Quantum Speculations **1** (2019) 46-84

Original Paper

H Spectrum New Interpretation: Implications for Foundations of Quantum Mechanics and Physics

Marcel Dubé

E-mail: jbmdube16@gmail.com

Received: 3 March 2019 / Accepted: 27 September 2019 / Published: 30 September 2019

Abstract: Interpreting the hydrogen line spectrum has been central in formulating quantum mechanics. A critical observation in the H spectrum has completely escaped attention for 100 years with potentially far reaching consequences. We have discovered that the series limit, every spectral line and their difference all come in integer number ratios, for instances (4:3:1) for Lyman alpha, (9:8:1) for beta, (16:15:1) for gamma lines, and so forth, in which the last number is the unit difference between the first two integers. Such ratios bear the obvious signature of a ubiquitous BEATING mechanism. Such missed observation is of utmost importance because contrary to the current paradigm in which line frequencies are postulated coming from transitions between putative energy levels, and oscillator strengths from transition probabilities, beating requires physical oscillators setting both line frequency and strength. The electromagnetic nature of radiation suggesting a primarily electric field origin, we conjecture that the needed oscillators may come from the quantization of the electric field itself into discrete field lines acting as oscillators beating with radial oscillations of the electron on orbit at orderly set discrete frequencies, the strength being determined by how frequently the field line oscillations coincide and get reinforced by radial oscillations of the electron. We show such electric field quantization is at the origin of every quantum behavior, accounting as from first principle for spectral lines and series, angular momentum, spin, fine structure, Lamb shift and atomic electronic structures. Such electric field quantization has further numerous implications in astrophysics and dark matter, thus bridging quantum and large scale worlds.

Keywords: Quantum mechanics; electric field; hydrogen spectrum; radiation mechanism; quantum electrodynamics: Lamb shift

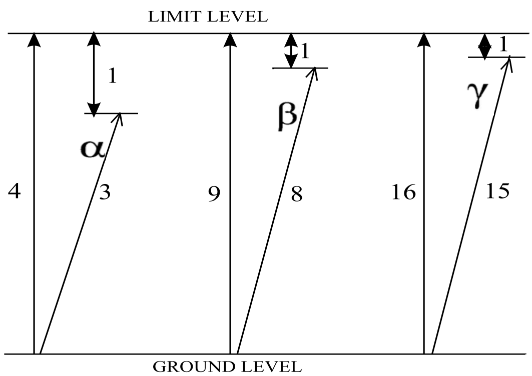
1. Introduction

In fundamental atomic physics, it is perceived as if everything is known and nothing new of interest is left to be uncovered. Yet much of current foundations remains based on postulates and mathematical rules concocted to account for observations, but not linked to actual internal physical elements and mechanisms at work. The existence in atoms of energy levels has been postulated, but we do not know why and how these come about physically. Similarly we have observed that energy exchanges between atoms can only occur in energy quanta and obey angular momentum quanta. Again we do not know the actual physical mechanism forcing the atom to behave this way.The inner physical workings in atoms therefore still remain a black box, and the fact that we have developed mathematical rules that account for observations cannot be an absolute proof that observations could not be accounted for otherwise. As an example, Ptolemy's earth-centered model of the universe had been the accepted model for over a millennium, because it had been successful in accounting for an otherwise unaccountable oddity, the back and forth motion of the planets against the background star sphere, by postulating that the planets had been endowed with epicyclic motions by the Creator. This means that we cannot rely solely on mathematical renderings of phenomena; we need a more satisfying understanding of the inner physical workings.

Furthermore we have been left with a legacy of unanswered basic questions which have been swept under the rug. For instances, what causes the energy levels in atoms, and their orderly decreasing spacing and transition probabilities? Why spectral lines do not get individually expressed, but only whole series appear and disappear? Also when hydrogen gas is progressively heated, one would expect from energy conservation that series with the lowest energy transitions would show up first, and the series with the highest energy transitions, the Lyman series, would be last to show up when the gas is hottest. Actually the exact opposite behavior is observed: series with higher energy transitions only appear last when the gas is cooler and series with lower energy transitions, such as the Paschen series, appear when the gas is hotter. Not only none of these questions were addressed when quantum mechanics was developed from the H spectrum, but the interpretation of the discrete line H spectrum may have been skewed by using only clues from black body radiation, a continuous, not a discrete spectrum, instead of pursuing hints of virtual oscillators.

According to classical physics, there ought to be an infinite number of possible frequency modes in a black body radiating enclosure, leading to the so-called ultraviolet catastrophe. To solve the problem, in 1900 Plank put out the hypothesis that radiation energy exchanges between atoms can only occur in discrete quanta. During the 2019-2025 period when quantum mechanics was developed, the concept of quanta originally postulated by Plank for black body radiation continuum was extended to discrete atomic frequencies, leading to a model in which emission and absorption of radiation result from transitions between stationary states occupying specific energy levels. However, it was also recognized early by the fathers of quantum mechanics that the observed line frequencies had to be computed as coming from virtual oscillators, not from the orbital motion of electrons. There resulted a definite dichotomy, which did not raise any concern, between computing the frequencies as from virtual oscillators and at the same time assuming their being produced through transitions between energy states. The neglect of the oscillator idea and the strict focus on the energy level hypothesis alone, however led to not looking deeper at the H spectrum itself and a most important cue being completely missed out then and ever since.

Figure 1. Beating within series. The Lyman series limit, the α line and their difference are in the ratio 4:3:1; similarly the series limit, the β line and their difference are in the ratio 9:8:1; and the series limit, the γ line and their difference are in the ratio 16:15:1, and so on, such ratios being evidence of beating between the series limit and the spectral line.



Indeed if for every line frequency in the H spectrum, one looks closely at the ratio [series limit: line frequency: difference between the two], one notices as shown in figure 1, that they all come in integer number ratios, for instances (in 10^{15} Hz units) [3.289: 2.467: 0.822] = (4:3:1) for Lyman α, [3.289: 2.924: 0.365] = (9:8:1) for β, [3.289: 3.084: 0.205] = (16:15:1) for γ lines, and so forth, in which the last numeral is the unit difference between the first two, thus the obvious signature of a ubiquitous *beating* mechanism at work between each line frequency and the series limit.

Such simultaneous beating in each and every spectral line strongly suggest that there may not just virtual but real oscillators beating in the atom. Contrary to energy states or levels which not only are only postulated and non-observable, but come from a less pertinent conjecture from black body radiation continuum, H spectrum itself line frequencies, their differences and their ratios are the truly pertinent direct observables. Such overwhelming evidence of pervasive beating cannot be dismissed and the consequences must be thoroughly investigated. Given that the fathers of quantum mechanics have been unaware of such a key beating mechanism, one may wonder along what path and in what form quantum mechanics could have evolved had they not missed such evidence? Quantum mechanics being a pillar of physics, it is therefore imperative that we revisit the assumptions and the path through which QM got developed, and on the other hand, investigate what could cause the beating. Since beating can only occur between real oscillators, we will look for what kind of oscillators could emit and absorb radiation through the spectrum and intensities of discrete frequencies observed in series and what causes the many series and their order of emergence.

Given the electromagnetic nature of radiation, one may suspect that there may be more to the electric field than just causing attraction/repulsion between charged particles and one may conjecture that the real emitter in atoms is not the electron itself and its motion, but oscillations of the electric field strung between the electron and the nucleus. The specific frequencies in series and beating could then come from various natural frequencies of oscillations of the strung electric field coinciding at various regular intervals with radial oscillations of the orbiting electron. Given the ubiquity of quantization, one may further wonder whether this most fundamental entity, the electric field, may not itself be quantized and such quantization be at the very origin of every other form of quantization? This has never been investigated nor even thought of. We show that if we dare make a most heretical conjecture that the electric field around an elementary particle may not be an influence smoothly extending away from the particle in a continuum, but could instead be quantized by being physically concentrated into radially extending discrete electric field lines acting as oscillators, all quantum phenomenology and atomic spectra rules get readily entailed, the emission/absorption mechanism, built-in oscillators with increasing natural frequencies and decreasing intensities in series, different series coming from radiation exchange being only possible between atoms with electrons orbiting at angular momentum harmonics. Indeed every other form of quantization will turns out stemming from the primary quantization of the electric field. Quantization of the electric field will also be shown to more physically account for the Lamb shift than Quantum Electrodynamics. Furthermore the quantized electric field will be demonstrated (mostly in coming papers) to be closely linked to astrophysical observations which current physics cannot fully explain and to help decipher the nature of dark matter, thereby bridging the puzzling gap between atomic scale QM and large scale physics.

1.1. Plan of article

In section 2, we review the probing and guessing that led to the formulation of quantum mechanics. In section 3, we present the motivation for considering a possible quantization of the electric field. In section 4, we reinterpret the energy levels via a beating mechanism. In section 5, we reexamine the origin of series, angular momentum and spin. In sections 6, we reexamine the origin of radiation momentum and synchrotron radiation. In section 7, we revisit the origin and computation of the Lamb shift. In section 8, we estimate the field self energy. In section 9, we examine the electronic structure in multi electron atoms. In section 10, we revisit the nature of the magnetic field. In conclusion, we review the main findings and extend their consequences to high energy physics and astrophysics.

2. Foundations of Quantum Mechanics

The foundations of quantum mechanics have been laid down between 1919 and 1925 to account for the H atom spectrum, the simplest atom. Quantum mechanics got developed in a process characterized by Van der Waerden, editor of Sources of Quantum Mechanics as "systematic guessing"[1]. In classical physics, as suggested by the radiation emitted by the harmonic oscillations of electrons in a linear antenna, emission is attributed to the motion of electrons. In atoms, radiation was first expected to come from the harmonic motion of orbiting electrons. But the different frequencies observed were anything but harmonics. There were actually two problems, firstly the emission process and the anharmonic distribution of frequencies in series and secondly computing the intensities of the spectral lines. To solve the first problem, following Plank's postulate of only single quanta of energy being possible in exchanges between atoms, it was postulated that emission and absorption in an atom was only possible in transitions between energy states or levels, the single quantum of energy emitted corresponding to the frequency. Whereas the beating mechanism comes directly from observing the discrete H spectrum itself, the photon-energy level transition concept only came distantly from the need to solve the classical problem of the blue catastrophe in black body radiation coming from an enclosure, a continuous, not a discrete spectrum. Therefore the beating mechanism found in the H spectrum itself is far more pertinent to interpreting its spectrum and emission/absorption process.

Beating may occur between waves or between oscillators. Oddly the discrete frequencies in the H spectrum were also deemed by the fathers of quantum mechanics to have to be computed as coming from virtual oscillators. Van der Waerden indeed states: "The feeling that something in the atom must vibrate with the right frequency was shared by all those who replaced the atom by a set of virtual oscillators, i.e. by Ladenburg, Bohr, Kramers, Slater, Born and others "[2].

According to Bohr, Kramers and Slater(1924) [3] : "the correspondence principle has led to comparing the reaction of an atom in a field of radiation with the reaction on such a field which, according to the classical theory of electrodynamics, should be expected from a set of virtual harmonic oscillators". Born further adds [4] : "According to Bohr, each stationary state carries with it a number of virtual resonators whose frequencies correspond to transitions to other stationary states". Kramers [5] also deemed the "the reaction of the atom against the incident radiation can be compared with the action of a set of virtual harmonic oscillators inside the atom ". In his 1924 article, Born [6] even goes as far as saying:: "With the present approach which looks upon the virtual resonators as the real primary thing...".

