The N particle Model

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The universe is made of a single elementary particle that is neither created nor destroyed. I have named that particle the N particle. A one elementary particle model that makes physics as simple as it can get is the ultimate in Occam's razor. This is a simple theory of everything. I analyze only simple symmetries, usually just point sources or spherical objects, so the geometry is simple and the equations are simple. Everything is at the level of introductory physics using calculus and some very important pieces of the puzzle are at the middle school science level.

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The TOE in simple form

The Theory of Everything in a nutshell: There are only two particles that account for just about all the important phenomenon, the electron and the proton (a neutron is a combination of an electron and a proton) so forces can only be on electrons and protons. Electrons and protons are the sources and the sinks for the electric, magnetic, photon and gravity fields. The four fundamental fields are made of point N particles. Electrons and protons are thin shell liquid phase spheres. When electrons and protons exchange point N particles over their surfaces with the four fields in the adjacent space forces and torques are generated on them, distributed on their surfaces as pressure vector fields. The fields have potential energy and the electrons and protons have kinetic energy when they have linear or angular velocity. We want to keep track of the flow of energy from field to particle and from particle to field. We can see the exchange process that generates the forces is the arrow of time for electrons and protons.

The microscopic meaning of some simple equations

There are some rather important equations, in fact all of them, for which the microscopic mechanism in terms of elementary particle mechanics and dynamics has not yet been elucidated. I have picked six of the most important ones and will provide an explanation for each in terms of N particle mechanics and dynamics. These are simple, elegant equations that must have simple, elegant microscopic explanations. Of course it is possible to explain all the Laws of Physics and all phenomena in terms of N particle mechanics and dynamics, a fully mechanical microscopic model, but being one person working alone I haven't completed that goal.

1. $F = \frac{dP}{dt}$
2. $F = G\frac{m_1 m_2}{R^2}$
3. $F = \frac{q_1 q_2}{4\pi\varepsilon_0 R^2}$
4. $E = mc^2$
5. $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$
6. $E = h\nu$

Where we will end up

I will preview the two most complex and the two most important equations in my theory to show where we will end up.

The first is a quadratic equation that is solved for the radius of non-metal atoms based on the limit of the line spectra, the ionization energy.

$$\text{Ionization Energy} = \frac{(q\times 1.6\times 10^{-19})^2\left(R_o-\frac{r_B}{2}\right)}{8\pi\varepsilon_0 R_o^2}\left[\frac{\left(q+\frac{1}{2}\right)^2}{q^2}-1+\frac{3}{4}\frac{(2q)^2}{q^2}\frac{1^2}{\sum_{x=1}^{x=v}x^2}\right]$$

where v is the number of valence electrons, $q=\frac{v}{2}$, R_o is the outer radius of an atom, and r_B is the Bohr radius.

The second is the equation that can be used to calculate the N particle flux, the flow rate, in units of Watts or N particles per second, in a free electron, free proton, hydrogen in the $n=1$ quantum state, or any macroscopic spherical capacitor with a single quantum of charge on the plates.

$$\frac{dE}{dt}=\frac{\dfrac{\dfrac{2\times m_e c^2}{2\pi R_o}}{\dfrac{\pi c}{2}}}{\dfrac{R_o}{r_B}\times 137.036^2}$$

where m_e is the mass of the electron, r_B is the Bohr radius and R_o is the radius of a free electron or proton, the outer radius of an atom, or the outer radius of a macroscopic spherical capacitor.

Also and important is another way of calculating the N particle flux in Watts for single charge atoms and spherical capacitors.

$$\frac{dE}{dt}=\frac{\dfrac{(1.602\times 10^{-19})^2\left(R_o-\frac{r_B}{2}\right)}{8\pi\varepsilon_0 R_o^2}}{\dfrac{R_o-\frac{r_B}{2}}{c}}$$

The equations are not in the most simplified form. They reflect the derivation so embed the mathematical description of the underlying phenomena. They are just algebraic equations but of course calculus is used to derive parts of them. The second equation I consider the proof of my theory. With it you can calculate the elementary quantum of charge from theory using the Bohr radius, electron mass, speed of light and fine structure constant. Until now the elementary quantum of charge is an experimentally derived quantity first measured by Millikan in his famous oil drop experiment in 1909.

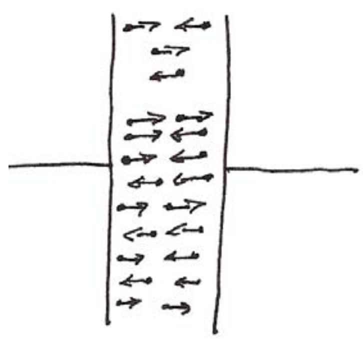
Getting started by observing a fatal error in the accepted paradigm

According to the Standard Model the two electromagnetic forces, $\mathbf{F}=q\mathbf{E}$ and $\mathbf{F}=q\mathbf{v}\times\mathbf{B}$, are mediated by exchange bosons and the exchange bosons for these forces are photons. Furthermore it is claimed electric and magnetic fields are made up of virtual photons. What photons or virtual photons are made of is not explained. That is simply wrong. The electric and magnetic field forces are not due to the exchange of photons and the fields themselves are not made up of virtual photons. Is that a serious error? It's fatal! Electric fields, magnetic fields, photons and gravity fields are of the very highest importance to physics. All four are collections of the N particle translating through space over time at the speed of light. It only takes five or ten minutes of original and creative elementary vector analysis to understand how they each can be collections of the same particle. We really only understand electrons and protons when we see the microscopic mechanism for how they give rise to these four fundamental fields and the fields are the window into the nature of electrons and protons. The first thing to see is how the N particle makes up electric, magnetic, photon and gravity fields.

