Reality Based analysis of Relativistic Dynamics

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Abstract

Scientific progress is often achieved when successful quantitative analyses emerge from reality-based qualitative models. However, in domains beyond direct human perception, many dynamic parameters cannot be adequately conceptualized due to observational limitations. To address such challenges, scientists frequently introduce hypotheses, assumptions, and mathematical axioms that may deviate from the apparent uniformity of nature in order to develop predictive mathematical models. While such models may yield accurate quantitative results, their underlying physical mechanisms often remain difficult to visualize or comprehend. Human knowledge of nature arises through the natural functioning of the senses and consciousness, both of which are fundamentally linked to reality. Therefore, a mathematical model that lacks physical conceptualization may represent only an abstract description of an underlying reality-based process. If a hypothetical mathematical model successfully predicts experimental outcomes, there is no inherent reason why a physically realistic model describing the same phenomenon should fail to achieve equivalent quantitative agreement.

Einstein's Special Theory of Relativity and its mathematical formalism represent a remarkable achievement in quantitative physics. Nevertheless, the physical mechanism responsible for the relativistic increase in resistance to acceleration at high velocities remains conceptually challenging. The present work proposes a reality-based field–particle interaction model to explain this phenomenon. According to the proposed concept, all particles in their neutral state possess a nucleus surrounded by an extranuclear space structure. Charged particles are characterized by a modified extranuclear structure with reduced dimensions. Space itself is considered a physical medium composed of matter in a finer domain rather than an empty vacuum. Consequently, this medium offers resistance to particles moving at extremely high velocities. As the velocity of a particle increases, the resistive interaction with the medium causes directional deformation of its elastic extranuclear structure. Simultaneously, portions of the outer structure are progressively stripped away, leading to a complete loss of the extranuclear structure when the particle velocity approaches the velocity of light, (v = c). Since electric and magnetic fields propagate with velocity (c), the effective field–particle interaction is proposed to be proportional to the relative velocity ((c-v)) rather than to the constant value (c). Furthermore, the interaction strength is assumed to depend on the effective interaction cross-section, represented by the field area swept by the particle's extranuclear structure during motion. As velocity increases, this interaction cross-section

continuously decreases and becomes zero at (v = c). The combined reduction in relative interaction velocity and effective interaction cross-section causes the field-induced force acting on the particle to decrease progressively with increasing velocity. Consequently, the particle experiences a substantial reduction in acceleration as its speed approaches the velocity of light. This interpretation provides a physically realistic explanation for the observed difficulty of accelerating particles to light speed. Based on this framework, a new dynamical equation for high-speed motion has been formulated, and its predictions are found to be in close agreement with the corresponding relativistic equation.

Keywords: *Relativistic Dynamics, Reality-Based Physics, Field–Particle Interaction, Physical Space Medium, High-Speed Particle Dynamics.*

Introduction

A body resting on the surface of a solid does not accelerate following straightforward Newtons law (F=Ma). The effective motive force for acceleration is obtained by deducting the frictional resistance to arrive at the working equation as F-μR = Ma, where μ is the coefficient of friction and R is normal reaction. For a particle moving in space, the insignificant resistance to motion offered by the medium becomes highly significant in high-speed motion which has to be accounted properly for the validity of Newtonian equation.

Every atomic and sub-atomic particle have structure comprising nucleus and extra-nuclear space structure in the new concept [1] [2]. The spatial space density of the space medium and its structural integrity with the nucleus decreases outwardly from the surface of the nucleus to the boundary of extra-nuclear space structure. The space medium, though devoid of micro particles but contains space matter particles of micro-micro domain light particles in neutral state. Hence the space medium is a photonic gas. Like the atomic gaseous fluid, the space medium is essentially a photonic gaseous fluid capable of offering resistance to motion of particles in space. The fluid resistance though insignificant in ordinary velocities becomes highly significant at velocities comparable to c, because the resistive pressure is proportional to square of velocity.

The particle with equilibrium extra-nuclear space structure in a locality is a neutral particle. In non-equilibrium state of mass-space association, the particle carries charge [3] [4]. The charge particle in a field (electric and magnetic field) experiences a force due to field-particle interaction. The interaction cross-section is the area that the extra-nuclear space structure of the particle sweeps the field. The extra-nuclear space structure deforms in motion due to the resisting pressure of the medium. The resisting pressure being proportional to the square of velocity, as the velocity increases the field-particle interaction cross-section decreases which in turn decreases the field induced motive

force. At speed close to velocity of light, the entire extra-nuclear space structure is removed by the resistive thrust [5]. Thereafter, the interaction cross-section becomes zero and no further acceleration is feasible. This limits the maximum velocity which can approach upto the velocity of light.