This shows the extent they were torn apart between the prevailing postulate of transitions between energy levels and the necessity to find a physical mechanism producing radiation at the observed frequencies. However the narrow focusing exclusively on the concept of transitions between energy levels led to the apprehended need for oscillators going into oblivion. Had not been such tunnel vision, they could possibly have noticed that ratios between spectral lines, series limits and their differences were indications of beating, and the development of QM and physics could have taken a completely different path.

A second problem was guessing the right approach for computing the intensities of the spectral lines or the then apprehended probabilities of transitions between energy levels. In this search for a mathematical formalism, Heisenberg started from the equation of motion of the electron, which in classical physics is responsible for producing the radiation, in which the quantity x represents the location of the electron, Heisenberg replaced the classical terms of the Fourier expansion of the harmonic motion of the electron, without any physical justification whatsoever, by a new kind of terms labeled transition amplitudes from one energy level to another level [1]. And from the observation that the intensity of the α line in the Balmer series had been recently reported to be four times the intensity of the β line, he simply squared the amplitude term [1]. From this he developed his famous matrix representation. But this gave no clue as to the actual physical mechanism involved. Besides, the cue was itself wrong, the actual ratio being 9/4!

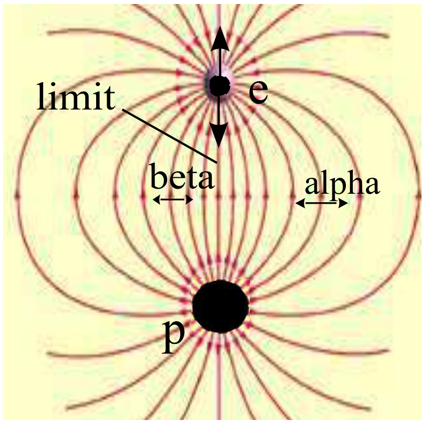
3. Quantized Electric Field Hypothesis

According to Maxwell, it is not the action at a distance of charges that produces attraction or repulsion, but rather the action of the fields upon each other. Furthermore one could expect that because of their related nature, electric and electromagnetic, oscillations of the electric field itself could be at the origin of any electromagnetic radiation emitted or absorbed. Indeed, because of its electric nature, oscillations of the electric field within an atom or outside, would be more conducive to generate local electric field variations which then travel away as electromagnetic perturbations. In an atom, such field variations *needs not result from the orbital motion of the electron, but from oscillations of the electric field strung between the orbiting electron and the nucleus*. This would explain the fact the electron does not emit radiation corresponding to its orbital motion. This is a radical departure from the classical picture and even from the starting point of Heisenberg in deriving quantum mechanics, who started from the equation of motion of the electron. How could then the electric field connecting the nucleus to the electron, not only oscillate at discrete frequencies, but in the many and well ordered frequencies and strengths observed in series? The discovered beating and harmonics in the ratio[limit: line: difference] for every spectral line in the H spectrum could suggest that the electric field strung between the proton and the electron could beat and oscillate at harmonics of in and out oscillations of the electron on orbit. However to account for the many possible frequencies in series, their well ordered geometrically increasing frequencies and concomitantly decreasing strengths, unique quantum properties of the strung electric field are needed.

As a working hypothesis, quantization being so pervasive in atomic physics, we may conjecture that a most elementary feature, the electric field, may itself be quantized, not in the usual sense, but in a special manner. We conjecture that rather than being considered as some continuous influence extending away from a charged particle, modeled by Maxwell as a non compressible fluid, the electric field around a charged elementary particle could instead be quantized in a very particular way, spreading away from an isolated elementary charged particle, concentrated into radially extending strings which mutually repel each other when of the same sign and attract one on one when of opposite sign. Such electric field lines could account for both the attraction and repulsion, as well as acting as micro-oscillators. We are very conscious that such a conjecture is quite heretical in the current paradigm and is bound to meet stiff resistance. However since the current quantum mechanics paradigm has been drawn strictly from assuming the existence of intrinsic energy levels and radiation resulting from transitions between them, while completely ignoring the beating mechanism at work for every emission and absorption line frequency, it is quite legitimate to investigate an alternate model suggested by the discovered evidence of beating. Indeed we will demonstrate that the proposed quantized electric field not only makes predictions that get vindicated through atomic physics and quantum electrodynamics, but every other form of quantization such as quantum angular momentum, spin, etc have their roots in the electric field itself being quantized.

In college physics, lines of forces in an electric field are described as lines emanating radially from a free isolated charged particle, and in the case of facing oppositely charged particles, curving out through space to the oppositely charged particle. We conjecture the electric field being concentrated along similar lines, kept spaced apart by a mutual repulsion force inversely proportional to their separation distance and counteracted by tension along the lines. Because of equal mutual repulsion, the field lines are assumed to emerge radially and equally spaced at the surface of particles. Not all the lines would participate in the electron to nucleus attraction or get involved in radiation production in atoms. The half of the lines emerging from the hemispheres facing outward the dipole, would actually tend to pull the particles apart. As these outer lines spread so far out, and so thinly through space,

Figure 2. Postulated electric field quantization. Instead of being some type of influence spreading in a continuous manner around the nucleus in which an orbiting electron bathes, we assume the electric field to be physically quantized by being concentrated along real lines, strung between the nucleus and the electron, in a similar way as lines of forces. Attraction is created by tension along the lines, which are kept spaced apart by mutual repulsion. Only the lines interconnecting the facing hemispheres participate in the attraction force. For reasons that will be made evident further on, only lines emerging at less than $45°$ from the dipole axis can produce discrete emission lines. They form an onion-like cocoon or spindle of lines. The Lyman alpha line gets produced by the outermost onionskin of lines in this spindle, whereas oscillations of the lines nearest the dipole axis produce the series limit.



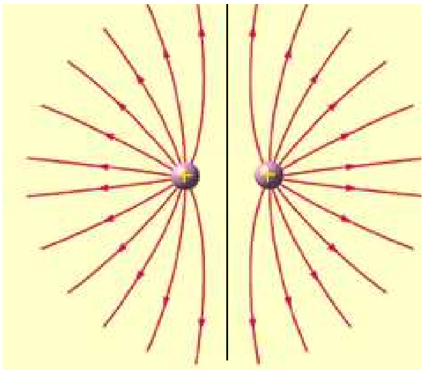
there is little mutual repulsion between them, and for the present purpose, can be neglected. In this toy model, only the lines interconnecting the facing hemispheres are considered as contributing to the attraction and only those emerging at less than $45°$ from the dipole axis will be shown to be involved in the spectral line radiation mechanism. This latter group of lines can be viewed as a spindly cocoon of lines strung between the nucleus and the electron as shown in figure 2.

3.1. Maxwell Stresses

What could keep apart the electric field lines? The answer is suggested by the classical concept of Maxwell stresses. The repulsion of point charges of same sign can be described classically by Maxwell stresses transmitted across the mid-plane of symmetry as shown in figure 3 .

The field lines next to the plane of symmetry tend toward being forced parallel to the plane, therefore there is a pure pressure stress tensor exerted everywhere across the plane against the opposite semi-infinite space (see for instance Becker [7]). It appears as if there

Figure 3. Maxwell stresses transmitted across the mid-plane of symmetry between same sign charges. The field lines next to the plane of symmetry tend to extend parallel to the mid-plane, as if there were a pure pressure stress tensor exerted everywhere across the plane on the opposite semi-infinite space. Every other field lines get proportionally displaced as if the pressure stress created near the mid-plane gets extended to all field lines.



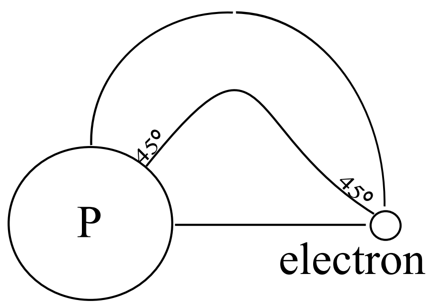
were pure repulsive stress acting across the mid-plane and between adjacent field lines. Field lines further away get proportionally displaced as if the pressure stress created near the mid-plane were progressively communicated to all field lines. This could be inferred as resulting from an equal mutual repulsion force between the quantized electric field lines of same sign.

Such equal mutual repulsion forces the lines to emerge equally spaced from the surface of of a charged particle, and for a free isolated charge keeps them extending away radially. Such mutual repulsion will be shown to account for an intrinsic electric field self energy plus additional energy when the field gets forcibly deformed from the radial pattern. When particles of same sign charge are approached, the lines of one charge repel the lines of the other charge, the fields thus deforming each other and inducing additional pressure stress over the original free particle mutual line repulsion, thus storing additional potential repulsion energy on top of the original inherent free charge self energy. Therefore one has to differentiate between the built-in self energy in the radially extending field around a free particle, and the additional energy resulting from a deformation of the field. On the contrary, opposite sign field lines attract each other, because they strive to neutralize each other. Where they meet at the mid plane, there is pure tensile force acting perpendicularly to the symmetry plane, whereas away from that plane, the field lines keep mutually repelling each other. As opposite charges in the dipole are allowed to get closer, the respective fields shrink symmetrically, so that the internal mutual repulsion self energy must be evacuated through the only possible channel, radiation, as will be shown to occur in electron positron annihilation.

3.2. Origin of Ground Orbit

Whereas an electron and a positron can spiral down onto each other, why can't an orbiting electron spiral down onto a proton or a nucleus? There is no reason classically why the electron should settle in a given ground orbit and not keep spiraling down onto the nucleus. In the current paradigm, one postulates the existence of a somehow built-in so-called wave function, concocted to fit the behavior, but which adds another postulate and does not explain the physical origin of the wave function in the first place. The discrete field line model readily offers a physical explanation. Let us examine the behavior of the discrete field lines as oppositely charged particles are allowed to get closer and closer to each other. If the two particles had the same size, as for a positron and an electron, the symmetry of the pattern of lines would remain unchanged allowing the pattern to symmetrically shrink ever smaller as to allow the particles to eventually merge. But if one of the particles is much smaller than the other, as in the case of an electron orbiting a proton, the symmetry gets lost as they get closer. As opposed to a metallic sphere where the free electrons can move around and accumulate toward the opposite charge, an elementary particle has a unique charge and the field lines can only emerge perpendicularly to the surface equally spaced due to their equal mutual repulsion. Figure 4 demonstrates the effect of particle size upon the attraction at close range.

Figure 4. Ground orbit of the H atom. Weakening of attraction due to field asymmetry. The lines emerging along the dipole axis or perpendicularly to it, always connect at the mid-plane perpendicularly to that plane and thus contribute their full attraction pull. Those emerging around $45°$, cannot join one on one without kinking, thus weakening the attraction and causing the electron to settle at equilibrium in a ground orbit. The closeness of the particles is exaggerated, in order for the effect to be more evident.



