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What Part of Coulomb's Law Don't You Understand?

The physical universe consists solely of nucleons with unit charge and mass, inextricably connected. Electromagnetic radiation is hypothesized to be a natural consequence of charge obeying Coulomb's law and mass obeying Newton's law of gravitation. This is equivalent to saying that the net distribution of charge in the universe remains constant and momentum is conserved.

This paper is an attempt to restate and extend the ideas presented in a paper given at Congress 2000.[1] It is a presentation of the best ideas the author has conjured to date. As with any speculation, it will be constructive to treat the hypotheses as such. If any assertion herein is known to be false, please inform the author, with data and logical connections thereto or citations of sources addressing empirical refutation.

For best results, the reader is requested to temporarily suspend notions of physics that lay multiple levels of inference beyond the realm of observation. Throughout, he is requested to maintain a sense of reality and reason.[2] As with geometrical proofs, the fundamental notions will be given, and more will be added only as empirical findings and logical conclusion allow. Insistence that muons, wavicles, wormholes, and other twentieth-century constructs are fundamental physical notions will be counterproductive to the intentions of this paper.

Charge and Mass

An atom is believed to consist of protons, neutrons, and electrons. The possibility that the neutron is not a fundamental particle, but a combined proton and electron, is often entertained. However, no experimental evidence has been forthcoming.[3] For the sake of simplicity, this paper will treat the neutron as a composite particle.

As the basic building blocks of all matter, electrons and protons are believed to have two properties, charge and mass.[4] The amount of charge on all nucleons will be assumed to be the measured 1.60×10^{-19} coulombs. This value, obviously, has never been quantified in the absence of ambient charge and other built-in inevitables, so it must include artifacts. Whatever the exact value of nucleon charge, it will not be relevant to this conceptual presentation.

The rest mass of the electron is roughly 9.11×10^{-31} kg; and the rest mass of the proton, 1.67×10^{-27} kg. Again, these values have never been quantized in the absence of mass or other mass-affecting factors; but any deviations from absolute values will not be important to this presentation. What is important is that the mass of the proton is roughly 1833 times greater than that of the electron. Some have proposed that mass is a coulombic interaction. This may be so, but mass and charge will be treated as equally fundamental for the purpose of this paper. Explaining why protons are more massive than electrons will be one of the more interesting challenges to a theory that accounts for mass in terms of charge.

It is also important to note that there is no reason to assume that charge and mass can ever be separated. Restated, the charge and mass on a nucleon are inextricably connected, if only by virtue of being unassailable, discrete and constant properties associated with each particle.

Allowing for questionable assumptions built into a system which cannot allow total isolation of variables, two charges can be assumed to act in accordance with Coulomb's law:

$$F = kq_1q_2/r^2.$$

Opposite charges attract, like charges repel. The force experienced by each is dependent on the square of the distance separating the charges. Forces add vectorially for multiple-charge scenarios. Ignoring mass for the moment, the change in position of any charge causes other charges within its sphere of influence to reposition in accordance with Coulomb's law. Equivalent to this statement is the assertion that the net distribution of charge in the universe remains constant. (See Fig. 1.)

Mass is commonly believed to obey two types of force laws. The first type, Newton's universal law of gravitation,

$$F = Gm_1m_2/r^2,$$

looks very much like Coulomb's law. The similarities have been construed by many to be an indication that electric and gravitational forces may be related somehow.[5]

Nothing of interest can be said about a closed system of only one electrically neutral mass. Since mass is only attractive, a closed system of only two neutral masses would become a system of one neutral mass. The same can be said for a system of any number of neutral masses – unless some masses are endowed with an initial velocity, or some masses gain velocity by virtue of attractive forces, appropriately vectored and strong enough to set up orbits instead of inelastic collisions. In a universe of any size, mass systems are balanced in accordance with the relative size and distance of all other mass systems, as well as the composite orbital mechanics of each system and subsystem. A foreign, electrically-neutral mass introduced into a universe would move under the influence of the positions and motions of all other bodies, always upholding Newton's law of gravitation. The pursuit of such a course by a body is referred to as its inertia. Any forces attributable to inertia are therefore only consequences of Newton's law of gravitation.[6]

The law of gravitation accounts for why masses fall, orbit, and remain suspended in their relative positions. Inertia, momentum, conservation of kinetic and potential energy, and Mach's principle are statements of this law that take into consideration all matter interactions over the entire universe. Laws addressing what is considered to be inertial, and not gravitational force, include Newton's second and third laws and conservation of momentum. Laws such as these may be derived from the law of gravitation when consideration is given to the interactions of colliding bodies.

Interactions

Every nucleon has one unit of charge and one of two possible units of mass, depending on its charge. Consequently, charge and mass are inextricably connected. Like charges repel, unlike charges attract, and mass attracts.

A closed system of only one proton and one electron, an isolated atom, would quickly establish equilibrium and thereafter be boring.[7] Therefore, imagine a system of two atoms. In accordance with Coulomb's law alone, like charges will repel, and unlike charges will attract. If, however, the atoms were suspended in place, as they would be if they had a universe imparting to them their positions via inertial forces, then the easiest way for the two atoms to establish equilibrium with each other would be to alter the positions of their electrons. (Remember, protons are 1833 times more massive than electrons, so the Gm_1m_2/r^2 force from the rest of the universe will be 1833 times greater on the protons.) (See Fig. 2.)

So now imagine a system of three atoms, all in a row. (See Fig. 3.) Assume they have had time to establish equilibrium, with respect to both charge and mass, with themselves and with the rest of the universe. Next, assume that an outside force causes the atom on the left to reconfigure its charge. The second atom in line will feel the change and adjust as in the former scenario, except that the atom to its right is exerting forces to make it want to remain as it was. In addition, the third atom in line is experiencing kq_1q_2/r^2 forces from the first atom, though to a lesser degree than the second atom is, making it want to align with the new configuration. The forces on the third atom are also affected by the efforts of the second atom to align with the first.

In longer chains of atoms, somewhere down the line, the inverse-square force of a change in charge configuration will not be strong enough to affect the inertia of the electrons. But once enough atoms in the chain have adjusted, the local coulomb force will become sufficiently strong to overcome it. (See Fig. 4.) Typical coulomb chain reactions as these would not be expected to travel very far. They should be quickly damped when the resisting forces imposed by the rest of the mass and charge in the universe are combined with reverberations for primary translations of the electron and fine-tuning for secondary responses, up and down the line – except under certain circumstances.

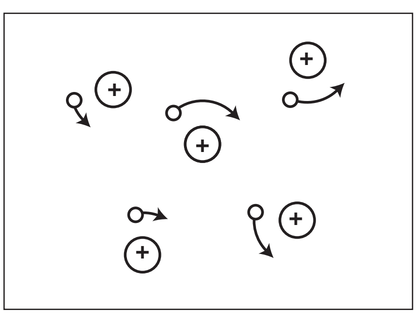


FIGURE 1 If one charge moves, neighboring charges must move to preserve the charge distribution.