The Maxwells field velocity is same as the velocity of light. Thus, the field effect on transfer of momentum from field to particle is a function of relative velocity (c-v) and not c. When the particle velocity reaches the field velocity the momentum transfer from field to particle becomes zero. Here again the velocity of particle can only approach c and cannot exceed c. The combined effect of decrease in interaction cross-section and the relative velocity cause a rapid drop of the accelerating force.

Besides the above considerations on reduction of effective motive force, we also notice a directional field effect due to charge polarization by the deformation of extra-nuclear space structure according to the new concept of charge. The new charge state of particle in high-speed motion has a role in the dynamics. The extra-nuclear space structure of particle, is deformed due to the impact of structured space medium which plays an important role in the dynamics, that becomes highly significant in high-speed motion. It is absolutely necessary to have the physical concept of space, time and spacetime for realizing the physical significance of special relativity.

Critical Analysis of Historical and Contemporary Concepts of Physical Space

The author identifies **mass and space** as the only two fundamental constituents of the physical universe and the existence of three primary interactions: **mass–space attraction, mass–mass repulsion and space–space repulsion** [6]. Within this framework, gravity [7], electric charge [3],[8] and various optical phenomena are interpreted as consequences of these fundamental interactions. The theory seeks to provide a unified physical basis for several natural phenomena while avoiding the conceptual difficulties such as associated with wave–particle duality [9],[5],[10],[11],[12],[13].

In the proposed model, space is regarded as a **compressible, continuous, and invisible fluid-like physical medium** containing space-matter particles of finer domain [14]. Owing to the intrinsic space-space repulsion, space naturally tends to expand and distribute itself throughout the universe, thereby establishing universal continuity. However, this expansion is constrained by the attractive interaction between mass and space. The competition between these two opposing tendencies generates a non-uniform spatial distribution of space around material bodies, producing regions of varying space density.

The interaction of mass–space attraction and space–space repulsion gives rise to pressure within the space medium. Consequently, regions possessing higher space density are associated with higher spatial pressure. Due to mass-space attraction, the nuclei in all domains organize and maintain the space structure surrounding it and the dense space retains the particles of finer domains within the space medium thereby forming space structures. These embedded constituents within space medium are referred to as **space-matter particles**. Accordingly, an increase in space density corresponds to an increase in the number density of space-matter particles.

Since the mass–space attraction is assumed to obey an inverse-square dependence on distance, every celestial body develops a variable nature of space-density distribution surrounding its central mass. This structure is conventionally recognized as the atmosphere of the celestial body and, in a broader sense, may be regarded as its **extra-nuclear space structure**.

The extent of this extra-nuclear space structure depends upon both the mass of the central nucleus and the background space density. The background space density acts as a boundary condition determining the spatial extent of the structure. The same principle is proposed to operate for particles of all domains, where analogous extra-nuclear spatial structures exist.

Spatial variations in both space density and the number density of space-matter particles of different kind can be represented through three-dimensional density distributions. Since these distributions are determined by the properties of the central nucleus, the resulting spatial gradients provide a direct measure of gravitational effects. Gravity, in this interpretation can as well be evaluated from the manifestation of the spatial density gradient surrounding the matter.

The theory further considers the nucleus and its extra-nuclear space structure as a single integrated physical system. Consequently, the spatial structure accompanies the nucleus during translational motion and co-rotates with it during rotation. Space-matter particles embedded within a rotating spatial structure experience centrifugal effects that oppose gravitational attraction. As rotational velocity increases, a condition may arise at a particular radial distance where centrifugal force exactly balances gravitational attraction, producing a state of effective zero gravity.

This equilibrium condition is expressed as

$$\frac{GM_1m_2}{d^2} = \frac{m_2v^2}{d}$$

Under this condition, no net radial acceleration acts upon the orbiting body. Objects located at different distances from the nucleus acquire different spatial velocities corresponding to the rotational state of the surrounding space medium. Since gravitational attraction and centrifugal force become numerically equivalent at equilibrium, gravity may be quantitatively determined through centrifugal considerations. This observation suggests an alternative interpretation of gravitational phenomena and invites a re-examination of conventional concepts such as Newtonian gravitation and Einsteinian spacetime curvature.