The lines emerging along the dipole axis or perpendicularly to it, always join at the mid-plane perpendicularly to that plane and thus contribute their full attraction pull. However being forced to emerge perpendicularly from a particle surface, those emerging near $45°$ angle cannot join without having to execute a kink. Using the method of Maxwell stresses applied at the mid-plane M, the tensile stress in the direction parallel to the axis of the charge dipole is according to textbook (Becker [7]):

$$T = \left(E^2/8\pi\right)\cos 2\theta \tag{1}$$

Full tension in the field lines exists only when the field E at the mid-plane is directed perpendicularly to the mid-plane, that is when full symmetry of the field is achieved. The tension gets weaker the more asymmetric the field pattern becomes as the charges get closer. As a result, the orbiting electron can only settle on an orbit where the weakened attraction force becomes equal to the centrifugal force, thus yielding the ground orbit, in which the electron settles at low and moderate temperature, and yields the Lyman series. The electric field quantization therefore most naturally explains the ground orbit in the H atom. As will shown later, this kinking and weakening of the lines emerging near $45°$ cause an uncoupling between the lines inward and those outward the $45°$ lines, so that only those inward can cooperatively act as oscillators and be involved in the emission process. As this group of lines takes the form of a spindle-like cocoon, we conveniently use the term spindle to designate it.

4. Origin of Spectral lines in Series

4.1. Micro-oscillators as source of radiation in atoms

What does the quasi exponential decrease in strength with increasing frequency in series suggest? Such a pattern could be possible if we were to conjecture the field lines in a spindle as micro-oscillators grouped into concentric onionskins about the axis of the electron-proton dipole. In such a toy model, the outer onionskin would contain more but less tensioned micro-oscillators, thus yielding stronger but lower frequency oscillators. Inward onionskins would contain progressively lesser but more tensioned micro-oscillators oscillating at increasingly higher pitch, until the series limit is reached at the dipole axis. The production of the different frequencies in a series, could then result from the micro-oscillators in each given onionskin, oscillating in unison with in-and-out excursions of the electron on orbit.

We show that in a series all the spectral lines are uniquely generated by one spindle of lines through internal feedback reinforcing the resonance of concentric onionskin-like layers of field lines in the spindle with oscillations of the electron on orbit, as can be seen most clearly in the Lyman series of atomic hydrogen. Let us imagine the electron orbiting the nucleus while hung at the end of the spindle of lines. The centrifugal force of the electron causes tension in the lines, while their mutual repulsion creates a repulsive pressure between the onionskins. Each onionskin, being differently tensioned and compressed, pulsates inflating and deflating at a frequency at which beating becomes possible with the radial oscillations of the electron on orbit. That the emission is produced by the field itself strung between the electron and the proton is more mechanically palatable than the classical picture in which radiation is assumed emitted by the electron itself oscillating about an equilibrium position on orbit. If the oscillation of the electron were the emission mechanism, the frequency of oscillation should mechanically be proportional to the attraction force acting as a spring between the electron and the nucleus, and inversely proportional to the mass of the electron at the end of the spring. In fact, just the opposite is observed. In Bohr's hydrogen atom formula and the de Broglie relation, upon which the Schroedinger picture is based, the frequency is directly (not inversely) proportional to the mass of the electron. Indeed the Bohr relation is actually more physically in harmony with an oscillator system in which the oscillations are those of mass-less strings anchored to a heavy central mass at one end, and a centrifugally pulled lighter mass oscillating at the other end. In this case, the more massive the oscillating mass, the more it pulls out, the stiffer the tension gets in the strings and the higher the natural frequency. In our toy model, the electric field conjectured concentrated into real physical lines, could yield such mass-less strings.

4.2. Frequency beating: spectral lines

Whereas in QM the frequencies in a series result from transitions between putative energy levels, here we show that beating is the mechanism responsible for the discrete spectral line frequencies and their orderly spacing in the H spectrum and their respective intensities. For every spectral line, the ratio between the limit, the line and their difference are in integer number in which the difference is a unitary number indicating beating occurs between every spectral line and the series limit. Such beating is further reinforced by the fact in these ratios, the limit and the line are also harmonics of the beating frequency. Furthermore such beating occurs not just between a spectral line and the series limit, but also between adjacent energy levels. This is put in evidence in the Grotian or term diagram. If one puts aside for a moment the current mind set about this diagram, in which the terms are only considered as energy levels, one can readily observe that, since the level difference between an upper term and the ground level term corresponds to the wave number or the frequency of a radiation, and as a beat frequency is expressed as the difference between two frequencies, then it becomes obvious that more generally:

The level difference between any two upper end terms can be interpreted as a possible beat frequency between the frequencies related to these terms.

This simple observation is of utmost importance. For instance, as shown in figure 1, the α line frequency, the series limit and their beat frequency are in the ratio 3:4:1; similarly the β line frequency, the series limit and their beat frequency are in the ratio 8:9:1; the γ line frequency, the series limit and their beat frequency are in the ratio 15:16:1, and so on. This is not limited to differences with the series limit, but also works for other level differences. For instance, the difference between the Lyman series 2P and 3P terms, can be interpreted as the beat frequency between the α spectral line frequency and the β line frequency, such that exciting an atom in the 2P level by their beat frequency can excited it to the 3P level.

This can be physically interpreted as follows. The outer onionskin in the spindle yielding the Lyman α line, inflates and deflates at its waist at a frequency such that its every third cycle is in phase with every fourth oscillation of the electron on orbit, both being furthermore harmonics of their beat frequency. Similarly, the next inward onionskin yielding the β line, has its every eight pulse in phase with every ninth oscillation of the electron on orbit. If we express the resonance condition for the various onionskins *n* as an integer fraction of the series limit, it becomes evident from figure 1, that n^2 is the common denominator to the three frequencies involved in frequency beating. It also follows that the beat frequency is $(1/n)^2$ times the series limit, and a particular onionskin frequency can be obtained by subtracting from the limit frequency, the beat frequency:

$$\nu_n = \nu_{lim} - \nu_{beat} = \nu_{lim}\left(1 - \frac{1}{n^2}\right) \tag{2}$$

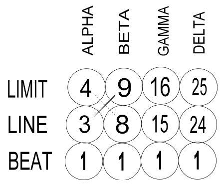
in which ν_{lim} equals the Rydberg constant, thus yielding the Lyman series formula.

What causes the beating conditions to occur only for the ratios 4:3:1, 9:8:1, 16:15:1, and so forth in which the series limit is proportional to quantum number n^2, and not in intermediate ratios 5:4:1, 6:5:1 etc.? The other condition imposed by the spindle of lines model, is that the scaling between successive resonance conditions must obey a square law. The successive onionskins are concentric with respect to the spindle axis. Each onionskin pulsates in and out about the spindle emitting radiation azimuthally about the waist plane of the spindle. the pulsating pressure variation in the waist plane due to the mutual repulsion must vary according to the square of the onionskin waist radius quantum number. In the proposed model, quantum number n corresponds to the onionskin number counting from the outermost, which yields the Lyman α line and is assigned number 2, since for number 1 there is no beating. As the onionskins are concentric, for each successive inward onionskin, the tension in the lines increases proportionally to n while the lines are more compressed my the mutual repulsion also proportionally to n, hence overall proportionally to n^2. Therefore beating can only occur for values n^2 of the limit as shown in figure 5.

4.3. Beating: line intensities

Spectral line intensity a key issue, as QM was actually formulated by Heisenberg specifically to mathematically account for the probability of transitions or line strength. Contrary to the QM paradigm, in which line intensities are postulated linked to associated probabilities, in the proposed model, the beating mechanism itself also controls line

Figure 5. Beating within Lyman series. The series limit, the α line, and their difference or beat frequency are in the ratio 4:3:1; similarly the series limit, the β line, and their beat frequency are in the ratio 9:8:1; and the series limit, the γ line and their beat frequency are in the ratio 16:15:1, and so on.



intensity. As the electron on orbit keeps oscillating radially at the series limit frequency, in beating every 3rd Lyman α pulse coincides and get reinforced with every 4th Lyman series limit pulse, its intensity is inversely $\propto 2^2$. Similarly, as every 8th β pulse coincides and get reinforced with every 9th series limit pulse, its intensity is inversely $\propto 3^2$. And as every 15th δ pulse coincides and get reinforced with every 16th series limit pulse, its intensity is inversely $\propto 4^2$. Therefore beating controls both line frequency and strength.

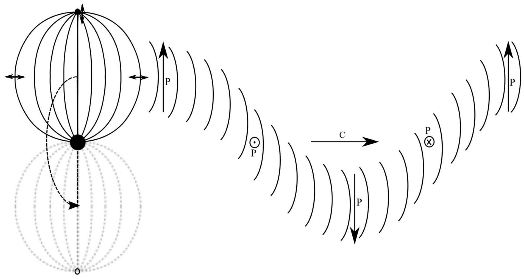
5. Origin of Series, Angular Momentum and Spin

5.1. Corkscrew wave train

The highly directional character of a photon is an essential feature, in order for it to conserve its full energy content, as its frequency and energy are conserved even after traveling billions of miles. This cannot be the result of the electron undergoing harmonic linear oscillations as in an antenna, since in this case the radiation is emitted modulated transversely to the direction of emission and expands azimuthally about the antenna as the waves produced by a stone falling in a pond. As such waves expand azimuthally, the amplitude and energy in a radial direction proportionately decrease outward, without however the frequency changing, in which case the frequency to energy relationship cannot hold.

The directional photon produced by an orbiting electron requires a different mechanism of generation, which the rotating spindle can most readily provide. As the electron oscillates on orbit at the end of the spindle of lines attached to the proton, the waist of the spindle alternately inflates and deflates sending out a series of pulses azimuthally about the waist of the spindle. As the spindle rotates around the nucleus, the plane these pulses get azimuthally emitted rotates. Pulses do not get successively emitted in a given direction, but all around in a sea of incoherent pulses, except for the one portion of pulses that get emitted parallel to the axis of rotation of the spindle, which can successively follow one another forming a coherent spiraling wave train of pulses traveling away from both sides

Figure 6. Spiral wave train of pulses emitted by the rotating spindle of oscillating field lines. The polarization in a pulse bears the imprint of the individual micro-oscillators in the spindle, thus being generally linearly polarized parallel to the spindle axis. The polarization vector P therefore keeps rotating along the spiral axis.



of the rotation plane, as shown in figure 6. Each such pulse is nearly a plane wave, and bears the polarized imprint of the many linear micro-oscillators that produced it. These micro-oscillators are oriented in a general direction parallel to the axis of the spindle, producing a kind of 'corrugation' in the pulses plane. This is what produces polarization. As the spindle rotates, the polarization direction of the electric field in the successive emitted pulses therefore rotates about the axis of the wave train. This accounts for the fact that emission and absorption are always observed perpendicular to the orbit plane, and for circular polarization in such a wave train. The spindle of another atom can be excited only when it momentarily coincide with passing pulses in the wave train and oriented in the same direction of polarization.