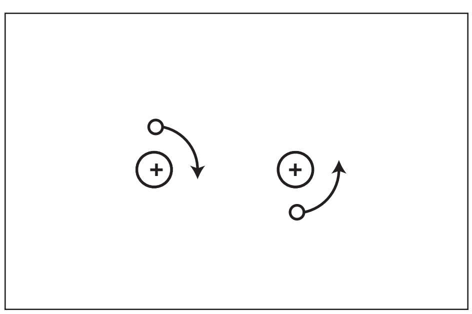


FIGURE 2 It is easier for the lightweight electron to move to preserve the net charge distribution.

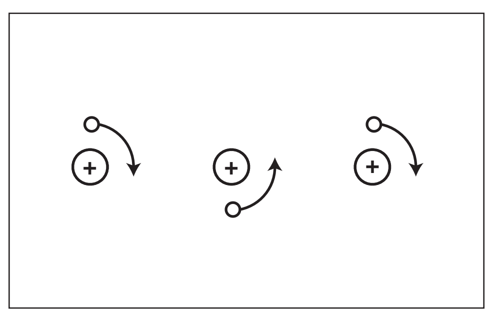


FIGURE 3 The response of two electrons to a change in position of the first – without reverberations.

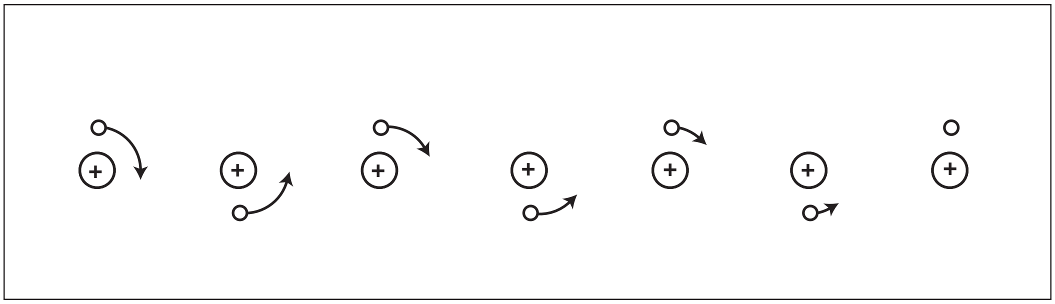


FIGURE 4 The inverse-square force from the first atom is too weak to move the last atom's electron, but the force from the other atoms will soon be strong enough to move it.

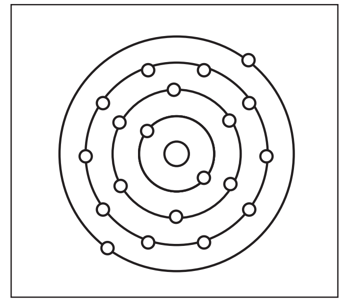
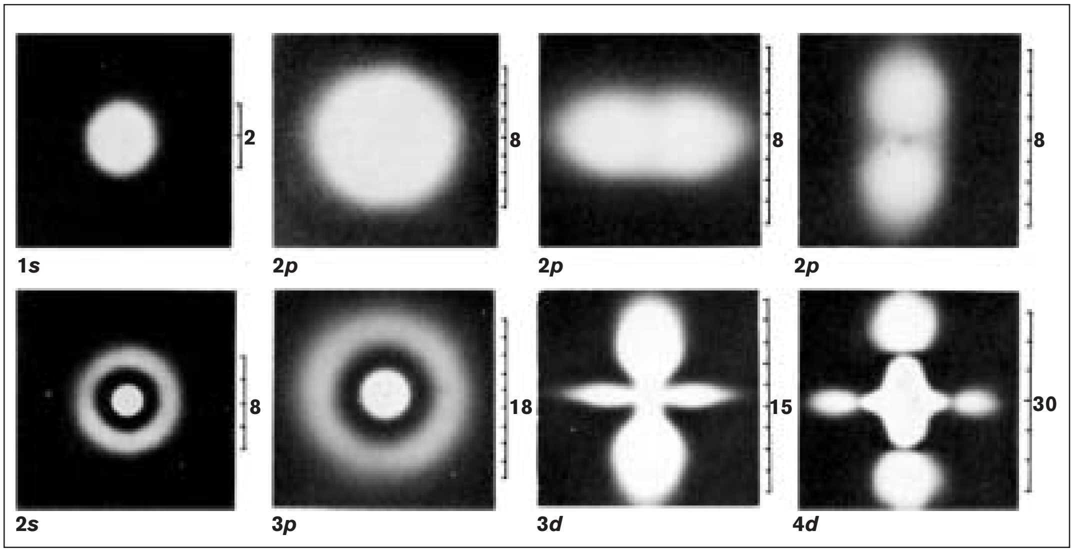


FIGURE 5 Bohr model of calcium, atomic number 20.



Adapted from White, *Introduction to College Physics*, 1969.

FIGURE 6 Electron density distribution models for hydrogen with one electron. Units are in Angstroms.

Timing

For any configuration of matter, a theoretical value, known as potential, is used to describe how any additional matter would behave if introduced into the system. If one of the original charges moves, all other charges begin to move in response to its change in position – instantaneously, or at least fast enough that the response appears to be instantaneous.[8] The assertion that potential is instantly known by all matter throughout the universe is equivalent to the statement that all matter is continuously and instantaneously aware of the charge and mass configurations of all matter throughout the universe. It may also be stated that all matter continuously and instantaneously responds to changes in potential. Since electric and gravitational force obey inverse-square laws, only relatively local matter will respond perceptibly to change.[9] The appropriate response for far distant matter may well be not to change.

Although potential is universally instantaneously known, complete reactions to changes in potential are not instantaneous. Matter cannot go from one point to another without transitioning along a continuous path. The sequential, point-by-point occupation of adjacent loci takes time. The speed at which changes occur depends on the magnitude of the change in causative potential, the quantity and separations of unbalanced charges and masses affected, and the opposing forces imposed by the local configuration of charge and mass (inertia). Whether or not some changes propagate to a perceptible distance with any speed depends on what are currently hand-wavily referred to as allowable transitions.

In conventional physical terms, an atom is said to be excited if an electron is moved to a higher energy state. This can be accomplished by heating a mass to very high temperatures (incandescence) or sending an electric discharge through it.[10] Excited atomic geometries, however, are not stable, for once excited, atoms quickly de-excite, emitting light. The concept of allowable transitions comes from the fact that light spectra show lines at characteristic frequencies for each element. This led first to an atomic model, attributed to Niels Bohr, with protons and neutrons in a compact nucleus, and electrons orbiting in concentric shells representing different energy levels. (See Fig. 5.) Later, Max Planck showed that electrons could only assume quantized energy levels defined by the step function, $E = h\nu$. Each atom has characteristic electron energy levels, each with a unique probabilistic shape and size.[11] Variations in probability clouds among elements are attributed to the presence of different quantities of charge and mass, and higher energy levels as a general rule have greater radii. (See Fig. 6.[12])

Bohr's model of the atom is sometimes almost disparagingly referred to as the planetary model of the atom, because it explains atomic phenomena in terms of the apparent orbital mechanics of the solar system. Ironically, quantum

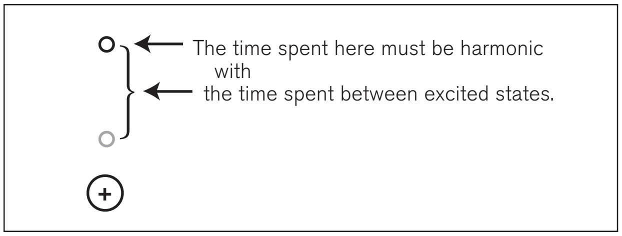


FIGURE 7 To produce a standing wave, the relaxation time must be harmonically related to the time it takes the electron to transit between states, or out-of-phase reverberations will damp out any attempts to establish a wave train.

