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Abstract

A comprehensive description of the nature of light, electricity and gravity is provided in terms of quantum wave mechanics. Detailed models include the photon as a travelling electromagnetic wave and the electron as a closed loop standing wave formed by a confined photon. An electron is modelled as a torus generated by a spinning Hopf link as a result of an imbalance of electrostatic and magnetostatic energy. Electric charge is a manifestation of a slight precession characterized by the fine structure constant. The physical vacuum as a polarizable medium enables wave propagation and appears ultimately to be quantized at the Planck scale. Standing wave transformations for objects in motion are reviewed and Lorentz Doppler effects compared. The mechanism for generation De Broglie matter waves for objects in motion is depicted including the inverse effect of induced motion of an object by synthesis of contracted moving standing waves. Gravity is viewed as a frequency synchronization interaction between coupled mass oscillators. The acceleration of gravity is described by a spectral energy density gradient. Gravitons are shown to be phase conjugate photons. The metric of curved spacetime corresponds to the electromagnetic wave front interference node metric. Hence, the gravitational field becomes quantized.

Keywords

acceleration, aether, anti-gravity, anti-matter, arrhythmia, boson, Bragg, charge, clock, contracted moving standing waves, co-gravitation, Compton, consonance, Coulomb, curvature, de Broglie, dielectric, diffraction, dimensions, dipole, Dirac, dissonance, Doppler, Einstein, electricity, electrokinetic, electromagnetic, electron, energy, Faraday, fermion, fine structure constant, frequency, Fresnel, gravitational frequency, graviton, gravity, gravitomagnetic, kinetic, Hopf link, impedance, inertia, interference, Ivanov, Jefimenko, Jennison, light, LaFreniere, Laithwaite, Lorentz, Macken, magnetic, mass, matter, matter waves, Maxwell, metamaterial, metric, moiré, Newton, neutrino, neutron, nonlinear, oscillators, phase, phase conjugation, phasor, photon, Planck, polarization, potential, Poincaré, Poynting, precession, Puthoff, quantum, quark, radiation, refraction, relativity, resonator, proton, scalar, Schrödinger, Schwarzschild, Shepard tones, soliton, spacetime, spectral energy density, spin wave, spinors, standing waves, Sternglass, Storti, symmetry, synthesized Doppler, Tesla, topological, torsion, travelling waves, universe, wave-based propulsion, wave function, wave vector, Winterberg, vacuum, vector potential, velocity, zero-point, zitterbewegung

Synopsis

The book provides a comprehensive description of the nature of light, electricity and gravity. What is a photon? Just what is electric charge? How is gravity generated and why does it result in attraction? How are photons and electrons created and interconverted? How is matter 'materialized' from the vacuum? Why is the speed of light limited to a fixed, finite velocity? This book gives a lucid, detailed account with numerous illustrations, numerical examples, formula relations and dimensions providing a visualizable, geometric quantum description for layman and specialists alike. Several interrelated themes are developed in terms of wave phenomenon with historical experimental and theoretical background providing an introductory review of relativistic, classical and quantum mechanical concepts and speculative extrapolation.

Section 1 gives a detailed description of the photon including a geometric helical soliton model with characteristic dimensions as a function of frequency and wavelength. Group/phase/signal velocity, spin, chirp, and wave vectors are illustrated. Properties of electromagnetic waves and antenna theory are reviewed including representations in terms of scalar and vector potentials. Diffraction, reflection and phase conjugation are reviewed and illustrated. Curvature and torsion characteristics of light are illustrated and Planck characteristics of the physical vacuum are detailed with explanation for the finite velocity of light, antenna radiation resistance and zero-point energy. Confinement of light within a fixed volume resonator is shown to result in creation of rest mass and inertia. Standing wave transformations for objects in motion is extensively reviewed and Doppler and Lorentz Doppler effects compared. Equivalent representations in terms of Lorentz transformations and Einstein special theory of relativity (SR) are delineated. The mechanism for generation De Broglie matter waves for objects in motion is depicted including the inverse effect of induced motion of an object by synthesis of contracted moving standing waves.