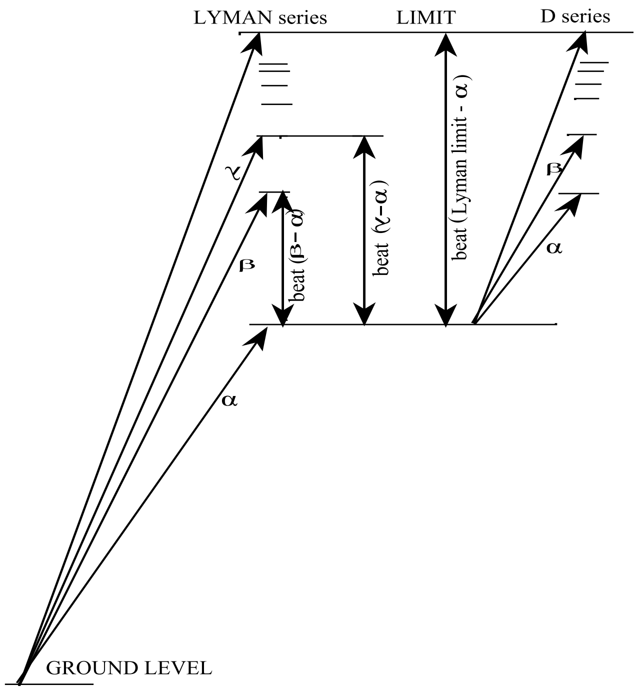
5.2. Excitation between series

We now show that the same beating mechanism is also acting in excitation between series. The excitation is first and foremost between similar size atom spindles, in atoms in which the electron is orbiting in the ground orbit, thus yielding the Lyman series, the only series observed at low and moderate temperature, when the electron settles in the innermost or ground orbit. As temperature increases, electrons get whirled around onto larger orbits. For most of these excited atoms, the size of electron orbit and consequently the resulting spindle are much too different to enter into resonance with any of the Lyman series spectral lines or limit. However a select number of them may turn out having just the right size of orbit and spindle so that the larger orbiting electron can oscillate in resonance with beat frequencies and harmonics of the exciting smaller atom. To be excited these spindles must meet a strict set of conditions. They must happen to be rotating on the path of a passing wave train and perpendicularly to its direction. Since the electron is orbiting on a larger slower orbit, it can only occasionally be swept by pulses in the passing spiral wave train, and the conjunction is so brief that little energy can be exchanged. Therefore, can get excited only those atoms whose electron orbit size and angular velocity are such that the spindle gets repeatedly excited at the proper frequencies and phase. These criteria are examined next.

5.3. Beating in cross excitation between different series spindles

The spectral line frequencies in smaller atoms such as Lyman series atoms are too high to be in tune with oscillators in larger spindles yielding the lower frequency Balmer series and others. Only beating frequencies in the Lyman series for instance, have low enough frequencies to match the larger oscillators in Balmer series spindles. Therefore only beat frequencies get involved in cross excitation between series as shown in figure 7.

Figure 7. Beating between frequencies within a series, and excitation of the Balmer series limit by the beat frequency between the Lyman series limit and α line frequencies. The excitation of the Balmer series α line is reinforced by the beat frequency between between the Lyman series α and β line frequencies, and so on.



The strongest exciting spectral lines in the passing wave trains, are the group of lines near the series limit on one hand, because it holds many spectral lines of high frequency closely grouped together, thereby packing a lot of energy, and the α line, because its onionskin has the greatest number of micro-oscillators. Their beat frequency is therefore the strongest low frequency component in the exciting wave trains suitable to excite larger spindles of lower natural frequency. If we look at the term diagram for hydrogen, as shown in figure 7, we observe that this is indeed the case: the difference between the Lyman series limit and 2P term corresponds to the beating frequency between the Balmer series limit and α line frequency. Physically, this beat frequency in the passing wave train, is in resonance with the field lines at the axis of the Balmer series spindle, their excitation thus directly setting its electron in oscillation on orbit.

Simultaneously, the outer onionskin of the excited spindle can get excited by the next strongest beat frequency in the exciting wave trains, resulting from the beating of the strong Lyman series α and β spectral lines. Thus the Balmer spindle get excited from both ends of the spectrum simultaneously. Therefore beat frequencies in a series can excite frequencies of onionskins in other series spindles: for instance, the beat frequency between the Lyman β and γ line frequencies matches the excitation frequency of the β line oscillators of the Balmer series, and so on throughout the term diagram. Similarly strong beat frequencies in wave trains produced by Balmer series atoms can excite the still larger spindles of F-series atoms; in turn strong beat frequencies in the wave trains produced by F-series atoms can excite the spindles of the G-series atoms.

5.4. Quantization of angular momentum

In the Bohr model, angular momentum could only be postulated. Here we show that the angular momentum quantization is not an intrinsic feature of a particle or the result of some wave function, but a direct consequence of the fact excitation between spindles can only be sustained between spindles of the right size rotating at the right angular velocity, so that the exchange of energy can occur repeatedly and the proper pulse phasing maintained through repeated conjunctions. The core field lines near the series limit in excited spindles are those excited by the strongest beat frequency in the exciting wave train. These core lines being nearly straight, are the strongest and the ones mostly responsible for holding the electron on orbit, so that the limit frequency is also the ionization threshold and is proportional to the centrifugal force. We are not so much concerned with their absolute values, but only in the ratio of these centrifugal forces, which must thus also be proportional to the ratio of their respective series limits:

$$\frac{\nu_{lim1}}{\nu_{lim2}} = \frac{F_1}{F_2} = \left[\frac{mr_1\omega_1}{mr_2\omega_2}\right] \frac{\omega_1}{\omega_2} \tag{3}$$

where *m* is the mass of the electron, *r* the radius of the orbit, and ω the angular velocity. We now use a numerical example to show the resulting constancy of the angular momentum and to demonstrate that the ratio of the centrifugal forces or the series limits is also equal to the ratio of the angular velocities. Suppose that the ratio of the limits is 4:1, as is the case of the ratio of the limits of Lyman and Balmer series, then we obtain for the ratio of the limit frequencies of these series:

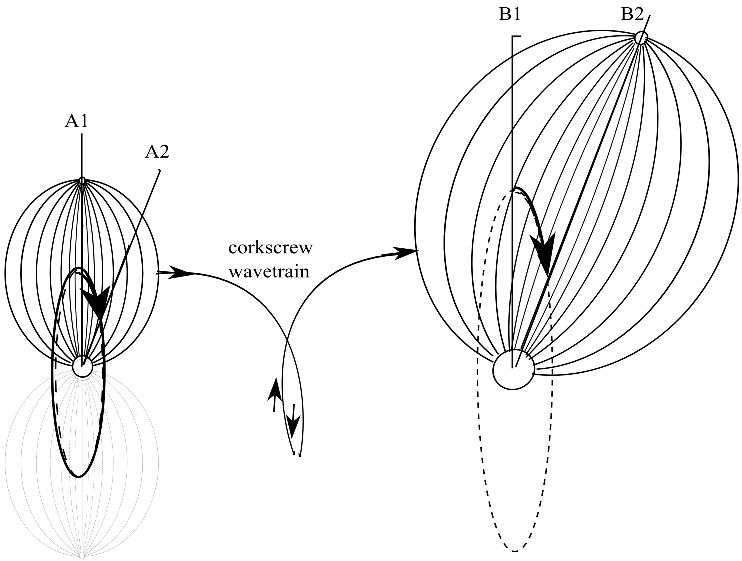
$$\frac{\nu_{lim1}}{\nu_{lim2}} = \left[\frac{mr_1}{mr_2}\frac{\omega_1}{\omega_2}\right]\frac{\omega_1}{\omega_2} = \left[\frac{1}{4}\times\frac{4}{1}\right]\frac{4}{1} = \frac{4}{1} \tag{4}$$

It shows that for the relationship to be mathematically consistent, the radius and the angular velocity must be inversely proportional to each other, so that the angular momentum is constant, thus retrieving the Bohr postulate. Furthermore the ratio of the series limits is equal to the ratio of the respective angular velocities. Therefore the above shows that the quantization of angular momentum in single electron atoms is nothing but the result of the selection of specific size atoms imposed by the beat frequency excitation mechanism and the phasing synchronization through repeated conjunctions when energy can be pumped in from one to the other. In fact there is not so much a quantization of the angular momentum, the electron mass being a constant, but rather primarily a quantization of the angular velocity itself. This quantization of the angular velocity into specific ratios leads to another type of quantization, that of the rotation angle of the respective electrons on their orbits between successive excitation conjunctions.

At this point, a more detailed description of a wave train is needed. Each electromagnetic pulse emitted by an onionskin in the spindle is made of the contributions of the individual field lines, each being a micro-oscillator; each pulse is therefore polarized along the general direction of alignment of these lines, the axis of the spindle. As the spindle rotates, the emitted train of pulses moves away in the form of a spiral wrapping around the traveling direction axis of the wave train, the polarization vector rotating while remaining directed perpendicular to the axis. Therefore at any given plane in space along the path of a passing wave train, the polarization vector would be seen rotating at the same angular velocity as the emitting spindle.

As shown in figure 8, an atom whose spindle happens to rotate about an axis coinciding with the axis of such a passing spiral wave train, would therefore have its spindle axis oriented in the direction of the polarization vector in the wave train at specific regular intervals, depending upon the ratio of its spindle angular velocity to the wave train spiral pitch, or the angular velocity of the emitting spindle. That ratio is identical to the ratio of the limits of the respective series. For instance, since the ratio of the limits and angular velocities of the Lyman series to the Balmer series is 4:1, we find for the ratio of their first conjunction 4/3:1/3. Thus the slower Balmer series spindle rotates 1/3 revolution, while the faster Lyman series spindle rotates one complete revolution plus 1/3 revolution to be again in conjunction. In the same way, for the Balmer series exciting the F-series, the angular velocity ratio is 9:4, so that the slower F-series spindle rotates 4/5 revolution while the faster Balmer series spindle rotates 9/5 revolution, between conjunctions. The angular velocity ratios and the ratio of the respective progression angles between conjunctions for the various exciting/excited series are:

Figure 8. Spindle B is first excited when its spindle is oriented parallel to the polarization vector in the passing wavetrain when in conjunction at S1 and B1, can get excited again only when they get again in conjunction at A2 and B2. During the time spindle B rotates from B1 to B2, spindle A must execute a full rotation plus the rotation executed by the slower B spindle. This can only happen for precise spindle radius ratios and angular velocities.



Ratio Limits	Angular Velocity	Conjunction Angle
$\frac{limP}{limD}$	$\frac{4}{1}$	$\frac{4/3}{1/3}$
$\frac{limD}{limF}$	$\frac{9}{4}$	$\frac{9/5}{4/5}$
$\frac{limF}{limG}$	$\frac{16}{9}$	$\frac{16/7}{9/7}$
$\frac{limG}{limH}$	$\frac{25}{16}$	$\frac{25/9}{16/9}$

From that table, it is evident that the angular velocity ratio for recurring conjunctions obeys the rule:

$$\frac{limit\ exciting\ series}{limit\ excited\ series} = \frac{(l+1)^2}{l^2} \tag{5}$$

and the conjunction angle ratio obeys the rule:

$$\frac{rotation\ angle\ fast\ spindle}{rotation\ angle\ slow\ spindle} = \frac{(l+1)^2/(2l+1)}{l^2/(2l+1)} \tag{6}$$

where l=1,2,3,etc. The fact these ratios are ratios of integral number fractions, ensures that the exciting pulses in the passing wave trains are always in phase with the spindle oscillators from one conjunction to the next, so that energy can continue to be pumped in at the right phasing. This requirement that exact phasing be retained between successive conjunctions means that excitation up to an upper energy level does not happen though the exchange of a single quantum of energy or photon as predicated in the energy level picture, but due to the briefness of the conjunctions only bits of energy can be exchanged at a time, and multiple successive conjunctions are needed to energize the receiving set of oscillators. This is a drastic departure from the current paradigm. Furthermore, each time the spindle gets oriented with the polarization vector of the passing wave train, there is only a definite time window during which the spectral lines in the exciting wave train can pump in a number of energy pulses into the excited spindle proportional to the frequency, hence yielding the famous relation $E = h\nu$. Note that this relation is only valid in exchanges controlled by definite excitation windows.

