

The Particle Effect

by William Gray

Abstract

This paper explains particle mass, charge and magnetism by a dark energy structure based on angular momentum's potential energy acceleration force in equilibrium with kinetic energy centripetal force. It then uses this dark energy structure to show that an EM wave with angular momentum results in mass, charge and magnetic effects in protons.

The proof shows a direct relation between inertial energy and electromagnetic forces. The principles used are consistent with Quantum Theory as set forth by Schroedinger and Relativity as developed by Einstein with the exception that angular momentum was incorporated in Schroedinger's wave functions and a time component was included for each dimension of Einstein's Euclidean space to allow for angular momentum.

This work, in conjunction with Quantum Dynamic Relativity and Wave Particle Duality, explains electromagnetic and nuclear forces in terms of inertia and Relativity and specifically calculates the empirical values for the proton's and neutron's mass, charge, spin and magnetons, and the nuclear binding energy, magneton, and spin values for deuterium, tritium, helium-3 and helium-4.

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De Broglie proposed that since photons exhibit wave-particle characteristics then perhaps so do particles, and provided a basis for quantum theory. If this is the case then is it possible that light, being electromagnetic, may also under certain circumstances exhibit the charge, magnetic and mass effects of particles?

According to Relativity large masses curve space and deflect light like a gravitational lens. From its perspective the light travels a straight path but to observers it bends and loses energy to the gravitational field (Red Shift). Similarly if a mass emits light while moving away from an observer its wavelength increases and its $E = hf = hc/\lambda$ energy decreases accordingly (Red Shift).

These behaviors show an interaction between inertial mass and EM waves that transfers energy and alters the momentum of light so a relation must exist between their forces and energies, and from this a question arises. Could particles be light deflected around a region of high energy density space, with angular momentum, and captured by the gravity of the high density region's inertial mass in a quantum state that is a resonant energy transfer between the light and the high density region's $E = mc^2$ mass-energy?

If this were the case, then it would explain the origin of mass in particles. However, for it to be true it would also have to explain:

- a) why proton and electron charges are equal and opposite;
- b) why they have specific masses and mass ratios;
- c) why they have specific charge and magneton values;
- d) why they have $\frac{1}{2}$ -spins; and
- e) how EM waves and particles remain stable.

Only if these questions are answered in terms of Planck's Constant and EM wavelength can the Particle Effect be considered explained.

There is evidence to support the concept of a particle being light captured in an orbital resonance with angular momentum. For example, electron and anti-electron annihilation produces λ -rays, such as occurs when an orbital energy decays according to quantum theory, and when a gamma ray of sufficient energy collides with a nucleus it produces an electron and anti-electron. Second, light is readily captured and emitted by quantum orbitals which means it is a structural form that is coherent with the 3-dimensional wave function energies and momentums of an orbital electron.

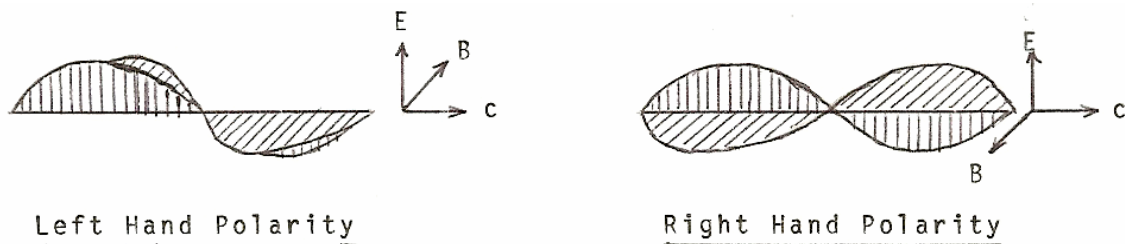
Third, a Bose Einstein Condensate (BEC) used as a non-linear optical medium with an abrupt change in index of refraction slows light (Lene Hau, Harvard) which indicates that increasing density by matter condensation can cause the extreme refraction needed to capture light into a particle state. Fourth, Optical Confinement captures atomic masses in BEC's with atomic matter-wave coherence and Optical Pumping captures orbital electrons in excited states with wave function coherence, so light can capture mass-energy.

Fifth, as E. H. Land showed with his Polaroid filter (aligned hydrocarbon chains doped with iodine and free valance electrons to conduct current) light with electric field vectors parallel to the molecular chains is absorbed, so its EM energy can be transformed into inertial current energy. Sixth, Chiral centers rotate light very specifically, indicating a close relation with the principles of angular momentum. Chiral centers are atoms with only 4 valence electrons bonded to unique functional groups so 4 unique electric field dipole moments form from a tetrahedral center. The light is rotated according to the order of dipole moment strengths and its wavelength which determines its travel time through their field.

Seventh, in Wave-Particle Duality it was shown that if a photon's energy equals the energy needed to change quantum states then its $\lambda = hc / E$ wavelength transit time through the orbital is exactly equal to the time needed for 8 orbital revolutions, 4 per half wavelength, to allow

for alignment of the orbital electron's and photon's electric fields. But the photon wavelength is 1000 X greater than the electron's matter wavelength so energy transfers by their E-fields, not by wave superposition, and if photon energy can transform through E-fields into a 3-d electron inertial motion then it can transform into a spherical charge and magnetic field.

Taken altogether the examples show that light's EM fields and energy can be "folded, spindled and mutilated" in such ways so as to manifest as a particle's mass, charge and magnetic fields. If in fact the Particle Effect results from a captured EM wave it explains polarity and charge equity between protons and electrons if charge is taken to be the field orientations and magnetic field strength is taken to be their resultant frequency, or oscillation density, since the photon's orthogonal EM field oscillations have two polarity configurations, one with the magnetic field emanating to the left of the electric field and one with it to the right.



Light has no charge and one of two possible magnetic B-field oscillation polarities with respect to their E-fields, as if phase shifted 180°, with a +/- spin 1 according to the Right Hand Rule along their propagation axis. But particles have constant charges of +/- $1.60217733 \times 10^{-19}$ C and a ½-spins, like a 90° phase shift. And light's frequency depends on its $E = hf = hc/\lambda$ energy just as a particle's $\lambda = h/mv$ de Broglie wavelength and frequency depends on its $E = mc^2$ mass energy, which means its magneton or magnetic field strength also depends on frequency since mass determines its $\mu_B = \frac{1}{2} e/m h/2\pi$ Bohr magneton value. So particle charge depends on the oscillation orientation while its magnetic field strength depends on the oscillation's energy density, or frequency.

To see how a particle's $\frac{1}{2}$ -spin and magnetic field result from an EM wave captured in a high energy density region's relativistic resonance oscillation it is necessary to first examine neutron and proton magnetons derived in Quantum Dynamic Relativity. A Nuclear Magneton is calculated with Bohr's $\mu = \frac{1}{2} e/m h/2\pi$ relation and the proton's mass. However a proton's actual magneton is 2.7928 times this value in the direction of the magnetic field used to measure it and 4.8373 times greater in its spin moment direction, and the respective neutron values are -1.9135 and -3.314 with minus signs to indicate opposite magnetic moment and spin moment directions.

The error occurs because mass attenuates a magnetic field, yet lower density mitigates it. The 1.0355 fm proton radius is 20.71 times the 0.05 fm electron radius so its volume is $20.71^3 = 8882$ times larger and 4.8373 times less dense when divided by the $m_p/m_e = 1836.153$ mass ratio and so its magneton is 4.8373 times greater. The fact that $4.8373 / 3^{1/2} = 2.7928$ also supports the concept of a proton being an EM wave captured in a 3-d spherical S-type orbital because the wave's propagation axis orbital motion and its E and B fields would each form 1-d Schroedinger type wave functions with a $(1^2 + 1^2 + 1^2)^{1/2} = 3^{1/2}$ 3-d resultant, and if the resultant is 4.8373 then the 1-d field direction component is $4.8373 / 3^{1/2} = 2.7928$.

Neutrons decay to a proton, electron, electron anti-neutrino and 0.78233 MeV and may be thought of as an excited hydrogen with a 0.78233 MeV orbital electron with $0.78233 \text{ MeV} / 3 = 0.260777 \text{ MeV}$ 1-d components. As such its ground state 0.52917725 Å Bohr radius would contract by the ratio of its 1-d 0.260777 MeV excited state and 13.605698 eV ground state energies or by 19166.75 to 2.761 fm. And since the added 0.78233 MeV increases the electron's mass by 2.531 it will also contract the 2.761 fm radius by the same amount to 1.091 fm. Classical treatment of a quantum orbital is allowed by Bohr's Correspondence Principle (quantum and classical physics agree at high energies where quantized level differences vanish). Since it is a hydrogen atom its magneton is calculated by the Bohr relation, using a proton mass since it occupies the entire radius.

This results in the same 4.8373 proton magneton but negative since an electron generates it so its moment is opposite the spin angular moment. From the electron's perspective the radius is 2.761 fm so the 2.531 contraction factors out to yield the actual $-4.8373 / 2.531 = -1.9111$ neutron magneton. This value is less than the measured -1.9135 value by 0.12% because deuterium nuclei with mass defects of 2.224 MeV (0.12%) are used to measure the magneton and lower mass means a higher value. The -1.9111 value is also in the magnetic measurement field's direction since it is generated by a hydrogen like orbital with a spin 1 moment in the field direction. However observers see the 2.531 contraction which causes a $\frac{1}{2}$ -spin offset and a $-1.9111 \times 3^{\frac{1}{2}} = -3.314$ resultant magneton value.

Laws of physics are the same in all inertial reference frames (Relativity) so the electron will always see itself as generating a spin 1 moment at a 2.761 fm orbital radius. But its 0.78233 MeV added energy causes a 2.531 mass increase, space contraction, and time dilation from the proton's and observer's perspectives so the orbital radius is 1.091 fm. This offsets the moment observers see toward the neutron's orbital electron surface by $(2.761 - 1.091) / 2.761 = 60.5\%$ which is the arc cosine of 52.8° and within 2° or 4% of the actual arc cosine $3^{-\frac{1}{2}} = 54.74^\circ$ $\frac{1}{2}$ -spin moment angle.

However, the electron also causes a harmonic oscillation in proton position and time dilation causes the proton to move toward where the electron was after it has moved along its orbital path to the proton's far side. So the proton has an average $r_n - r_p = 1.091 - 1.0355 = 0.05535$ fm distance from the electron with a $2^{\frac{1}{2}} \times 0.05535 = 0.0783$ fm gyration peak 180° away from the electron which from its vantage is $2.761 - 1.091 = 1.67$ fm from the proton's far side. The $2.531 m_e/m_p = 0.1378\%$ electron to proton Relative mass ratio times the proton's 1.0355 fm radial arm also reduces its 0.0783 fm gyration to $0.0783 - (0.1378\% \times 1.0355) = 0.0768$ fm 180° away from the electron caused 60.5% offset to the spin 1 moment to yield a $(2.761 - 1.091 - 0.0768) / 2.761 = 57.7\%$ offset or arc $\cos 0.577 = 54.76^\circ$, within 0.04% of the 54.74° $\frac{1}{2}$ -spin value.