Section 2 provides a discussion of electric charge and relation to topological charge. The dimensions of electric charge in terms of mass, length and time dimensions are detailed. An explanation of the fine structure constant α is given and a derivation of this mysterious constant developed. A geometric toroidal model of the electron is illustrated with an extensive tabulation of characteristics including spin and precession. A physical model of Faraday electric field lines and magnetic field lines is shown in terms of the underlying

quantum vacuum enabling a physical understanding of abstract quantum electrodynamic concepts. A detailed geometric description is illustrated for pair production and annihilation of electrons and positrons providing a level of intuitive understanding beyond that of Feynman diagrams and representations of point-like elementary particles. The sequence of geometrical transformation of an energetic gamma ray into an electron/positron during pair production and the inverse process of annihilation is diagrammed.

Section 3 chronicles the development of various gravitation theories. Einstein's general theory of relativity (GR) is detailed and contrasted with an optical theory of gravity providing a physical description of 'curvature' of spacetime in terms of nodal distances of electromagnetic waves. Deflection of light in a polarizable vacuum is illustrated and transformation in terms of variable index of refraction and gravitational gamma are given. The frequency of gravitational fields is shown with examples of the Earth's gravitational field illustrated. A geometrical helicoidal model of the graviton is detailed and a quantized electromagnetic description of gravity is developed. Properties of a phase-locked, phase conjugate resonator in a gravitational field are shown with concept examples of future technological development of wave-based propulsion.

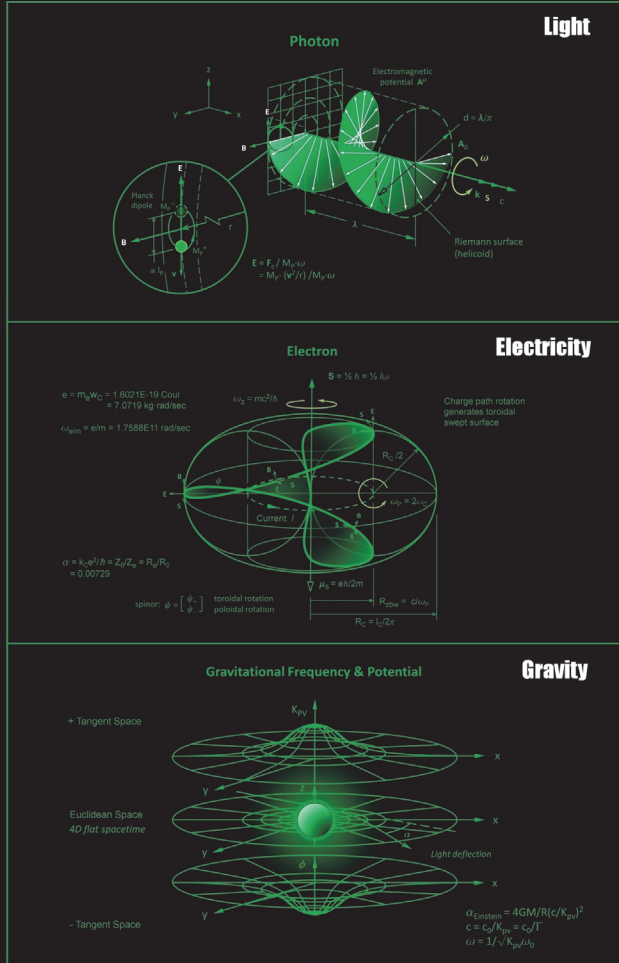
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Quantum Wave Mechanics