The riddle of attractive and repulsive electric forces[2]

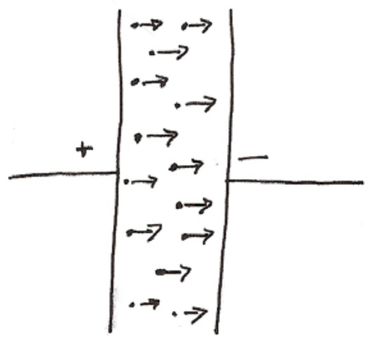
Like charges repel and unlike charges attract. This is the central riddle of the electric field force and is the single most important phenomena to interpret in all of physics. Electrons and protons are held together to form atoms through electric fields. However you define an exchange process when the particle being exchanged has mass the process of exchange of that particle must include a repulsive force so that the conservation of momentum and Newton's third law are observed. This can be seen by considering two ice skaters, who start out skating parallel and are exchanging a massive object. Each time each skater receives and throws the massive object a quantum of repulsive force is generated. To see how an attractive force may arise is the single most important insight into elementary particle physics.

Consider a parallel plate capacitor. What is happening on each plate is that they are emitting the N particle, as a very small point-like particle, that has velocity of the speed of light, is emitted normal to the surface and also receives the N particle from the other plate. The arrow represents the direction of the velocity of the particles. ½ are moving left and ½ are moving right.

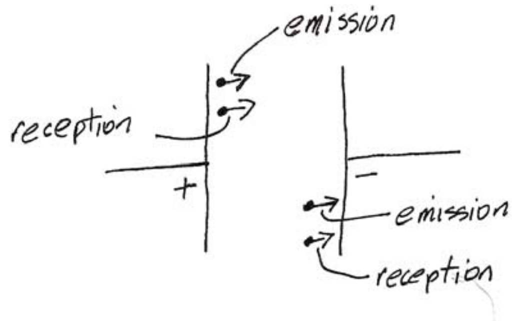


Now hypothesize there is a vector associated with the N particle that represents the direction of the electric field that I will call the **E** vector. The particles emitted from the positive plate have the **E** vector parallel to the velocity vector of the particle and the particles emitted from the negative plate have the **E** vector anti-parallel to the velocity vector of the particle. In this graphic the arrow represents the direction of the **E** vector. They all point in the same direction.

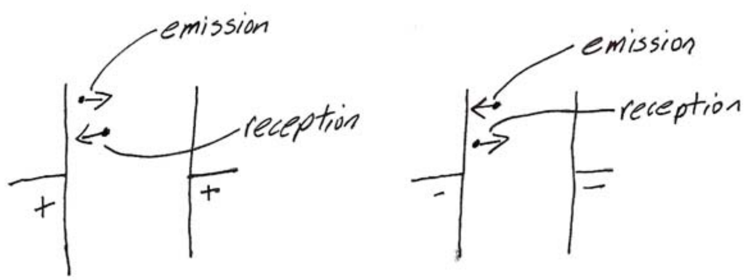
[2] This took me 45 minutes in December 1985 and changed my life. I have had the tiger by the tail since and you can't let go.



Now the symmetry of the attractive electrical force is apparent. What is going on at the positive plate is exactly like what is going on at the negative plate. Both receive and emit the N particle with the **E** vector pointing in the same direction and both feel an attractive force.



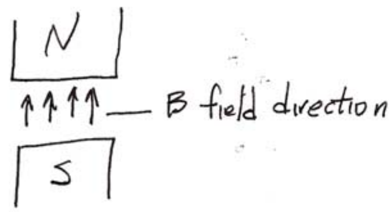
Now consider a repulsive force between like charges. Note there is no net electric field in the space between plates because ½ of the particles **E** vector point in one direction and ½ the particles **E** vector point in the opposite direction. In positive/positive and negative/negative exchanges both receive and emit the N particle with the **E** vector pointing in opposite directions and both feel a repulsive force. Then what is going on at each plate when both plates are positive and what is going on at each plate when both plates are negative have this same symmetry.



The difference between a positive and negative charge is they emit the N particle backwards from each other, rotated by π with respect to the velocity vector. The **E** vector is parallel to the velocity vector for positive charges and anti-parallel to the velocity vector for negative charges. Of course it is impossible to get like charges on the plates of a capacitor since the repulsive force doesn't allow that charge configuration to arise.

After thinking about that for a few minutes the reader may wonder if the magnetic field is present in this picture. Hypothesize that there is a magnetic field vector that I call **B** also associated with the N particle and that it is perpendicular to the electric field vector, transverse to the velocity. Furthermore hypothesize that in electric fields this vector that is in a plane normal to the velocity vector points in a random direction in that plane for each different particle in the collection that makes up an electric field so there is no net magnetic field in an electric field

Consider the macroscopic magnetic field between N and S poles.



This system has all the same properties and symmetries as the capacitor system. Hypothesize a S pole emits the N particle with the **B** vector parallel to the velocity vector and a N pole emits the N particle with the **B** vector anti-parallel to the velocity vector. The **B** field vector for emission and reception are in the same direction on both the N and S pole and both feel an attractive force just like the symmetry for attractive electric field forces. Like the **B** vector in an electric field hypothesize that the **E** vectors in a magnetic field are transverse to the velocity vector and each points in a random direction in planes normal to the velocity vector so there is no net electric field in a magnetic field. In N/N and S/S interactions the **B** field vector for emission and reception are in the opposite direction on both poles and both feel a repulsive force.

It is immediately obvious what photons are made of. The **E** and **B** vectors are transverse to the velocity vector so $\mathbf{E}\times\mathbf{B}$ is parallel to the velocity vector. A photon is a string in space and time of N particles, on a line of length λ, arranged with linear density to reproduce the linear energy distribution that is given by $\mathrm{E}_{\max}^{2}\sin^{2}\theta$ for θ from 0 to 2π and with orientation to produce the Thomas Young transverse wave of the electric and magnetic fields description of photons.

With a little time to think about it we might guess that gravity fields is a collection of single N particles oriented so $\mathbf{E}\times\mathbf{B}$ is parallel to the velocity vector and that in gravity fields all emission is $\mathbf{E}\times\mathbf{B}$ and the force is always attractive. Since the **E** and **B** vectors of each particle in the collection of particles making up a gravity field points in a random direction there is no net electric or magnetic field in a gravity field.

