**, as has been indicated by both Newton and Maxwell. On the other hand the reader must realize that by using the simple algorithm based on the 'energy-momentum' equation, we have been able to provide consistent and coherent explanations to 'relativistic phenomena'. So the purpose of this discussion is also to find out what the secret power behind this equation and the algorithm is, and to show what Newton and Maxwell has indicated as a fundamental requirement is in fact what we discover in regard to the secret power of the algorithm.

We first settle accounts between the first two philosophers above (i.e., Spinoza and Leibniz), and then we come to Newton. We find that Spinoza and Leibniz in turn have assimilated their philosophical concepts from Eleatics (monism) and Pythagoreans (monad) respectively where monism concerns an undifferentiated oneness found to be inherent in everything and monad concerns its opposite, the differentiated individuality of different things. The connection between these two opposites – an undifferentiated oneness (monism) and the differentiated individuality (monad), represented by Spinoza and Leibniz as expressed by Hegel, is as follows:

> "While Spinoza asserted the universality, the oneness of substance merely … Leibnitz, by means of his fundamental principle of individuality, brings out the essentiality of the opposite aspect of Spinoza's philosophy, existence for self, the monad, … The opposed principles, which were forced asunder, find their completion in each other, since Leibnitz's principle of individuation completed Spinoza's system as far as outward aspect goes" – "History of Philosophy" [7].

Let us read the last part once again:

> "The **opposed principles**, which were forced **asunder**, find their **completion in each other**, since Leibnitz's **principle of individuation completed Spinoza's system** as far as **outward aspect** goes"

What was this outward aspect that Hegel refers to? In Descartes' philosophy, matter had extension, but had no 'soul', the ability to sense, think, and respond. However, in Spinoza's and Leibniz' philosophies, matter had extension as well as the soul. This was the outward aspect in which they were similar.

How about the inward aspect? And what is it? And in discovering this, we not only bring Spinoza and Leibniz together, we also fulfill the aforementioned pre-condition, that is basing of physics on **general** properties - that both Newton and Maxwell declared to be essential to arrive at a proper theory of physics.

> "To tell us that every Species of Things is endow'd with an occult specifick Quality (of Gravity, and of magnetick and electrick Attractions, and of Fermentations) by which it acts and produces manifest Effects, is to **tell us nothing**: But to derive two or three **general Principles of Motion** from Phaenomena, and afterwards to tell us how the **Properties and Actions of** *all corporeal Things* follow from those manifest Principles would be **a very great step** in Philosophy, though the Causes of those Principles were not yet discover'd: And therefore I scruple not to propose the Principles of Motion above mention'd, they being of **very general Extent**, and leave their Causes to be found out" - [2, Query 31, p. 53]

> "The success of this method depends on the **generality** of the hypothesis we begin with. If our hypothesis is the **extremely general one** that the phenomena to be investigated depend on the **configuration and motion** of a material system, then if we are able to deduce any available results from such an hypothesis, we may safely apply them to the phenomena before us … If, on the other hand, we frame the hypothesis that the configuration, motion, or action of the material system is of a **certain definite kind**, and if the results of this hypothesis agree with the phenomena, then, unless we can prove that no other hypothesis would account for the phenomena, we must still admit the possibility of our hypothesis being the wrong one … It is therefore of greatest importance that we should be thoroughly acquainted with the **most general properties** of material systems, and it is for this reason that in this book I have rather dwelt on these general properties than entered on the more varied and interesting field of the special properties of particular forms of matter." [1, p.122]

This, consideration in terms of the behavior of a generic substance underlying all physical processes, is the piece in the jigsaw that had been overlooked in physics. Once this piece is discerned, the puzzle of relativistic phenomena will be solved. In order to make the relevance clear to the reader of what relativistic phenomena have got to do with resolution of the nearly 2700 year old debate between Eleatic monism and Pythagorean monads, let us consider the "energy-momentum equation" once again.

$$\left(Mc^2\right)^2 + \left(pc\right)^2 = \left(\gamma Mc^2\right)^2 \qquad (1)$$

Let us identify the **individual** terms of the equation as "monads". And we may notice coincidentally that the equation consisting of these terms certainly have a Pythagorean flavor to it , where the sum of the squares of the two terms of the left is equal to the square of the term forming the resultant on the right.