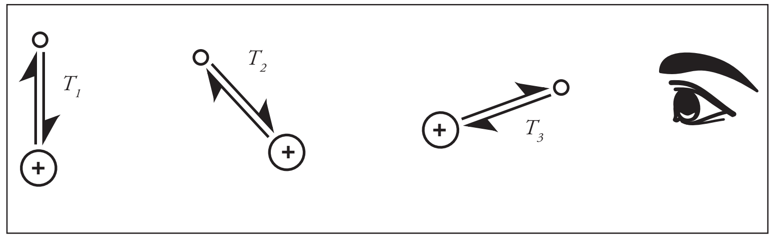


FIGURE 8 The same oscillation for a given atom is observed to have the same period, T, and therefore frequency, regardless of the orientation of the axis of polarization with respect to the observer.

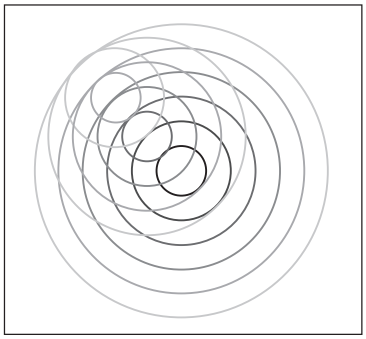


FIGURE 9 Huygens' principle states that each point on a wavefront of light generates wavelets.

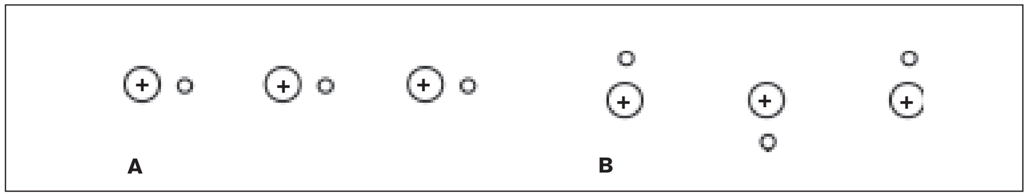


FIGURE 10 (**A**) Longitudinal coulomb chain reaction, and (**B**) Transverse coulomb chain reaction.

mechanical energy levels, as presented at the undergraduate level, appear to impose a form of Ptolemaic crystalline spheres on the structure and behavior of the atom.[13] Fortunately, there is a more straightforward explanation of why atoms only emit light of a characteristic frequency.

Observations have led to the conclusion that induced polarizations do not remain in matter once the imposing force is removed. Relaxation time is a quantification of the time required for a macroscopic charge gradient to fade.[14] When an atom is excited, the dipolar separation of the electron and the nucleus is extended. According to the previous assertions, all other atoms should be instantaneously aware of this change, and those near enough to react to the change will instantaneously begin to move their charges so as to restore the initial net distribution of charge in the universe. If the time during which an electron remains at its furthest extent from the atomic nucleus is equal to, or harmonically related to, the time of transit back to its point of nearest nuclear approach, a standing-wave coulomb chain reaction will be established.[15] (See Fig. 7.) All other factors equal, the ratio of the relaxation time to the period of oscillation would be the same, regardless of the orientation of the dipole axis. (See Fig. 8.)

The result would resemble the waves sports fans make in stadiums as each person in a row stands up in succession. This coulomb chain reaction is what is referred to as electromagnetic radiation, or, for certain frequencies, light.

The simple mechanical requirement that the relaxation time occur inphase with the electron transit time for standing waves of EM to be established explains why atoms do not radiate, or lose energy, with the routine buzzing of the electron from one side of a nucleus to another. The buzzing would give rise to greater coulomb forces than changing energy levels would in many cases. But since these random motions damp out so readily, they go unnoticed – unless they constitute background effects that are taken for granted, such as the 4 K background radiation.

Observation

Light is seen when the eye intercepts a coulomb chain reaction, and the atoms that make up the visual receptors are impacted accordingly. The eye can only detect that portion of radiation which is propagated on the straight line between the observed and the observer.[16] That which goes straight to the eye was either emitted directly or reflected, in accordance with the law of reflection, off an emitter or another reflector. Laser beams are visible only because the light from the source reflects off particulate matter in the air such that the reflected beams are directed toward the eye. The same applies for any detector of electromagnetic radiation. Light does not exist outside of matter. Light emitted into a perfect vacuum would only become manifest when a detector (matter) was inserted along a line of advance of the coulomb chain reaction. Air molecules sustain the reaction, but they are not visible because of optical properties that will be discussed later.

In three dimensions, the atoms surrounding a single excited atom would share the burden of adjusting their own charge configurations so as to maintain the net distribution of charge in the universe. This is true whether the atom in question is the atom initially excited or is one of many atoms anywhere in the reaction chain. The result is commonly referred to as Huygens' principle. (See Fig. 9.) If a mass of many atoms is heated to incandescence or stressed to its electrostatic breakdown voltage, the chaotic jostling of atoms under these circumstances will surely result in random orientations of the atomic dipoles. Light, generated by exciting the electrons of a mass of atoms with random dipole orientations, if not restricted by asymmetrical chemical properties in the medium, will, assuming an approximately spherical bulk mass, propagate with spherical symmetry. The concept of rectilinear propagation only describes that portion of the expanding sphere on a line connecting the observer and receiver.

As stated before, the frequency of excitation and de-excitation for two atoms, with the same degree of polarization but different orientations in space, will be the same. If one sets up a standing wave, the other should also. However, coulomb forces are smaller for the projection onto a plane of polarizations making a greater angle with the plane in question. These smaller forces would not propagate as rapidly as the larger forces due to smaller spheres of instantaneous influence, and also would likely damp out from interactions with secondary Huygens waves – except at characteristic beat frequencies. If it were not so, single excitations would amplify infinitely. As it is, spherical wave fronts propagate in accordance with an inverse-square law, along finite radii defined by standing-wave coulomb chain reactions. Reasons to believe that both transverse and longitudinal components are propagated will be discussed later. (See Fig. 10.)

Intensity is a function of the number of atoms excited. If it were a function of the degree to which an electron was stretched away from the proton, some other law of physics would be needed to explain how the ratio of an electron's relaxation time to its oscillation frequency magically stays the same for any displacement from the nucleus.

One of the most amazing properties of the atom is its ability to reconfigure its charge in accordance with stimuli from all directions. That is, a group of people standing in a circle will view different images through the group of atoms they enclose. (See Fig. 11.) A tiny, high-speed electron or an amoeba-like electron cloud capable of polarizing inphase with vibrations coming from all directions are two mechanisms by which this may be accomplished. For the purposes of this paper, both models are equivalent.