In electric, magnetic and gravity fields in steady states at each point in space where the field exists there are two flows of this particle, with equal flux magnitude, going in opposite directions. The three-dimensional energy density, μ_{E}, the "strength" of the field in steady state electric, magnetic and gravity fields is simply the quantum of energy of the N particle, e_{N}, times the limit of the number of particles in a volume divided by that volume, the N particle density, $\mu_{\mathrm{E}}=\lim_{\triangle\mathrm{V}\to 0}\mathrm{e}_{\mathrm{N}}\dfrac{\text{the number of N particles in }\triangle\mathrm{V}}{\triangle\mathrm{V}}=\mathrm{e}_{\mathrm{N}}\rho_{\mathrm{N}}$.

In summary life is greatly simplified because there are only three orientations possible in electric, magnetic, photon and gravity fields, mechanical forces, covalent bonds, electricity and circuit generated electromagnetic radiation.

1. $\pm\mathbf{E}\parallel\mathbf{v}$ in electric fields where the symbol $\parallel$ means parallel and $\mathbf{v}$ is the velocity vector of an N particle in an electric field.

2. $\pm\mathbf{B} \parallel \mathbf{v}$ in a parallel macroscopic magnetic field such as between N and S poles. Spinning electrons and protons generate magnetic fields over their surfaces and $\mathbf{B} \parallel \vec{\omega}$ for spinning electrons and $\mathbf{B} \parallel -\vec{\omega}$ for spinning protons.
3. $\mathbf{E} \times \mathbf{B} \parallel \mathbf{v}$ for photons, gravitons, mechanical forces, covalent bonds, electricity and circuit generated electromagnetic radiation. In this orientation the N particle has a non-superimposable mirror image.

Introduction to the N particle

The N particle is in perpetual motion at the speed of light in fields and a little more complicated motion in electrons and protons and always possesses a quantum of mass that I call m_N, a quantum of momentum that I call p_N, and a quantum of kinetic energy that I call e_N. $E = mc^2$ is true because $e_N = m_N c^2$ is true of the N particle. The momentum is given by $p_N = m_N c$. The quantum of energy the N particle always possesses is $e_N = 2.68138 \times 10^{-54}\,\mathrm{J}$. The fact the N particle is neither created nor destroyed and is in perpetual motion gives rise to the conservation of mass and the conservation of energy, both of which are always simultaneously true for all phenomena. The particle is a classical particle and can and must be visualized to understand the model. The N particle always has a precise location in space at any instant in time and is always in motion moving through three-dimensional space over time. The N particle model uses classical three-dimensional space, the same kind of space Newton thought of and used and absolute time, the same time Newton thought of and used. The particle exists in three possible geometric configurations, a point-like particle in fields, a dynamic growing and shrinking membrane in electrons and protons and a small thin shell sphere that fills the empty space between free electrons, free protons, atoms and molecules. The electric field, the magnetic field, a photon field and the gravity field are all collections of the N particle translating at the speed of light as a very small point-like particle that does not undergo collisions with each other or at least not very many of them, as if a mathematical point. An electron is a thin shell sphere with a radius of ½ the Bohr radius, almost zero thickness and is a collection of 3.058×10^{40} N particles. $3.058 \times 10^{40} = \frac{E_{\mathrm{electron}}}{e_N} = \frac{8.199 \times 10^{-14}\,\mathrm{J}}{2.68138 \times 10^{-54}\,\mathrm{J}}$. A proton is a thin shell sphere with a radius ½ the Bohr radius, almost zero thickness and is a collection of $5.614 \times 10^{43} = 1836.15 \times 3.057 \times 10^{40}$ N particles. Free electrons and free protons are single plate spherical capacitors and atoms are fancy spherical capacitors with an atomic number of protons as the inner positive plate and an atomic number of electrons as the outer plate. The familiar surfaces of liquids and solids we see and can touch in our macroscopic world are the outside surfaces of the outer electrons that make up atoms. The electric fields adjacent to the surfaces of the plates of capacitors are fully defined by the size and shape of the plates and the charge on the plates. The precise size and shape of electron and proton plates in atoms gives rise to the precise line spectra of the atoms. In electrons and protons the N particle is a dynamic membrane with almost zero thickness. When a point N particle as an electric or magnetic field strikes an electron or proton, a process I call reception, it grows from a point particle to a membrane until it coats the electron or proton, then reverses direction and shrinks back to a point and is emitted as a point particle, a process I call emission.

A free electron or free proton exchanges N particles at a total energy flux, a power, of emission plus reception of $12.34\mathrm{W}$. That translates to exchanging $4.60\times10^{54}=\dfrac{12.34\mathrm{W}}{2.68\times10^{-54}\mathrm{J}}$ N particles per second. A neutron is a combination of an electron and a proton. A neutron is a spherical capacitor with an electron as the inner plate and a proton as the outer plate. Neutrons are a lot smaller than atoms, are located inside the inner spherical proton plate and I will pretty much ignore them. All of space outside free electrons, free protons, atoms and molecules is filled with the N particle as a small thin shell sphere, much smaller than electrons, protons and atoms. I have named that geometric configuration of the N particle the foam. In the foam particles are in some kind of close packed lattice. Foam particles have access to the interstices of solids and liquids in addition to the space between heavenly bodies. Foam particles play the important role of reflecting N particles as electric, magnetic and gravity fields back to the sources, electrons and protons, making the number of particles in the field, the energy in the field, finite and also account for lensing phenomena. The N particle model focuses on the fields, electrons, protons and the foam, only four fundamental entities.

Predictions and explanatory ability

My model predicts the line spectra of hydrogen from the ionization energy. I believe it will be possible to predict the line spectra of all atoms using this model but I have not done that. I predict the size of free electrons and free protons. I predict the size of the non-metal atoms from the ionization potential, in particular H, C, N, O, P and S that are so important to biology. I predict the size of the metal atoms from the unit cell dimensions. I predict the elementary quantum of charge using the radius and mass of the electron, the speed of light and the fine structure constant.

This model is capable of explaining all of physics and chemistry but I am one person and only explain a subset of known phenomenon. The model shows the mechanism, the elementary particle mechanics and dynamics, for all the main phenomenon of chemistry and physics: electric fields, magnetic fields, photon fields, gravity fields, Newton's second law, Einstein's increase of mass with velocity, the geometry of atoms and molecules, the electromagnetic spectrum, oxidation and reduction, covalent and electrostatic bonds, the nature of attractive and repulsive forces involved in liquid, solid and gas phases, metals, conductors, electricity, current, voltage, continuous electromagnetic waves from radio waves to microwaves, antimatter and the decay of unstable particles.