We need to note that if the first and second terms on the left hand side (i.e. Mc^2 and pc) do not belong to the same qualitative category of thing, they cannot enter into a meaningful quantitative relationship and produce the term on the right hand side, which is γMc^2, as the resultant. This is in accordance with the principle pointed out by Aristotle, which states that in order that a given number of quantities to be commensurated with one another, there has first of all got to be **qualitative equality** (i.e. qualitative sameness) among these quantities. In the modern context it means that all terms of an equation should have the same dimensionality for the equation to be valid. Now Mc^2 and pc both have the same dimensionality ML^2T^{-2} of energy. Mc^2 is the quantity of energy that a given matter particle consists of. Since pc (which is the momentum x c that is applied to set the particle in motion), has the same dimensionality, it means that pc has to have a quality identical to that of the particle itself, at some level. So we conclude that pc is 'energy of motion'. But as we see,

1. Mc^2 represents the energy of the particle which is something corporeal and pc represents energy of motion, which is something **incorporeal**.
2. The Mc^2 is passive (being inertial) and pc is **active**, which tends to overwhelm inertia of Mc^2 and set it in motion.
3. So in their individual empirical states (as monads) they are entirely different, physically and functionally, to one another.
4. Therefore, we need to infer from the above differences between Mc^2 and pc, that their **qualitative equality must lie at non-empirical** level.
5. Then, on the one hand, for them to be in empirical states that are quite different (i.e. the particle being corporeal and the energy of motion being incorporeal); and on the other hand, for them to be in a non-empirical state, in which they are qualitatively the same (for the equation to be valid), they then both have to be dualisms existing in empirical and non-empirical states at one and the same time.
6. This is possible if the empirical states of both these are modalities of the same (non-empirical) primitive substance in their origin.
7. Then we can conclude that their qualitative equality as required by Eq. (1) is founded in this common origin. In their empirical form they exist in two different modes, nevertheless they still innately bear the **character of the common primitive substance,** from which they originated. Thus, the dualism.

$$\text{In origin primitive substance} \begin{array}{l} \nearrow \text{ energy in Matter, } Mc^2 \\ \searrow \text{ energy in Motion, } pc \end{array}$$

This **inherited character** arising from the non-empirical primitive substance being the **common genetic origin** of both, is the Eleatic monism that underlies the Pythagorean relationship of the 'monads' in the above equation. In other words, the monism is due to the omnipresence of Spinoza's substance in everything in this universe. And this substance is energy in the generic form. And this generic energy is the 'genetic material' that lends the

common quality to Leibniz monads having different identities (in our case matter particle Mc^2 and energy of motion pc in our above equation).

The failure to recognize the existence of generic energy in non-empirical form is why science has not progressed forward on the basis of Leibniz monads. It cannot move forward without identifying the interconnection correctly. Spinoza identifies substance at primitive undifferentiated level. Leibniz monads are different from one another. Leibniz failed to realize that Spinoza's substance is universal and it is the primitive whose secondary modifications and transformations that have metamorphosed into Leibniz monads. Leibniz considered his monads were primary.

In actual fact Leibniz monads are developments of Spinoza's primitive substance and they still exist within a sea of this primitive substance. However, Leibniz sees the products of Spinoza's substance (monads), which form the next level of physical states as the primary. This is the connection between Spinoza's substance and Leibniz monad which has not been made.

Does this mean that Spinoza's substance is the ultimate primitive? That we do not know. The notions of primitive and derivative are hierarchical relationships. As we go further deep into such a hierarchy what is 'primitive' at one level, turns out to be the 'derivative' for the next and so on.