This solution for the neutron's $\frac{1}{2}$ -spin in terms of classical and relativistic principles demonstrates how inertial energy under EM force constraints can result in the $\frac{1}{2}$ -spin effect of particles. And if EM energy can freely transform between the integrity of its massless wave structure and an orbital electron's inertia, charge, and magnetic energies then there is no reason to believe that an EM wave could not also manifest as a mass-energy structure with the $\frac{1}{2}$ -spin, charge and magnetic effects of a particle by the same classical and relativistic effects. And if protons and electrons comprise neutrons then they are the Universe's primary particles and its elements are merely proton-electron composites in hydrogen ground state atomic-type configurations with excited neutron state configurations to bind the protons of their nuclei.

If this recursive scheme is correct and light is the basis of electron and proton structures it means that the Universe's energy is differentiated into dark energy with boundary conditions of EM waves captured by high density regions of dark energy in electron and proton form and free EM waves that interact with their quantum structures. Such an epistemology provides a very simplistic basis for a relationship between gravity, EM forces and relativistically enhanced EM forces (nuclear binding) based on dark energy density, gradients and boundary conditions that occur from 3-d oscillations with 1-d inertias or 3-d angular momentums. It also means protons and electrons are the boundary conditions of the EM waves captured in particle states just as excited neutron states and ground state hydrogen are the proton-electron structures' boundary conditions.

To see the relativistic binding effects of captured EM waves it is necessary to first examine the relativistic basis of quantum behavior in orbital electrons as shown in Wave-Particle Duality. From a proton's vantage an electron behaves according to standard Quantum Theory but an electron sees a proton as a very high energy state particle that behaves according to classical physics (Bohr's Correspondence Principle). So atomic behavior is relativistically continuous to an electron and quantum statistical to observers and this is Riemann's "unseen communication"

behind Schroedinger wave functions describing statistically continuous distributions while only being individually discontinuous "snap shot" type functions.

Schroedinger differentiated Bohr's 2-d orbital spin 1 motion to a 1-d side-to-side Particle in a Box spin 0 sine wave function based on particle wave nature. He then integrated it into a 3-d spin 0 wave function to describe the electron's spherical ground state orbital. But Calculus differentiation factors out initial conditions and when he did this he lost its spin 1 angular momentum which carries the cause and effect information of its motion. So by Schroedinger's equations the proton, and observers, only see a statistical electron behavior in terms of an orbital circumference wavelength and its standing wave envelope that is a wave function and complex conjugate product but which does not take into account Left-Right or R-L momentum and retrograde or foreground position.

However from an electron's vantage the Heisenberg Uncertainty is considerably less than $\frac{1}{2}$ the 3.33 Å orbital electron wavelength a proton sees because of the $m_p / m_e = 1836.153$ mass ratio (Bohr's Correspondence Principle) and the proton's 8882 X greater volume. In a proton-electron harmonic oscillator their mv^2/r centripetal forces, mvr angular momentums, and mv momentums conserve so their velocity and radii ratio is $v_p/v_e = r_p/r_e = m_e/m_p = 5.4462 \times 10^{-4}$. So if an electron's 13.605698 eV $\frac{1}{2}mv^2$ KE yields a 2.1877×10^6 m/s = 0.007297353 c velocity and its Bohr radius is 0.529177249 Å then the proton has a 28.82 fm radial gyration and 1191.5 m/s velocity.

The electron's velocity creates a $v_e^2/c^2 = 0.00005325136 m_e = 27.21139532$ eV relativistic energy ratio that is exactly twice its 13.605698 eV KE and yields a $\lambda = (1 - v^2/c^2)^{-1/2} = 1.000026627$ mass and time and $1/\lambda = 0.999973374$ space Lorentz Transform. This 27.2 eV must equal its total orbital harmonic resonance energy with the proton if their resonance structure is to remain stable so it sits in a -27.2 eV structural negative energy well with a 13.6 eV KE to yield a -13.6 eV orbital energy state. However these relativistic effects are only

perceptible to the proton, since all physics laws are the same in all inertial reference frames by the Principle of Relativity. And the electron therefore, unable see its own mass increase, sees a Relative proton mass decrease and a corresponding increase in its gyration radius about the system's center of mass.

A 1.000026627 Relative electron mass increase is 13.606239 eV and 0.00054 eV or 0.0039% over the 13.605698 eV Bohr orbital KE of its 0.52917725 Å ground state radius. It contracts the space the proton sees to the electron by 0.0039% (2.06 fm) and increases its 28.82 fm gyration about the system's center of mass by 2.06 fm / 28.82 fm = 7.15% ($m_p/m_e = 1836$ X greater than the 0.0039% effect). The proton also sees the electron as having 7.15% more mass-energy because their m_p/m_e mass ratio determines its gyration radius and this effect is further compounded by an equal 7.15% time dilation that causes the electron momentum wave behavior observers see.

So the proton sees the electron with 7.15% more mass-energy and the effect persists for 7.15% of the proton's orbital gyration time, after the electron has continued on along its orbital path. Time dilation is a space contraction adjunct. The speed of light depends on free space permeability and permittivity, $c = (\mu_0 \epsilon_0)^{-1/2}$, because μ_0 and ϵ_0 determine the velocity by which the magnetic and electric field EM wave energies penetrate space orthogonal to its propagation axis and return. When space contracts its density and thus μ_0 and ϵ_0 increase by Relative μR and ϵR factors to Red Shift the EM wave's wavelength and frequency, as in a gravity field, so light travels with the same velocity but its frequency slows down.

This is the Twin Paradox where less time passes for the twin traveling in space and more time passes for the stationary one or the observation of a star's past that has moved on. A stationary proton sees a higher energy electron with a smaller orbital radius for the passage of more time while the electron sees a lower mass proton with a greater radial gyration so it conserves their mv^2/r centripetal forces by increasing its orbital radius 7.15%.

These effects are the basis of electron wave nature since the proton sees an effect where no electron exists, sees it as closer, with a 7.15% higher energy, and then sees it compensate by moving further out to reflect a 7.15% lower energy, averaging to Bohr's $E_0 = 13.605698$ eV orbital energy. At the same time, the proton's gyration radius offset causes a Right Hand Rule $F = qv \times B$ Lorentz force torque on the electron's spin 1 orbital magnetic moment that results in orbital precession. The 7.15% offset and time dilation also combine to a 14.3% 1-d $\frac{1}{2}$ -wave (28.6% full wave) effect with a $3^{\frac{1}{2}} \times 28.6\% = 49.54\%$ 3-d wave function resultant, or half of the proton's gyration period (2 wave cycles per orbital period provide the symmetry necessary for proton position resonance stability).

This proton offset - time dilation relativistic wave function of a hydrogen ground state orbital in conjunction with the maximum excited neutron energy state now provide the basis for a particle structure with mass, a $\frac{1}{2}$ -spin, uniform charge, and a magneton that results from the resonance of energy. It must be remembered that a neutron is a particle, until it decays, and exists by capturing 0.78233 MeV in relativistic energy that causes a mass increase and $\frac{1}{2}$ -spin. It also has 0 charge, the result of combining the proton and electron charges, but the resonance of their inertial harmonic oscillation also results from their electric field forces.

For a stable resonance all forces must equalize over time so the relativistic space-time oscillation caused by the electric fields must inversely reflect the disparity between the proton and electron charges, with a 0 potential center. So the relativistic space-time oscillation that holds the proton and electron in their neutron state must exactly reflect the equal and opposite electron and proton charge fields that created it, with 0 charge midway and surface charges on each face that capture the particle's motions. This effect was shown by Hofstadter at Stanford and researchers at Cornell in 1961 when they scattered electrons with protons to show that protons have 0 charge in their centers, a $\frac{1}{2}e^+$ charge at about 0.3 fm, and a full e^+ charge on their surfaces.

This was explained at the time by the concept of $\frac{1}{2}e^+$ and $\frac{1}{2}e^-$ charge doublets where protons and neutrons have a $\frac{1}{2}e^+$ central core with a 0.3 fm radius surrounded by a shell extending to about 1 fm with $\frac{1}{2}e^+$ for the proton and $\frac{1}{2}e^-$ for the neutron to yield their +1 and 0 respective charges. This concept was subsequently replaced by the 1963 Gell-Mann and George Zweig quark models where a proton and neutron are composed of Up and Down quarks with $2e^+/3$ and $e^-/3$ respective charges. A proton with a **uud** configuration thus yields a +1 charge and a neutron's **udd** configuration yields a 0 charge.

But quarks are intangibles with assigned charge, energy, and spin properties whereas a relativistic wave function causes charge with a polarity and strength dependent on wave orientation and the equilibrium resonance between mass and the relativistic inertias that contain it. It explains mass and spin, Hofstadter's observed proton and neutron charge structures, the Strong force that binds particles, and if an orbital inertia causes the neutron magneton, as shown on pages 4-5, then it explains particle magnetons by the $u = \frac{1}{2} e/m h/2\pi$ Bohr relation adjusted for density, and it agrees with Schroedinger's wave function Quantum Physics if the orbital angular momentum and relativistic effects he omitted are included.

In 1939 Linus Pauling substantiated Quantum Theory by showing how electron pairs with resonating wave forms are more stable than single electron wave forms (The Nature of the Chemical Bond). By Pauli's Exclusion Principle 2 electrons can only share an orbital if they have opposite spins, resulting in opposing magnetic fields that form a resonance bond with the inertias and charge repulsions (shown to cause electron wave nature by relativistic effects from their harmonic oscillation on pages 2-4 on Wave Particle Duality), with the resonance energy constituting their bonding energy.

If one electron is replaced by a proton an even stronger resonance bond results because now both magnetic and charge forces resonate with the relativistic inertial forces, which explains why electron pair chemical bonds have lower energy than orbital bonds with electron-proton

pairs. Molecular hydrogen's 104.2 kcal / mol bonding energy equates to 4.52 eV / bond while the electron-proton orbital bond is 13.605 eV, a 1 to 3 ratio that also equals the $e/3$ basic quark charge to particle integer charge ratio, both of which would occur if bonding energy results from EM wave superposition.

If Left and Right Hand EM waves combine one field cancels and one doubles in amplitude, and if same polarity waves combine both fields double in amplitude unless one is inverted and 180° out of phase in which case both fields cancel. If bonding occurs when a field cancels, localizing force and energy, then bond strength is $1/3$ of the maximum in the first case and maximum in the final case with a $2/3$ change in strength by changing a field from opposing to bonding. This is molecular Linear Combination of Atomic Orbitals extended to include orbital electron-proton charge force bonding.

As was shown on pages 7-9 (detailed in Wave Particle Duality) the wave nature of particles derives from the relativistic effects caused by particle resonance oscillation inertias. The resonance arises from EM forces between particles and also occurs for single particles since observation by EM waves or apparatus can not occur without EM field interaction or relativistic wave superposition by an EM wave or matter wave in the apparatus. A single neutron also has a matter wave since its proton and electron resonate. And if wave nature derives from relativistic inertias then particles are not waves, it is their relativistic effect on space that causes a Heisenberg position and momentum Uncertainty lens effect that we, another particle, or apparatus see as a wave.