The N particle model will always be a theoretical model since the N particle is too small to be seen or experimentally captured. For the most part the same is true of electrons, protons and atoms. Although we can see atoms in an electron microscope the picture is fuzzy and not precise like the size and shape of atoms. But we can see everything in the minds eye and render computer graphic pictures and video of all phenomena N particles give rise to. We can achieve with my model a fully mechanical understanding of the Laws of Physics. The Laws of Physics are just the properties of the N particle.

As a new theory I answer many questions and raise many new ones. This is not an end to theoretical physics. There are many new challenging problems for theoreticians. But as far as identifying the N particle as the only elementary particle it is an end to a certain kind of physics.

There are three questions that cannot be answered by humans: define a beginning to time, define an edge to space and why do N particles exist in the first place?

My interest and a proof that will come from technology

The problem I am most interested in is the protein folding and function problem. Proteins do myriad remarkable physical things. When in a membrane they can convert charge separation energy to chemical bond energy. They can receive and emit visible photons, in eyes, in photosynthesis, and in fire flies and other bioluminescent organisms. They can form the dynamic structure of the mitotic and meiotic spindle. They can put supercoils in and take supercoils out of DNA. They can catalyze uphill reactions by transferring the energy from an NTP to the chemical bond involved. Being able to design and engineer proteins will be a revolution like no other before in technology, even more important than chips.

So why do proteins fold? Simple answer: Because the energy is minimized but what energy? What are the repulsive forces and what are the attractive forces? Under the current paradigms of the standard model and quantum mechanics these questions are not understood and do not have solutions. With my quantum mechanics the protein engineering problem can be put on a firm theoretical foundation that will enable it to be solved although I'm not saying it will be easy.

The repulsive force in proteins is the exchange of thermal photons. All atoms at constant temperature are in a steady state of emitting and receiving a spectrum of thermal photons. Both the emission and reception of photons are repulsive forces due to the fact photons have momentum, the conservation of momentum and Newton's Third Law. The attractive forces are electrostatic forces. All atoms have charge patches on their surfaces that are dipoles, with equal amounts of negative and positive charge arranged in some kind of geometry on atom surfaces. In proteins the plus and minus charge patches on adjacent atoms are moved as close together as possible, that is touching, minimizing the electric field energy stored in the dipoles and simultaneously maximizing attractive forces. There are also ions in proteins such as the O^- and N^+ in the peptide linkage group and the minimization of energy in the electric field of those ions is also important. Since according to the standard model the electric force $q\mathbf{E}$ and the magnetic force $q\mathbf{v}\times\mathbf{B}$ are thought to arise by exchange of photons and the electrons are thought to be point particles or quantum mechanical orbital's it can be seen how utterly lost one is when trying to understand protein folding under the existing paradigms of the standard model and the current quantum mechanics.

What is a force?

Newton's Second Law defined a force as $\mathbf{F}=\frac{d\mathbf{P}}{dt}$ where the force and the momentum are vectors. The N particle definition of a force is $\mathbf{F}=\frac{d\mathbf{P}}{dt}=p_N\frac{dN}{dt}$ where $\frac{dN}{dt}$ is the flow rate of the N particle, the mathematical flux of the N particle in particles per second. At the microscopic level forces are on electron and proton surfaces. In a macroscopic force that flow of the N particle occurs over a surface patch that in atoms is the outer surface of electrons. Consider a cue stick striking a cue ball. Over the time interval when there is contact there is a flow of N particles out of the cue stick and into the cue ball. N particle flow also occurs inside atoms over the surfaces of electrons and protons. Then force is a flux, a real number associated with a vector field defined on a surface, and not a simple single vector. Each N particle that collides with the surface of an electron or proton transfers one quantum of momentum to the electron or proton at the point of impact on the surface of an electron or proton and in a very short time, as if in an instant of time. Because the N particle is so small there are a great many of them in a flow field defined on a surface area so that approximating a force as a pressure field distributed over some surface area is a good approximation. In this treatment the pressure is a vector field defined on the surface area.

$\mathbf{F} = \int_S \mathbf{p} \cdot d\mathbf{A}$ where $\mathbf{p}$ is a pressure vector field defined on surface S and $\mathbf{A}$ is the area vector field that is normal to the surface. The N particle flux is the surface integral of the N particle flux density vector field defined on surface S. $\frac{dN}{dt} = \int_S \frac{d\mathbf{n}}{dt} \cdot d\mathbf{A}$ where $\frac{d\mathbf{n}}{dt}$ is the N particle flux density in particles per second per meter squared defined on S. The N particle is discrete but we treat it mathematically as a continuous vector field. We do this in electric fields, magnetic fields, photon fields and gravity fields. All the fields are discrete, made up of N particles, but we treat them as if continuous, and this is an excellent approximation because of the small size of the N particle and the large number of them involved in the underlying phenomenon.

Two configurations of forces

There are two basic kinds of forces to consider.

1. Where a net force exists and an electron and/or proton is being accelerated.
2. Forces that are in balance or equilibrium with there being no net force so no electrons and/or protons are being accelerated.

The latter is a very important type of configuration that includes free electrons, free protons and atoms and molecules that are not translating through space with a net force on them. In this configuration the underlying pressure vector fields have two or more components that are equal in magnitude and opposite in direction everywhere on the surface of electrons and protons. This configuration is a steady state of N particle exchange.

The other kind of force is where there is a net force and electrons, protons, atoms and molecules are being accelerated or decelerated. These include the conventional forces of mechanics like those that occur in pistons, rods and crankshafts of an internal combustion engine and also a charged object in an electric field and a massive object in a gravitational field. Photon emission and reception are other important configurations where there are net forces, an atom emitting a photon, and reception, a photon colliding with, being received by an atom. In both of these processes there are net forces at work over time and the associated electrons and protons undergo accelerations and decelerations.