However, for the understanding of the relativistic phenomena, we need to recognize that there is a connection between these two levels, where Spinoza's substance is sub-micro, Leibniz monad is micro, and therefore complex combinations of monads form the macro. So we have, so to speak, a co-habitation of three generations - the progenitor and two levels of progeny living side by side each other. The progenitor pervades all space and matter throughout the universe in the form of the governing field. Now if we identify Spinoza's substance as energy in the generic form, the common **genetic material** out of which the three forms of energy, namely a) matter particles, b) energy of motion and c) photons are made of, then we find that these latter three kinds are represented by Leibniz' monads. Spinoza's substance is the genetic material (the generic energy) which has the form mc^2. Since Monads are made of this genetic material, they too have the same genetic signature $Mc^2 = n \cdot mc^2$.

7.1. Newton's Governing Substance:

For Leibniz, the monad intrinsically has the ability to sense and respond. This for Leibniz was Godliness living in the empirical monad. In lower forms this ability is decentralized but in higher forms it even develops entelechy, the centralized governing organ, within the monad itself.

In 1714, Newton added the General Scholium at the end of the Book III of the *Principia*. This was, firstly in opposition to Leibniz idea of God's empirical presence, where Newton effectively adopted Spinoza's omnipresent, non-empirical, undifferentiated primitive substance. The improvement Newton made was that he assigned the omnipresent primitive substance to be one and only entelechy, the governing organ of all empirical substances in the whole universe. However, Newton was an Arian. Therefore, through this Scholium, he was not only opposing Leibniz, but was also opposing the concept of Holy Trinity.

> "God is the same God, always and everywhere. He is omnipresent, not *virtually* only, but also *substantially*; for virtue cannot subsist without substance. In him are all things contained and moved; yet neither affects the other: God suffers nothing from the motion of bodies; bodies find no resistance from the omnipresence of God.
>
> "….'Tis allowed by all that the supreme God exists necessarily; and by the same necessity he exists *always* and *every where*. Whence also he is all similar, all eye, all ear, all brain, all arm, all power to perceive, to understand, and to act; but in a manner not at all human, in a manner not at all corporeal, in a manner utterly unknown to us. As a blind man has no idea of colours, so have we no idea of the manner by which the all-wise God perceives and understands all things. He is utterly void of all body and bodily figure, and can therefore neither be seen, nor heard, not touched; nor ought he to be worshipped **under the representation of** any corporeal thing". ('Thou shalt not consider Jesus Christ as God's representative and worship him') [3, p 545].

Since in his Arian frame of mind the concept of God incarnating into human form was anathema, he has aborted the possibility of the non empirical primitive substance transmuting into empirical substance and the reverse. Such a notion would have equated to the non-empirical God descending from heaven to incarnate Himself in human flesh (i.e. into the empirical form) and then ascending back into heaven in the non-empirical form. It would have been heresy for him to admit this even in analogy. Nevertheless, it is this heresy, that provides us with final concept that completes the perspective necessary to solve the riddle of relativistic phenomena.

I am unable to include here the relevant extracts of the Scholium for lack of space. His concluding paragraph is stated once again below: "And now we might add something concerning a certain most subtle Spirit, which pervades (all space – VF) and lies hid in all gross bodies; by the force and action of which Spirit, the particles of bodies mutually attract one another at near distances, and cohere, if contiguous; and electric bodies operate to greater distances, as well repelling as attracting the neighbouring corpuscles; and light is emitted, reflected, refracted, inflected, and heats bodies; and all sensation is excited, … (but there is no means for -VF) demonstration of the laws by which this electric and elastic spirit operates". It would be important for the reader to refer to the whole of the General Scholium to capture Newton's perspective and to grasp it in full.

In this paper by taking Newton's idea of governing non-empirical substance, and incorporating into it what would have been the inadmissible heresy for Newton of transmutation between empirical and non-empirical forms of substance, I have upgraded Spinoza's substance to the level that it is sovereign and that it also participates all interactions of empirical substances. It exists as **generic energy** of the **governing field** pervading the whole universe, inside and outside all empirical substances. I leave it for those who are religious whether or not this governing, non-empirical entity is to be considered as God or God's instrument, as they so wish (because some people are likely to tweak the governing field as 'God's Sensorium' anyway).