This wave effect is Bohr's Correspondence Principle, where we see a resonating orbital particle with a relativistic momentum and position as a discrete $\lambda = h/mv$ wavelength and $E = hf$ energy level but it sees us and other massive particles with no Relative motion or discrete energy levels according to classical EM force physics. The wave is caused by Relative particle inertias that reflect the EM forces between them and constitutes a localized resonance bond.

For this reason particles in resonance should have identical matter wavelengths, and a proton and electron in resonance do have $\lambda = h/mv = 3.3249 \text{ \AA}$ wavelengths by their respective 1191.5 m/s and $2.1877 \times 10^6 \text{ m/s}$ velocities and masses. But the proton's 28.82 fm gyration radius circumference is only 181 fm so it's not physically possible for it to have the $m_p/m_e = 1836 \times$ greater 3.3 \AA electron wavelength. However it has a $\lambda = h/m_p m_e = 181 \text{ fm}$ wavelength with the electron's velocity, which it has since its point of reference is the electron and it measures its velocity with respect to it.

This is incontrovertible proof that particle wave nature is a relativistic resonance effect. From our vantage it has a 1191 m/s velocity and calculated 3.3 \AA wavelength, but we can resolve it to within a 28 fm radius of a hydrogen's center of mass and this can only occur if it has the Relative $2.2 \times 10^6 \text{ m/s}$ electron velocity and an associated 181 fm wavelength. And Hofstadter resolved the proton's $\frac{1}{2}e^+$ charge doublets to a 0.3 fm radius core and a shell extending to 1 fm. A 0.3 fm resolution wavelength would require 4 GeV protons that relativistically distort their core 4 to 1 to a 0.075 fm radius, so instead he scattered high speed electrons with very short wavelengths to determine the proton's structure.

The protons had to behave classically with a small, Heisenberg Uncertainty for such incredibly high resolution measurements from his stationary perspective. To the high speed electrons in their own inertial frame of reference (unaware they are waves or moving) the protons are moving with the electron's velocity and a momentum greater by their mass ratio. The proton's $\lambda = h/mv$ wavelength and thus its change in position and momentum $dx \cdot dp = \frac{1}{2}h/2\pi$ Heisenberg resolution Uncertainty is therefore smaller by their mass ratio so stationary observers only see the electron resolution Uncertainty, in accordance with Bohr's Correspondence Principle that high mass energy objects with small quantum level differences are classical. Otherwise slow massive object's with long matter wavelengths would have high quantum differentials and resolution errors and the high speed electrons could not have resolved the proton's structure.

Thus in Hofstadter's experiment the short wavelength electron could interact with the long wavelength proton with the repeatable precision of a Snell's law light refraction at a boundary between different mediums, where $\sin \theta_2 / \sin \theta_1 = v_2 / v_1 = \text{constant}$, θ_1 is incident angle, θ_2 is refraction angle, and v_1 and v_2 are the speeds of light in each medium. With a short electron wavelength no quantum error is introduced by a velocity, frequency and $E = hf$ energy change because for an extremely high relative frequency the percentage error is too small to affect behavior and a repeatable outcome results without quantum distortions.

This is a very important concept because if charge uniformity and polarity in particles result from EM wave orientation and this refraction effect without quantum distortion explains mass-energy, $\frac{1}{2}$ -spin, magneton field intensity, and the Strong force that binds it then the loop may be considered closed on the Particle Effect. The speed of light and thus its frequency and, energy depend on the permeability and permittivity of the medium it passes through by $c = (\mu\epsilon)^{-\frac{1}{2}}$. These coefficients determine how fast its E and B field energies oscillate from its propagation axis and thus define its $E = hf$ energy and relative velocity in a medium it passes through.

For a high relative frequency only a phase shift occurs as a wave passes through the permeability and permittivity change of a medium's boundary and the resultant effect is only a sine function of the phase shift caused by the velocity change. A greater shift in velocity causes a greater phase shift in the wave's interacting energies and resultant refraction angle, and because the wave also has a trough there is a reflection opposite the angle of incidence by refraction from its equal and opposite phase shifted energies. This quantum effect is the same as the one in Schroedinger's wave functions based on differentiation of orbital momentum into a 1-d wave momentum and re-integration into a 3-d orbital wave function. Schroedinger's equations could only predict a quantum probability based on the product of the wave function and its conjugate that represented the retrograde direction of the orbital's motion.

Wave nature is a relativistic effect on 3-d space and time by acceleration of particle masses by the EM forces between them. In resonance this is a uniform 3-d effect and the electron's wave is only slightly modulated by a massive proton's long wavelength low velocity relativistic effects so Heisenberg's Uncertainty is only the $\Delta x \cdot \Delta p = \frac{1}{2} \hbar / 2\pi$ position and momentum changes of the electron's wave with uniform and repeatable results. However a high velocity short wavelength proton adds a relativistic effect to the electron that superimposes as an added quantum harmonic energy to resonate its wavelength and cause quantum refraction angle errors.

The one exception to this occurs when a proton's velocity is exactly opposite the electron's in which case their velocities add to yield a higher frequency greater resolution electron. This all derives from Bohr's Correspondence Principle where if wave effects combine to a higher relative frequency for an electron its quantum energy difference between adjacent frequencies approaches 0 with a small Heisenberg resolution Uncertainty and classical results, but if wave effects combine to a lower relative frequency the adjacent frequencies have large quantized energy differences and pronounced quantum behaviors with high resolution errors. So electrons with very short relative wavelengths could resolve the proton's 0.3 fm $\frac{1}{2}e^+$ core with a high degree of accuracy by refractive scattering.

Hofstadter's 0.3 fm radius $\frac{1}{2}e^+$ core charge relates to the up and down quark $e/3$ and $2e/3$ charges by $\frac{1}{2}r_p/3^{1/2} = 0.299$ fm, where r_p is the 1.0355 fm proton radius used to calculate its 2.7928 u_n magneton and neutron's -1.9135 u_n magneton and $\frac{1}{2}$ -spin (pgs. 4-5), and the H-2, H-3, He-3, and He-4 nuclear BE's, spins and magnetons shown in Quantum Dynamic Relativity, if a charge's polarity is wave orientation and its force is the $1/3$ to $1/3 + 2/3 = 1$ chemical to orbital bond strength ratio seen in Pauling's wave superposition bonding (pgs. 10-11). So if Schroedinger's 3-d wave function is a proton-electron charge and magnetic field EM wave, then for a $\frac{1}{2}r_p$ radius propagation axis the $3^{1/2}$ resultant is a $\frac{1}{2}e^+$ charge at 0.3 fm with 1-d $e/3$ units that yield $e/3$ and $2e/3$ quark charge effects.

A $3^{1/2}$ EM wave resultant is a composite of orthogonal electric, magnetic, and inertial field components just as a hydrogen orbital wave function is a composite of orthogonal electron-proton charge, orbital magneton and electron inertial force components. In atoms these forces stabilize into wave functions that result in specific matter structures based on particle mass-energy, charge, magneton, and spin properties so it is reasonable to surmise that these same principles in reverse could yield the structure and properties of a particle. A proton and electron naturally form an EM wave that mirrors their external properties and forms the internal structure of atoms so could EM waves not also cause the internal structures and external properties of particles at nuclear levels.

An EM wave with an orbital propagation axis at $1/2$ a particle's radius would need an mv momentum, a $\lambda = h/mv$ de Broglie wavelength and equal and opposite mv^2/r centripetal and $k_e e^2/r^2$ charge forces to maintain structural integrity and exhibit ,mass, charge, $1/2$ -spin and a magneton. In hydrogen the EM wave carries the effect of the proton's mass to the electron and transforms the electron's motion and charge to a magneton and spin effect at the proton's position, and if the wave function can transmit these properties then it can also manifest them but the mechanism has been elusive.

In a hydrogen atom the 0.529 \AA orbital's relativistic effects are small so the EM wavefunction closely followed Bohr's classical analysis until minor quantum spectral wavelength deviations led to Schroedinger's wavefunction interpretation. However as summarized on pages 7 - 9 and detailed in Wave Particle Duality these quantum Heisenberg Uncertainties occur from relativistic electron angular momentum space-time effects that significantly affect the proton's and observer's perspective of electron momentum and position, and which were overlooked by Schroedinger when he differentiated the Bohr 2-d orbital angular momentum into a 1-d wavefunction.

In neutrons however the 0.78233 MeV electron energy increases its mass-energy 2.531 times to 1.29333 MeV so relativistic effects are very

large and its mass increase is 57,500 times the 13.606 eV orbital energy and 230,000 times its adjacent $13.606 / n^2 = 3.4$ eV quantum energy level so quantum effects vanish to only $1/230,000 = 0.0004\%$. And if quantum energy level differences vanish then the neutron's 939.56563 MeV mass, $\frac{1}{2}$ -spin, -1.9135 magneton and charge precisely match classical-relativistic physics according to Bohr's Correspondence Principle. Thus when Relativity dominates quantum effects the proton-electron EM wavefunction manifests a particle (i.e. a neutron).

The neutron EM wavefunction has mass, a $\frac{1}{2}$ -spin, magneton, and mirrors the proton-electron charge difference but it is unstable. However in Nuclear Force (Quantum Dynamic Relativity) deuterium's stable bond was shown to occur by the resonance of a neutron state between protons. A 2.224 MeV mass defect occurs by an $E = mc^2$ mass loss from proton charge repulsion deceleration in an acceleration field created by the electron's neutron state resonance. A proton 1 fm from the neutron's electron creates an $E = k_e e^2 / r = 1.442$ MeV charge energy increase in the electron's mass with a 0.78233 MeV component in the proton's direction that contracts the separation of 1 fm by 2.531 to the observed 0.3951 fm nuclear bond.

The 0.78233 MeV is the maximum energy permitted in a proton's direction because the 2.531 mass increase contracts the electron's 2.76136 fm classical neutron state orbital radius to its observed 1.091 fm radius, 0.0555 fm above the 1.0355 fm proton's surface. The remaining $1.442 \text{ MeV} - 0.782 \text{ MeV} = 0.660 \text{ MeV}$ is the electron's angular momentum component, orthogonal to the 0.78233 MeV neutron state resonance energies with each proton. Resonance occurs since $2.531 \times 0.78233 \text{ MeV} / 3 = 0.660 \text{ MeV}$, relativistically equal to the neutron state electron's 1-d orbital energy component so it orbits between the protons instead of around one. The electron now has equal 0.782 MeV relativistic resonance components with each proton and a 0.660 MeV relativistic orbital angular momentum component.