Questions may be raised about how starlight travels through space. First of all, interstellar space is not a perfect vacuum, but is suspected of having an average density of somewhere around 1 particle/cm^3.[17] Most of these particles, are ions and electrons, so the atomic arguments presented above cannot strictly apply. Yet, it is not too much of a stretch to assume that the charged and massed entities between the source and observer would move however they had to to preserve the net distribution of charge in the universe. Whatever these compensatory adjustments are would define the speed of light in vacuo.

EM advances only as electrical forces outweigh prior inertial forces at the wave front of a coulomb chain reaction. The rate of advance is a function of the number of particles that must undergo the chain reaction over a given volume of space and, therefore, uniform throughout any homogeneous collection of molecules. In any given medium, potential is instantaneously known, but the exertion of force by one excited atom must overcome the balance of the inertial forces of all other atoms to encite motion. Therefore, denser media, or media composed of more sluggish atomic or interatomic configurations, will propagate changes more slowly. (See Fig. 12.) There is no apparent reason to assume that velocity is dependent upon frequency. Velocity depends on the constitution and density of the medium, and frequency is determined by the time it takes electrons to transit between excited and de-excited states. Wavelength is simply the ratio of velocity to frequency.

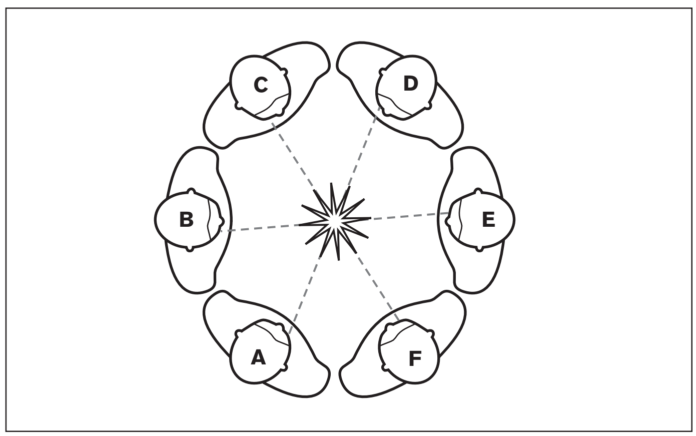


FIGURE 11 Person A sees Person D's eye, and vice versa. The same applies to Person B and Person E, and to Person C and Person F, and all lines of sight go through the same atom of air simultaneously. How is this done?

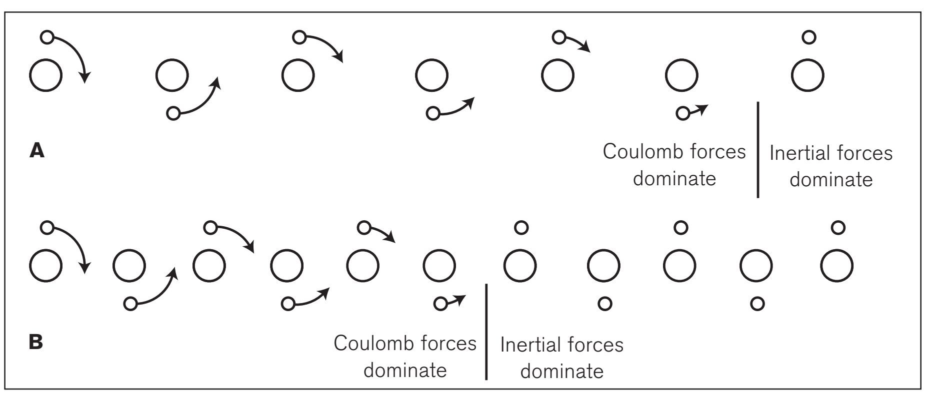


FIGURE 12 A single Coulomb reaction can overpower inertia over a greater distance in a less dense medium (**A**) than in a more dense medium (**B**).

Geometrical Optics – Light Meets Bulk Matter

The discussion so far has pertained to emitted light caused by intense thermal or electrostatic agitations of electrons at a primary source, such as the sun, lamps, and lightning bolts. As stated before, standing-wave coulomb chain reactions propagate radially from excited atoms in a uniform manner until the chain reaction encounters a change of medium. Secondary phenomena, normally addressed in the study of the behavior of light as it transits from one medium to another, are explained below in terms of the coulomb chain reaction. In short, visible surfaces may be thought of as being radiating, reflecting, and/or transmitting.

Reflection

Gravity cannot be shielded. Electromagnetic radiation can. Shielding occurs when the coulomb chain reaction encounters a medium, such as a substance with very strong interatomic bonds, with sufficient mechanical inertia to damp out the oscillations. If the coulomb chain reaction encounters a surface that damps the wave entirely and reflects nothing, the surface will appear black. The reaction can also be prevented from transmitting through a medium if it is totally reflected at the surface. The surface will appear white or colored as long as some visible light is reflected. If a medium reflects the signal totally or damps it out before it gets to the other side, it is said to be opaque. If it transmits coulomb chain reactions, all or in part, with or without changes in frequency, it is said to be transparent.

Reflectivity can be lustrous or glossy. Metals are reflective because extensions of electrons in the portion of a transmitting medium bordering a metal are elastically repulsed off the sea of conducting electrons that characterize the surfaces of bulk metals. Nonmetals may appear glossy if the material surface is sufficiently smooth to provide a more or less level electron coating over a plane of aligned protons. If the surface is grainy, then, even though all nuclei may be considered to be surrounded by electron clouds, the normals drawn to the surface on any portion of any bump will not be parallel, the reactions will be reflected in a jumble of directions, and whole image reflection will not occur.

FIGURE 13 The photograph shows a section of all non-shielded reflecting and emitting surfaces surrounding the camera.

Each atom on an interface reflects, in accordance with the law of reflection,[18] information coming from all points on the surface comprised of the union of all non-shielded reflecting and emitting surfaces surrounding that atom. (See Fig. 13.) If one ray of a coulomb chain reaction is bright, the atom reflects brightness along the corresponding path. If the incident light is blocked, as from the deeper portion of a crevice, the atom reflects blackness along all corresponding paths. Atoms and interatomic structures have characteristic frequencies at which they will vibrate. When impacted by white light, oscillations of only certain frequencies will be reflected. When impacted by only certain frequencies of light, objects will be visible only inasmuch as they are capable of vibrating at the frequencies provided. All combinations of color and reflectivity should be explainable in terms of resonant vibrations and inelastic reflections induced by coulomb chain reactions. The proposed causes of optical surface properties are summarized in Table I.

At this point, the burning question is, "How is it done?" An electron suspended in space transmits information from all directions and to all directions, along any given line segment between shielding media interfaces. Electrons of atoms on shielding interfaces transmit and reflect information from the neighboring medium from all possible directions and to all possible directions. How does the electron vibrate at so many frequencies in so many directions at once? This will be answered in the section on diffraction and interference.