Historically, numerous concepts of space have been proposed and subsequently abandoned because of theoretical inconsistencies or experimental limitations. Nevertheless, many of these historical models contained valuable insights regarding the active role of space in physical processes. The present theory seeks to synthesize these useful elements into a revised conception of physical space, time and space-time.

Proposed Properties of Physical Space

The principal characteristics of the proposed space model may be summarized as follows:

- Space is a real physical entity containing space-matter particles of finer domains due to space-mass attraction.
- Space is both compressible and capable of indefinite expansion due to space–space repulsion.
- Matter compresses space through mass–space attraction.
- Space density varies spatially due to distribution of matter.
- Spatial density gradients arise naturally around material bodies.
- The number density of space-matter particles is directly proportional to local space density.
- Gravitational field is a reflection of the directional gradient of space density or the density of space-matter particle since they are proportional to one another.
- Space-matter particles may possess electrical or non-electrical charge characteristics thereby different charge fields arise from their density gradients.
- Charge fields can undergo polarization under the influence of external charge distributions.
- For practical purposes, space may be modeled as a fluid-like continuum.

- The continuity of space provides continuity to the physical universe.
- Matter and its associated spatial space structure constitute a unified dynamical system that translates and rotates together.
- **As a physical medium, space can exhibit spatially varying structural and state properties.**

Distinction from Classical Ether Theories

Although the proposed concept attributes physical reality to space, it differs fundamentally from the classical luminiferous ether. Wave theories of light require a medium possessing an exceptionally high elastic modulus to support the propagation of electromagnetic waves. Such a medium would simultaneously need to offer negligible resistance to the motion of celestial bodies. These requirements appear mutually incompatible. A medium sufficiently rigid to sustain light waves would impede planetary motion, whereas a medium permitting unrestricted planetary motion would be incapable of supporting the required wave dynamics.

This conceptual difficulty provides a basis for questioning the wave interpretation of light and motivates reconsideration of a particle-based description. In the present framework, physical space is envisioned as a low-density photonic gas analogous to an atomic or molecular gas. If light is fundamentally particulate rather than wave-like, then the absence of ether drift in the Michelson–Morley experiment does not necessarily preclude the existence of a physical space medium, since such a medium would not be essential to function as a carrier of light waves. Instead, it would serve as the physical substrate within which light particles propagate and interact.

This revised conception seeks to restore an active physical role to space while avoiding the theoretical limitations historically associated with classical ether models.

Progressive development in concept of time, historical to updated.

The concept of time has evolved continuously through philosophy, astronomy, classical physics, relativity and modern quantum theories. Human understanding of time progressed from a simple measure of natural cycles to a profound physical and philosophical entity connected with motion, change, matter and the structure of the universe.

In ancient civilizations, time was understood mainly through repetitive natural phenomena such as day and night, lunar phases, seasons and planetary motions. Early

Greek philosophers viewed time differently. Aristotle considered time as a measure of change and motion, not an independent substance. According to him, time exists because events and motions occur in nature.

During the scientific revolution, Isaac Newton introduced the concept of absolute time. Newton proposed that time flows uniformly and independently throughout the universe, unaffected by matter or motion. In Newtonian mechanics, time was universal, identical everywhere and completely separate from space. Every observer shared the same cosmic clock.

Later, Gottfried Wilhelm Leibniz challenged this view by arguing that time is relational rather than absolute. According to Leibniz, time is only the order or sequence of events and has no independent existence apart from physical processes.

In the nineteenth century, the development of thermodynamics introduced the concept of the “arrow of time.” The increase of entropy suggested that natural processes possess directionality, distinguishing past from future. Time was no longer viewed merely as a neutral parameter but as something associated with irreversible physical change.

A major transformation occurred with Special Relativity developed by Albert Einstein. Einstein showed that time is not absolute but relative to the observer’s motion. Clocks moving at high speeds experience time differently, leading to the phenomenon of time dilation. Later, General Relativity demonstrated that gravity can also affect the flow of time. Strong gravitational fields slow down clocks, linking time directly with matter, energy and spacetime geometry.