Einstein's increase of mass and energy with velocity

Once one realizes a net force is a flow of the N particle out of a source and into sink Einstein's increase in mass and energy with velocity follows immediately. This also leads to a limiting velocity for translating or spinning electrons, protons, atoms and collection of atoms.

The momentum of an object measures the number of N particles that have been transferred to an object over some time interval t (please excuse my habit of using the same variable as the limit of integration and the variable of integration):

$$P = \int_0^t F\, dt = \int_0^t p_N \frac{dN_t}{dt}\, dt = \int_0^{N_t} p_N dN_t = p_N N_t$$

where N_t is the number N particles transferred over interval of time from 0 to t.

The rest mass of an object is $m_0 = m_N N_0$ and the rest energy $E_0 = e_N N_0$ where N_0 is the number of N particles in an object at rest. The translating mass of an object is m and the translating energy E. Calculating the mass and energy of a moving object simply requires taking the integral of force over distance:

$$E_{\text{kinetic}} = E - E_0 = \int_{E_0}^{E} dE = \int_0^R F\ dR \int_0^R p_N \frac{dN_t}{dt}\ dR$$

$$\mathbf{v} = \frac{d\mathbf{R}}{dt} = \frac{\mathbf{P}}{m} = \frac{c^2\mathbf{P}}{E} = \frac{c^2 p_N N_t}{E}$$

Substituting and solving the integral yields:

$$E = e_N \sqrt{N_0^2 + N_t^2}$$

The similar result for mass is:

$$m = m_N \sqrt{N_0^2 + N_t^2}$$

The gamma, defined as $m = \gamma m_0$ and $E = \gamma E_0$, implicit in these results is:

$$\gamma = \sqrt{1 + \frac{N_t^2}{N_0^2}}$$

The magnitude of velocity definition is:

$$v = \frac{cN_t}{\sqrt{N_0^2 + N_t^2}}$$

The limiting velocity since N_0 is greater than zero but finite is the speed of light:

$$\lim_{N_t \to \infty} \frac{cN_t}{\sqrt{N_0^2 + N_t^2}} = c$$

Using the N particle definition of velocity the N particle gamma reduces to Einstein's gamma as it must:

$$\sqrt{1 + \frac{N_t^2}{N_0^2}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

A similar relationship applies to spinning electrons and protons that have moment of inertia mR^2:

$$\sqrt{1+\frac{N_t^2}{N_0^2}}=\frac{1}{\sqrt{1-\frac{\omega^2}{\omega_{max}^2}}}$$

where $\omega_{max}=\frac{c}{R}$. When the moment of inertia is mR^2 it is if the entire mass is located at the equator, either as a point particle like in the Bohr model of hydrogen or a zero thickness one-dimensional ring like approximated by a gyroscope.

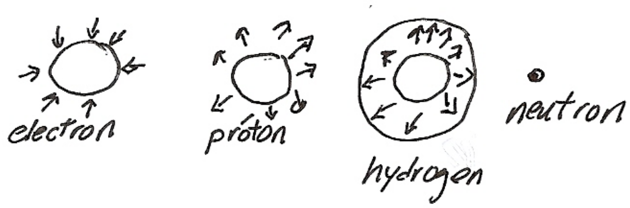
Einstein's Special and General Theories of Relativity

We see the increase in mass and energy of an accelerated object is quite real. The velocity of the accelerated object is relative to a particular frame of reference for that object, the rest frame where the object has zero velocity. But time dilation and curved space are nonsense. People who believe in time dilation and curved space need to see a psychiatrist. The notion that space and time are in someway connected in a four-dimensional combination of space plus time is nonsense. Space and time are both classical and the mass and energy increases in precisely the manner Einstein described and we see that Newton's Second Law $\mathbf{F}=\frac{d\mathbf{P}}{dt}$ is also correct when properly interpreted. Empty space is nothing physical, it is the empty space between N particles and time is nothing physical, it is just the simple classical time with a past, a present and a future and a constant flow rate. Since empty space is nothing it cannot have a property of curvature. Curvature is associated with N particle fields. Since time is nothing it cannot have a property of dilation. The rate we traverse time ultimately rests on the N particle property of always having velocity the speed of light in its rest frame. We can see this is not true simultaneously for rest frames that are moving relative to each other. The Einstein assertion that the speed of light is the same simultaneously in different reference frames that are moving relative to each other is nonsense. The idea that time runs faster or slower as a function of velocity or gravitational field strength is nonsense. Of course some phenomenon such as the decay of a mu meson or a vibration in a crystal lattice may run faster or slower as a function of velocity or gravitational field strength but it is the physical phenomenon that runs faster or slower and not time itself. The speed of light velocity of the N particle is relative to its rest frame. In space filled with the N particle foam the speed of light is relative to the rest frame of the foam. There is curvature of the foam due to the gravitational field and that is why photons travel on curves through space. There is also curvature of the foam in electric and magnetic fields.

A first introduction to free electrons, free protons and atoms

We know the four fields are made of point like N particles. What are the electrons and protons like? After brushing off the fog of point electrons and protons, after walking past the wave-particle dual nature of light and matter, after overcoming the stifling concept of an atomic "orbital", we finally can get sober and think about what is the precise physical nature of electrons and protons.

I have forgotten the chain of logic that led from fields to electrons and protons since I did that work over twenty years ago so I will just cut to the conclusion. Free electrons and free protons are extremely thin shell spheres as if with zero thickness. They are also liquid phase and can change radius and shape. Most importantly they are single plate spherical capacitors and the electric field in the surrounding space is described by Gauss's Law. A capacitor is simple to define requiring only shape, size and charge to determine it's properties if we leave out inserting dielectrics between the plates. So the big question is what are the radii? It turns out it is a lot easier to determine the radii of electrons and protons in the hydrogen atom then in free electrons or free protons. A hydrogen atom is a spherical capacitor with the electron as the outer plate and the proton as the inner plate. It is relatively simple to determine the size of the electron and proton in hydrogen since in a single charge capacitor the area of the plates and the distance of separation of the plates determine the energy stored in the capacitor. To determine the size of hydrogen I use spectroscopic data. The limit of the Lyman series of hydrogen is 13.5984 eV and is the ionization energy for hydrogen. From my model and using that piece of empirical data I determine a free electron or free proton has a radius one half the Bohr radius. In hydrogen the proton radius is also one half the Bohr radius and the electron is at the Bohr radius. A neutron is a spherical capacitor with a proton as the outer plate and an electron as the inner plate and has dimensions $\frac{1}{1836.15}$ of hydrogen. In deuterium the neutron is trapped in the annular space inside the proton. The arrows in the following show the direction of the electric field.