The $2(0.78233) + 0.660 = 2.224$ MeV resonance energy has equal 0.78233 MeV energies toward each proton. The neutron state proton

sees its 2.761 fm orbital electron contract to its surface and the other sees its 1 fm gap to the electron contract to 0.3951 fm, so both see 0.3951 fm and $E = k_e e^2 / r = 3.65$ MeV repulsion energy. (A proton has a surface charge so calculations are to its surface for distances less than r_p and to its center if greater.) The 3.65 MeV repulsion equals 2.531×1.442 MeV because proton repulsion equals a relativistically enhanced 1.442 MeV proton-electron attraction. The neutron's proton sees the 1.442 MeV acceleration its electron does toward the other proton compounded by the 2.531 contraction from 1 fm to 0.3951 fm caused by the electron, so it sees a 3.65 MeV acceleration equal to the 3.65 MeV proton's charge repulsion.

Thus a neutron's 0.78233 MeV electron absorbs 1.442 MeV from the 1 fm proton to form a 2.224 MeV positive energy resonance and cause a 2.531×1.442 MeV = 3.65 MeV relativistic acceleration for the protons as 1 fm contracts to 0.3951 fm but they lose 3.65 MeV by decelerating to equilibrium in the acceleration field. Since a proton's 3.65 MeV mass loss is offset by a 1.442 MeV acceleration mass increase for the electron the mass defect is only 2.224 MeV, that is, the electron gains 1.442 MeV in acceleration mass that is also an acceleration for its neutron proton so even though 3.65 MeV is lost by repulsion deceleration the net is only 2.224 MeV.

This means the unstable 0.78233 MeV neutron EM wave function becomes a stable 2.224 MeV wave function by resonating between two protons with a specific geometry, like a pendulum's potential and kinetic energies. Deuterium's 1-d 2.224 MeV bond expands to 2 and 3-d H-3, He-3 and He-4 bonding by a simple $BE = 3^{1/d} (p \times 2.2147)^n$ geometric relation, where d is the structure's 2 or 3 dimensions, p and n are the number of protons and neutrons in them, and 2.2147 MeV is deuterium's 1-d energy adjusted for resonance distortions and proton gyrations from the structure's added dimensions.

The significant aspect of this resonance is that 2.224 MeV of positive mass-energy from the neutron and protons is being stored in a region of space contracted by the resonances charged masses.

The nuclear force is coulomb force relativistically magnified by spatial contraction from the electron's inertial resonance and the resulting EM wave transmits each particle's characteristics to the others through its interim space so it actually possesses its own mass, spin, charge, and magnetism characteristics. For deuterium its mass-energy is 2.224 MeV and as was shown in Nuclear Force it has a spin 1 magneton that results from the sum of its neutron and proton -1.9135 and 2.7928 magnetons attenuated by 0.975 to 0.8574.

The 0.975 is a relativistic effect of the 1.442 MeV electron mass increase, where $R.E. = m_e / (m_e + 1.442 \text{ MeV}) = 0.26165$. The resonance orbital has a $(2.761 \text{ fm} - r_p - 0.998 \text{ fm})/2 = 0.36375 \text{ fm}$ radius, where 2.761 fm is the neutron's orbital electron radius, $r_p = 1.0355 \text{ fm}$, and 0.998 fm is its distance to a proton's surface where it absorbs 1.442 MeV, so the electron resonates 1 fm from a proton's surface to 2.761 fm from its center as it changes neutron states with each proton. The 0.26175 RE contracts the 0.36375 fm to a 0.0952 fm peak oscillation radius and a $0.0952 \text{ fm}/2^{1/2} = 0.0673 \text{ fm}$ average (by the 2nd Law of Thermodynamics entropy increases in natural processes and by Quantum Theory all regions are accessible to the electron so the 2-d resonance precesses and its orthogonal components combine to a $1/2^{1/2}$ resultant contraction effect).

Since the resonance occurs within a 2.761 fm neutron orbital radius it reduces it by 0.0673 fm to 2.6937 fm which the neutron's 0.78233 MeV contracts by 2.531 to 1.0643 fm. This compound effect on the neutron's own 2.531 contraction of its 2.761 fm orbital to 1.091 fm results in the $1.06428 \text{ fm} / 1.091 \text{ fm} = 0.975$ attenuation of the proton and neutron magnetons, just like a neutron's 4.8373 lower density than an electron and 0.12% BE mass loss in deuterium mitigates its magneton and its 2.531 contraction attenuates it to its $4.8373 \times 1.0012 / 2.531 = -1.9135$ magneton value.

This 0.975 effect constitutes the deuterium EM wavefunction's $0.8574 - (2.7928 - 1.9135) = -0.0219 u_n$ magneton component, which along with its 2.224 MeV and spin 1 are actual physical phenomena. This

behavior is typical for a magnetic field when permeability is increased, like shunting a horseshoe magnetic's fields with a nail across its poles. To observers the external field is reduced by the increased permeability within the nail. The electron orbital magnetons in the iron shunt the field by Lenz's Law which is what occurs with the resonance orbital electron in deuterium.

By Bohr's $\mu = \frac{1}{2}(e/m) (h/2\pi)$ magneton relation mass reduces an external magneton field and as seen in neutrons and protons, lower density increases it (lower iron content reduces a nail's ability to contain a horseshoe magnet's field). This is because the $h/2\pi$ angular momentum of the charge e generates the field and its flux takes the path of least resistance, the region of highest relative permeability. Thus deuterium's relativistic mass increase in the electron resonance increases the permeability of the neutron's and proton's interim space to net $-0.0219 \mu_n$ magneton value.

However it actually contains a magneton as seen for neutrons. A magneton is a current loop x area product, $\mu = I \cdot A$. The neutron electron has a $(0.78233 \text{ MeV} + m_e) / m_e = 2.53098129$ mass increase. By the $m = m_0 / (1 - v^2/c^2)^{1/2}$ Lorentz Transform its velocity is $v_n = 2.75400306 \times 10^8 \text{ m/s}$. Its radius is $r_n = r_B \times E_0 / (0.78233 \text{ MeV}/3) = 0.529177249 \text{ \AA} \times 13.605698 \text{ eV} / 0.260777 \text{ MeV} = 2.760916 \text{ fm}$ with a $C_n = 2 \pi r_n = 17.34735 \text{ fm}$ circumference and $A_n = \pi r_n^2 = 2.39473 \times 10^{-29} \text{ m}^2$ area. Thus its current is $I_n = ev_n / (2\pi r_n) = 2543.56 \text{ A}$ with a $\mu_n = I_n A_n = 6.09115 \times 10^{-26} \text{ J/T}$ magneton but the 2.5309813 radial contraction reduces the observed area to increase relative" strength to $\mu_n = 6.09115 \times 10^{-26} / 2.5312 = 9.5087 \times 10^{-27} \text{ J/T}$.

This results in a $4.97516 \times 10^{-27} \text{ J/T}$ magneton value when the $4.8373/2.5309813 = 1.911235$ density effect is factored out, nearly identical to the $\mu_n = \frac{1}{2}eh/2\pi m_p = 5.0507866 \times 10^{-27} \text{ J/T}$ Nuclear Magnetron value. The discrepancy is caused by proton and neutron $(r_n/r_p)^{1/3} = (1.091/1.0355)^{1/3} = 1.0175$ volume and $m_p/m_n = 0.99862$ mass differences which yield a $(1.0175)(0.99862) = 1.01609$ factor that equates the $4.97516 \times 10^{-27} \text{ J/T}$ value to $5.0552 \times 10^{-27} \text{ J/T}$.

The 0.09% deviation from the Nuclear Magneton value is attributed to radius resolution error and the analysis shows that the neutron magneton results entirely from the orbital electron wave function.

The electron and proton spin magnetons are exactly shunted by each other's mass. According to Bohr's $\mu = \frac{1}{2}(e/m)(h/2\pi)$ magneton equation the particles generate a magneton based on charge angular momentum and if mass attenuates an external field by capturing the generated field within its increased permeability then it makes no difference whether the mass is within a particle or external to it like the nail to the horseshoe magnet. So the proton's 1836 times larger mass captures the 1836 times stronger electron magneton and the electron's smaller mass captures the proton's weaker magneton. The proton's lower density results in an electron magneton leakage exactly equal and opposite to the proton's so they cancel.

Deuterium's electron resonance similarly generates a magneton and as shown on page 18 the electron's 1.442 MeV mass increase has a 0.26165 relativistic effect on its 0.36375 fm orbital radius and causes a $m_0/m = 0.26165 = (1 - v^2/c^2)^{1/2}$ Lorentz Transform velocity of 2.8934854×10^8 m/s, with an $I = ev/2\pi r = 20,284$ A current and $\mu = IA = 8.4315 \times 10^{-27}$ J/T = 1.669334 μ_n nuclear magneton. This value is however further reduced by the relativistic contractions that condense space, increasing mass-energy and permeability, and thus capture the generated magnetic field by the ratio of increase in captured energy to the dark energy permeability of free space.

Since a magneton depends on the current loop area its 0.26165 radial contraction has a $(0.26165)^2 = 0.06846$ effect. And because the 2-d resonance is a 3-d orbital component with equal orthogonal parts it factors by $2^{1/2}$ to 0.048409, reducing the 1.66934 magneton to 0.0808113 μ_n . The resonance orbital is also contained within a neutron orbital so it is divided by its 2.531 contraction squared to 0.0126152 μ_n and multiplied by $3^{1/2}$ to obtain its -0.02185 μ_n 3-d resultant, (-) since it is from an orbital electron, which adds to the 2.7928 and 1.9135 proton and neutron magnetons to 0.8574 μ_n .

Thus the EM wavefunction's charge angular momentum generates its own unique magnetic field which it captures proportionately to the increase in its mass-energy density. The particle charges are also equalized by the wavefunction's transmission of their charges to each other, so an e^- charge polarity presents to the proton and an e^+ polarity presents to the electron at the wave's boundaries, with charge force being a wavefunction's relativistic acceleration gradients and proportionate to its mass-energy density increase. This perspective makes charge force a function of the mass-energy density and its polarity and equivalence an orientation function.

Hofstadter demonstrated this when he showed the $\frac{1}{2}e^+$ charge at a 0.3 fm proton kernel radius since an EM wave's propagation axis is neutral with polarized fields emanating from it. One observer sees it moving right with its E-field up and B-field toward them while an observer on the other side sees an opposite polarity wave moving left with the B-field pointing away. We see a proton with a positive surface charge and a $\frac{1}{2}e^+$ scattering surface at 0.3 fm but an observer at the center would see the opposite polarity if polarity is the orientation of a 3-d oscillation with an angular momentum and its force is a $3^{-\frac{1}{2}}$ resultant of its 1-d components.

Thus if the propagation axis is at $\frac{1}{2}$ a proton's radius, $r_p/2 = 1.0355 \text{ fm}/2 = 0.51775 \text{ fm}$, it would contract space to $0.51775 \text{ fm}/3^{\frac{1}{2}} = 0.2989 \text{ fm} = 0.3 \text{ fm}$ because charge polarity orientation would be opposite from the center and propagation axis perspectives. So we see it as 0 charge, $\frac{1}{2}e^+$ at 0.3 fm and e^+ at its surface based on our 0 charge reference but a center observer would see an opposite oscillation orientation and the charge going from 0 to $\frac{1}{2}e^-$ to e^- with a $\frac{1}{2}$ charge force difference to the propagation axis and a $\frac{1}{2}$ charge force difference from the propagation axis to the surface.