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Preface

This book attempts an explanation and geometrical description of a quantum field theory of light, electric charge, and gravity. Understanding the fundamental nature and interactions of such quantum fields is facilitated with knowledge of wave phenomena and physical properties of the vacuum that enable wave propagation. All light and matter is composed of quanta that share a fundamental characteristic in that they are composed of quanta that spin and with spin angular momentum of only certain discrete multiples of Planck's constant (integer spin bosons and half-integer spin fermions). Why does this manifest, highly localized, quantized spin wave effect occur and how does it result in concentrated energy in the form of matter? The estimated quantum mechanical energy content of the vacuum (10^{113} J/m³) is vastly larger by ~ 122 orders of magnitude than the energy contained in the observable universe (10^{-9} J/m³) composed of fermions and bosons. What accounts for this incredible mismatch in the minute fraction of energy in that we can directly perceive and experience (i.e., quanta with spin) and vacuum energy (fluctuations without spin) that which is inaccessible to observation? Just what are photons, electrons, and gravitons? How are they created from the seeming void of the vacuum, and how do they interact? Why is the speed limit of the universe set at a certain finite velocity of light? What exactly is electric charge? What is mass? How does mass interaction result in gravitational attraction? We seek an *explanation* for such phenomena, not just an ad hoc label description without visualization. Several interrelated themes are developed in terms of wave phenomena, energy density gradients, spin waves, and quantum effects in a physical vacuum. The subject matter and concepts discussed are necessarily speculative but are founded on known wave-mechanics principles. Major themes addressed include the following:

Light. A freely propagating photon wavetrain or light quanta in empty space is described as a helical traveling electromagnetic wave of quantized spin angular momentum moving at the velocity of light *semper et ubique*. Photons are classified as integer spin bosons. The physical vacuum as a polarizable medium enables wave propagation and appears ultimately to be quantized at the Planck scale. In the Winterberg Planck aether hypothesis, the vacuum is a Bose-Einstein condensate (BEC) superfluid composed of positive and negative Planck mass dipoles. Fundamental particles such as the photon and the electron are viewed as polarized quasi-particle wave excitations of much smaller Planck particles. Electromagnetic waves are conjectured to consist of spin density waves of Planck dipoles enabling formation of kink or antikink solitons. Similar to the exotic properties of supercooled ^3He BEC liquid helium superfluid, spin waves are not tolerated by the vacuum but quickly become localized and isolated quantized vortices. A BEC condensate represents a fifth state of matter in which particles collectively act in coherent waves oscillating in phase at the same frequency. The formation of electric charge q , magnetic vector potential \mathbf{A} , electric field intensity \mathbf{E} , and magnetic field intensity \mathbf{H} in a vacuum devoid of matter may be understood in terms of the relative volumetric density, density fluctuations and motion of Planck dipoles. The speed of light is a function of the Planck energy density of a polarizable vacuum characterized by the variable index of refraction K_{PV} .

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Photons and electrons/positrons may be directly interconverted in high-energy processes of pair production and annihilation. Any viable model of the photon or electron must account for this interconvertability. Oscillation of electrons generates electromagnetic waves. Electrons can resonantly couple with electromagnetic waves. Photons and electrons can interact, for example, as plasmonic waves of free electrons in a metal surface, in secondary emission of electrons due to the photoelectric effect as in a photomultiplier, in an ionized plasma as plasmons (quanta of electron waves), in a vacuum as in free-electron lasers, magnetrons, photomultipliers, etc., in photonic-excited condensed matter excitons, and in absorption of photons in photo-sensitive semiconductor P-N diodes or photon emission in laser diodes. Absorption of energy of a photon in a semiconductor can be transferred to an electron as potential energy. Photon emission occurs when the electron loses potential energy when electron-hole pairs recombine. P-N-P junctions of quantum dimensions can provide a storage medium for electrons as quantum mechanical standing wave traps. Photonic devices enable conversion of photons into an electron current and vice versa to generate an electrical signal or photo signal. Photon interaction with electrons can result in motion of matter as, for example, in particles suspended in an EM tractor beam by photophoretic forces in an optical trap.

In addition to frequency and spin, a photon traveling wave disturbance may be described in terms of curvature and torsion. The straight line motion of a photon in a gravity-free, zero-curvature vacuum reflects a balance in electric and magnetic energy. A change in torsion of a photon in an optically dense medium is associated with effective mass. The processes of electron/positron pair production and annihilation are described in terms of the geometry of a photon helicoid. During electron/positron pair creation, the increased curvature k and decreased torsion τ of a helical wave train due to Faraday rotation and Levi-Civita effects results in formation of two counter-rotating loops of opposite topological charge. Each loop contains two spinors corresponding to poloidal and toroidal rotation of a toroidal electron and positron spin wave. Electric charge is related to topological charge associated with precessional rotation and is quantized as a result of quantization of spin angular momentum described by Planck's constant \hbar .