Appearance	Explanation (incident light implicit)
Transparent	Lattice transmits
Black	Lattice absorbs
Colored	Lattice vibrates exclusively at select frequencies available
White	Lattice vibrates at most or all frequencies available
Flat	Uneven electron surface disrupts continuous reflection
Glossy	Polished surface deflects well
Lustrous	Polished metal surface with sea of free electrons provides near elastic deflections
Iridescent	Thin film reflects interfering frequencies off top and bottom
Bright	Many excited electrons at immediate source
Dim	Few excited electrons at immediate source

TABLE I Atomic-Level Explanations of Surface Appearances

Refraction and Dispersion

Refraction can be described in terms analogous to conservation of momentum. A coulomb chain reaction propagates rectilinearly. When the reaction crosses a boundary between two supporting media of different densities and/or chemical compositions, a portion of the reaction will reflect off the interface of the media as explained above.[19] However, to preserve the balance maintained by the initial wave, a complementary portion of the chain reaction must continue into the second medium, with the speed and direction necessary to equal the difference between the velocity of the initial wave and that of the reflected wave. If the refracted component damps out, it will do so via equal and opposite coulomb and inertial forces, so momentum and the net distribution of charge in the universe will be conserved.

When moving into a denser medium, chain reactions do proceed more slowly. It is easy to envision an electron in a single gas molecule being excited and creating an instantaneous dipole. If this molecule is on the boundary of a solid or liquid with intermolecular bonds, the chain reaction will meet with more resistance to change and therefore more immediate damping effects. In denser media, the long-range thresholds of motion will occur at more constricted radii.

In accordance with Snell's law, a coulomb chain reaction, encountering a medium interface at some angle that is not normal to the surface, will bend.[20] When moving from a less dense to a more dense medium, the intermolecular binding forces from the more dense medium will push the advancing wave back with inertial forces in front, and pull it back with inertial forces behind. For a two-dimensional slice of a standard cubic crystalline structure, it can be seen that the lateral component of restraint, imposed by particles to the left and right of the coulomb chain reaction, outweighs the inward component of restraint imposed only by molecules on one side. (See Fig. 14.) The relative lack of restraint experienced by a chain reaction moving from a more dense to a less dense medium deflects the reaction away from the normal. The effect can be extrapolated to three dimensions.

The phenomenon known as dispersion is the separation of, for example, white light into its component frequencies when passed between media. Over the visible spectrum, red light is bent furthest from the normal when entering a more optically dense medium, violet light is bent least. Lower-frequency oscillations require more time for completion at the interface of the media, where the bending force is applied; and more time spent undergoing the bending force leads to a greater deflection.[21] It should be noted that refraction and dispersion effects in this model occur in a transition zone defined by a threshold of significant motion for both media, and not simply between two interfacing molecules. Therefore, a chain reaction will curve as it is affected less by the first medium and more by the second. It

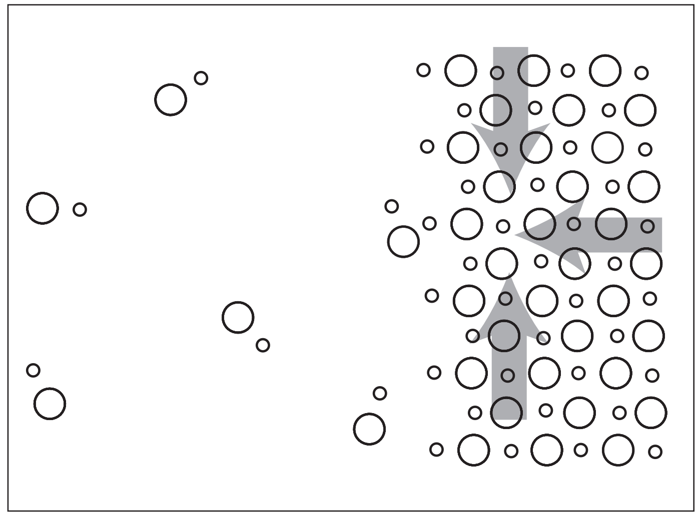


FIGURE 14 The coulomb chain reaction entering the denser medium is pushed back more by interatomic stabilizing forces to the left and right of the normal, than it is pushed out by forces collinear with the normal. It bends accordingly.

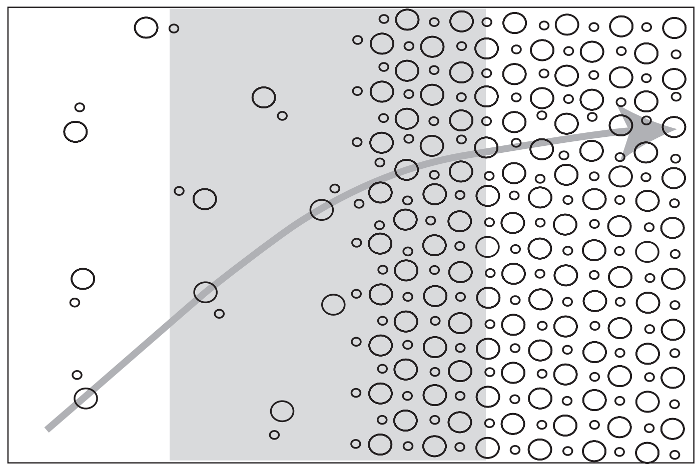


FIGURE 15 A coulomb chain reaction is linear in a homogeneous medium, but when it approaches a denser medium, forces exerted from both media affect the particle in a tradeoff function until the reaction is sufficiently inside the new medium to be only affected by that medium's forces, and resume a, usually different, rectilinear path.

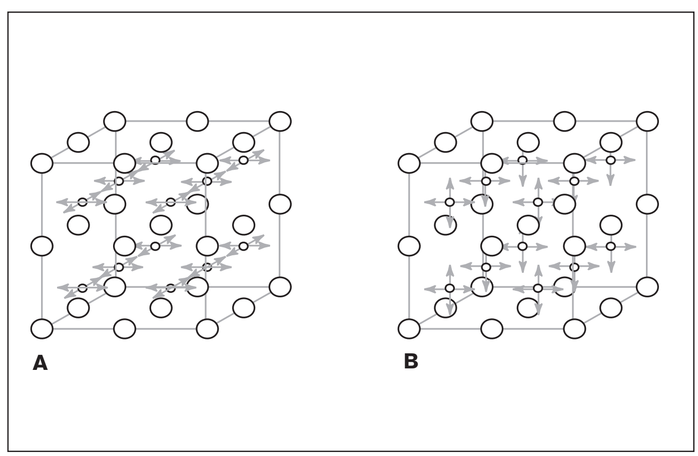


FIGURE 16 The molecular structure of polarizing media is such that electron oscillations are damped in one transverse direction. (**A**) and (**B**) have different axes of polarization.

FIGURE 17 Calcite is one of the better-known doubly-refracting materials.

will resume rectilinear propagation as soon as the threshold of motion for the reaction is governed solely by a homogeneous mix of molecules. (See Fig. 15.)