We are going to get to know the electron, the proton and atoms very well and there will be much confirmation of the radii.

What are the electric field and magnetic field in terms of N particle dynamics?

This can be derived many ways but one of the simplest ways to derive the relationship is to consider the energy density in electric and magnetic fields. The energy density in an electric field is given by $\mu_E = \frac{1}{2}\varepsilon_0 E^2$. The energy density in a magnetic field is given by $\mu_E = \frac{1}{2\mu_0}B^2$. These expressions are known to be true and are the basis of capacitors and inductors.

The energy density in an electric field is defined as $\mu_E = e_N \frac{dN}{dV}$ where $\frac{dN}{dV} = \lim_{\triangle V \to 0} \frac{\text{the number of N particles in } \triangle V}{\triangle V}$. Consider the field in a parallel plate capacitor that is everywhere the same magnitude and direction and the electric field is parallel to the surface area vector. Then everywhere in the field $\frac{dN}{dV} = \frac{A\ dn}{A\ dl}$ where A is the plate area and dl is a length differential. Then $e_N \frac{A\ dn}{Ac\ dt} = \frac{1}{2}\varepsilon_0 E^2$ where $dl = c\ dt$ and the flux density $\frac{d\mathbf{n}}{dt}$ points in the direction of the electric field at that point. Rearranging gives the N particle definition of the electric field vector:

$$\mathbf{E} = \sqrt{\frac{2p_N}{\varepsilon_0}\frac{d\mathbf{n}}{dt}}$$

In stable electric fields, electrostatic fields, that are steady states of N particle dynamics, there is an equal and opposite flux density at every point in the field. One half are going in one direction and the other one half are going in the opposite direction. Consider the surface of an electron that is emitting the N particle and receiving the N particle in a steady state. For that surface we define the magnitude of the flux density as always positive and the simple sum of the absolute values of the emission and reception flux density and similarly for flux:

$$\frac{dn}{dt} = \left\| \frac{dn}{dt_{\text{emission}}} \right\| + \left\| \frac{dn}{dt_{\text{reception}}} \right\|$$

$$\frac{dN}{dt} = \left\| \frac{dN}{dt_{\text{emission}}} \right\| + \left\| \frac{dN}{dt_{\text{reception}}} \right\|$$

Where needed in my model I make use the definition that the emission flux is negative and the reception flux is positive. This is natural because if an electron is emitting at a greater rate then reception its mass and energy are decreasing and if an electron is receiving at a greater rate than emission its mass and energy is increasing.

Likewise for the magnetic field:

$$\mathbf{B} = \sqrt{2\mu_0 p_N \frac{d\mathbf{n}}{dt}}$$

The elementary quantum of charge

Gauss's Law with **E** parallel to the area vector reduces to $EA = \frac{e}{\varepsilon_0}$ where e is the elementary quantum of charge. Then using the definition of the E field in N particle dynamics the elementary charge is:

$$e = \sqrt{\varepsilon_0 EA} = \sqrt{2p_N A \frac{dn}{dt}}$$

What area A and what magnitude of flux density $\frac{dn}{dt}$ are to be used in the expression for elementary charge that must be a constant? The correct area is the area of an electron in a hydrogen atom $A = 4\pi r_{Bohr}^2$. As the radius of an electron decreases the flux density increases according to Gauss's law. It reaches a maximum in hydrogen at the Bohr radius. When an electron shrinks further the flux remains constant so the flux in a free electron or free proton is the same as an electron at the Bohr radius in hydrogen. So we want to use the flux of the N particle when the electron is at the Bohr radius in the expression for the quantum of elementary charge. Then the N particle definition of the elementary charge is:

$$e = \sqrt{8\pi\varepsilon_0 r_B^2 p_N \left.\frac{dN}{dt}\right|_{r_B}}$$

where $\left.\frac{dN}{dt}\right|_{r_B}$ is the N particle flux as an electric field on the surface of an electron at the Bohr radius. $\left.\frac{dN}{dt}\right|_{r_B}$ is the sum of emission flux and reception flux on the electron surface.

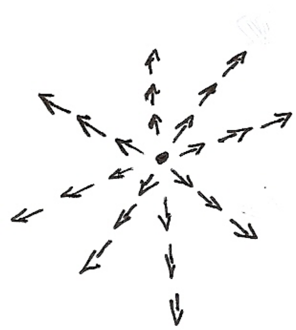
I have derived the flux as power of the electron in hydrogen at the Bohr radius and $\frac{dE}{dt} = 12.34\,W$. $\frac{dE}{dt} = e_N \frac{dN}{dt}$. Since the quantum of energy of the N particle is $e_N = 2.68138\times10^{-54}\,J$ the flux of the N particle of the elementary quantum of charge is $\frac{dN}{dt} = \frac{12.34\,W}{2.68138\times10^{-54}\,J} = \frac{4.60\times10^{54}}{s}$.

The charge is simply an integer times the quantum of elementary charge. I will designate the integer z. $z = 1, 2, 3...$

$$q = ze$$

What does Gauss's Law mean in N particle dynamics? The requirement for the foam

Consider a small source emitting point particles normal to its surface out into space in the radial out direction.



Then the flux of particles, the flow rate $\frac{dN}{dt}$, is constant for all radii. The flux density falls off as $\frac{1}{R^2}$, $\frac{dn}{dt} = \frac{\frac{dN}{dt}}{4\pi R^2}$. The number of particles in the field goes to infinity over time as space becomes filled with particles and the radius they fill becomes ever larger. Since the number of particles has to be finite this can't work for long before the small source runs out of particles to emit.