Mass. Mass is a fundamental, intrinsic property of matter attributed to the interaction of electromagnetic quantum fields, i.e., a wave interference effect. In the Einstein relation, mass $m = E/c^2$ where E is energy and c = the celerity of light. Energy is a measure of wavefront curvature. Mass is associated with retardation of energy flow and resultant time dilation. Wave energy packets are separated by nodes which obstruct energy flow restricting propagation to the wave group velocity. Mass is a measure of EM wave volumetric nodal density. Rest mass is observed only in fundamental particles with electric charge and is a ratio of charge to Compton angular frequency. Fundamental particles are viewed as standing wave resonant structures and not physical points. Travelling waves such as light and neutrinos acquire effective mass during propagation in regions of higher EM density. Standing waves acquire mass and inertia as a result of confinement of travelling waves as demonstrated in work by Jennison and Drinkwater. The self-referral dynamics of radiation trapped in a phase-locked cavity accounts for Newton's First Law of Motion, i.e., every object in a state of uniform motion tends to remain in motion unless an external force is applied to it. Hence, there is no need to

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attribute inertia to instantaneous interaction with the rest of the matter in the universe according to the Mach hypothesis. Mass and inertia are local phenomena. Mass may be understood as an interaction of electromagnetic fields resulting in accelerative wavefront curvature without recourse to the hypothetical, vaguely described Higgs field with unexplained mechanism for imparting mass to massless particles. The confinement of light, consisting of massless photons, in a fixed reference frame of a cavity resonator results in the creation of mass and inertia. At a sufficiently high energy level corresponding to the rest mass of the electron, the imbalance of electrostatic and magnetostatic fields results in topological confinement of a photon within a fixed volume of Compton radius R_c . Hence, fermions may be interpreted as spinning, phase-locked, topologically confined, standing wave resonant structures with electrons and positrons as the fundamental building blocks of matter.

In general, the motion of a push-pull phase-locked cavity resonator consists of an oscillatory sequenced series of accelerative jumps interspersed with coasting periods of constant velocity. In this respect, a cavity resonator is somewhat analogous to an inflated bouncing rubber ball alternately compressing and decompressing without internal dissipative losses. The rhythmic pulsation of a phase-locked resonator in motion generates longitudinal and transverse EM waves with frequency which varies with the cavity velocity. For matter (composed of resonant EM standing waves) in motion, the Lorentz contraction is interpreted as a physical wavelength compression due to variation in EM field energy density as measured by vacuum refractive index K_{pv} . A phase-locked resonator in motion exhibits an oscillatory, pulsing compression and expansion emitting dipole radiation transverse to the direction of motion. Interaction of these radiated waves with nearby electrons via the electromagnetic vector potential A^{μ} results in coupling of N number of electrons increasing their effective collective inertia as N^2 .

The Lorentz transformations of motion in terms of velocity ratios compared with Ivanov-LaFreniere standing wave transformations in terms of standing wave ratios are shown to be equivalent. Ivanov and LaFreniere have shown that standing waves undergo wavelength (nodal) contraction in the direction of motion. An object in motion relative to a fixed observer undergoes a Lorentz contraction (wavelength compression) in the direction of motion and a Lorentz Doppler shift in frequency (reduction). The wavelength compression is a physical result of an increase in the vacuum energy density. Moving clocks which are made of standing matter waves undergo time dilation as a result. This is in keeping with de Broglie and Schrödinger's view that matter waves are real physical waves and not merely particle location probability amplitudes described in the Born interpretation. The EM wavelength contraction and frequency shift in a polarizable vacuum accounts for mass in motion and gravitational effects, including the energy change, deflection of light, gravitational frequency shift, and clock slowing. The speed of light c appears invariant in all inertial frames due to Lorentz contraction of the measurement apparatus and a concomitant Lorentz Doppler frequency shift. Spacetime remains Euclidean over scales comparable to wavelength. The apparent Lorentz space contraction and time dilation are the result of contraction of the nodal distance of the standing wave(s) which constitute the length of measurement. Time dilation is equivalent to a change in the size of the units of

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measurement which are undetectable to an observer as both the object and the comoving measurement apparatus undergo Lorentz transformation.