5.5. Environment constraints on possible series

As noted in introduction, the appearance and disappearance of series are inversely temperature dependent, in a counter intuitive manner. The series in which the frequencies are lower thus with lower energy start appearing as more energy is pumped in the gas, and the series with the highest frequencies and highest energies, the Lyman series, is the last one to disappear when the gas is cooled down. This is the opposite one would expect if the series energy were to come from the heat energy pumped in the gas. This is due to the fact that when the atoms are not kinetically excited, the orbiting electron settles in ground orbit. Upon heating the gas, the electrons get whirled out on larger orbits. In some orbits the angular velocity is such as to allow repeated conjunction and radiation energy exchanges. These specific atoms then yield the other series, the larger the orbit, the lower the frequencies. The largest stable orbits are only possible when there is ample space between the atoms. This is why the Paschen and Bracket series are only observed in thin space yielding the so-called nebular lines.

5.6. Origin of spin

Spin is believed to be some mysterious intrinsic property of a particle. We show that, at least for the electron in the H atom, the frequency shift attributed to the spin of the electron, actually comes from the two possible rotation senses in cross excitation between atoms. When exciting and excited atoms rotate in the same sense, the latter get excited at exactly the frequency of the exciting atom. However if they rotates in opposite sense, the excited atom spindle intercepts the pulses in the passing spiral wavetrain of pulses in a counter direction to the spiral train, thus seeing the pulses coming at a slightly faster rate, like a doppler shift. The spindle thus gets excited at a slightly higher frequency. As counter conjunctions have shorter duration, the excited spectral lines are thus weaker. The frequency shift should be related to the pitch angle of the corkscrew wavetrain and the velocity of light. True spin is therefore not a universal intrinsic property of particles.

6. Radiation Momentum and Synchrotron Radiation

6.1. Radiation momentum

Momentum is primarily an attribute of mass in motion; the observation of a behavior mimicking momentum in the interaction of mass-less radiation with a charged particle is very perplexing and has led to reluctantly having to accept a dual wave and corpuscular behavior for radiation. We show here that the absorption of radiation by a spindle of lines readily entails the application of an electromagnetic force that mimics the transfer of momentum in the Compton and photoelectric effects. We first point out that not every type of radiation can do so. Some types of radiation which expand either azimuthally about the source as from an antenna cannot do so, because the energy across a pulse keeps decreasing with expanding diameter. Only can do so a directed wave train such as produced by a rotating spindle of lines about its rotation axis in an atom, or synchrotron radiation which will be shown to result from the forward and backward wobbling of the spindle of lines about the particle mass. These beams are traveling trains of plane waves maintaining constant spacing and amplitude of electromagnetic variations. This well recognized planar character of such radiation is very important in exciting the bundle of oscillators in the atom being excited; it also accounts for the interference pattern created in double split experiments.

As the electron orbits around the proton, the spindle linking the electron to the proton rotates in the orbit plane. As the electron oscillates radially on orbit, the spindle of lines inflates and deflates harmonically at the waist, sending away azimuthally about the waist of the spindle, e.m. pressure-like variations. However as the spindle keeps rotating in the orbit plane, these pressure variations are sent in all directions as incoherent radiation. Only in the direction of the rotation axis, do the pulses travel away in a coherent spiral wavetrain. The successive planes in the wave leave with a memory of the onionskin pulsations. As the spindle inflates, the spindle field lines move in the same direction as the departing pulse, so that they stay longer with the departing signal, imprinting on that phase portion the memory of a longer stay and a denser local electric field stressing of the vacuum akin to a higher electromagnetic pressure. In the next half portion of the cycle the spindle waist deflates so that the spindle lines move counter to the direction of the departing pulse. During that portion of the cycle the leaving pulse registers a memory of the field lines having spent less time, or a dilution of the electromagnetic vacuum stressing or pressure. The net effect is to create a bunching of the electromagnetic stress or kind of an increased electromagnetic pressure front during one half of the cycle and a dilution during the next half, hence the planar character of the pulses.

A charged particle is differently influenced by a passing transverse modulation of the field as produced by a Hertzian dipole than by a passing pressure-like modulated electromagnetic pulse. Like a cork riding a water wave, a light charged particle will ride a transversely modulated electromagnetic perturbation with no net displacement. The modulation by the pulsating spindle is more like pressure waves created by the skin of a drum; however the result on a charged particle on the path of the wavetrain is different from that of a dust particle in air for instance. In air the dust particle is bombarded from all side by the air molecules and is therefore intimately bound to the medium, so that the passing pressure wave has no effect in producing a net displacement. Such is not the case for a charged particle which does not react with the vacuum except when its own field lines are set moving near the velocity c. Because of the inertia of mass of a charged particle, an electromagnetic pressure front meeting at velocity c the field lines of the charged particle pile up creating a rapidly increasing electromagnetic local stressing which cannot be relieved away at a velocity greater than c, thus compressing the electric field lines of the particle against their mutual repulsion. The field compression is then relieved by energy transfer to the mass of the particle, translating into an increase in momentum.

What gives the ability of the field concentration in the pulses to somewhat rigidly interact with the field lines of the electron and instead of simply reflecting like upon a mirror, imparting the electron a quantum of momentum? First what causes electromagnetic variations to travel at a unique velocity in vacuum? The so-called vacuum is not really empty. Every point in the observable universe is filled with the energy of coherent and incoherent electromagnetic radiation from everywhere in the universe. This creates an energy-filled medium that any passing electromagnetic variation must stress. The rate at which this medium may be stressed sets a limit on the velocity of propagation of the variation, hence the fixed velocity of light. The resistance of such vacuum to electromagnetic stressing is shown to be the main factor that produce the applied force mimicking a momentum transfer. Such vacuum behaves like a perfectly elastic fluid, in which the velocity at which a local stress can be transferred from one point to the next is controlled by its elastic constant. The elastic constant of the vacuum is what makes the electromagnetic stress in a radiation pulse travel at and only the velocity c. When an increased e.m. stress condition in the incoming pulse encounters the electric field that surrounds an electron, the local field build up cannot grow faster than at velocity c. As the incoming pulse is piling in at nearly the same velocity at the interface with the field lines surrounding the electron, the electric field strength tends to increase at a rate faster than the vacuum elastic constant allows. The result is a force applied against the electron field lines. The rear reaction to the force is provided by the resistance of the vacuum to the increasing electromagnetic stress buildup rate.

6.2. Compton effect

The concepts derived above lead to a different interpretation of the Compton effect. Instead of a single corpuscular collision, in which all the momentum and energy is transferred, it is rather a succession of the above stress applications, leading to a λ shift in the deflected wave train and a cumulative addition of energy in the struck electron. The incoming radiation wave train is a succession of modulated pulses described above separated by a distance λ_i. Each pulse imparts the struck electron with a quantum of momentum, increasing the electron forward velocity incrementally. After an interaction, the following pulse has to catch up with a faster electron, so that it bounces off the electron with a delay translating into a larger spacing λ_f in the deflected wave train. The larger the equivalent momentum transfer in the forward direction, the larger the change in λ.

A number of consequences follow from this. First as the electron forward velocity relative to the velocity c of the pulses keeps increasing with each pulse bouncing off the electron, the λ difference keeps increasing. However since the frequency is not directly measured, only an average $\delta\lambda$ can be inferred from the energy of the deflected beam. This λ spread is to some extent offset by a reduction in momentum transfer as the electron forward velocity approaches the velocity c of the incoming pulses. For lower angle scattering, the electron is more quickly kicked out of the path of the incoming train of pulses so that the scattering angle would keep increasing during the encounter and a lesser number of pulses impact the electron. All of these unexpected factors not included in the current single particle impact picture, could likely explain the observed unaccounted discrepancies between theory and experiments.

The polarizing of the Compton scattered beam is difficult to visualize in the picture of colliding particles. As polarization is generally produced by passing through a lattice of particles or glancing off a surface, how could an unpolarized incoming beam turn out being polarized through scattering off a single electron, and furthermore with its electric vector ending up perpendicular to the scattering plane? In an incoming screw like wave train, the electric field vector keeps rotating with the traveling screw; however the pulses can only bounce off the field of the electron if the electric vector is perpendicular to the scattering plane. When a first pulse in the wave train glances off the electron properly oriented, the successive pulses keep following up thereby ending up being also reoriented; in other words the spiral wave train gets straightened up as its electric field vector locks on glancing off the cocoon of field lines of the electron, oriented perpendicular to the scattering plane. As a corollary, a polarized incoming beam could not produce the Compton effect except in a scattering plane perpendicular to the polarization plane.

Besides the Compton shifted frequency polarized perpendicular to the scattering plane, the unshifted frequency is also observed scattered in all directions and unpolarized. How do both end up being scattered so differently? The Compton shifted frequency results from the interaction of the wave train with free or freed weakly bound electrons; the unshifted frequency results from the interaction with electrons strongly bound on orbit. The spindle of lines of a firmly held orbiting electron struck at a near right angle to its orbit plane will be excited at the same frequency as the exciting frequency if in its continuum; as it gets excited however it is also imparted momentum at right angle to its orbit causing the orbit to precess, so that the excited spindle then reemits in a new direction an unpolarized screw like wave train of the same unshifted frequency.

6.3. Synchrotron radiation

How is synchrotron radiation produced in the new paradigm? In a synchrotron, the work of the magnetic field is to keep the electron on the orbit, whereas repeated electric field impulses speed up the electron. When an electric field impulse is applied behind the electron, its electric field gets suddenly conically deflected ahead of the mass, because of the inertia of the latter. The field mutual repulsion forcing it to resume a radial pattern, the deflected field pulls the mass, which then because of its inertia overshoots the center. The field and the mass wobble about each other until the original impulse energy gets dissipated. In wobbling back and forth along the direction of motion, the field sends electromagnetic pulses fore and aft as synchrotron radiation. Similarly when a relativistic neutral particle elastically hit an electron, the mass gets kicked ahead of the field retarded by the vacuum drag, starting up a wobbling about each other as shown, and the emission of synchrotron-like radiation. In a separate paper on the nature of dark matter, we will show that being neutral, relativist dark matter particles do in colliding with electrons produce synchrotron radiation such as observed in pulsars and relativist jets.