An EM wavefunction thus explains Hofstadter's findings of the 0.3 fm core and stacking of $\frac{1}{2}e^+$ charges to the proton's surface because a radial convergence of the force from 3 dimensions would contract its space to a 0.3 fm radius. His structure also matches

Bohr's $k_e e^2 / r^2 = mv^2 / r$ charge-centripetal force equilibrium model, the $d_{ep} = 4.4373 / 3^{\frac{1}{2}} = 2.7928$ electron/proton density effect on the magneton, and $\frac{1}{2}$ -spin, all of which derive from PE-KE resonance and the balance between charge, magnetic and mass energies as seen for hydrogen, its unstable relativistic neutron state, and the stable relativistic resonance bonds in deuterium, H-3, He-3 and He-4.

These same principles would apply for an EM wave particle if an $k_e e^2 / r^2 = mv^2 / r$ charge-centripetal force equilibrium and its equivalent $m = k_e (e/v)^2 / r$ mass form can be shown to exist, with a $u = \frac{1}{2}(e/m)h/2\pi = IA = \frac{1}{2}evr$ Bohr magneton attenuated by mass and a proton's lower density than an electron, mitigating its magneton, must be accounted for. In a neutron and deuterium mass attenuates a field by capturing it in the mass-energy permeability increase resulting from the relativistic resonance and its density depends on radius by $V = 4/3\pi r^3$. And the common denominator in each of these relations is radius and its relativistic contraction.

A neutron's 0.78233 MeV mass increase is captured in its $m_e + 0.78233 / m_e = 2.531$ relativistic contraction and its $\frac{1}{2}$ -spin was shown to result from the proton's 2.531 relativistic contraction toward the electron's 2.761 fm orbital. And since an associated 2.531 time dilation occurs the proton sees the electron's effects after it has moved on along its orbital path. This added 0.78233 MeV is thus captured in dilated relativistic time and the proton is being attracted to an electron that is not there by its charge effect held in time, which means an EM wave can contain the charge and mass effect of a particle when there is no particle.

Similarly when the electron is on the proton's opposite side the same phenomena occurs in the exact opposite direction and if a wave can hold a particle's effects in opposing degrees of freedom it can do so in all six degrees of freedom. If it can do this for the electron's mass and charge effects then it can do so for the proton's. But in the neutron's case the captured mass-energy is 0.78233 MeV, not m_e , and this was shown on page 19 to result from a 2.75400306×10^8 m/s

electron velocity. If this phenomena is to result in the $m_p = 938.2723$ MeV proton mass it requires an $RE = 938.2723/0.78233 = 1199.32915$ relativistic effect and Lorentz $m_0/m = (1 - v^2/c^2)^{-1/2}$ relation velocity of 2.99792354×10^8 m/s.

By de Broglie's wavelength relation this yields in $\lambda = h/mv \times 2.99792354 \times 10^8$ m/s = 1.321410432 fm wavelength that yields the $2\pi \times 1.322$ fm / $2\pi = 0.29742$ fm = 0.3 fm radius core observed by Hofstadter. The $2^{1/2}$ factor is the resultant of 2 equal orthogonal orbitals, like average electron position in hydrogen. The 0.29742 fm radius multiplied by $3^{1/2}$ to remove 1-d relativistic contractions yields a 0.51515 fm radius EM wave propagation axis and 1.0303 fm proton radius (within 0.5% of 1.0355 fm used in the calculations) and means an EM wave based on the proton-neutron mass-energy ratio matches the effects of one derived through calculations.

In a proton however no discrete particle masses are needed to form the harmonic resonance equilibrium state because relativistic time dilation maintains the EM wave's mass-energy-charge effects in the orientated energy density of its contracted space after the wave has moved on along its propagation axis, as a neutron's wave maintains its charge, 0.78233 MeV, and $1/2$ -spin proton offset after it moves on. From its perspective it moves in a straight line but to observers and other particles the effects remain in space. In a neutron the (-) electron charge orientation transmits toward its proton so charge goes from a 0 center to $1/2e^+$ at its 0.3 fm core and cancels to 0 through the proton and contracted orbital region.

However in a proton the charge goes from a 0 center to $1e^+$ at the propagation axis to e^+ at the surface with associated oriented contraction fields so the wave sees a $1/2e^+$ charge radially outward and a $1e^-$ charge radially to the center resulting in a net radial coulomb force acceleration toward the center because the wave will always be entering this charge field maintained in dilated time as it moves along its propagation axis. Since an orbital EM wave charge field generates a magnetic field there is a $u = 1/2(e/m)h/2\pi$ Bohr

magneton adjusted for the density of mass-energy contained by the EM wave's associated coulomb force acceleration fields.

If only the EM forces were at work there could be no coulomb-centripetal force equilibrium to maintain the wave's orbital so it would spiral in and collapse the structure. However time dilation causes its charge and inertial contraction effects to persist as a surface charge and 3-d relativistic acceleration gradient. By the General Theory of Relativity gravitational and inertial masses are equivalent, both contract space and occupy it with $E = mc^2$ energy density. The wave creates time dilated charge acceleration fields that contain its orbital and its mass-energy angular momentum and charge interacts with the acceleration fields its inertia created.

Thus the EM wave's dynamic mass-charge effects and the static ones it relativistically created in space-time exist in a harmonic equilibrium, where charge is its motion's orientation polarity. This is a PE-KE equilibrium identical to the one between a proton and electron in hydrogen. In Wave Particle Duality particle wave effects were shown to result from harmonic resonance, the effects on space-time that relativistically equate particles to each other over time. In hydrogen the proton looks like an electron to the electron through the wavefunction's relativistic lens effect and the electron inertias that create the lens equate it to the proton over time, or they could not exist in a harmonic equilibrium.

The $k_e e^2 / r^2 = mv^2 / r$ charge-centripetal force equilibrium is stable because time dilation maintains a charge difference between the proton's center and surface, forming a radial dimension of PE The EM wave's RE = 199.32915 relativistic effect, with respect to the neutron's 0.78233 MeV EM wave, enhances this coulomb PE field as shown for nuclear bonding. The EM wave's mass-energy resonates within the PE field because its (+) charge orientation accelerates it to the center by $k_e e^2 / r^2$ and its orbital angular momentum that created the RE accelerates it out by mv^2 / r with a $mv^2 = \frac{1}{2} k_e e^2 / r$ KE and a $E_{tot} = KE + PE = \frac{1}{2} mv^2 - k_e e^2 / r = -\frac{1}{2} k_e e^2 / r$ as shown by Bohr.

If this concept is correct for particles it means all matter, neutrons, nuclei, atoms, ..., planets and stars, exists by the same principle, a static $F = ka_1a_2/r^2$ unipolar PE acceleration field in resonance with 3-d $F = mv^2/r$ KE acceleration. This comports with Cause and Effect because if the principle is uniform, matter is a simple recursive permutation of added degrees of freedom, with each structural element of the Universe naturally integrating into the next by the 2nd Law of Thermodynamics where entropy increase in a degree of energy freedom adds a degree of structural complexity.

Integrating a point into available dimensions results in two equivalent permutations, a static non-linear PE gradient in space and time in equilibrium with a KE resonance of the dimensions. In other words the boundary conditions for a point's energy is static non-linear dimensions of space and time and a dynamic resonance of those dimensions. This constraint only requires the four observed dimensions of space and time that vary according to the principles of Relativity, specifically a $m_0/m = E_0/E = (1 - v^2/c^2)^{1/2}$ Lorentz Transform of each dimension according to the momentum it contains.

A point may be Einstein's $ds^2 = dX_1^2 + dX_2^2 + dX_3^2 + dX_4^2 = 0$ Euclidean quantum of space and time with a total 0 average energy or it may be part of his $ds^2 = 1/\mu\nu \Sigma g_{\mu\nu} dx^\mu dx^\nu$ Riemann summation where it is influenced by an external acceleration field g and $\mu\nu$ Lorentz Transform effects. This means that each point has a local classical perspective and an observer perspective influenced by an acceleration field g and M -inertial Lorentz Transform effects on its dimensions of space and time. And this provides a basis for a wave-structure Universe that can be observed as finite and quantum or continuously variable depending on the observer's vantage.

For instance if we look at stars we see Relative continuity, if we look at atoms we see quantum discontinuity, and if we change our perspective to the electron we again see Relative continuity because to the electron everything it interacts with has a greater energy with small quantum level differences that appear classical

to it by Bohr's Correspondence Principle. The electron views them through a relativistic lens dominated by an acceleration influence from them and the Lorentz Transforms its velocity causes so they seem continuous, but they see the electron as always being accelerated with Lorentz Transforms in each dimension that appear wavelike.

This is the basis of the electron's wave nature because as it passes from dimension to the next its classical mv^2/r centripetal acceleration away from the $F = ka_1a_2/r^2$ acceleration field causes its momentum and thus Lorentz Transform to vary in each dimension. This is where Heisenberg's $mv \cdot x = \frac{1}{2}h/2\pi$ Uncertainty for observers arises since if something has an $h/2\pi$ angular momentum then it changes dimensions at a uniform rate and thus its velocity changes in each dimension according to a sine function with Lorentz Transforms of each dimension's space and time in accordance with Schroedinger's conjugated wave functions because the Transform is a square root.

These conjugates occur because space and time vary inversely with respect to each other and also with direction of motion with respect to the observer, since it contracts space and dilates time as it enters a region and space dilates and time contracts as it leaves, so there is a wave function disparity in electron momentum and position according to $h/2\pi$ angular momentum, which equals the mv^2/r angular momentum because the space-time wave energy effects must synchronize with the classical orbital energy and period that generates each dimension's wave effect for resonance equilibrium. This means any observer always sees some wave effect because they always create an acceleration field, if only by mass, on any other object which causes an angular momentum on its motion.

These concepts provide a basis for dark energy, EM waves, and EM waves with angular momentum in particles, since distribution of a point's energy between its 4 dimensions requires it to oscillate in each dimension of space with respect to the energy in its time flow dimension. It can oscillate synchronously in all dimensions, there can be a phase shift between each dimension's oscillation to give it an angular momentum

component, and it can have an inertial momentum component like an EM wave moving at light speed. In this case its dimension in the direction of motion would contract to 0 so only the orthogonal dimensions' oscillations are apparent.

The reason for this and the basis of oscillation is energy density. If a point has energy there is nothing to contain it in each dimension unless all neighboring points have equal amounts of energy. And if energy only exists in space dimensions then time flow has no relation to space which it does by Lorentz's Transform relating energy to space and time by velocity. The presence of time domain energy attenuates time flow because increased energy density inhibits the velocity of energy into its dimension, which is the measure of time flow (i.e. increased $E = mc^2$ energy limits velocity increase because the inertia has less relative effect).