Fundamental particles of matter exhibit properties of standing EM waves trapped in a phase-locked resonator including Doppler frequency shifts in motion, inertia (resistance to motion) and de Broglie waves. Matter in motion relative to an observer exhibits de Broglie 'matter' waves as a modulated moving standing wave. The inverse effect of self-induced motion of matter may potentially be realized utilizing synthesized red- and blue-shifted Lorentz Doppler waves parametrically amplified in a phase conjugate phase-locked resonator. Energy of motion results from conversion of energy of the pump waves to the contracted moving standing wave formed from the signal wave and its counterpropagating phase conjugate wave within the resonator. Velocity of the resonator wave system is proportional to the wave phase difference while acceleration is proportional to the frequency difference. Synthesized matter waves would provide means for inertia modification and control as well as self-induced motion of matter. Such technology would enable EM wave-based propulsion without wheels, friction, reaction or expulsion mass. Inverse effects are not without precedent as, for example, inverse Doppler effect, inverse Sagnac effect, inverse Faraday effect, inverse Compton effect, inverse spin Hall effect, inverse Cherenkov effect, inverse Raman effect, inverse Cotton-Mouton effect, inverse Barnett effect (Einstein de Haas effect) and inverse piezoelectric effect, etc.

Electric charge. Traditionally, electric charge has been opaquely described as a separate dimension without geometrical description or explanation of its origin. In this book, a description of electric charge is detailed relating it to dimensions of mass, rotation rate and time which is interpreted as a rate of precession of closed loop standing waves and described by the fine structure constant. Spin momenta is associated with loop closure failure defects or dislocations in spacetime and resultant torsion stresses. The electron is described as a helical toroid standing wave formed from an energetic photon travelling wave with a full twist looped into a circle of a radius equal to the Compton wavelength. The photon helicoid may be envisioned as a twisted ribbon spinning around its longitudinal axis. The electron toroid geometry may be described in a twisted ribbon analogy as a spinning closed-loop Hopf strip – the simplest form of topological knot. The torus geometry is formed by a rotating charge path in the shape of a Hopf link with toroidal and poloidal components. The $\frac{1}{2}$ -spin characteristic of the electron arises as a result of a toroidal spin component of Compton frequency ω_c and a poloidal spin component of Zitterbewegung frequency equal to $2\omega_c$. The imbalance of the electrostatic and magnetostatic energy gives rise to the fine structure constant α . The charge-to-mass e/m ratio corresponds to a precession frequency equal to $\omega_{e/m}$. The whirl number is found equal to the inverse fine structure constant α^{-1} . Electric charge has mechanical dimensions of MLT^{-1} and represents an angular precession of $\sim 1/137$ ($= 0.007$) radians/sec. The mass of the electron is a function of electric charge, angular frequency and the internal magnetic field reflecting an angular deficit angle.

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Gravity. All matter is composed of quantum oscillators emitting electromagnetic waves over a broad range of frequencies. Gravity is viewed as a standing wave interaction between coupled oscillators. Inertia and mass are the result of standing electromagnetic waves generated by an isolated oscillator within a phase-locked resonator representing a fermion. Electromagnetic resonant wave interactions in a polarizable vacuum (PV) model in Euclidean space exhibit geometrical spacetime curvature consonant with Einstein SR/GR. Acceleration of gravity is the result of a spectral energy density gradient and corresponds to the rate of change of rapidity. Inertial mass of matter in motion and gravitational mass of matter in a gravitational field are equivalent as both arise from acceleration into regions of increased EM flux energy density and nonlinear frequency dependent alterations in vacuum dielectric constant.