Gauss's Law states the mathematical flux of the electric field is a constant for any closed surface $\oint_S \mathbf{E}\cdot d\mathbf{A}=\frac{q}{\varepsilon_0}$ where S is some closed surface surrounding the charge q. I'll look only at spherical symmetries where $\mathbf{E}$ is parallel to $d\mathbf{A}$ so can drop the vector notation and integral formulation and just use the algebra. Gauss's Law with simple spherical symmetry is $4\pi R^2 E=\frac{q}{\varepsilon_0}$.

I'll plug the N particle definition of the electric field and elementary quantum of charge into $E^2A^2=\frac{q^2}{\varepsilon_0^2}$:

$$\frac{2p_N}{\varepsilon_0}\frac{dn}{dt}_R 16\pi^2R^4=\frac{8p_N\varepsilon_0\pi r_B^2\frac{dN}{dt}_{12.34}}{\varepsilon_0^2}$$

Where $\frac{dn}{dt}_R$ is the flux density at radius R. Simplifying and using $\frac{dN}{dt}_R=4\pi R^2\frac{dn}{dt}_R$ we see:

$$\frac{dN}{dt}_R=\frac{r_B^2}{R^2}\frac{dN}{dt}_{12.34}$$

So Gauss's Law means the flux decreases as $\frac{1}{R^2}$. What's going on? "Space" must be reflecting the N particles back to the source, an electron or proton. Then an electron or proton is both emitting particles into the field and receiving them back from the field. This makes the energy in the field finite and the system able to get to a steady state where emission of the N particle by the source equals reception. The foam is hypothesized as the solution to this problem. The foam fills all the space outside free electrons and free protons and atoms and even has access to the interstitial space in liquids and solids. The foam reflects N particles in the field back to the source, precisely reversing their trajectory. The only place the foam does not have access to is the space inside of atoms. So we can see two domains, one where there is foam and Gauss's Law applies and a second inside atoms where there is no foam and where the N particle flux is constant for all radii between positive and negative charge. Without the foam naked charge such as a free electron or free proton would not be stable but would rapidly decay through emission of N particles. The foam gives to the electric field what I call the capacitive property. I define that as where the electric field energy, the number of N particles making up the field, is finite, and at every point in the field there are two components of the flux going in opposite directions, that I call emission and reception. We can note the foam must do the same for magnetic and gravity fields because they are also finite.

What does Coulombs Law mean in N particle dynamics and why is it a $1/R^2$ force?

Coulomb's Law is $F=\frac{q_1q_2}{4\pi\varepsilon_0R^2}$. It describes the force between small charged conductor spheres separated by a center to center distance of R. It is only an approximation and applies for $R\gg r$ where r is the radius of the spheres. It is a very good approximation for electrons and protons due to their small size. The electric field for a spherical source is defined by $E = \frac{q}{4\pi\varepsilon_0 R^2}$ and the electric force on a point particle with charge q in that electric field E is $F = qE$. Consider a system where the two charges are either electrons, protons or one of each, a point particle configuration. I will leave the directions of the forces out of the equations since they are cumbersome and the direction is obvious, like charges repel and unlike charges attract. We can plug the N particle definitions for the electric field and the elementary quantum of charge into $F = qE$ to describe these simple configurations.

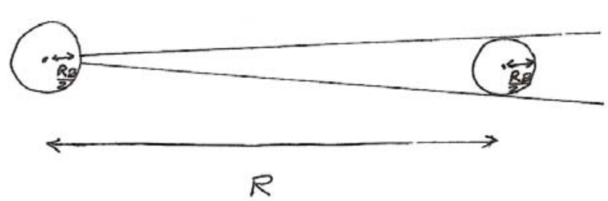
$$p_N \frac{dN}{dt}_F = \sqrt{8p_N \pi\varepsilon_0 r_B^2 \frac{dN}{dt}_{12.34} \frac{2p_N}{\varepsilon_0} \frac{dn}{dt}_R}$$

Where $\frac{dN}{dt}_F$ is the exchange flux that gives rise to the force between the two charged objects and is the one way flow from source to sink, representing a small charge q in an electric field E. Simplifying we get to:

$$\frac{dN}{dt}_F = \frac{2r_B^2}{R^2} \frac{dN}{dt}_{12.34}$$

$\frac{dN}{dt}_{12.34}$ is emission flux plus reception flux. I give it the subscript 12.34 because that is the number of watts of energy flux used in the definition of the quantum of elementary charge. This result is almost identical to Gauss' Law and only differs by the factor of two. This equation says that the exchange flux that is the force has double the value of the entire flux at radius R. Since the electron or proton is very small this indicates a new and important phenomenon.

Here's the simple geometric ray optics picture:



A sink sphere with radius $\frac{r_B}{2}$ intercepts $\frac{\pi \frac{r_B^2}{2^2}}{4\pi R^2}$ of the source sphere by simple geometry. I will call this cone the conduction cone between source and sink and will define conduction shortly.

For a point charge like an electron or a proton in an electric field E only the emission flux from the field source should be used. So we add a factor of two to $\frac{dN}{dt}_F = \frac{2r_B^2}{R^2} \frac{dN}{dt}_{12.34}$ and arrive at:

$$\left.\frac{dN}{dt}\right|_F = \frac{4r_B^2}{R^2}\left.\frac{dN}{dt}\right|_{6.17}$$

The radius of a free electron or free proton is $\frac{r_B}{2}$ so we modify the equation with another factor of two:

$$\left.\frac{dN}{dt}\right|_F = \frac{16\frac{r_B^2}{2^2}}{R^2}\left.\frac{dN}{dt}\right|_{6.17}$$

Now I will add a 4π factor to denominator and numerator:

$$\left.\frac{dN}{dt}\right|_F = \frac{64\pi\frac{r_B^2}{2^2}}{4\pi R^2}\left.\frac{dN}{dt}\right|_{6.17}$$

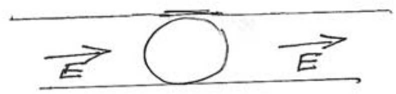
This equation tells us the sink charge receives 64 times the total emission flux intercepted by a cross section circle with a radius $\frac{r_B}{2}$ at radius R. What is going on? Let's construct the geometric equation we would expect that uses Gauss's Law and reflects the capacitance of the foam. This just uses the N particle definition of Gauss's Law, $\left.\frac{dN}{dt}\right|_R = \frac{r_B^2}{R^2}\left.\frac{dN}{dt}\right|_{12.34}$, with the ray optic geometric factor.