As shown for the proton and neutron, mass-energy has density but the time domain has no structural containment as in particles so no force inhibits its release except for the energy density of other available dimensions, but there is force opposing addition of energy. This is the basis of a PE-KE equilibrium between space and time dimensions which for these reasons resonate with time's energy and is why time and space have inverse Lorentz Transforms. Thus each dimension has an energy flow wave function that alters its respective size to maintain the relativistic resonance and the resonance must similarly occur with neighboring points.

If energy enters a dimension of space its restriction depends on presence of energy in adjacent points' dimensions, otherwise no increase in a dimension's $E = mc^2$ energy density exists to oppose its inertia toward the adjacent point. If opposing forces are not equal, energy transfer will occur until uniform density equalizes them. Since a space dimension has a PE-KE resonance with its time flow dimension's energy density the adjacent points' density forces form sympathetic PE-KE resonance wave functions so density uniformity causes wavelength uniformity in each of the dimensions.

Wave functions thus result from energy exchange between space and time driven by the forces of energy density in each dimension with time flow modulation by the Relative ratio of inertial energy flow (which measures time flow) with respect to the inert energy density present in its dimension. Energy flow is described by an $e^x = x^0 + x^1 + x^2/2! + x^3/3! + x^4/4! + \dots$ expansion of available degrees of freedom specified by the exponents (i.e. such as static energy in each dimension and its velocity, acceleration, etc) and with factorial denominators that specify the degree of energy flow attenuation into each degree of freedom level, with each level of degrees of freedom being an integration of the prior level.

However Euler's $e^{ix} = \cos x + i \sin x$ Identity describes the energy flow if it resonates between orthogonal dimensions, such as space and time, where i defines one as orthogonal and the sine and cosine functions define a 90° phase shift between their energies. This means a resonance wave function is conjugated with 2 possible boundary condition states, like an electron with equal probability of being on either side of its orbital, and uncertain in between since energy flow through dimensions relativistically alters them. But Euler's Identity is incomplete, like Schroedinger's equations based on it, because it separates the odd and even harmonic degree of freedom levels to only describe how energy behaves between the boundary conditions over time whereas e^x describes its behavior as it moves from one boundary condition to the other.

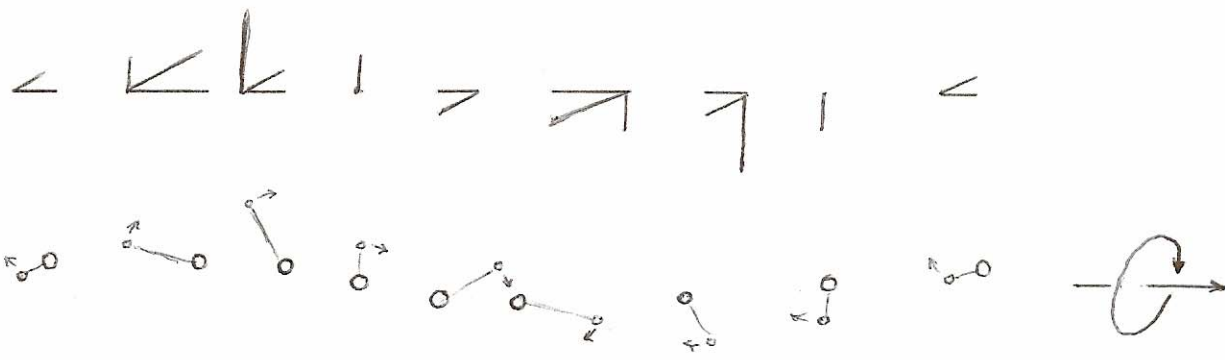
They are entirely different perceptions because one describes how something behaves over time as a quantum state with boundaries and the other describes how it specifically gets from one boundary to another. One is a probability of being somewhere and the other has a Cause of being someplace with a completely described energy and an Effect of getting from one place to the next. Schroedinger overlooked Conservation of Angular Momentum when he differentiated Bohr's 2-d orbit to a 1-d wave function and unfortunately Einstein did too when he defined his dimension of time. Had he included it he would have unified the EM forces with gravity and inertia.

Einstein defined his time flow dimension as $x_4 = (ict)^{\frac{1}{2}}$ which is a distance in the imaginary time dimension a photon moves from one point to its neighbor in a specific amount of time, defining time flow in terms of the speed of light and a distance. But both space and EM waves are 3-d so $(ict)^{\frac{1}{2}}$ is only a resultant time flow that does not include the possibility of angular momentum with an ordered change in time flow for each dimension. If the dimensions of space are orthogonal nothing prevents resonance between them in which case the resultant time flow has a component in each spatial dimension. If a 90° phase shift between a dimension's energy flow and the other dimensions exists then so does an angular momentum with a corresponding rotational direction of energy flow.

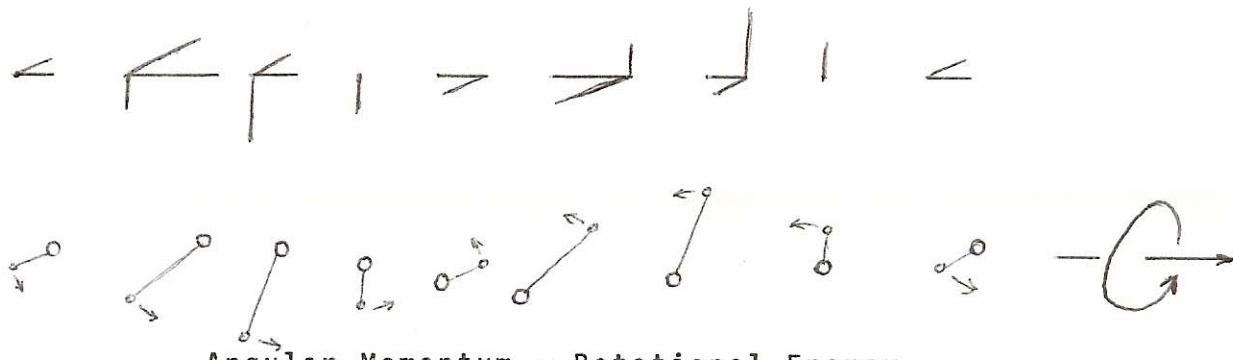
Wave functions still describe the energy flow over time for observers but a rotational component can only be tracked from the local classical perspective of the energy with respect to the vast sea of other points in the Universe. And rotational energy has an associated spin and oscillation orientation polarity observed as a charge and magnetic effect, charge polarity being a left or right orientation of oscillation by the other 2 dimensions with respect to the direction of energy flow in the 3rd dimension. When energy rotates it radially contracts space which increases energy in the center by creating a relativistic offset and the offset influences the rotational energy by causing its precession, as with hydrogen.

However precession is a relative energy flow between energy relativistically concentrated in the center and rotational energy that concentrates it. Thus the rotational energy always sees the energy in the center moving in a specific direction orthogonal to its orbital plane. That is, as it orbits it sees the center energy move according to a left or right hand orientation but it's really only precessing with respect to it. This creates a toroidal flow of energy around the rotational energy's direction of motion, the direction of which depends on the 1-d energies phase relation with respect to each other. This energy flow along with its relative energy concentration is what is observed as magnetism.

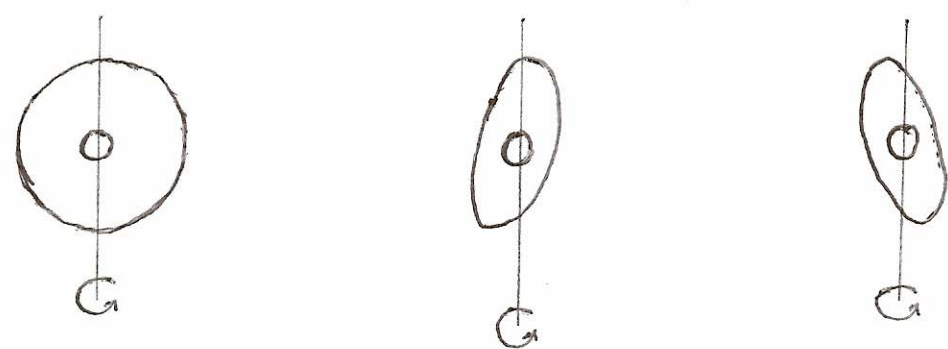
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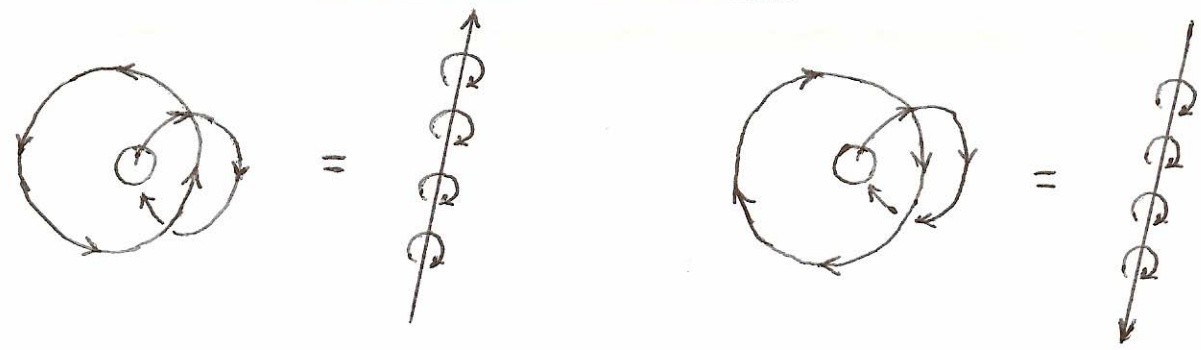
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Angular Momentum - Rotational Energy



Precessional Energy



Apparent Toroidal Energy Flow Effect

In reality, rotational energy is a phase shift in oscillation energy between 1 dimension of space and the other 2, precession is caused by rotation of the phase shift between the dimensions by a shift in each dimension's time flow rate (energy affects time flow and the phase shifted dimension's lower energy with respect to the other 2 causes its time to speed up so its phase shift goes to 0° and its time shift moves on to the next dimension in the direction of rotation), and toroidal energy flow is the precessional energy flowing through the rotational energy's plane as the mass center appears to precess (by the 2nd Law of Thermodynamics and Quantum Theory all energy states are equally available, entropy fills them, and thus energy equally distributes between all the dimensions).

This is not new theory. It is simply the product of existing theory applied to distribution of energy between known dimensions. And the mathematical description is relatively straightforward, as shown by Pauling's treatment" of gases and thermodynamics (General Chemistry, Chapters 9-10), if the phase shifted dimension's energy density is represented as a mass and the energy of the other 2 is represented as twice its mass. Pauling showed how monatomic and diatomic gas behaviors result from Classical and Quantum Physics, and in Wave Particle Duality relativistic effects were included to show that particle wave nature results from harmonic resonance.