Gravitation in the Einstein General Theory of Relativity (GR) is ascribed to a curvature of space and time in an abstract mathematical representation. However, the GR theory metaphysical description of gravitation does not describe the physical mechanism for how matter induces curvature or how spacetime curvature influences motion of matter. It is argued that space and time are not physical objects but are merely the mathematical ordering of location of points in space and events in time. Time represents the flow of energy. In an optical theory of gravity, the deflection of light in a gravitational field is the result of variation in the vacuum refractive index K_{pv} which is a measure of the electromagnetic field energy density. Gravitation is equivalent to a dielectric gradient force in a polarizable vacuum as a result of local Fresnel zone variation in electromagnetic (EM) flux density and vacuum refractive index K_{pv} . The gravitational force F_g is proportional to the gradient of K_{pv}^2 ($F_g \propto m \nabla K_{pv}^2$). Interference of electromagnetic waves from coupled oscillators produce Moiré patterns and Fresnel zones. EM wave front interference creates a Fresnel zone effect between coupled mass source oscillators concentrating the local flux density and increasing the electric permittivity gradient. Gravitons are illustrated as wave interference of counterpropagating phase conjugate photons reflected from Fresnel zone boundaries. Wavefront curvature provides an accelerative force indistinguishable from gravity. The observed contraction of wavelength nodal distances is responsible for the perceived Lorentz spatial contraction and time dilation effects. The metric of curved spacetime corresponds to the wave front interference node metric. Hence, the gravitational field becomes quantized and spacetime remains Euclidean. The quantized gravitation field may be understood as purely an electromagnetic phenomena. As such, gravitational fields may be subject to modification by alteration of the local electromagnetic field density to check the propensity to fall or neutralize weight. Ability to effect at will modification of the gravitational spectral energy density gradient and concomitant neutralization of the local gravitational frequency shift differential will mark a significant technological achievement and prove a benchmark of human intellect.

A conundrum of modern physics is the apparent incompatibility between quantum mechanics and general relativity, each of which have had considerable success in describing aspects of the physical universe. It is asserted that the mathematical construct of spacetime curvature as represented in Einstein's GR applies not to spacetime itself but rather to wavefront curvature and nodal contraction of electromagnetic waves in spacetime. Based on investigations by Michael Faraday, the

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existence of electromagnetic waves theorized by James Clerk Maxwell was experimentally demonstrated by Heinrich Hertz, Nikola Tesla and others. The exact nature of just what is doing the ‘waving’ in electromagnetic waves has remained a mystery. What constitutes Faraday’s invisible electric and magnetic field lines of force? What Planck scale vacuum elements are in contact to enable transmission of force? What accounts for the apparent tension and pressure? The vacuum is calculated to have enormous energy density and is characterized by quantum oscillators with zero point energy. What is the nature of such oscillators that support propagation of electromagnetic and gravitational wave disturbances? In this book, *Quantum Wave Mechanics*, electromagnetic fields and waves are conjectured to be composed of rotating quantized Planck dipoles in the physical vacuum. A Planck dipole consists of a coupled positive and negative Planck mass with net zero mass and angular momenta and, hence, under symmetry breaking, easily induced to spin. Electric and magnetic field lines are manifestations of temporal and spatial spin alignments of groupings of adjacent Planck dipoles. The Planck vacuum is represented as an exceedingly dense energetic medium composed of Planck mass dipoles. Bosonic and fermionic fields correspond to resonant spin wave interactions between such dipoles. Bosons represent traveling waves while fermions represent standing wave structures both of which are electromagnetic. The spacetime metric is a mathematical overlay describing the relative positioning of objects in space and ordering of events in time. The underlying quintessence or “stuff” of the vacuum postulated as a form of dark energy remains a mystery. Positive and negative Planck masses are thought to arise spontaneously as a result of vacuum instability from a state of nothingness. Modeling the quantum vacuum as a foam of bubbles of positive and negative curvature and mass provides an alternative explanation amenable to visualization and analysis.

Concept and inspiration is the aegis of design and invention. A deeper understanding of the quantum wave mechanics of the vacuum may lead to new technological developments such as wave-based propulsion, enhanced energy conversion, vacuum engineering, programmable quantum dot nanostructures or artificial atoms and force field effects. The relation and interconversion of fundamental and derived dimensions of physical quantities and geometrical interpretations illustrated herein are intended to relate previous discoveries and provide new sources of insight and ideas as to the nature of physical reality and the universe in which we live.