8. Lorentz' Transformation and Leibnitz Principle of Relativity

Leibniz principle concerns interactions of energy, and is therefore a dynamic principle. Consequently, it facilitates the understanding, and therefore providing of a **coherent explanation** of how the relativistic phenomena as a group of interrelated phenomena occur.

I will first explain why classical physics and SRT are unable to answer point 5) in our list on page 1. The Poincare-Einstein Principle and the Classical Principle of relativity both consider that the motion of the system (i.e. the motion of local reference frame -LRF, relative to which the motion of an object occurs), does not have any effect on the motion of the object. This means that no matter whether an experiment is conducted on Jupiter orbiting at 13 km/sec or on Mercury moving at 48km/s, the results will be identical. The same force will make the body to move at the same velocity irrespective of the motion of the system (LRF). This is because these principles do not take into account that a fraction of the energy applied to move the body relative to the system gets usurped to co-move with the system. So, the above principles have closed the door, to even thinking in dynamic terms of a possibility the motion of the **local** reference frame having an influence on the motion of a particle moving relative to it. Since this is an essential element in the present paradigm, almost everybody is afflicted with this syndrome, of axiomatic assumption of the nil influence of the motion of the LRF. Therefore they are forced to concoct cock and bull stories in kinematic terms such as length contraction, time dilation, mysterious character of co-ordinate transformations, etc., when confronted with the phenomena arising from this influence.

In Leibniz principle, a fraction of the applied energy gets usurped to enable co-movement with the system. For instance on Jupiter this fraction usurped to co-move with the system will be less than that usurped on Mercury. Therefore the same force *F* applied to move a body of same mass *M* on Jupiter will move faster relative to Jupiter than relative to Mercury. However, both will move at the same velocity when considered relative to the frame of the sun. (That is the total velocity, which is equal to the velocity of the object relative to the planet + planet relative to the sun; is the same for both cases). The efficiency of the applied energy would be highest if the object were to move relative to a hypothetical rest frame (i.e. if the system were at rest). On the other hand, the faster the system moved, the efficiency of the applied energy drops. It is the same in a thermodynamic system. Higher the temperature of the background, lower the efficiency of energy. If the background temperature were absolute zero, then the efficiency would be 100%.

This paper explains Lorentz transformation (in accordance with Leibniz principle) in terms of this usurpation of a fraction of energy for the common motion with system and the consequent drop in the efficiency of energy. Lorentz transformation is for mechanics, what is the theorem of impossibility of *perpetuum mobile* in thermodynamics. They are both particular cases of the same Leibniz principle of relativity. In order to co-move with the local reference frame, the energy of motion Mvc requires to dedicate a fraction of it equal to $(u/c)Mvc$. Therefore there occurs a fission in the energy of motion, into $(1-u/c)Mvc$ and $(u/c)Mvc$. So the energy of motion available for the particle to move relative to the local frame is not Mvc, but $(1-u/c)Mvc$.

We saw that when there is a fusion of two quantities of energy, there was a scaling down of both the quantities of energy (as in the pair production). The opposite is true when there is a **fission** of a quantity of energy into two parts, the energy gets **scaled up** by the factor γ_u. So the energy of motion available for motion of the particle relative to the local reference frame is

$$\gamma_u(1-u/c)Mvc = \frac{1-u/c}{\sqrt{1-u^2/c^2}}Mvc\,.$$

The velocity of the particle is: $v' = \dfrac{1-u/c}{\sqrt{1-u^2/c^2}}v$.