7. Lamb shift

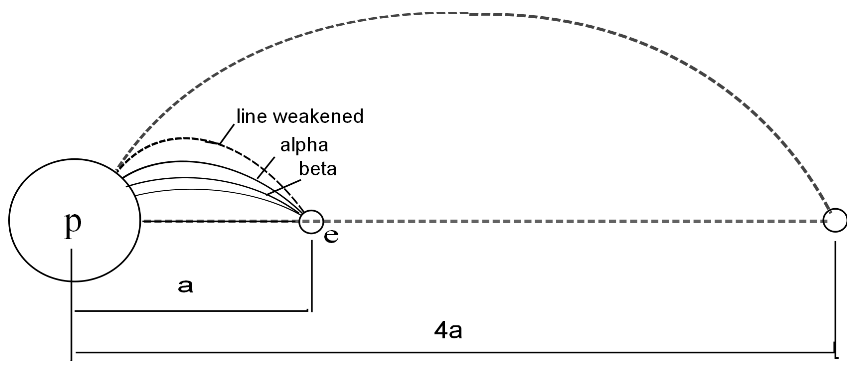
7.1. Origin of the ground orbit in H atom

In classical and quantum physics, the emission is attributed strictly to the electron motion, the energy levels being dictated by the Dirac equation. Deviations from this equation such as the Lamb shift, are attributed in quantum electrodynamics (QED) to perturbations of the electron motion mainly by the electron's own field and the putative emergence from the vacuum of virtual electron-positron pairs. In the drastically different proposed emission mechanism, the electron motion gets replaced by the oscillation of real discrete electric field lines tensioned between the nucleus and the electron, the latter relative sizes now acquiring yet unsuspected influences. We have previously shown in figure 3 that the effect of the proton being of much larger size than the electron, at close proton electron separation distance such as is the case for a Lyman atom, where the electron is in the ground orbit, the lines emerging around $45°$ from the dipole axis, cannot join one on one without having to execute a kink, leading to a weakening of the attractive force. This is the more important as will be shown, this is the group of lines contributing the most to the overall attraction. The onset of such weakening of the attraction force countering the centrifugal force, forces the electron to settle at equilibrium in the ground orbit of the H atom.

7.2. Emitting lines

The attraction force between the proton and the electron is a function of the varying pulling force of the lines and their number. Neglecting for now the difference in size of the proton and electron, the lines emerging perpendicularly from the surface of the proton, the effective force in a direction parallel to the axis of the dipole for a line emerging at an angle θ from the axis, is proportional to $\cos\theta$. Assuming the lines emerge equally spaced apart from the surface of the proton, the line density on surface concentric rings about the axis vary as per $2\pi r\sin\theta$. As the maximum of the function $\sin\theta.\cos\theta$ occurs at $45°$, which happens to be the angle at which line kinking also occurs, this doubly increases the effect of weakening the overall attraction between the proton and the electron, and firmly stabilizing the electron on the ground orbit. Due to line weakening around $45°$ emitter field lines are restricted to less than $45°$, as shown in figure 9.

Figure 9. Origin of the Lamb shift. In the smaller radius Lyman atom, because of the large difference in radius between the proton and the electron, the field lines emerging from the proton at near $45°$ from the proton-electron dipole axis suffer from asymmetry and their tension weakens causing a level shift compared to the $4\times$ larger orbital radius Balmer atom.

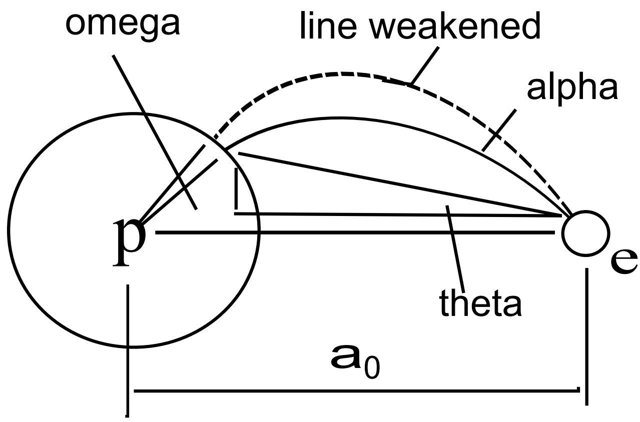


As spectral frequency or energy turns out being proportional to $\cos\theta$, the series limit resulting from the lines directly connecting the proton and the electron at $\cos 0°$, the field lines responsible for the spectral Lyman α line are estimated as emerging at $41.1°$ from the axis, and field lines for higher frequency spectral lines emerging progressively more inward.

7.3. Lamb shift direct computing

We show that the Lamb shift, as in the origin of the hydrogen ground orbit, naturally stems from the effect of the much different sizes of the proton and electron, affecting more the much smaller orbit Lyman atom, than the 4 times larger orbit Balmer atom. We deal specifically with the $2S_{1/2} - 2P_{1/2}$ Lamb shift which is the shift that the $2S_{1/2}$ energy level is considered anomalously raised. From uniquely geometrical considerations illustrated in figure 10, we show that the level shift comes entirely from the slight reduction in field line tension resulting from the asymmetry in proton vs electron radii reducing the attractive force at the shorter orbital distance in the Lyman atom compared to the Balmer atom.

Figure 10. Lamb shift direct computation. Because the particles have different sizes, the surface attachment points of the field lines are offset in proportion to tan θ, resulting in a reduction in line tension and a level shift from the symmetric pattern in the Balmer atom.



As proxy for the physical proton radius we use the value 0.84087 fm determined from the proton charge radius in muonium hydrogen, which is considered the most accurate determination. There exists no determination of the electron radius. However if we make the most natural assumption that matter in the proton and electron has a same intrinsic *density*, then we can guess the electron radius to be proportional to the cubic root of the proton/electron mass ratio 1836, suggesting the electron radius as being 12.24 times smaller than the proton radius. Field line weakening is prominent at 45° but extends to nearby line Ly α estimated emerging more inward at $41.1°$. As The Bohr radius a_0 is much larger than the proton radius, any variation parallel to the axis of the dipole is extremely small and can be neglected. The major relative deviation from symmetry occurs perpendicularly to the axis. We measure first the effect of the difference of radius on the main line weakening at 45°, which affects the full attraction between the proton and electron. That deviation is proportional to:

$$\delta \mathrm{R} = (\mathrm{P\ radius}\ -\ \mathrm{e\ radius})\ \mathrm{sin}45° = 0.84087fm\left(1-\frac{1}{12.24}\right)0.707 = 0.546fm \quad (7)$$

therefore

$$\tan\theta = \frac{\delta R}{a_0} = \frac{0.546\times 10^{-15}m}{5.29\times 10^{-11}m} = 0.103\times 10^{-4} \quad (8)$$

For small angles, sine $\approx$ tan, and around $45°$, small sine variations are nearly proportional to small cos variations. Therefore one can estimate the change in tension or level shift in the nearby field line Lyα emerging at $41.1°$ and thus the Lamb shift of the Lyα directly as:

$$\text{Lamb shift} = 10.2eV\times 0.103\times 10^{-4}\left(\frac{1}{4}\right)^2 cos41.1° = 4.314eV \quad (9)$$

where $\left(\frac{1}{4}\right)^2$ comes from, as previously seen, the 1:4 electron orbital radii ratio of the Lyman atom and the unperturbed reference Balmer atom. It is squared because the attraction is proportional to the square of the distance.

This computed value differs by only 1.3% from the latest 4.372 eV Lamb shift measurements. Considering 1) that the whole computation is based on using the proton charge radius as a crude proxy for the true physical radius, and 2) the current uncertainty and the large puzzling difference between the charge radii measured in electronic hydrogen and muonic hydrogen, the 1.3% difference is small. It is of course quite far from the accuracy claimed in QED, but contrary to QED we use only observable and measurable entities, not virtual non observable and non measurable entities and perturbations which cannot be independently corroborated. Here we do not have to bypass the problems of infinities by conveniently inventing regularization and normalization. We do not have to keep adding and subtracting ever smaller putative perturbations in order to close in on the experimental value.

7.4. Claimed accuracy in QED

The QED claimed accuracy of the Lamb shift is based on the extreme smallness of the perturbations added at the highest orders of the fine structure constant α. This presupposes that all previously added larger contributions have accuracy better than the final added smaller contributions, otherwise the accuracy of the latter is meaningless. Furthermore the overall inaccuracy should be the sum of the inaccuracies accumulated along the way. In that regard, one should be critical of the potential inaccuracies accumulated in estimating the major contributions to the Lamb shift. Since 1950, the Bethe, Brown and Stehn (BBS) [8] theory is considered to cover by far the main contribution to the Lamb shift, However because the numerical evaluation of integrals and summations were difficult and required greater computing power than was available at the time, BBS had to make several approximations with consequences left unexplored. The BBS theory with its approximations yielded a theoretical value of 1054 MHz close to the experimental value of 1062 MHz. Further progressively smaller QED corrections were thereafter added and subtracted to fill the small remaining discrepancy.

In 2005, thanks to the much increased computing power available, Blaive [9] repeated the BBS computations, but this time following fully the BBS theory with tighter approximations. Whereas BBS had originally cut off the spectral lines contributions at level n=6, Blaive computed the contributions up to level n=11, and took into account the previously neglected important contribution from the continuum. He found the exact BBS theory now gave a 1S level shift 352 MHz above the experimental value of 8174 MHz, a 4.3% discrepancy, huge by QED expectations, and much larger than all the combined finer QED corrections later added. This means that the approximations BBS used were not legitimate in the first place, and that the BBS theory itself may have flaws, and secondly, that the QED corrections later introduced to supposedly account for the then remaining moderate gap to experimental value, claiming the highest accuracy level in physics, may be nothing but wishful and totally unjustified. The 1.3% accuracy we got in our humble straightforward computation simply using the proton charge radius and geometrical considerations, is crude by the claimed accuracy in QED, but it is still smaller than the actual 4.3% discrepancy obtained using the exact BBS theory.

8. Field Self-energy

In the proposed quantized electric field model, the self energy in the undisturbed electric field around an isolated particle, would come from the mutual repulsion between the freely radially spreading lines. Its value could be best estimated from the difference between the state when the field is freely radiating outward and the state when the field is shrunk so much as to nearly completely disappears from space, as in the case of positron-electron annihilation.

8.1. Electric work in merging or separating charged particles of infinitely small size

It is basic physics that the electrostatic force acting between two charged particles varies according to the inverse of the squared distance. For *point-like particles* the electric attraction or repulsion force (depending on the charge signs) then become infinitely large when infinitely close to each other. As the distance r varies only to first order, whereas the force varies inversely to the distance squared, the work or potential is proportional to $1/r$. To bring from infinity, two point-like electrons next to each other against their mutual repulsion, would require a near infinite amount of work. Similarly in the mirror process, to separate point-like electron and positron apart from an infinitely close position just prior to merging and annihilating, and bring them out to infinity, a very same near infinite amount of work would be required. Inversely, when they are allowed to merge, *because of conservation of energy, a similarly near infinite amount of electric energy should be released and be observable*.