Modern physics further transformed the concept of time. In quantum mechanics, time generally appears as a parameter rather than a measurable operator, creating difficulties in unifying quantum theory with relativity. Some modern theories suggest that time may emerge from deeper microscopic processes rather than being fundamentally continuous. The process-based time is dependent on the kinematics of the process which depends on local process parameters.

Contemporary alternative approaches sometimes interpret time as a manifestation of physical change, energy transformation or structural reorganization of matter and space. Some thinkers propose that time is not an independent entity but a measure of sequential physical processes occurring in nature. In such views, the flow of time reflects the evolution of material systems rather than the movement of an invisible universal clock.

In another contemporary interpretation, time is regarded not as an independent entity or a separate dimension of nature but as a conceptual measure derived from physical processes. According to this view, the perception of time emerges from the

sequential occurrence of events, motion of matter, and transformation of energy within the universe. The apparent flow of time reflects the continuous evolution of material systems, while clocks merely register the rate of ongoing physical processes. Thus, time has no existence independent of matter, motion and change; rather, it serves as a quantitative description of the progression of natural phenomena. This perspective seeks to provide a more cause-and-effect-based understanding of temporal experience by relating time directly to the dynamics of physical reality [15].

Thus, the concept of time has progressively evolved from cyclic natural observation to absolute universal flow, relativistic spacetime dimension, thermodynamic directionality, quantum uncertainty and modern process-based interpretations. The history of science shows that time remains one of the deepest and most evolving concepts in human understanding of nature.

In view of the foregoing discussion, time is not regarded as an independent entity that flows irrespective of matter; rather, within the process-based interpretation, it serves as a parameter describing the dynamical evolution of material systems. From this perspective, Einstein's proposition that the passage of time is influenced by spacetime geometry warrants deeper examination in terms of process-based time and the role of boundary conditions.

A fundamental principle of physical inquiry is that the local dynamics of an event are not altered by its distant observation. Observers situated in different frames of reference may record or describe the same event differently owing to their relative states of motion; however, such observational differences do not necessarily imply a change in the intrinsic physical reality of the event itself. The event remains singular, even though its description may vary among observers.

Consequently, the interpretation of spacetime should provide an unambiguous account of physical reality that clearly distinguishes between the actual dynamics of a system and the observational effects associated with different reference frames. The remarkable predictive success of relativistic equations cannot be disputed; nevertheless, their conceptual foundations deserve continued scrutiny. **It may therefore be worthwhile to investigate whether the relativistic relations can be derived from a framework based on physically relevant dynamical parameters, thereby preserving both their predictive power and conceptual clarity.**

Historical concept of space-time prior to Einstein.

Before the development of relativity by Albert Einstein, space and time were generally treated as two completely separate and independent entities. The historical

understanding of space-time evolved gradually through philosophy, astronomy, and classical mechanics.

Space and time were associated with physical events but were not unified into a single framework. Time was viewed as flowing continuously, while space was regarded as the static arena in which motion occurs.

Leibniz argued that space is merely the order of coexistence of objects, while time is the order of succession of events. According to him, neither space nor time possesses independent existence apart from material relations.

Thus, prior to Einstein, the dominant historical view considered space as a fixed three-dimensional stage and time as a separate universal flow. The modern unified concept of spacetime had not yet emerged, though late nineteenth-century electromagnetic theory and transformation mathematics gradually prepared the foundation for Einstein's revolutionary interpretation.

Physical space possesses geometrical attributes such as extension, distance, and spatial relations. The dynamical evolution of matter, on the other hand, represents an intrinsic process that is not itself a geometrical property. If time is interpreted as a parameter characterizing this intrinsic dynamical evolution, then geometrical and dynamical aspects of physical reality belong to distinct conceptual categories. The spacetime formulation combines these categories into a unified four-dimensional geometric structure. While this formulation has proven mathematically successful, its physical interpretation remains a subject of philosophical discussion because the resulting four-dimensional geometry is not directly accessible to perception or intuition. **If the dynamics of matter can be formulated with equal predictive success while maintaining a distinction between geometrical and dynamical parameters, then such an approach may provide greater conceptual transparency without sacrificing mathematical rigor. The question is therefore not whether spacetime mathematics is valid, but whether the fusion of geometrical and non-geometrical parameters is physically necessary or simply one among several mathematically equivalent descriptions of reality.**

The key challenge of the program is not philosophical consistency but demonstrating that a space-plus-process formulation can reproduce all experimentally verified relativistic effects—time dilation, length contraction, relativistic momentum, mass-energy equivalence, gravitational redshift, GPS corrections, and so forth without invoking spacetime as a fundamental entity. If that can be achieved, then it would become a scientific alternative rather than merely a philosophical critique.