Hence the displacement for any velocity $0<v<c$ is:

$$x' = \frac{x-ut}{\sqrt{1-u^2/c^2}}\frac{v}{c}\,. \tag{4}$$

Eq. (4) is the universal equation which is applicable to all situations. For the special condition $v \to c$, and $v/c \to 1$ (for which the "Special Theory" is valid) the v/c term becomes a hidden parameter. Hence

$$x' = \frac{x-ut}{\sqrt{1-u^2/c^2}}\,. \tag{5}$$

9. The Ruling Paradigm Fails to Understand Relativistic Phenomena

Unlike in Newton where a body consists of passive *vis inertia*, according to Leibniz, each body consists of an actively interactive substance. This paper explained why it requires energy $\gamma_v Mvc$ to set a body of mass *M* in motion at velocity v), in terms of interaction that occurs between the internal energy of the body Mc^2 and the applied motive energy $\gamma_v Mvc$. This interaction entails in bonding the energy of motion $\gamma_v Mvc$ and the internal energy of the body Mc^2. And this bonding is achieved by usurping, a proportionate fraction $1/\gamma_v$ of both quantities of energy to the governing field. This leaves Mvc as the energy available for motion. But in Leibniz principle, there is a **dual motion for a particle**, it not only moves relative to the local reference frame, but must also co-move with the local frame at velocity *u*. In order to achieve this dual motion, the energy Mvc must fission into two components. And this fissioning is brought about by an influx of energy from the governing field such that it **scales up** the two components of energy by the factor γ_u.

The question would arise that if Leibniz principle were true, then why these phenomena are not evident to us in our day to day observations. In order to explain this, I would like to present the following example. Consider a road in a somewhat of a bad condition; that has some degree of ruts and bumps all over. Yet a very careful driver can drive a car (with good shock absorbers) within state stipulated speed limits, in a manner a passenger will not feel the lateral motions, shakes and jerks, and he will think

that the car is moving smoothly. This is because the shakes and jerks remain insensibly small at the low speeds. So once the passenger gets acquainted with this experience, (since so far he has never had a fast ride) he will come to the conclusion, that the car ride will be smooth irrespective of the speed as well as the condition of the road.

He will turn this into a paradigm that irrespective of the condition of the road, I can pour a drink into a glass without spilling it while the car moves at any speed whatsoever, in the same manner as I would, while the car is stationary. This is because he does not notice that within the seemingly uniform flow of the drink into the glass, there are subsidiary processes creating little eddies. But if the car speeds up far, far beyond these limits that he is hitherto used to, no matter how careful the driver is and no matter how good the shock absorbers are, what were previously imperceptible eddies due to the subsidiary processes, will **amplify** many fold and develop into menacing proportions. He will find that the drink gushes out while trying to pour and some of it spills over.

Similarly, whether a particle is in slow motion or fast, the same interactions occur. First, the interaction involving fusion of the applied energy and the internal energy of the particle, and the usurpation of bonding energy into the governing field the consequent reduction of internal energy and slowing down of internal processes; and secondly the interaction involving the fission of the available energy of motion to facilitate co-movement with the local frame while at the same time moving relative to it, and the concomitant scaling up of this energy that we discussed above, occur. What needs to be understood is that when a body moves in slow motion (i.e., at 'classical velocities') the whole ensemble of phenomena related to these interactions lies imperceptible. It appears as if, when a force is applied the particle moves in a **linear relationship**, in accordance with Newton's second law in straight forward manner. But in fast motion (i.e. at relativistic velocities) these phenomena **amplify** and manifest themselves. The subsidiary processes which generate these phenomena are of a non-linear character. Since at lower velocities, they are negligibly small, in the development of classical mechanics, the existence of these subsidiary processes have missed the attention of the founders of classical mechanics from the time of Newton to the end of the 19th century. Thus it became the ruling paradigm that the motion of an object is independent of the motion of the system where it is located.

It is only by the end of the 19th century, physics arrived at the stage of conducting experiments with fast moving particles at 'relativistic velocities'. When in fast motion, the subsidiary processes (which remained imperceptible at classical velocities) amplified non-linearly and began to manifest phenomena, physics was thrown into a crisis, because they could not explain these phenomena under the existing paradigm. The existing paradigm ruled out the possibility of such phenomena arising from subsidiary processes. Besides, the paradigm entertained only the idea that motion gets inflicted on the body in direct linear proportion to the applied force under Newton's second law.

In order to find a solution to the crisis, the leading physicists of the era, at the behest of Poincare, adhered even more firmly like a drowning man clings to a straw, to the very same rogue principle of relativity (denying interaction with the background), which in fact was at the bottom of the crisis. Pseudo-concepts like length contraction and local time that were developed by his predecessors, were re-hashed by Einstein and he concocted the wonderful theory SRT.