Polarization

Light can be polarized because some molecular structures confine vibrations or expansions of atomic dipoles to parallel planes while absorbing orthogonal vibrations. (See Fig. 16.) Some materials with crystalline structures more complex than standard cubic configurations allow transmission of the chain reaction along two or more linear paths. In these cases, oscillations with axes of polarization orthogonal to the plane of oscillation for the ordinarily transmitted coulomb chain reaction are not damped out, but are transmitted, with characteristic polarization, along other routes. (See Fig. 17.) Doubly-refracting media may be used to produce circularly-polarized coulomb chain reactions in accordance with the mechanics of traditional optics.

Diffraction and Interference

The wavelike nature of coulomb chain reactions in three dimensions has already been explained. Near-instantaneous polarizations of molecules are passed along, just like the changes in vertical position of water molecules in a wave. If a planar, light-emitting surface is used as the source, all light, or coulomb chain reactions, begin from single atomic electrons exciting or de-exciting along the flat surface. The reaction to each atom's change in polarity is transmitted as a spherical shell, which simplifies at great distances to a linearly-propagating standing wave.

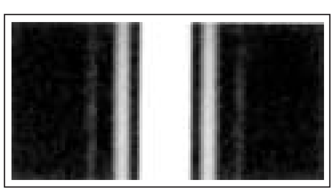


FIGURE 18 Single-slit diffraction pattern.

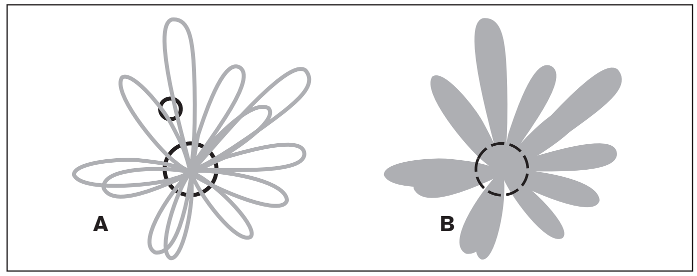


FIGURE 19 Whether an electron is (**A**) a tiny, ultra-high-speed particle capable of setting up various frequencies along all radii or (**B**) an amoeba-like cloud capable of simultaneously extending along all radii at any given frequency has no bearing on the speculations presented in this paper.

When a three-dimensional coulomb chain reaction encounters a barrier opaque to its transmission, it will either be reflected or absorbed. If the opaque medium has a thin slit, the forces in the chain reaction lying on the path between the source and the aperture will pass through the opening in the barrier, largely unaffected. In addition to the wave front passing directly through the aperture, there will be some wave fronts that pass through with radii oblique to the barrier. The result will be a bright spot on the screen. However, the situation is slightly complicated because certain radii of propagation will encounter the physical surface constituting the border of the slit and be reflected into the wave pattern emerging on the transmitted side. The result, known as Babinet's principle, describes the fringes observed on edges of shadows. (See Fig. 18.) This effect will be better understood after discussing double-slit diffraction.

In accordance with the material presented to this point, it stands to reason that it doesn't matter whether the electron is a super-fast-orbiting speck of matter or a continuous blob surrounding its atom's nucleus. What matters is that the electron can extend, essentially simultaneously, along all atomic radii, with magnitude and frequency prescribed by Coulomb's law. (See Fig. 19.) This model will concur with modern concepts of excited atoms in the sense that atoms excite and adjust to excited atoms by extensions, and not contractions, of the electron.

When light is caused to pass through two slits, each excitation of whatever orientation and frequency, first radially propagated from a source atom in a coulomb chain reaction, now continues in two radially propagating coulomb chain reactions compensating for the initial reaction. If a screen is inserted into the chain reactions transmitted from the two slits, fringes of light will be seen. This is because each atom on the screen is receiving instructions from each excitation at the source twice. Along the line defined by points equidistant from both slits, atoms on the screen are receiving simultaneously a pair of instructions to extend the same way. (See Fig. 20a.) At some points, due to the difference in path lengths of the signal, atoms on the screen will be receiving contradictory instructions. One chain reaction will arrive at the screen requiring the

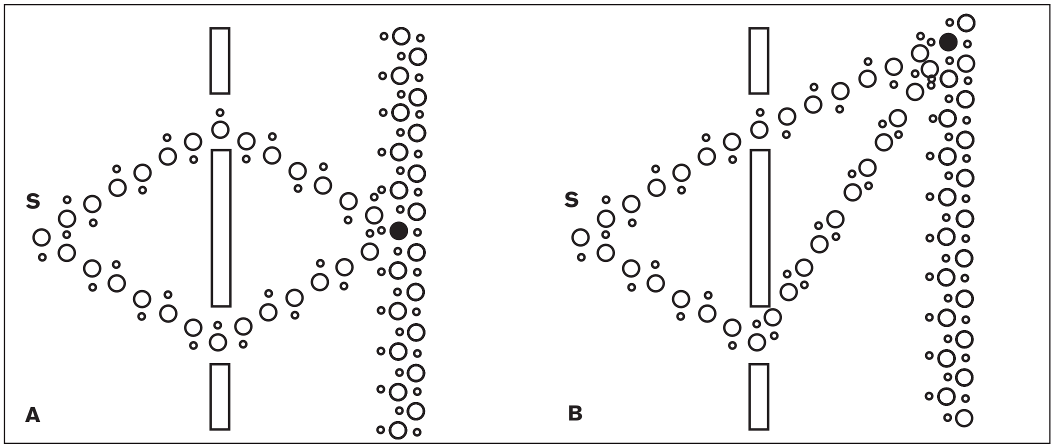


FIGURE 20 Two light rays traced from excited source particle **S**. The black atom on the screen in (**A**) receives the signal inphase; in (**B**) it receives it out-of-phase.

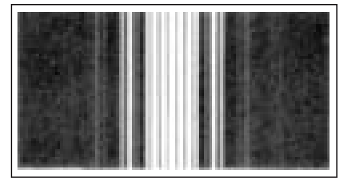


FIGURE 21 Double-slit diffraction pattern.

next atom in line to extend an electron in one direction, while the other chain reaction arrives 180° out-of-phase, requiring the electron to go the opposite way. In compliance, the electron will balance the commands to net zero. (See Fig. 20b.) Reminiscent of Edgar Degas' description of his painting technique, we have focused on the light and dark areas, and the rest should follow. (See Fig. 21.)

Extraordinary Popular Delusions and the Nature of Light

Relativity

There is no reason to propose a system of mechanics that requires Lorentz contractions and time dilations to prevent light emitted from a moving body from moving faster than the established speed of light for a given medium. Light cannot be pushed into light because an emitting vehicle is moving, but every molecule must wait its turn as before. (See Fig. 22.) The speed of light is governed solely by the time it takes electrical forces to outweigh prior inertial forces at the wave front of a coulomb chain reaction. The density and relative motility of electrons prescribes a characteristic average time for any given mix and distribution of atoms. As long as the net velocity of the source and particles in the medium, with respect to the receiver, does not exceed the speed of light, no force can slow or speed the wavefront generated by the initial change in potential. Relative motions will only affect the ability of particles in the transmitting medium to overcome initial inertial conditions, thereby changing the wavelength at which light is propagated.