A motor bike moving on a road has a velocity 'v' at a given rate of energy input (fuel consumption). The windage resistance offered by the atmospheric air is proportional to the projected area of motor bike with rider, the density of the air, squire of relative velocity of the bike and the properties of the air medium. If the wind is in the direction of the motion, the bike will move at a higher relative speed than that in still air and has a reduced relative velocity when the wind is in opposite direction. A person sitting in a train observes the velocity of bike as 'v_r'. He further finds v_r varies with the speed of the train relative to the earth. It is found that the speed of the bike that respond to acceleration by fuel supply to the engine has a little significance with v_r. On the other hand, the motion of the medium (wind speed) has a role in the dynamics. However, it is not easy to translate the changes of local physical conditions when an object moves in free space or vacuum. In the existing concept though space is considered physical with ability to interact with matter but the physical nature of space is conceptualised through mathematical objects and events which is beyond human perception. The present author, on the basis of uniformity of nature has explored the existence of matter in finer domain (micro-micro domain) thereby perceiving a real structure of space similar to gaseous form of matter. He further, adds to the feasibility of different fields due to presence of non-electric charge (photonic charge) in space matter particles (photon). The new concept of physical space can have space density (space content per unit volume) and mass density due to number density of space matter particles and the space medium can have different spatial velocities similar to wind velocity. Thus, the dynamics of a particle can be reworked out by considering the local relevant parameters instead of the consideration of observational special relativity. The observed motion from a moving frame, not connected with dynamics can be replaced by local parameters (local frame of reference) for a reality-based analysis. In this new concept the fused space-time has an ordinary significance of space with a dynamism where time is a function of dynamism.

The dynamic equation $F = ma$ though valid at lower velocity but doesn't hold good at extreme high velocity due to improper coupling of the motive field force and the exponential increase of resistance offered by the medium. A body moving at same speed cannot transfer momentum to another body at same speed. When the speed of the charge particle increases, the effectiveness of electromagnetic coupling with charge particle decreases with increase of speed which causes reduction in the value on the interaction force $E.e$ or qBv. The drive (interaction) from a field to a particle depends on the differential speed of the field particles and the particle being accelerated. The propagation velocity of electromagnetic field disturbances in vacuum medium is constant having the value 'c'. But the velocity of an accelerated particle goes on increasing with a constant field-particle interaction. At any spatial velocity 'v', the field-particle coupling factor is dependent on $(c - v)$. When 'v' is comparatively very small the difference can be approximated to 'c'. Thus, the electromagnetic force for low velocity coupling condition

gives a constant value given by $E.e$ or qBv. However, when 'v' approaches 'c' the force coupling reduces very-very rapidly thereby the effort to accelerate is drastically reduced and becomes zero at the speed c. In the new concept every particle has a nucleus and extra nuclear space structure which in equilibrium in neutral state. A charge particle with limited extra nuclear shell structure has a definite interaction cross-section for the field-particle interaction. The extra nuclear space structure is highly elastic and is subject to deformation in highspeed motion. Thus, the spherical extra nuclear space structure deforms to spheroidal form, the longitudinal cross-section of which is ellipse. The interaction cross-section of the extra nuclear space structure reduces from πr^2 reduces to πb^2 where b is the semi-minor axis of the ellipse. With gradual increase of velocity, the kinetic energy of the particle goes on increasing and the particle successively loses electronic shells of extra nuclear space structure of the particle by attending successive ionization potentials thereby, further reducing the interaction cross-section. At extreme high velocity the particle will lose all its extranuclear space structure and the bare nucleus approaches the zero-interaction cross-section. In the new concept the interaction cross-section is dependent on the form on which the interaction takes place. However, following the old concept of interaction cross-section of the charge particle one may limit the interaction cross-section from the electromagnetic response time.

However, the success of this new approach ultimately depends on whether it can quantitatively account for all relevant experiments, including muon decay, particle accelerators, atomic clocks and other precision tests. The subsequent discussion is made through mathematical interpretation.