SRT can be overthrown only by the rejection of the Poincare-Einstein principle of relativity and by replacing it with Leibniz principle of relativity.

10. What is Leibniz Principle of Relativity?

The elements of Leibniz principle [8] are found in the following statement (broken down to indicate the elements separately):

> "And indeed every single substance is a certain force of acting, or an endeavor to change itself with respect to all the others according to certain laws of its own nature.
>
> "Thus, any substance whatever expresses the whole universe, according to its own point of view.
>
> "And in the phenomena of motions this fact is especially apparent, since every single body that one posits there must have **a motion in common with some other**, as if they were in the same ship, as well as its own motion, reciprocal to its bulk; how this could be so could not be imagined if motions were absolute and every single body did not express all others."

It must be noted that in Leibniz view four basic differences are to be found.

1. His principle is applicable to all physical processes universally, (not only for motions of bodies).
2. The body contains within itself a certain interactive capacity, (as against Newton's passive *vis inertia*).
3. By this inherent interactive capacity, it maintains a universal connection with all the processes in the universe.
4. There is also a local organic link by virtue of having a common motion between the object in motion (or the physical process) and the energy of motion of the background.

The body is in a dual motion. It has its discrete motion relative to its local reference frame (ship), and it also has a motion in common with the local reference frame. If the energy of motion of the body were strictly with respect to the local frame (i.e. absolute), and if it did not have a component of energy to move with the local frame, it will not be able to be an integral part of the hierarchy of motions of the universe.

What is stated here last is most important to understand. The moon moves relative to the earth, and at the same time it has a motion in common with the earth round the sun. How this is effected is that by virtue of the centre of mass of the earth-moon system moving round the sun, the moon moves discretely relative to it. Then at the next level the same process is repeated, planets move round the sun discretely while they all move in common with the centre of mass of the solar system, and so on. By this means the moon's motion becomes an integral part of the hierarchy of motions of the universe.

In order to understand the deeper meaning of Leibniz principle, we need to contrast it with Huygen's principle of relativity, which is almost identical to Poincare-Einstein principle.

> "The motion of bodies and their equal and unequal speeds are to be understood respectively, in relation to other bodies

which are considered as at rest, even though perhaps both the former and the latter are involved in another **common motion**. And accordingly, when two bodies collide with one another, even if both together are further subject to another uniform motion, they will move each other with respect to a body that is carried by the same **common motion** no differently than if this motion extraneous to all were absent.

"Thus, if someone conveyed on a boat that is moving with a uniform motion were to cause equal balls to strike one another at equal speeds with respect to himself and the parts of the boat, we say that both should rebound also at equal speeds with respect to the same passenger, just as would clearly happen if he were to cause the same balls to collide at equal speeds in a boat at rest or while standing on the ground."

In discussing Leibniz principle we discussed the efficiency of energy. If a force F were to be applied to an object of mass M located in a hypothetical rest frame then the efficiency of energy is 100%. In Jupiter (moving at velocity 13 km/sec) energy is more efficient than in Mercury (moving at velocity 48 km/sec).

In contrast, in Huygen's principle of relativity, energy is 100% efficient in all inertial reference frames irrespective of whether the frame is at rest or moving at any velocity whatsoever. That is, a fraction of the energy applied to set the body in motion relative to the local frame does not get usurped for the motion in common with the frame. It is this same idea that is found in Poincare-Einstein principle of relativity.

And here is Poincare's version:

"The laws of physical phenomena must be the same, whether for a fixed observer, as also for one dragged in a motion of uniform translation, so that we do not and cannot have any means to discern whether or not we are dragged in a such motion."

Therefore Huygens (and Poincare too) is at the other extreme from Leibniz view. For Huygens, motion of a body is discrete, there is no organic link between the energy of motion of a body with the energy of the background. Whereas in Leibniz principle there is an organic link between the energy of motion of the body moving relative to its local frame and the energy of motion of the local frame.

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