8.2. Self-energy estimate from fine-structure constant

It is of interest to estimate the amount of such released energy. To my knowledge, nowhere in the literature is there any discussion or attempt at estimating it. For energy conservation, it should mirror the energy required to move two electrons from infinity to next to each other. Such energy could possibly be derived from the fine-structure constant α, which in QED represents the strength of interaction between electrons and photons. According to one of the many textbook interpretations (see Wikipedia), the constant α can be viewed as representing the ratio of the energy that has to be spent in overcoming the repulsion between two electrons brought from infinity to a given center distance S apart, and the radiation energy of a photon of wavelength λ equal to that final distance:

$$\alpha = \frac{e^2}{4\pi\epsilon_0} \frac{\int_S^\infty \frac{1}{s^2} ds}{\frac{hc}{\lambda}} = \frac{e^2}{4\pi\epsilon_0} \frac{\frac{1}{S^2}}{E} \tag{10}$$

where we integrate the work against the electric repulsion force proportional to $1/s^2$ from ∞ to a final charge separation distance S . The energy needed to bring the two electrons to a side by side center separating distance $S = 2\times$electron radius, would therefore be:

$$E = \frac{e^2}{4\pi\epsilon_0\alpha} \frac{1}{S^2} = \frac{(1.602 \times 10^{-19})^2}{4\pi 8.854 \times 10^{-12} \times 7.294 \times 10^{-3}} \frac{1}{S^2} = \frac{3.162 \times 10^{-26}}{S^2} \tag{11}$$

where values are in MKS units. One is left to estimate a reasonably likely physical electron radius, for which there is none in the literature. The so-called classical electron radius being unphysically larger than the proton charge radius itself, cannot be realistically used. On the other hand, assuming all material particles share a similar specific matter density, one could try to estimate the radius of an electron size particle based on the proton/electron mass ratio 1836, and the known charge radius of the proton. However this would not take into account the composite nature of the proton, possibly introducing voids between the partons or quarks, if considered solids with physical dimensions. Therefore it would seem more appropriate to use instead a slightly larger 'volumic' ratio tentatively around 2000, yielding a trial electron radius of $1.11 \times 10^{-15} \div (2000)^{\frac{1}{3}} = 8.8 \times 10^{-17}$ meter, thus getting a tentative estimate of the energy needed:

$$E = \frac{3.162 \times 10^{-26}}{(2 \times 8.8 \times 10^{-17})^2} = 1.02 \times 10^6 eV = 2 \times 0.51 MeV \quad (12)$$

The result is amazingly close to the photon energies observed in the putative electron-positron annihilation. Critics could argue that the 2000 ratio was selected arbitrarily. The ratio could indeed reasonably be expected to range between 2000 and 1836. Had we used the mass ratio 1836, the lowest likely value assuming a spherical proton, we would still have obtained an overall energy of 0.954 MeV instead of 1.02 MeV. The important thing is not so much the exact size of the energy, but **the fact a substantial amount of energy is involved, and comparable in magnitude to the very electron-positron annihilation energy**. Note that such energy is strictly to overcome the electric repulsion between two electrons. *No annihilation is involved!*

8.3. Annihilation and violation of conservation of energy

Similarly in the mirror process wherein two electron-size particles of now opposite signs are allowed to close in on each other from infinity to next to each other, because of conservation of energy, the very same self-energy in the respective fields thus disappearing from space, ought to be transformed into radiation energy also equivalent to a photon of wavelength equal to the final separation distance, or of the order of two photons of 0.5 MeV. We stress that such energy is strictly to account for the self energy in the electric fields, as the opposite sign particles have not merged yet, and if the two particles are an electron and a positron, no actual merging and annihilation has yet occurred. If when an electron and a positron merge, only two 0.5 MeV photons do get observed, and these need to account for the energy of the disappearing fields, there is no energy left to account for some putative annihilation of the masses as predicated by SR. We stress again that the same electric field work is involved whether two electrons are brought against each other from infinity, or an electron and a positron are pulled away from next to each other to infinity. One could argue that the annihilation occurs before they actually merge. But how can they annihilate if they do not merge? In any case even if annihilation were to occur before a final merging, there would be still a sizable amount of electric energy to account for the charges coming from infinity to some close distance. And such sizable energy should show up in addition to the putative annihilation energy. Important consequences result from this exercise. First the current e+ and e- annihilation of mass into energy violates the fundamental principle of conservation of energy. Secondly we have estimated the energy observable when the field disappears which likely represents the self energy content of the field. Thirdly from strictly following the principle of energy conservation, the positron and electron do not annihilate, but do survive as a composite neutral dipolar particle, which will in a separate paper, be shown to be a lepton-based candidate dark matter particle having many unsuspected actions throughout astrophysics.

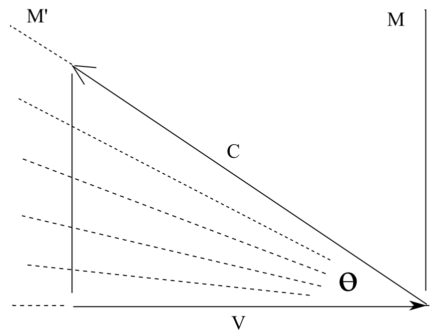
8.4. Energy increase at relativistic velocity

We have estimated the self energy of the freely radially extending electric field surrounding a stationary point-like particle. What extra energy would be involved when the field gets deformed from the radial pattern? Maxwell derived its famous equations by adapting the then new Bernouilli fluid concepts, and compared the electric field around a free charged particle as a fluid flowing from the charged particle [10]. Secondly the electric field around a charged particle, and electromagnetic radiation share a common electric nature, causing them to react similarly to the medium through which they move. They undergo a certain "electromagnetic" drag which sets a limit to their velocity of propagation or the rate of the deformation of their electric field. In other words, the fixed velocity of light in a medium, can be viewed as resulting from the rate at which the medium can be electromagnetically stressed and that electric stress transmitted from point to point. Even what we consider vacuum may not be entirely empty. It could be empty of atoms or electrons, but it remains filled with the electromagnetic energy of a sea of passing photons. Therefore in the same way the dispersion measure of longer wave radiation is affected by the density of electric field created by free electrons in the vacuum of space, any electromagnetic pulse passing through that electromagnetic substrate must electrically stress it, its velocity thereby being limited by the velocity at which that stress can propagate through.

The electric field accompanying a moving charged particle or ion must be subject to the same drag effect by the medium, an effect that gets increasingly dominant at relativistic velocity. A relativistic charged particle that keeps changing position relative to such a medium, keeps at every point sending around a new position signal at the velocity of light through the immediate surrounding medium. Because of the velocity limit on the transfer of stress or information, every point in the surrounding field is causally informed late of the actual position of the particle. This is a standard textbook interpretation [11]. As a result, the field which would extend radially from a particle at rest, gets deflected backward relative to the moving particle, as shown in figure 11, but reinterpreted here more according to Maxwell's views of a field.

Being concentrations of electric field, when moving through a medium, the quantized electric field lines react in the same way electromagnetic pulses would do in that medium, except that they have their root anchored to a mass endowed with inertia. The field lines of

Figure 11. Backward deformation of the electric field at relativistic velocity, due to particle position information travel delay [11]. We consider the particular median portion of the field, which at rest, would be fanning around in a plane M passing through the particle and perpendicular to the line of eventual motion. We take the backward conical deflection of this median plane to M' once in motion, as representing the average backward conical deformation of the overall field , and a measure of the work required to deform it against its own self-energy, due to the mutual repulsion of the lines spherically spreading from the particle at rest.



a charged particle in motion relative to its surrounding medium feel a drag proportional to the ratio of the velocity *v* of the particle to the maximum velocity *c* an electromagnetic fluctuation could possibly move through the medium. This drag forces the field lines backward against their mutual repulsion, in so doing storing additional potential energy in the deformed field over the self energy already present in the undeformed field at rest .

Two consequences follow. One could expect a possible error in measuring the mass of a relativistic charged particle in a magnetic field. The measuring magnetic field sees the effective electric field of the charged particle as severely deformed and mismatching its own field lines. Therefore the interaction strength between the deformed traveling field and the stationary magnetic field gets weakened, thus leading to wrongly interpret the effect as resulting from an increase in mass. The precise computation of this effect is beyond the scope of this paper. To a first approximation, the discrepancy is estimated proportional to $\sin^{-1}(v/c)$, the average angle by which the projection of the field lines on a plane perpendicular to the magnetic field, are deflected backward. The second consequence is an increase in stored energy reflecting the amount of energy that has been spent in deforming the moving electric field lines conically backward against their own mutual repulsion. When such a relativistic particle then comes to rest in a target, that portion of potential energy gets released along the much smaller ordinary mass kinetic energy, which we shall neglect. The self-energy due to mutual repulsion in the non-deformed radially extending field of a free isolated unit charge particle at rest has been estimated above, when discussing the electron positron annihilation, as approximately 0.511 MeV. The added stored energy at relativistic velocity *v*, would therefore be to a first order, proportional to the amount by which the field lines at rest get further compressed against each other mutual repulsion from the undeformed radial pattern to the conically deformed pattern.

For a proper treatment, the energy involved in deflecting the field lines backward against their mutual repulsion should be summed up for all the lines, as all the lines are not equally deflected backward. However our aim being to show that even a coarse approximation yields adequate predictions, we consider the particular circumferential set of lines which when at rest in figure 10 fans around in a plane M passing through the particle, and perpendicular to the line of eventual motion. We take the energy required to deflect backward this set of lines into a conical plane M' once in motion , as representing the total energy needed to curb all the lines. The lines in that cone are bent backward at an angle θ with the line of direction, with an included conical solid angle $\pi(2\theta)^2$. To first order the energy required to deform the field lines against their own mutual repulsion can therefore be estimated as:

$$StoredEnergy = \frac{.511MeV}{\pi(2\theta)^2} = \frac{.511MeV}{\pi[cos^{-1}(\frac{v}{c})]^2} \tag{13}$$

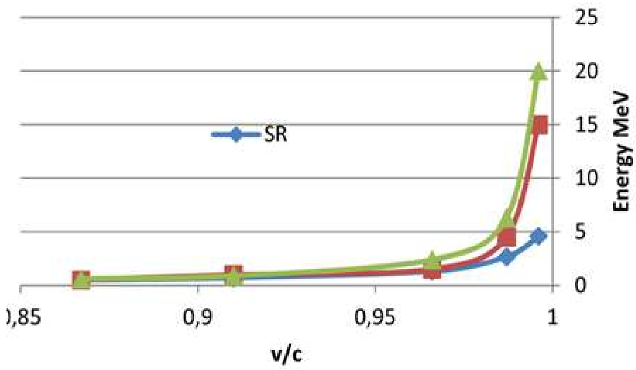
Where .511MeV is the computed self energy of the undeformed field around an electron at rest, which may be slightly lower for the much larger proton. In Table 1, we compare the predictions of the above relation to those of special relativity (SR) and to the measured energy of relativistic protons arrested in a copper block, in one of the only few such experiments reported in the literature [12].

Table 1. Comparison of predictions of SR and of the derived new relation versus Bertozzi experimental observations

v/c	SR MeV	Bertozzi MeV	New relation MeV
0.867	0.5	0.5	0.6
0.910	0.72	1.0	0.9
0.966	1.32	1.5	2.4
0.987	2.66	4.5	6.3
0.996	4.6	15	20

As can be observed from Table 1 and figure 12, the new derived relation yields predictions nearly similar to SR at lower energy, but much closer to the experimental data than SR, at higher relativistic velocity, with a deviation of just 25% versus over 300% for SR at *v/c*=0.996. Therefore the apparent increase of mass with velocity can not only be

Figure 12. Plot of Table 1 predicted energies according to SR (blue diamonds) and the proposed quantized electric filed derived relation (green triangles) versus the experimental data of Bertozzi (1964) [12] (red squares). Note the much larger discrepancy for SR at higher energy



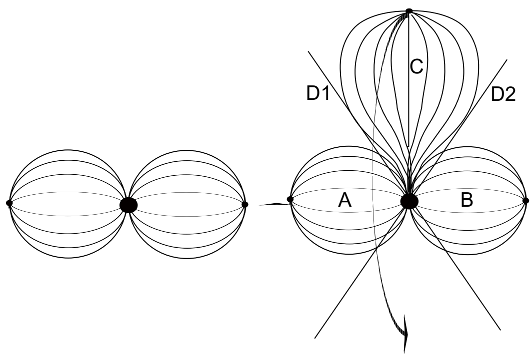
explained outside of SR precepts, but the quantized electric field theory predictions better match the available experimental data.