Mathematical analysis on Newtonian Force equation for high-speed motion

Step 1: Basic Newtonian Equation

The author retained the universal status of the basic Newtonian equation and considered decrease of accelerating force due to changes in field-particle interaction.

The basic Newtonian equation:

$$F = Ma$$

$$q.E = Ma$$

Where, E = Charge field
q = Charge of the particle

The field induced force on a charge particle considers $q.E$ don't remain constant for all velocity of the particle since it depends on the relative velocity between field and

particle as well as the field-particle interaction cross-section. Hence, the force equation is modified in high-speed motion as:

$$q.E.\alpha_v.\beta_v.\eta = Ma\ , \qquad Eq^n - 1$$

Where,

α_v is the force reduction factor at velocity v due to change in relative velocity.

β_v is the force reduction factor at velocity v due to decrease of interaction cross-section.

η is the force reduction factor at velocity v due to change of sheer resistance and drag force.

Determination of α_v

The velocity of field lines is same as velocity of light (c), thus the relative velocity between the field and particle at rest is c. However, when the particle accelerated to velocity (v) the relative velocity for field-particle interaction changes to $c - v$, hence, the force reduction factor at velocity v due to change of relative velocity is:

$$\alpha_v = \left(\frac{c-v}{c}\right).$$

Determination of β_v

The interaction cross-section of extra nuclear space structure reduces gradually with increase of velocity of the particle due to the resistive thrust from the space medium. The force due to field-particle interaction decreases in proportion to the decrease of interaction cross-section. If the sweeping area of extra nuclear structure is reduced from A_0 to A_v then β_v is given by:

$$\beta_v = \left(\frac{A_v}{A_0}\right)$$

The interaction cross-section area (A_0) due to the presence of extra nuclear space structure at rest or slow motion compared to velocity of light (c). The interaction cross-section reduces to A_v at velocity v by stripping off part of its extra nuclear structure that correspond to A_{Lv} and the interaction cross-section area reduces to A_c at velocity c by stripping of the entire interaction cross-section. A_c becomes zero when A_{Lc} becomes A_0 when the interaction cross-section is stripped off fully.

Thus: $A_c = A_0 - A_{Lc} = 0\ , \quad when\ A_{Lc} = A_0\ (Numerically)$

Where, A_{Lc} is the loss of interaction cross-section at velocity v = c

Similarly, $A_v = A_0 - A_{Lv}$

The reduction factor of loss of interaction cross-section at velocity v is given by

Now,

$$\beta_v = \frac{A_v}{A_0} = \frac{A_0 - A_{Lv}}{A_0}$$

$$= 1 - \frac{A_{Lv}}{A_0}$$

$$\beta_v = 1 - \frac{A_{Lv}}{A_{Lc}}$$

The loss of cross-sectional area is directly proportional to the dynamic pressure caused by the relative velocity between particle and the structured space medium which in term is proportional to square of relative velocity [16].

Thus, $A_{Lv} = kv^2$ and $A_{Lc} = kc^2$, where k is proportionality constant.

$$\beta_v = 1 - \frac{A_{Lv}}{A_{Lc}} = 1 - \frac{kv^2}{kc^2}$$

$$= 1 - \frac{v^2}{c^2}$$

Or $\beta_v = \frac{c^2 - v^2}{c^2}$

Determination of η

The factor η contributing towards change in the accelerating force due to the thrust of structured space medium and sheer at the interface of extra nuclear space structure of particle and the space medium. The contributing factor is a function of dynamic pressure and interaction cross-section. The factor increases with rise of velocity dependent dynamic pressure and decreases with velocity dependent interaction cross-section. Thus, $\eta = \left(\frac{p_v}{p_0}.\frac{A_v}{A_0}\right)$ remain constant for all velocities. Therefore, the factor $\eta = 1$.

Substituting the value of α_v, β_v & η in equation-1

$$F_v = F_0\left(\frac{c-v}{c}\right).\left(\frac{c^2-v^2}{c^2}\right) = Ma, \qquad Eq^n - 2$$

F_v = Accelerating field force at high velocity v.

F_0 = Accelerating field force at rest or low velocity.

When $v \rightarrow c$, c can be substituted by v but c^2 can not be substituted by v^2.

