Introduction

This book has two parts. In the first part, various inadequacies of fundamental physics have been discussed, where a change in approach, a paradigm shift is called for. The second part studies the evolution of matter particles and fields from space-time distortions. As per the current theoretical approach, natural phenomenon is modeled on abstract mathematical notions, without recognizing the necessity for mental visualization and comprehension of the associated physical phenomenon. Mathematical models based on actual physical observations cannot obviate the necessity of a physical theory with causal linkages for logical explanation of the associated phenomenon.

In first two chapters it is brought out that whereas the metric scaling property is only associated with coordinate space, the physical measurable properties of permittivity ε_0, permeability μ_0 and intrinsic impedance Z_0 are only associated with physical space. Existence of aether medium has been under fierce debate for more than a century now. In reality, various notions of physical space, empty space, vacuum, aether and their modern reincarnation, the quantum vacuum, all mean the same entity – call it by any name. We will however, prefer to call this entity 'Elastic Space Continuum'. A significant point to be highlighted here is that just like the intrinsic impedance $Z_0=\sqrt{\mu_0/\varepsilon_0}$, the speed of strain wave propagation $c=\sqrt{1/(\mu_0\varepsilon_0)}$ is also a measurable property of the physical space.

The curvature of space (and spacetime) is a sophisticated buzz word under the current paradigm of fundamental physics. However, the interpretation associated with the curvature of space is quite misleading. As per General Theory of Relativity (GR), gravitation induced 'change' in metric of space, induces a corresponding change in the value of Riemann tensor, which by '*convention*' implies a change in curvature of space. It is clarified in chapter 7 that any 'change' in the metric coefficients of space actually implies a change in arc length ds between two neighborhood points, which in turn implies a deformation of space. Any such deformation of space is mathematically linked with the strained state of the space continuum. Since gravitation induced deformation or strained state of the space continuum is technically reversible, it implies the association of elasticity property with the space continuum. Hence, we may regard the empty space as an **elastic space continuum**.

In chapters 3 to 6, various issues related to the Special Theory of Relativity (SR) have been discussed. It is shown that except for the mass energy equivalence, all other assertions and postulates of this theory are fundamentally wrong and misleading. Specifically it is shown that an

absolute fixed reference frame, like the International Celestial Reference Frame (ICRF), can be constructed in any closed volume of space with finite matter content. The notion of infinitely many reference frames, flying around with relative uniform motion, with fictitious observers riding them, is basically redundant and misleading. The concept of absolute reference frame is extended to the Universal Reference Frame and an experimental technique has been outlined for practically establishing the same, just like the ICRF.

In chapters 8 and 9, it is shown that the notion of spacetime continuum or spacetime manifold is just a mathematical abstract notion and not a physical entity as assumed in the General theory of Relativity. In GR, localized mass energy content in a certain region of physical space (say the solar system) is '*supposed*' to influence the metric of whole spacetime, including the region of spacetime identified with the past time. But the transmission of 'influence' from the present to the past region of spacetime is logically impossible. Once we understand that spacetime is just an abstract mathematical notion, we cannot accept GR to be a physical theory. Even if we '*assume*' spacetime continuum to be a physical entity, it can be shown that the gravitation induced deformation of space leads to an incompatible set of strain components which cannot be valid due to physical constraints. At the most GR could be regarded as a mathematical model in which an abstract notion of spacetime manifold has been used as a graphical template with differential scaling of its space and time axes, to represent the particle trajectories as geodesic curves.

It is shown in chapter 10 that the famous uncertainty principle is strictly applicable for certain mathematical representations of the physical phenomenon and not to the phenomenon itself. However the uncertainty principle has scuttled our attempt to mentally visualize the physical phenomenon. For example, once we accept the shackle of uncertainty on our imagination, we cannot mentally visualize the orbital motion of electron around the proton. In chapter 11, it has been specifically demonstrated that without the uncertainty principle we can study the orbital motion of electron around proton in great detail. We can even simulate the photon emission phenomenon and visualize the orbital transitions. Further, it is shown that the so called total energy E is the total amount of energy already removed (emitted out) from the system and hence does not 'belong' to the system any longer. The negative potential energy V is the amount of energy released by the 'superposed' fields of the system of interacting particle and does not 'belong' to any one particle at any time.