9. Electronic Configuration in Atoms

How does the quantization of the electric field influence or control the electronic structure in multi-electron atoms? In the proposed field interpretation, an orbiting electron is bound to the nucleus through an onion-like bundle of real electric field lines. Because of the mutual repulsion, the bundles cannot penetrate one another and must cooperatively navigate their way around the nucleus without bumping unto one another on the same orbital radius. As more electrons join the carousel, they can only fit in on additional layers or shells, their number and circulation pattern being dictated by the layers below. We examine how the bundle system controls the allowed architecture of the shells.

When only 2 electrons are orbiting, the two bundles simply repel each other diametrically to opposite sides as in the He atom shown in figure 13 left. An extra electron, as in the Li atom, cannot fit in on that same orbit as it gets squeezed out by the combined action of the pair. It can only join in on a larger orbit and by slicing through the pair when they offer the least resistance to the crossing of their orbit plane, as shown in figure 13 right. Having to orbit on a larger orbit, it is limited to have a lesser angular momentum. Therefore it has to time its crossing of the pair of inner electrons, to their angular velocity. It can only execute a half revolution for every full revolution of the inner pair. Therefore the angular velocity and orbit diameter of an upper shell is controlled by the angular velocity of the lower shell. However a larger orbit allows a larger number of electron to be fitted in. A further extra electron bundle can naturally fit in diametrically opposite the first electron on the larger orbit, yielding the Be atom. However as in the He atom, a further additional

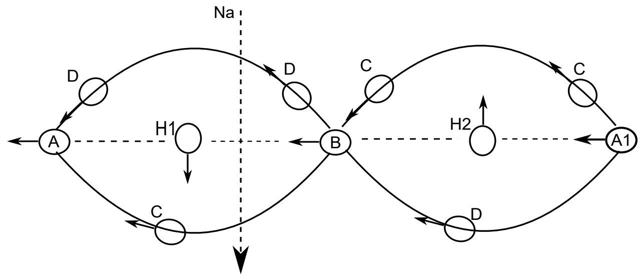
Figure 13. On the left, the two-lobes electron structure of He. On the right a three electron atom. The two inner He-like electron lobes A and B rotate as a dumbbell, in a horizontal plane perpendicular to the paper. The lobe of a third electron can only cross the A-B plane on a larger orbit when A and B are on opposite sides of the crossing plane, not to bump onto any of them. Yet just one extra electron on that larger orbit could be added symmetrically opposite to the first electron on that orbit, creating a larger dumbbell. To avoid bumping onto the inner orbit electrons, the larger dumbbell must slice through the middle of the inner dumbbell, rotating at half the angular velocity of the inner dumbbell. Further additional electrons can only be added if they slice in at an angle D1 and D2 between the passing lobes of the two dumbbells



electron cannot fit on that larger orbit. It can only fit in by slicing in between the passage of both the inner He electrons and the Be electrons, across their orbit plane, D1 in figure 13 right. Another electron can be added similarly slicing across the orbit plane at an angle D2 from the opposite side.

The requirement for spindles not to bump onto one another limits the size and number of these bundles on these 'side' orbits that can weave their way across the main orbit plane, and forces a strict phasing for the crossing of the planes. As this is difficult to show in 3D, we have developed in figure 14, a circumferential view around the orbit plane of the first two electrons labeled A and B in the second shell. A1 represents A at the beginning of the next revolution. We take the orbit plane A-B-A1 as the reference plane which all other electrons must cross at some phase. H1 and H2 are the inner (He) electrons which, having twice the angular velocity, cross twice the reference plane half way between the passage of the A and B electrons. The C and D electrons are left with tight windows for in turn crossing the plane back and forth. A little toying with the model shows that only 3 electrons per side orbit can be phased in, leading to a maximum 8 electrons on this second shell. Because the planes of the C and D electrons are at an angle to the A-B electron orbit plane, they must have a slightly higher velocity (with smaller orbit) on their own orbit planes, with their velocity projection on the main plane having to keep phase with the A-B

Figure 14. A circumferentially developed view of the Na atom electron shell illustrating the weaving past each other and the rigorous phasing that must be maintained for the electrons and their attached spindle not to bump onto one another. A and B are the first two electron diametrically rotating on the second shell. H1 and H2 are the He atom inner orbit electrons, which cross the A-B orbit plane halfway between the passage of the A and B electrons. The C and D electrons on side orbits slicing across the A-B orbit plane, must maintain their phasing for each in turn being able to cross the plane,



electrons. Additional electrons can only be added on a further out shell, taking advantage of small crossing windows as shown for the Na electron crossing orbit at nearly right angle to the A-B lower orbit plane, similarly starting up a new shell.

10. Nature of Magnetic Field

Experimentally a magnetic field is on;y observed when charged particles are in motion. In the MKSA unit system the magnetic force unit is defined as the force between two one-meter distant parallel conductors carrying a one ampere current in the same direction, or a traveling charge of one coulomb per second. If the conductors were charged with the same number of electrons but stationary, the two conductors would repel each other. What causes the same charges in motion to instead create an attraction? The only difference between static charges and traveling charges is motion. In the new paradigm, in motion the field lines get all conically deflected in one direction by the drag of the medium. The lowest energy state for the system is when all the conical fields queue into a single line of cones. When two stream of electrons are restricted into flowing in two parallel conductors the same tendency of the moving electrons to queue causes the two conductors to attract each other if the charges move in the same direction, and to repel each other if the charges move in opposite directions. Similarly free electrons moving in the same direction will tend to queue up so that each conically deformed field fits behind the preceding one. This accounts for the electrons in cathodic rays to not repel each other, but precisely queue up in a fine string. Therefore the magnetic field has no ontological reality of its own, but is just the result of the conical deflection of the field of charges in motion with respect to a medium. In a separate article, we will show that such queuing has important consequences in particle colliders.

11. Astrophysical consequences

To highlight the fact that the quantized electric field not only accounts for all quantum observations at atomic scale, but also bridges the current gap to larger scales, we give an example of a few of the many actions of the quantized electric field in astrophysics, to be reported in a separate article. In that article we will show that from the consequences of the quantized electric field and other missed critical observations, we can entail as from first principle, both a lepton-based candidate dark matter particle, and a much heavier quark-based dark matter candidate. These particles turn out having an electric dipolar structure, allowing the heavier cool dark matter dipoles to stack up all aligned into a giant rotating crystal, which itself becomes a giant rotating dipole through which all the electric field lines enter one pole and exit the other pole. Its fast rotation forces the emerging field lines to extend away from the poles twisting about the rotation axis, thus yielding kind of electric Archimedes-type screw conveyors wherein charged particles can get transported at up to relativistic velocities. This is the mechanism driving the highly relativistic jets observed extending far out along the rotation axis of putative black holes in active galaxy nuclei, jets off the poles of pulsars and protostars, as well as the flux ropes emerging from sun spots.

12. Conclusion

The current interpretation of the H spectrum has been drawn from an energy level picture stemming from Plank's photon assumption to resolve the ultraviolet catastrophe problem encountered in the classical treatment of continuous black body radiation, whose pertinence when extended from a continuous to a discrete lines spectrum may be questioned. The evidence of beating discovered in the H spectrum itself is far more pertinent and having gone entirely unnoticed, may have skewed its interpretation and hence the foundations of quantum mechanics and overall physics. Exploring such path can be considered maverick, but it could and should have been pursued at the time of Bohr. Had they kept toying a bit further with the then raised hint of virtual oscillators in atoms, and had they not boxed themselves in the concept of transitions between energy levels and examined more closely the H spectrum, they could have uncovered that there were in plain view evidence of beating at work for every spectral line. What we have done is simply picking up on their incomplete investigation and toying a bit further into the possibility of real oscillators made possible by quantizing the electric field into physical electric field lines. Beating has been shown to be the one mechanism not only controlling line frequencies, but their intensities, the central issue in Heisenberg's formulation of QM.

Since the concepts of energy states and transition probabilities, have been postulated to incorrectly interpret the H spectrum, and the H spectrum interpretation has led to the formulation of QM, such concepts and QM itself may be questioned or need to be revisited. The physical origin of energy levels or states in atoms has never been determined, and transition probabilities simply hide our lack of understanding of the inner workings. Instead of lazily resting on probabilities, the search for true causality must be restored in physics.

The proposed quantization of the electric field being a most drastic departure from current long held views, it must pass the most stringent tests. A guiding test is Occam's razor, which states that among competing hypothesis, the one should be favored which with the fewest assumptions most coherently accounts for the fullest range of observations. Whereas in the current paradigm multiple postulates are needed all along, in the proposed model, we need only posit the electric field around elementary particles being physically quantized by being concentrated into radially emerging extending and mutually repelling field lines. Everything thereafter gets entailed as mandatory consequences, such as the emission, absorption and exchange mechanism, the quantization of energy and angular momentum, and all the 'selection rules' of atomic spectra. Such electric field quantization even accounts for the Lamb shift in a much simpler and direct way than does QED. Whereas in QED, one has to posit a long list of putative virtual interactions and particles that, being virtual cannot be proved or disproved, and hundreds of pages of equations needing to be numerically resolved, here we only need plain geometrical considerations. Such a fundamental shift in paradigm would not be without consequences through the rest of physics, from micro physics to astrophysics. We therefore need to extend the investigation to all other major field of physics to check if the entailed consequences are consistent with actual observations. In sequel papers, we will show that the concept of quantized electric field is key to accounting for many astrophysical phenomena in particular those most resisting explanation by current physics such as the nature of dark matter and dark energy.

References

[1] Van der Waerden, Sources of quantum mechanics, edited by B.L. Van der Waerden, Dover Publications Inc. N.Y., p.8.

[2] Van der Waerden, Sources of quantum mechanics, op. cit., p.29.

[3] Bohr, N., Kramers, H.A. & Slater, J.C., Phil. Mag. 47,785,1924; in Sources of quantum mechanics, op.cit., p.29.

[4] Born, M., Zs. F. Phys. 26, 379-395, 1924; in Sources of quantum mechanics, op. cit., p.163.

[5] Kramers, H.A., Nature 113 (1924) 673-676; in Sources of quantum mechanics, op. cit., p. 179.

[6] Born, N., Zs.f. Phys. 26 (1924) 379-395; in Sources of quantum mechanics, op. cit., p. 190.

[7] Becker, R., Electromagnetic Fields and Interactions, Dover Publications, Inc., N.Y.1964.

[8] Bethe, H.A., Brown,L.M., & Stehn, J.R., Phys. Rev. 77, 370(1950).

[9] Blaive, Bruno, Concepts of Physics, Vol. II (2005).

[10] Buchwald, J.Z., From Maxwell to Microphysics, p.58, The University of Chicago Press.

[11] Purcell, E.M., Electricity and Magnetism, Berkeley Physics Course, 1965.

[12] Bertozzi, W., Am. J. Ph., 32,551, 1964.

Copyright © 2019 by Marcel Dubé. This article is an Open Access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction, provided the original work is properly cited.