Photons

Radiation momentum and radiation pressure are two reasons why a particle nature is imparted to light. Radiation momentum is not hard to understand in terms of the mechanics of refraction, when it is remembered that the electrons moving around to compensate for neighboring atomic reconfigurations possess mass. Radiation pressure is a measurement of the force incident light imposes on a surface. It has been explained previously that light consists of expansions and returns to former configurations of electron clouds – no contractions from the original configuration. Expansions in chain reactions can add pressure, but not reduce it. Whether the expansion is sufficient to produce the measured changes in pressure is, as all other notions in this paper, a question of degree which must be empirically quantified.[22]

The photoelectric effect, or the ability of light to dislodge electrons from a surface, is given as another reason to attribute a particle nature to light. Yet, if coulomb chain reactions routinely move electrons to excited states, it is not unreasonable that they could constructively interfere to overcome the ionization energy for some materials.

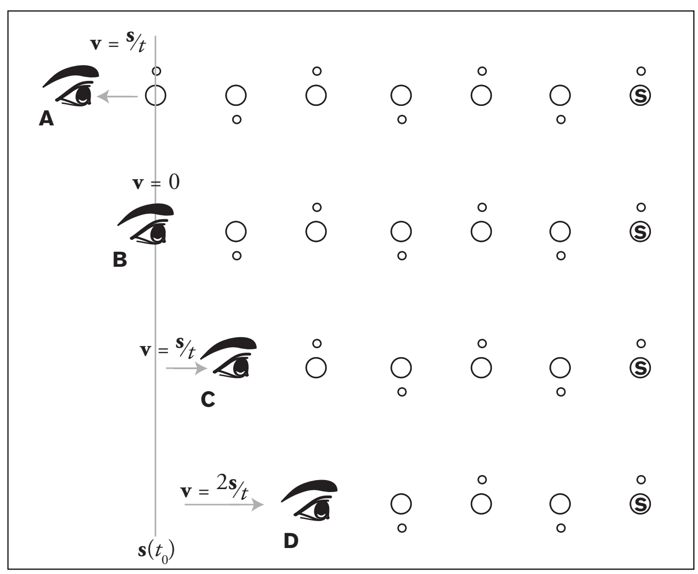


FIGURE 22 Let **s** be the distance between consecutive particles in the Coulomb chain reaction. Let t be the time required for the wavefront to advance from one particle to the next. At t_0, all four receivers were located a distance $6\mathbf{s}$ from the continuously emitting source **S**. All snapshots were taken at t_1. For a receiver stationary with respect to the source (**B**), the velocity of intercepted EM at t_1 is $6\mathbf{s}/6t = \mathbf{s}/t$ (taking into account the excitation of atoms in the eye for detection). For the receiver shown receding from the source (**A**), the instantaneous velocity of intercepted EM is $7\mathbf{s}/7t = \mathbf{s}/t$. For the receiver approaching the source (**C**), the instantaneous velocity of EM is $5\mathbf{s}/5\mathbf{s} = \mathbf{s}/t$; for (**D**), $4\mathbf{s}/4t = \mathbf{s}/t$.

Dual Nature of Light

It has been demonstrated that two forces, gravitational and electrical, can explain all physical phenomena in the macroscopic world. Light is merely a chain reaction of Coulomb's law. There are no snaky lines of energy wiggling through the universe, no lines of force, and no photon balls.

Spookiness

When two, identical particles are sent off in different directions at high speed, an alteration in the state of polarization of one instantaneously results in a compensatory change in state of the other particle. Einstein said this phenomenon was "spooky," impossible, and a reason to discredit quantum mechanics.[23] Modern physics has problems explaining it, and yet it happens. The fact that the single particle takes the brunt of the change is consistent with the tendency of all of nature to take the path of least resistance. If momentum and the net distribution of charge in the universe are to be conserved, it is much easier to flip a single particle that will continue with the correct compensatory path, than to affect all atoms in the half-space defined by the partner particle. If not so, the half-space would have to align its charges and conserve momentum so as to compensate for the flip, setting up the essence of the flipped particle for any detector to register.

Conclusions

It has been proposed that all matter consists of nucleons. Each nucleon consists of either a positive or a negative quantum of charge, and one of two allowable masses, depending on its charge. Charge and mass are inextricably connected. Masses move so as to conserve the overall momentum of the universe in accordance with Newton's law of gravitation. Charges move so as to conserve the net distribution of charge of the universe in accordance with Coulomb's law. The universe remains dynamic as each nucleon moves in cooperation with its neighbors to satisfy the demands the entire universe is making on both its mass and charge. All laws of physics can be derived from these simple principles.[24]

This paper has described how electromagnetic radiation may be explained in terms of a coulomb chain reaction. Other extensions of the premises of this paper will show that energy, in all its forms, is merely a secondary consequence of the fundamental principles herein presented.[25]

Having reviewed the previous comments, some may presume this theory is advocating a clockwork theory of the universe. It is. Since the beginning motions of the universe, matter has been adjusting to keep the net distribution of charge constant while simultaneously conserving momentum. This is the law by which matter must abide. Many object that a clockwork universe consigns man to predestination. Indeed, some of the paradox of modern physics was forced upon the science out of philosophical motivation to leave an out for options. As for me, I have said nothing about how the mind decides what to do with matter.

> "I can predict the motions of heavenly bodies, but not the madness of crowds."
>
> -apocryphally attributed to Newton by economists

Notes

1 Kulba, Leslee, "Two Fundamental Laws," Congress 2000 Proceedings, St. Petersburg, Russia, 2000. <http://www.physical-congress.spb.ru/english/kulba/kulba.asp>.

2 The author is aware that notions of consensual "reality" and "reason" are not acceptable in politically correct presentations. Unfortunately, removal of these concepts from argument invalidates the principles upon which science, and more fundamentally, mere understanding, were founded. Paradox, though academically fashionable, is not scientific. Since this paper is a plea for science to return to the realm of the empirically verifiable and rational, toleration is requested.

3 One of the more interesting and credible physical interpretations of how protons and electrons configure to form neutrons was presented by Lucas and Bergman. It was summarized in Bergman, David L., "Physical Models for Elementary Particles, Atoms, and Nuclei," *Electric Spacecraft Journal* 21, 1997, pp. 20-23. For details and extensions, consult Bergman's web site <http://CommonSenseScience.org>.

4 Rest mass.

5 The more credible suggestions express gravitation in terms of or terms similar to van der Waals forces. See Charles Yost, "The Alzofon Papers: Gravity Control," *Electric Spacecraft Journal* 13, 1994, pp. 7-14 and Fran De Aquino, "The Gravitational Spacecraft," *Electric Spacecraft Journal* 27, 1998, pp. 6-13.

6 Discrepancies between measurements of inertial mass and gravitational mass are likely caused by omissions of gravitational forces, either unknown or erroneously assumed to be negligible.

7 An atom isolated from all other matter is difficult to imagine; the conditions imposed by all other mass and charge are taken for granted.