While simulating the photon emission phenomenon during electron transitions from higher orbits to lower orbits, it emerges that the time required for emission of photon is just about 5 percent of the orbital time period in higher orbit. That means the emission of photon is not related to the physical oscillations of the electron and that its emission time is much shorter than L/c where L is the total length span of the photon along its flight path. In fact the photon gets emitted from the interacting fields of the electron and proton almost instantaneously. Based on this observation, a new hypothesis is proposed at chapter 12 regarding the variation of photon wavelength with the velocity of 'light source'. An alternative explanation for the null result of the famous Michelson–Morley experiment has been developed from this hypothesis.

Fundamental limitations of the Standard Model (SM) of particle physics have been discussed in chapter 13 of the book. In particular it has been shown that the exchange theory of interaction, which is the founding postulate of the SM, is fundamentally invalid due to the absence of any suitable physical mechanism for prior exchange of required information. Further, the SM has practically failed to provide adequate information on the characteristic shape, size and internal structure of any of the elementary particles. Hence, even if we retain the Standard Model as an excellent empirical mathematical model, we cannot afford to abandon the search for a more appropriate theory of elementary particles and their interactions.

Part II of the book mainly covers the hitherto unexplored field of space-time distortions or 'space dynamics' to analyze the shape, size, internal structure and mutual interactions of elementary particles. The study of space-time distortions or dynamic deformations in the space continuum, through a detailed study of corresponding time dependent displacement vector **U**, strain tensor **S** and stress tensor **T** fields in the elastic space continuum, may be termed as space dynamics. A detailed analytical study of dynamic deformations in the physical space continuum, through the time dependent displacement vector field **U** provides a more fundamental level of investigation into the workings of Nature, in comparison to the fields currently employed for the purpose. Apart from unification between electric and magnetic fields, the displacement vector field provides a unique mechanism to demarcate the physical boundaries of elementary particles.

In the Elastic Space Continuum, due to lack of discrete atomicity, we must assign the Poisson's ratio equal to zero. Also noting that there are no translational or rotational rigid body motions in the continuum, we find that the components of strain tensor $\mathbf{S}=[S^i_j]$ need not be symmetric.

The components of strain tensor referred to a coordinate system y^i, will therefore be related to the components of displacement vector $\mathbf{U}=[u^i]$ through the relation $S^i_j = \partial u^i/\partial y^j$ or $u^i_{,j}$. The Hooke's law of elasticity, relating the stress tensor $\mathbf{T}=[\tau^i_j]$ to the corresponding strain tensor components, takes the simple form $\tau^i_j = (1/\varepsilon_0)\ S^i_j$, where $1/\varepsilon_0$ is the elasticity constant for the continuum in appropriate units.

The equilibrium equations of elasticity in the Elastic Space Continuum turn out to be identical to the Maxwell's vector wave equation for the electromagnetic field as $\nabla^2\mathbf{U} = (1/c^2)\ \partial^2\mathbf{U}/\partial t^2$. The displacement vector **U**, strain tensor **S**, and the stress tensor **T**, are absolute entities and are invariant under coordinate transformations. These equilibrium equations, subject to appropriate boundary conditions, do not permit of any static (i.e. time invariant) strained state in the continuum and all permissible solutions in terms of displacement vector components u^i will be functions of space and time coordinates. The partial derivatives of u^i with respect to time t (more correctly ct) that is, $(1/c).\partial u^i/\partial t$ will constitute temporal strain components S^i_t in addition to the spatial strain components mentioned above.

The detailed study of any deformed or the stressed region of the Elastic Space Continuum primarily involves the detailed solution of the equilibrium equations subject to appropriate boundary conditions. In the deformed or stressed state of the Elastic Space Continuum, certain amount of strain energy will get stored in the region under stress. The strain energy density W or the energy of deformation per unit volume, at any point of the continuum, is a function of the intensity of strain at that point, and is an invariant. The strain energy density in the Elastic Space Continuum is given by $W = (1/2\varepsilon_0)$[Sum of squares of spatial and temporal strain components].

A closed region of Elastic Space Continuum in a strained state, satisfying the equilibrium equations & boundary conditions, may be termed as a strain bubble, provided the total strain energy content in this closed region is time invariant constant. Although the strain components at any point within the strain bubble are always functions of space and time coordinates, yet the strain energy density at that point may or may not vary with time. If the strain energy density at all points within a strain bubble is time invariant, the strain bubble is likely to be stable, otherwise unstable. The total strain energy content E_0 of a strain bubble will represent its 'rest mass' m_0 through the famous energy equivalence relation $E_0/c^2 = m_0$.