Recreation of Pauling's diatomic harmonic oscillator with the relativistic effects here would be lengthy and redundant but the analysis applies if the phase shifted dimension's energy density is treated as half the mass of the other dimensions' energy, with precession occurring by phase shift rotation between dimensions by time flow modulation from their relative energies and the toroidal energy flow is what the phase shifted dimension and an observer in that dimension sees as a precession of the other dimensions' energy. The 3rd dimension precessional or toroidal energy is $\frac{1}{2}$ the angular momentum or rotational energy of the other 2 dimensions or $\frac{1}{2}h/2\pi$, and oscillation orientation (charge) determinions the direction of toroidal energy flow, thus $\frac{1}{2}eh/2\pi$ is the total magnetic energy.

In a particle the $\frac{1}{2}eh/2\pi$ total magnetic energy is attenuated by mass to $\mu = \frac{1}{2} (e/m)h/2\pi$ by capturing the precessional energy in the inertia of the mass, with mitigation for lower mass densities. Thus what is observed as magnetism is the relativistic effect of inertial energy oscillating in the space-time dimensions such that a 90° phase shift exists in 1 dimension's oscillation to yield a rotation with a relativistic time shift between its energy and the other 2 dimensions causing rotation of the phase shift between the dimensions to yield precession, observed as toroidal energy flow from the plane of rotation, with energy equally distributed in the dimensions in accordance with Quantum Theory and Thermodynamics.

Since the resultant energy of the 3 dimensions is $3^{1/2}$ and the phase shifted dimension's energy is $\frac{1}{2}$ the energy of the others the dark energy structure's spin angular momentum is $\frac{1}{2}3^{1/2}h/2\pi$, as for particles, and its magnetic spin moment is $\frac{1}{2}(e/m)h/2\pi$ because the precession to rotation energy ratio is the magnetic effect that is relativistically attenuated by mass in the 3 dimensions according to the $E_0/E = m_0/m = (1 - v^2/c^2)^{1/2}$ Lorentz Transform. Because the precession or toroidal effect makes the mass center appear to pass overhead, moving at a right angle to the rotational energy's flow according to $F = qv \times B$, where B is the $\mu = \frac{1}{2}eh/2\pi$ magneton, an increase in $E = mc^2$ mass-energy inversely affects velocity with respect to the speed of light c and thus reduces the net force.

In dark energy the dimensional energies of a point resonate with those in neighboring points, like conjugated resonance bonds in chemistry, and gives the dark energy its density. There is no distinguishable mass because energy distributes uniformly between neighboring points but the energy density in a point's dimensional resonances becomes the Relative reference for mass in particles by the ratio of energy density increase in the dimensional resonances of particles. Since dark energy density is the reference base it determines the speed of light by permeability and permittivity, the effects of dark energy's density and structure on dark energy with inertial velocity (a photon) by determining its wavelength.

The resonance between points causes their energies to be 180° out of phase with equal and opposite inertias, charge oscillation orientations, toroidal energy flows and magnetic polarities. Thus precession energy conducts through adjacent points' dimensions and back to the original point, completing the loop and canceling any magnetic fields except for permeability and permittivity effects. And if a dark energy structure has an inertial momentum it travels through the dark energy with its velocity limited only by how fast its momentum can propagate through the dimensions of dark energy and how fast its orthogonal energy oscillations can realign dark energy's oscillation orientations to it and back again.

This limitation is the permeability and permittivity of free space and the basis of EM wave oscillation stability. Dark energy oscillations are stable because the energy density of every point is exactly balanced by the energy density of every other point but a photon can have any energy value which must be balanced by its effect on the dark energy. Also instead of an angular momentum it has inertial momentum with a phase shift in its propagation axis dimension proportionate to the effect of its momentum on the dark energy in front of it. If it has a phase shift of any value other than 0° or 180° it will have an angular momentum and would have to transfer that information to the dark energy which is entropically unfavorable since dark energy fills its available energy states.

This is a chemical thermodynamics problem where the photon is both reactant and product governed by the $dG = dH - T dS$ standard free-energy difference relation. There is no dH reaction enthalpy so the limitation to the reaction proceeding is dS entropy under uniform T temperature conditions. Momentum requires one degree of freedom and the orthogonal oscillations each require two, for a total of five. Incorporating an angular momentum would affect two degrees of freedom but restricting phase shift to 0° or 180° only affects one and by the 2nd Law of Thermodynamics a natural process with no energy gain will take the least intrusive approach to dark energy's already filled states and restrict the phase shift.

Since a 0° phase shift would mean momentum has no effect on either the photon or dark energy in its path, contrary to Newton's 3rd law that action has an equal and opposite reaction, the phase shift must be 180° , thus restricting a photon to always moving at maximum velocity. This doesn't mean other structures cannot exist with the same or different velocities, it just means EM waves move at the speed of light through dark energy, and depends on the rate its orthogonal oscillations interact with dark energy. Since the only parameters of interaction present are oscillation orientation (charge) and energy density they define the interaction rate.

Since dark energy consists of points equally distributed with opposite orientations a photon's oscillation orientation (charge) must realign half of the points. That is defined as permittivity, $\epsilon_0 = 1/u_0c^2 = 8.854187817 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$, with units of Coulombs squared per meter squared per Newton units of forces because the photon's charge orientation realigns dark energy's in 2 dimensions with a net Coulomb per meter resistance in each dimension combined to C^2/m^2 and the Newton force needed for this realignment depends on the energy density of the dark energy displaced from its ground state condition of being aligned with its neighboring points to an excited energy state of being aligned with the EM wave.

The second parameter is the ratio of photon's energy density to the dark energy's density and is defined as the permeability of free space, $\mu_0 = 4\pi \times 10^{-7} \text{ N}/\text{A}^2$, where A is amperes or Coulombs / second. Since orientations are interfered with in 2 dimensions at once the effect is in $\text{A}^2 = \text{C}^2/\text{s}^2$ and the force required for this is $4\pi \times 10^{-7}$ Newtons. This is the magnetic parameter because the force needed to realign charge orientations at a specific rate is equivalent to realigning electron spins from a bonded state with opposing spins according to Pauli's Exclusion Principle to aligned spins in an antibonding state in chemical reactions. The magnetic spins from the toroidal energy flow in the dark energy are aligned to the polarity of the EM wave and the rate this occurs at depends on the force of its energy density with respect to dark energy's.

Because the magnetic parameter specifies the realignment rate of the dark energy's magneton in 2 dimensions for a specific force and the charge parameter specifies the orientation realignment per meter in 2 dimensions per unit of force the two together specify a space-time equilibrium relation in terms of force. In other words a force of $4\pi \times 10^{-7}$ Newtons will realign a Coulomb worth of dark energy charge orientations in a second in 2 dimensions and if they are already realigned $8.854187817 \times 10^{-12}$ Coulombs worth per meter of space in 2 dimensions will return a Newton worth of force.

Thus inertial energy in an EM wave's 2 oscillations aligns a quantity of dark energy orientations in a finite time, creating a specific force with orthogonal charge and magnetic fields by their orientation, and they reorient to their ground state over a finite distance in the 2 dimensions as they return that force's energy. The equations for this space-time force equilibrium have the same form as Maxwell's $dE/dx = -dB/dt$ and $dB/dx = -\mu_0\epsilon_0 dE/dt$ EM wave equations relating the change in charge per unit space or time to the change in magnetic field per unit time or space and result by the EM wave oscillations' inertial energy aligning inertial energy in the phase shifted oscillations of dark energy.

Permeability and permittivity relate a charge field formation and decay to time and distance in 2 dimensions with equal opposing forces over time and define a velocity in the dimensions bounding a radial energy transfer area between the EM wave and dark energy. Thus energy moves from the wave by the force of its density until it creates an opposing dark energy density force to restore it and this cycle takes a finite time equal to the time it takes for the EM wave's inertial momentum to traverse the distance of one cycle. Because of this an EM wave's velocity exactly equals the velocity of an inertial energy cycle in each orthogonal dimension and since μ_0 and ϵ_0 define the time and distance taken for energy transfer between an EM wave and charge field area it creates, the EM wave's velocity is defined by $c^2 = 1/\mu_0\epsilon_0$ and the electric and magnetic field rates of change relate by $dB/dx = -\mu_0\epsilon_0 dE/dt = -1/c^2 dE/dt$.

In actuality EM wave's have a spin 1 angular momentum because the 3rd dimension oscillation's 180° phase shift makes it coincide with the other dimension's oscillations so they have symmetry over time along a propagation axis instead of orbital spin 1 symmetry. This does not impact its dark energy interaction entropy since the orthogonal oscillations still only have 2 degrees of freedom while a ½-spin 90° phase shift would cause them to each affect 4. For light, wavelength is $\lambda = hc/E$ because the energy density ratio of light to dark energy determine its relative energy E and the force into the dark energy's already filled degrees of freedom.

Since e^x defines the degrees of freedom in its exponents and attenuation of energy flow by prior filled states in its factorial denominators it defines the rate of energy flow into dark energy's filled states in space and time. And since dark energy's charge orientations and magnetic toroidal energy flow constitute relative capacitance and inductance for free space represented by C_0 and U_0 there is a dark energy fundamental resonance frequency given by Hertz's $f = \frac{1}{2}\pi(LC)^{\frac{1}{2}}$ relation where $f_0 = \frac{1}{2}\pi(\mu_0\epsilon_0)^{\frac{1}{2}} = 1c/2\pi$, which has a corresponding $\lambda_0 = c/2\pi f_0$ wavelength. This occurs because a charge differential in space is an electric field V.

The current (charge flow or free space transformation rate) is $I = V/R$, where R is charge flow resistance from dark energy's resonant oscillation structures (i.e. to form a charge field each neighboring point's orientation must invert its spin so all points have the same charge and magnetic orientations). Current flow for RC and LC circuits is $I(t) = V/R e^{-t/RC}$ and $I(t) = V/R e^{-t/(L/R)}$, according to the e^x energy transfer relation, with capacitance and inductance out of phase with respect to R, so they have an $e^{ix} = \cos X + i \sin X$ Euler Identity resonance where $f = \frac{1}{2}\pi(LC)^{\frac{1}{2}}$.

Thus the energy from the EM wave forms a tuned resonance with free space's permeability and permittivity that defines frequency, wavelength, velocity and $u = u_E + u_B = \epsilon_0 E^2 = B^2/\mu_0$ instantaneous and $u_{av} = \epsilon_0 E_{av}^2 = \frac{1}{2}\epsilon_0 E_{max}^2 = \frac{1}{2}B_{max}^2/\mu_0$ average energy densities.

But as de Broglie showed mass has a $\lambda = h/mv$ wavelength attenuated by its interaction with dark energy and results in a velocity less than c so it completes an oscillation cycle before it moves as far and has a shorter wavelength. Thus a 13.6 eV electron has a 3.3 Å wavelength but a 13.6 eV photon's is 911.6 Å, 275 times more, and an electron wavelength reduces by $(E)^{1/2}$ but a photon's reduces with energy increase because the electron's $\frac{1}{2}mv^2$ energy is proportional to v^2 but its wavelength is inversely proportional to v .