8 It is not uncommon to hear credentialed physicists argue against action-at-a-distance. This does not negate the fact that mainstream physics is dependent upon the instantaneous transmission of potentials. David J. Griffiths argues for instantaneity of potentials in his widely-used text, *Introduction to Electrodynamics*, 2nd ed, (Englewood Cliffs, NJ: Prentice Hall, 1989), pp. 317-318:

> There is a peculiar thing about [$V = \frac{1}{4\pi\varepsilon_0}\int\frac{\rho}{\imath}d\tau$, the solution to Poisson's equation]: it says that the potential everywhere is determined by the distribution of charge right now. If I move an electron in my laboratory, the potential V on the moon instantaneously records this change. That sounds particularly odd in the light of special relativity, which allows no message to travel faster than the speed of light. The point is that V by itself is not a physically measurably [sic.] quantity – all the man in the moon can measure is $\mathbf{E}$, and that involves $\mathbf{A}$ as well. Somehow it is built into the vector potential, in the Coulomb gauge, that whereas V instantaneously reflects all changes in ρ, the combination of $-\nabla V - (\partial\mathbf{A}/\partial t)$ does not. $\mathbf{E}$ will change only after sufficient time has elapsed for the "news" to arrive.

This requirement is perhaps best illustrated with examples from astronomy. Ephemerides for the planets cannot be calculated correctly, without some form of “epicycles,” if retardation effects are taken into account. According to Sir Arthur Eddington in, *Space, Time and Gravitation* (1920; reprint, Cambridge: Cambridge University Press, 1987), p. 94, if celestial bodies interacted with each other’s retarded positions, a couple would be introduced into the orbital mechanics, causing the orbits to become spirals. Tom Van Flandern, in personal communications, is quick to point out that the destruction of planetary orbits can be easily illustrated by putting any retardation factor into any computer program that models celestial mechanics. See also Leslee Kulba, “The Speed of Gravity,” *ESJ* 36, 2003, pp. 18-19.

9 The relative timing of events in charge interactions is not explicitly addressed in Coulomb’s law.

10 Lest it appear that mysterious energy is being invoked to start the process, heating is simply an increase in average kinetic energy of a mass of molecules via collisions with molecules from another system, and spark discharges are streams of electrons. These phenomena require nothing beyond the motions of atoms or nucleons to conserve momentum and preserve the net distribution of charge.

11 There was some debate about whether electron orbital radii for a given atom would be influenced by the presence of more or fewer neutrons. The answer depended on the relative influences of coulomb and gravitational forces at the atomic level. Spectral analysis by Suzanne Fiacco, et. al. at St. Lawrence University, NY, 2001 indicates that the wavelengths of deuterium lines are demonstrably 1-2 Å shorter than those of hydrogen lines. The shorter wavelength corresponds to a higher frequency, which would be most easily explained by a shorter oscillation distance. In sum, an extra neutron will have a negligible constricting effect on the electron orbital radius. See Suzanne Fiacco, “The Visible Spectrum of Hydrogen vs. Deuterium,” <http://it.stlawu.edu/~physics/stuff/student_projects/2001/fiacco.shtml>.

12 From Harvey E. White, *Introduction to College Physics*, NY: Van Nostrand-Reinhold Company, 1969, p. 591.

13 This is not to be confused with Erwin Schroedinger’s derivation of electron orbital configurations in accordance with standing wave geometries. By defining the shells as workable wavelengths, Schroedinger effectively eliminated the need for Ptolemaic crystalline spheres to define steady-state electron orbits. By contrast, the conditions for standing waves discussed in this paper pertain to interatomic interactions. The time one atom remains in the excited state must be harmonically related to the time required by the next atom in line to move an electron to the requisite level of excitation. Combined, the standing wave propositions eliminate the need for crystalline spheres in two different circumstances.

14 See the back-cover reports, “Electrical Relaxation Time,” *ESJ* 36, and “Ponderomotive Forces,” *ESJ* 35. Technically, relaxation time is only a percentage of the time required to totally discharge. It is loosely used in this paper to refer to an as yet unknown quantity of time required for an as yet unknown threshold of charge retention to be passed.

15 It may be that electrons are only excited for an instantaneous moment, in which case some other, as yet unconsidered, nonzero time event would be needed to establish the standing wave phenomenon proposed.

16 This philosophical implication would be a corollary to Heisenberg’s uncertainty principle: It is not possible to probe an experiment without affecting it. For example, to see directly with his eyes, the experimenter’s head must necessarily block the path of some information that had been affecting the test objects, causing the experiment to respond to the scientist’s head instead.

17 “Cosmic-Ray Secondaries,” <http://imagine.gsfc.nasa.gov/docs/science/know-12/cosmic_rays.html>, 29 January 2004.

18 In the plane defined by the normal drawn to any surface and the line along which a particular coulomb chain reaction is proceeding, the angle between the normal and the incident ray will equal the angle between the normal and the reflected coulomb chain reaction.

19 Technically, refraction occurs when light transits between two media of different optical densities, or, equivalently, different dielectric constants or permittivities. All are a measure of the conductivity of a material.

20 For two media, A and B, with indices of refraction n_A and n_B, respectively, the angles of incidence θ_A and refraction θ_B are such that $\frac{\sin \theta_A}{n_A} = \frac{\sin \theta_B}{n_B}$.

21 This is the definition of impulse: $F\Delta t = m\Delta v \Rightarrow \Delta t \, \alpha \, \Delta v$.

22 Many mainstream physics publications still explain the operation of radiometers and the formation of comet tails in terms of radiation pressure. Both phenomena have been explained by physical processes which would far outweigh radiation pressure. The radiometer turns because differential heating leads to a pressure gradient. Particulate matter surrounding comets is pushed away from the sun by the solar wind, which consists mostly of ions and electrons.

23 This paradox, now known as the EPR puzzle in honor of its framers, was only one reason given to denounce quantum mechanics in Einstein, Albert, Boris Podolsky, and Nathan Rosen, “Can Quantum Mechanical Description of Physical Reality Be Considered Complete?,” *Physical Review*, 47:777-780 (1935). Thanks go to Brian Lee for defying me to explain it.

24 Henri Louis LeChatelier deserves much credit for observing that when a system undergoes a stress, its components will shift so as to relieve the stress. LeChatelier’s principle is usually referenced in the context of chemistry and thermodynamics, but has universal applications. Conservation of momentum and preservation of the net distribution of charge, the two laws from which this paper states all other laws of physics may be derived, are expressions of this principle.

25 This is discussed somewhat in Kulba, Leslee, “Two Fundamental Laws,” Congress 2000 Proceedings, St. Petersburg, Russia, 2000. <http://www.physical-congress.spb.ru/english/kulba/kulba.asp>.

Thanks are due to Carl Milsted, Ph.D., whose independent derivation of similar conclusions revived interest in this rewrite, and whose expertise provided a good sounding board and handy reference. Thanks also go to Richard Hull for his constant encouragement.

upcoming events

Electrostatics Society of America 2004
June 26-28, 2004
Rochester, NY
Contact: Kelly Robinson
E-mail: kelly.robinson@kodak.com

Electrostatics 2005
June 15-17, 2005
Helsinki, Finland
Contact: electrostatics2005@congreszon.fi