Hence

$$(c-v)^2 = c^2 + v^2 - 2v^2 = c^2 - v^2$$

Hence, $(c-v)^2 = c^2 - v^2$ or $c - v = \sqrt{c^2 - v^2}$

Now, $\frac{c-v}{c} = \frac{\sqrt{c^2-v^2}}{c} = \frac{\sqrt{c^2-v^2}}{\sqrt{c^2}} = \sqrt{\frac{c^2-v^2}{c^2}} = \sqrt{1-\frac{v^2}{c^2}}$

Thus,

$$F_0\left(\frac{c-v}{c}\right).\left(\frac{c^2-v^2}{c^2}\right) = Ma$$

Becomes

$$F_0\left(\sqrt{1-\frac{v^2}{c^2}}\right).\left(1-\frac{v^2}{c^2}\right) = Ma$$

$$F_0\left(1-\frac{v^2}{c^2}\right)^{\frac{3}{2}} = Ma$$

Substituting $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$

$$\frac{F_0}{\gamma^3} = Ma, \qquad Eq^n - 3$$

The above equation is the realistic equation in high-speed motion where the effective interaction force is reduced due to dynamical change in the form of extra nuclear space structure of the accelerating particle.

If the above equation is written in the form:

$$F_0 = \gamma^3 Ma, \qquad Eq^n - 4$$

For particle accelerator

$$q.E = \gamma^3 Ma$$

The equation assumes the expression of relativistic equation. Though mathematically there is no difference between equation-3 and equation-4, but philosophically there is a great difference where the realistic equation-3 considers the accelerating force reduces due to situational conditions, whereas the relativistic equation-4 considers unrealistic relativistic effect.

If now v becomes zero or close to zero (at rest or at low speed) the equation-2 reduces Newtonian equation form, $F = Ma$.

For the magnetic force in accelerator

$$F = qvB \qquad Eq^n - 5$$

For circular motion in accelerator:

$$F_B = \frac{mv^2}{r}$$

At low speed:

$$qvB = \frac{mv^2}{r} \qquad Eq^n - 6$$

As the velocity increases the magnetic flux B intercepting the particle reduces by a factor $\frac{c-v}{c}$. Thus, at low speed the factor remains near to 1 but is reduced drastically when v approaches the speed of magnetic field lines (c). The value of $\frac{c-v}{c} \approx \sqrt{1-\frac{v^2}{c^2}}$, where $v -> c$. The interaction cross-section for magnetic flux has a near ellipse form where at high-speed the semi-minor axis (b) decreases and semi-major axis (a) increases with square of velocity. Hence, the interaction cross-section for magnetic field lines remains nearly constant. Therefore, the term $1 - \frac{v^2}{c^2}$ doesn't appear for the magnetic interaction.

Hence, at high-speed condition the equation-6 becomes:

$$qv\left(B \times \sqrt{1-\frac{v^2}{c^2}}\right) = \frac{mv^2}{r}$$

Substituting $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ we get:

$$q\left(B\frac{1}{\gamma}\right) = \frac{mv}{r}$$

In this equation q, r & m remaining constant the effective interaction of magnetic flux B reduces realistically with increase in velocity. On the other hand, if q, B & r is assumed constant then the momentum (p) becomes associated with the γ factor. Therefore, the conceptual mode of equation changes to:

$$qB = \frac{\gamma mv}{r}$$

$$p = qBr = \gamma mv \qquad Eq^n - 7$$

Conclusion

The present work attempts to provide a reality-based interpretation of relativistic dynamics by introducing a structured physical space medium and velocity-dependent field–particle interactions as the underlying cause of the observed resistance to acceleration at high velocities. By considering the reduction of effective field coupling and interaction cross-section as velocity approaches the speed of light, the analysis derives a mathematical expression that assumes a form equivalent to the relativistic force equation while preserving a direct cause-and-effect physical interpretation. The paper further discusses revised concepts of space, time, and spacetime within a unified mass–space framework and highlights the possibility of explaining relativistic phenomena without invoking intrinsic modifications of space and time. Although the proposed model offers an intuitive conceptual alternative, its ultimate scientific validity depends on its ability to quantitatively reproduce all experimentally verified predictions of relativity with equal precision. The study therefore serves as an exploratory step toward a more physically interpretable framework for high-speed dynamics and the broader unification of physical sciences.

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