However a neutron's electron wavelength is not de Broglie's $\lambda = h/mv$ relation proportional to $1/(E)^{1/2}$, it's proportional to $1/E$. By Lorentz's $(1 - v^2/c^2)^{1/2}$ Transform the 0.78233 MeV electron has a 2.754×10^8 m/s velocity and $2.531 m_e$ mass with a $\lambda = h/mv = 1.04 \times 10^{-12}$ m de Broglie wavelength, larger than the electron's actual $\lambda_n = r_n \times 2\pi = 17.35$ fm classical or $\lambda_n/2.531 = 6.854$ fm observed relativistic wavelength. But the neutron's wavelength is exactly proportional to the inverse of the electron's energy increase over its 13.6057 eV ground state energy, where its 1-d $0.78233 \text{ MeV}/3 / 13.6 \text{ eV} = 19166.7$ energy increase reduces its 3.325 Å ground state wavelength to 17.35 fm. Thus as velocity of mass approaches c its $E_0/E = (1 - v^2/c^2)^{1/2}$ energy is proportional to velocity, and means that at relativistic velocities mass becomes like EM wave energy.

In a neutron the 2.754×10^8 m/s electron EM wave presents a proton charge to the electron and vice versa because standing on either side as it passes shows its E-field in opposite directions with respect to the E-field in the direction of motion and it also contains measurable mass. This is because angular momentum, with precession, gives the wave a mass-energy effect by equalizing its own EM oscillations with respect to the oscillation of its motion. In other words, it cancels its orthogonal oscillation orientation charge effect toward the center of rotation by the orientation it presents from the opposite side of its orbital motion. In essence angular momentum orientation becomes a charge effect that is equal and opposite to the charge it sees relativistically presented in a time dilation while it was on the opposite side of its orbital.

With light, the EM orientations realign dark energy's by the force of its energy density with respect to dark energy's density, with a time-frequency relation that relates the speed of light and its wavelength to the permeability and permittivity of free space. The dark energy restores the EM wave's energy by conserving the inertial energy of its orthogonal oscillations in time as it moves along a straight line, giving it an oscillation wavelength in time and space. But if the EM wave has an angular momentum dark energy cannot return the oriented inertial energy of its oscillation with respect to its propagation axis because it has moved laterally.

That is, the propagation axis moves laterally to the opposite side of its orbital just as fast as it moves on its axis so when the dark energy goes to return the inertial oscillation components the EM wave is no longer there. This occurs because the inertial angular momentum energy counters the EM wave's oscillation energy with an orthogonal energy that moves its propagation axis to the opposite side so the axis resonates with its EM oscillations. And when the dark energy goes to return the oriented inertial energy it essentially becomes a charge source because it now presents its own oriented energy from the center of angular momentum rotation.

From the opposite side of its orbital the EM wave sees this as the presentation of an opposite charge. If the dark energy is presenting the charge oscillation inertias radially outward and the EM wave on the opposite side needs those inertias to complete its EM oscillation it perceives an energy void between it and the inertias presented on the opposite side of its orbital so it moves in the direction of the inertias, which gives the axis oscillation an energy density disparity that is the force of its oscillation. Thus the propagation axis oscillates in 3-d exactly out of phase with its 3-d EM wave oscillations, forming a harmonic resonance equilibrium. And since the charge orientations in the dark energy represent an excited energy state for its own points' oscillation orientations it constitutes a dark energy density increase that relativistically persists over time as a mass-energy with charge.

This description applies equally to the neutron's EM wave or proton's EM wave. The only difference being that the neutron has the masses of the proton and electron to resonate so it is a much smaller energy and its EM wave charge is equalized by the electron and proton charges to present a net 0 charge. In the proton the EM wave's orientations have no external charged particle to offset the orientations it presents in the dark energy while it is on the opposite side of its orbital so it presents an e^+ proton charge orientation. Internally the EM wave's oscillation inertias are on its orbital's opposite side so its charge is separated from it in time until it can return to the opposite side to regain them.

This means there is a 0 charge at the EM wave's axis and a e^+ at the outer surface of the exposed dark energy and the EM wave is oscillating between the proton's center and the surface on an axis that is half the proton's 1.0355 fm radius but contracts to 0.3 fm as previously described, with a $\frac{1}{2}e^+$ the charge from the center to 0.3 fm and a $\frac{1}{2}e^+$ to the surface. And this configuration forms the basis for the proton's $\frac{1}{2}$ -spin and magneton value since the excited energy state of the dark energy is a density increase that results in a relative permeability and a mass increase, relativistically offset like the proton in a neutron to yield a $\frac{1}{2}$ -spin.

The excited state of the dark energy's orientations yield the charge effect, its volume and density results in mass, and the EM wave's angular momentum is the basis for its $u = \frac{1}{2}eh/2\pi$ magneton effect, so it is possible to correlate these parameters to verify that they result in the known mass, $\frac{1}{2}$ -spin, magneton and dimension values of the proton. The permittivity is related to permeability by $\epsilon_0 = 1/\mu_0 c^2$ and the $k_e = \frac{1}{4\pi}\epsilon_0 = \mu_0 c^2/4\pi$ Coulomb constant so the $F_c = k_e e^2/r^2$ charge force relates to the $E_c = k_e e^2/r$ captured charge energy that manifests as mass. Also, as was shown for the proton and neutron, the mass and the 4.8373 relative density with respect to the electron yield the $\mu_p = \frac{1}{2}e/m$ $(h/2\pi) (\rho_e/\rho_p)/3^{1/2} = 2.7928 \mu_n$ proton magneton, and Bohr's $E = KE + PE = \frac{1}{2}mv^2 - k_e e^2/r$ energy and $k_e e^2/r^2 = mv^2/r$ force relationships apply.

On page 23 the proton EM wave was shown to have a 2.99792354×10^8 m/s velocity by comparison to a neutron's and yielded the 0.3 fm core and $\frac{1}{2}e^+$ charges Hofstadter observed. Since this is 0.999995 c the value of c will be used for velocity in determining the proton's EM wave mass effect. The premise is that an EM wave aligns dark energy orientations to reflect its E and B fields and constitutes an excited energy state which relativistic compression by an EM wave with angular momentum would increase in density and constitute mass contained in a Bohr orbital model equilibrium.

Dark energy density cannot be measured directly since it is a Relative reference from which mass, charge and magnetic effects in particles, nuclei and atoms derive, like the relative permeability effects of a proton's mass and density with respect to an electron determining its magneton value or the relative permeabilities and permitivities of different matter types with respect to those of free space. For this reason the hydrogen atom ground state energy and orbital radius will be used as the reference for the EM wave's mass effect since its orbital EM wave is the simplest known form.

In a Bohr model charge-centripetal force equilibrium, total energy is defined as $E_{tot} = KE + PE = \frac{1}{2}mv^2 - k_e e^2/r$ if the $k_e e^2/r^2 = mv^2/r$ charge and centripetal forces are equal. This simplifies to a $mv^2 = k_e e^2/r$ mass KE - charge PE equilibrium where the mass energy is exactly balanced by the charge energy over a distance r. At near light speed the mv^2 mass energy becomes the $E = mc^2$ mass energy equivalent so $mc^2 = k_e e^2/r$, and in orbital equilibrium this means $m = 1/c^2 k_e e^2/r$. Since $k_e = \frac{1}{4\pi\epsilon_0} = \mu_0 c^2 / 4\pi$ this becomes $m = \mu_0 / 4\pi e^2/r = e^2/r \times 10^{-7} = 2.5669722 \times 10^{-30}$ kg / fermi.

This is mass density per unit radial distance for dark energy in a ground state hydrogen atom's EM wave charge field with almost no relativistic compression. Comparing Lorentz $\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}$ Transforms of the 2.187691411×10^6 m/s electron and 2.99792354×10^8 m/s proton EM wave velocities yields a 1200.514 compression. Adjusting this for the $(\frac{4}{3}\pi r^3) / (2r)^3 = 4.18879 / 8 = 0.5236$ spherical to cubic volume ratio

and multiplying by the $2.5669722 \times 10^{-30}$ kg/fm mass effect yields a 1.61357×10^{-27} kg mass for the proton, within 3.53% of its actual 1.672623×10^{-27} mass.

This error results because there is some relativistic offset present in the hydrogen atom as shown on page 8. This distortion occurs because of the 7.15% offset to the proton's gyration from the orbital electron's contraction of space and these mass effects introduce an error into a EM wave compression ratio analysis based solely on charge effects. The proton's 7.15% gyration offset is a peak offset with a $\frac{1}{2}(7.15\%) = 3.575\%$ wave average compression that would not occur to the hydrogen EM wave if the proton and electron masses were not present. Since the EM wave equalizes their mass as well as charge effects to each other the added proton gyration is a wave compression that must be factored out of the analysis.

This 3.575% effect results from the 1.0000226627 relativistic mass increase to the electron from its velocity and corresponded to a 13.606239 eV energy, 0.0039% over its 13.605698 eV value seen by observers. But observers reference to hydrogen's proton center of mass so the observed EM wave error is 3.575%, and when this is factored out the compression ratio based on charge alone is 3.575% greater, or 1243.43, and this value yields a 1.671256×10^{-27} kg mass within 0.1% of the proton's actual mass.

This now substantiates that a proton's mass is the result of dark energy charge field compression by simple extension of Bohr's angular momentum analysis. Hydrogen's EM wave presents a proton's charge and polarity to the electron so its compression reduces the same effect to the 1.0355 fm radius of the proton. It's $2.7928 u_n$ magneton has already been shown to result from the mass and energy density of the proton. And its $\frac{1}{2}$ -spin offset is the result of the EM wave's 3-d oscillation $3^{\frac{1}{2}}$ resultant and a relativistic offset as in the neutron. All of these effects clearly result from the same common principles and show that the Particle Effect, dark energy, nuclei and atomic structures are all recursively related.

Conclusion

By the 2nd law of Thermodynamics entropy increases in all natural processes and by Quantum Theory all regions are accessible regardless of energy. These principles mean that energy states form a progression from an initial reference state to increasingly complex forms with each added degree of freedom. And as energy is added it must flow through the structures of filled energy states into available higher energy states so its flow is attenuated by the constraints of the energy in those filled states.

This process is characterized by the e^x expansion and its Euler Identity form with complex conjugates that allow for PE - KE equilibrium oscillations between opposing degrees of freedom in the four space-time dimensions. These energy states are quantum by nature and energy transfer between them to form new states is relativistic, and as such, results in a wave nature appearance to observers since the dimensions of space and time distort in each state of the e^x expansion as energy flows through them. Since the states exist in Euler Identity PE - KE equilibrium the distortions must have a wave nature that is integral multiples of the existing energy in each state.

By this reasoning, the principles of angular momentum, with centripetal acceleration in equilibrium with the .acceleration force created by stable structural states, has led to a recursive structure of matter from dark energy, to particle, to nuclei, and all higher structures, that results in the behaviors of mass, charge and magnetism we observe. Indeed, the structure of reality is of a fractal nature where behaviors exceed boundaries.