If the strain fields of two strain bubbles overlap in a certain region of the Continuum, then total strain components will be obtained by superposing the corresponding components of both the strain bubbles. Strain energy density and hence the total energy of the common field will be governed by the sum of squares of the resultant strain components. Interaction energy (E_{int}) or the conventional potential energy, of two such interacting strain bubbles is defined as the difference between the total strain energy with superposed strain fields (E_{sup}) and the sum of their separate strain field energies (E_1 and E_2) that is, $E_{int} = E_{sup} - (E_1 + E_2)$. A negative interaction energy or potential energy will imply release of a portion of the total strain energy of two interacting bubbles. The released energy may either transform into another strain bubble wholly or partly and emitted out of the system, or transform into kinetic energy of motion of the interacting strain bubbles.

At subatomic scale the primary constituents of matter, namely the electrons and nuclear particles are known to occupy an extremely small volume fraction of the order of 10^{-12} percent of the physical volume of any material body. These 'material particles' concentrated in such a small volume fraction of entire space, consist of so called 'elementary particles' and are essentially characterized by their 'mass', 'charge' and interaction properties. In the parlance of strain bubbles existing in the Elastic Space Continuum, the clusters of pure and composite strain bubbles depicting 'elementary particles' are essentially characterized by their 'strain energy content', 'strain wave fields' if any, and their interaction properties. In principle, there could be a large number of different types of strain bubbles occurring in the Space Continuum, that may be correlated with equally large number of stable and unstable elementary particles.

We have obtained particular solutions for the strain bubbles that correspond to well known stable particles namely electron, positron, proton, neutron and the photon. Strain bubble solutions that correspond to neutrinos and some of the unstable particles like mesons, have also been discussed. Specifically the electron, positron pair is found to be the lowest order spherically symmetric strain bubble solution of equilibrium equations. This strain bubble consists of standing strain wave core of about 1.61×10^{-15}m (1.61 fm) radius, surrounded by a radially propagating phase wave field extending up to infinity. The amplitude of these phase waves keeps diminishing with radial distance. These phase waves propagate outwards from the core at radial velocity c for the positron and propagate inwards to the core at radial velocity c for the electron. The effective strain components in this wave field are proportional to the

'root mean square' (rms) value of the amplitude of the corresponding strain waves. The unique characteristic features of these radial strain wave fields manifest in the unique charge property of these strain bubbles. Detailed computations of strain energy content show that almost 65 percent of the total mass energy of the electron is contained in its core and remaining 35 percent in its field.

The nucleon core is represented by one lowest order, cylindrically symmetric solution of equilibrium equations of elasticity in the Elastic Space Continuum. The strain energy density within the core region of this strain bubble is completely time invariant, implying overall stability of the nucleon. Detailed computations show that the nucleon core is of the shape of a right circular cylinder of 5.4 fm diameter and 3.1314 fm length. The familiar strong interaction between nucleons results from the physical overlap of their cores. The proton consists of a positron entrapped inside a nucleon core through strong interaction and moving around the nucleon core center within a radius of about 1fm. The neutron consists of an electron entrapped inside the outer periphery of a proton through strong interaction and moving around the core center within a radius of about 2.6 fm.

The strong interaction between two or more strain bubbles or particles is physically effected through the superposition of the strain fields in their cores. The so called range of strong interaction is small just because the physical spread of the core region is small. On the other hand the electrostatic as well as the electromagnetic interaction is physically effected through the superposition of the radial wave fields of the interacting particles. Since the electrostatic wave fields of all charge particles physically extend up to infinity, the range of electromagnetic interaction is said to be infinite. Similarly the gravitational interaction between two or more neutral particles is shown to be physically effected through the superposition of their neutral ripple wave fields, which too extends unto infinity.

Finally, the fundamental nature of the matter particles and their associated fields, as brought out in this book, represents only the proverbial 'tip of the iceberg'. Significant amount of further research work is called for in this direction. The Quantum Mechanics needs to be recast in terms of strain waves instead of probability waves. Finally, the detailed new understanding of the strong interactions among nucleons, positrons and electrons can be of great value in the planned development of nuclear fusion processes and controlled fusion devices for peaceful energy generation in the future.