$$\left.\frac{dN}{dt}\right|_F = \frac{r_B^2}{R^2}\frac{\pi\frac{r_B^2}{2^2}}{4\pi R^2}\left.\frac{dN}{dt}\right|_{12.34}$$

This would predict a $\frac{1}{R^4}$ relationship of the force with the separation. Here's the solution: there is no capacitance in the conduction cone, it is what would happen without capacitance, i.e., as if there was no foam in the geometric cone that connects the two spheres so only the geometric factor of $\frac{\pi\frac{r_B^2}{2^2}}{4\pi R^2}$ is involved. Conductance is when the foam does NOT reflect back the N particles in the field to the source so only geometrical factors are at play and the flux of the field in the conduction cone is constant at different radii.

$\left.\frac{dN}{dt}\right|_F = \frac{64\pi\frac{r_B^2}{2^2}}{4\pi R^2}\left.\frac{dN}{dt}\right|_{6.17}$ additionally says the flux has 64 times the geometrical value based on constant flux in the conduction cone. This is also an important new phenomenon. What is going on? This is due to curvature of the foam by the electric field having the net effect of focusing the flux that would be spread over an area of $64\pi\frac{r_B^2}{2^2}$ at radius R on the $\pi\frac{r_B^2}{2^2}$ cross section of the electron or proton. So the foam when curved can act like a lens.

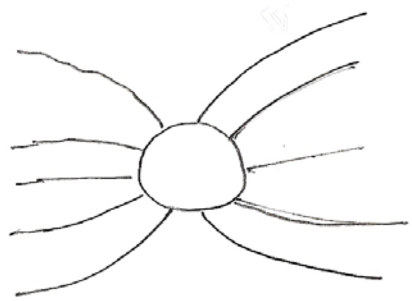
There is one last factor of two needed. For a point charge in a field a force is exerted on both sides of the electron or proton, attractive on one side and repulsive on the other side, so we must account for this factor of two.



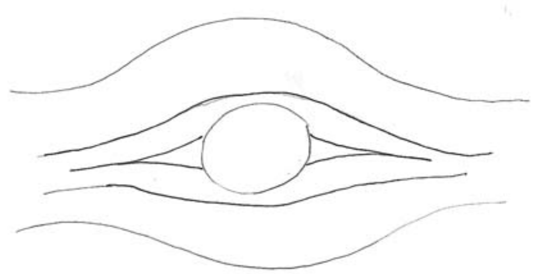
So the final equation with lensing on both sides is:

$$\frac{dN}{dt}_{F} = 2 \times 32 \frac{\pi \frac{r_B^2}{2^2}}{4\pi R^2} \frac{dN}{dt} \quad 6.17$$

Then the curvature of the foam is to increase the flux by a factor of 32 from each side.



It's interesting that the curvature of space due to the electric field for an electron and/or proton system gives rise to an exactly 32 amplification factor. We can see the quantity $32\frac{r_B^2}{2^2}$ must be constant so that $32\frac{r_B^2}{2^2} = (\text{lens amplification}) r_{\text{object}}^2$. Atoms and objects with larger radii and therefore lower electric field intensities at their surface curve space less and larger ions such as polonium even have the opposite effect on space, diffusing the conduction cone instead of magnifying it.



For the gravitational field interaction between two electrons or two protons the space curvature factor is $\frac{2}{\pi}$, less than one, so the field is diffused, as it is for the earth in the suns gravitational field.

We have seen three phenomena of the foam that are central to understanding fields at the microscopic level: capacitance, conductance and curvature. And now we know why Coulomb's Law is a $\frac{1}{R^2}$ force. All three phenomena are also at work in gravity.

In general for charge $q_2 = z_2 e$ with radius r_{z_2} in the field of charge $q_1 = z_1 e$ the following equation describes the interaction. This equation is true for any spherical charge configurations, from free electrons and free protons, to ions to any charged spherical conductors, the only requirement is that $R \gg r$. This is a remarkably general and profound result and the derivation and meaning should be transparent.

$$\frac{dN}{dt}_F = 2\left(32\frac{z_2}{z_1}\right)\frac{\pi r_{z_2}^2}{4\pi R^2} z_1^2 \frac{dN}{dt}_{6.17}$$

Free electrons and free protons

Electrons and protons are liquid state thin shell spheres surrounded by electric fields. Free electrons and free protons are single plate spherical capacitors. The electric field surrounding free electrons and free protons are identical except for the direction of the electric field. The energy in the fields is given by Gauss's Law for the electric field. The energy stored in the electric field of a free electron or free proton defined by the elementary quantum of charge e and the radius is:

$$U = \frac{e^2}{8\pi\varepsilon_0(2.645\times10^{-11}\mathrm{m})} = 27.2\mathrm{eV}$$

The thickness of the thin shell spherical electrons and protons is so small it can be assumed for most purposes to be zero, but that of course would be impossible. The electrons and protons are maintained at one half the Bohr radius because there is a balance of forces on their surfaces at that radius and there are restoring forces to that radius that arise when a convex or concave deformation develops in the surface of an electron or proton. There also must be a deeper reason why the radius is chosen but I don't know what it is. The mass of free electrons and free protons is 27.2 eV less than the rest masses. I call this a mass defect from rest mass and it is an important concept. Then the total mass of particle plus field in both systems is the rest mass. In free electrons and free protons the electric field is only on one side of the thin shell sphere, the outside surface. The inside surface is a surface without an electric field adjacent to it, a surface without charge.

The mass defect

When an electron shrinks in radius the flux increases according to Gauss's Law up until the Bohr radius where it is maxed out. When an electron shrinks further the flux remains constant and a mass defect appears. A mass defect means the mass of the electron is less than the rest mass. So a free electron and free proton have the same flux as an electron at the Bohr radius in hydrogen and have a mass defect of 27.2 eV. The mass defect in the free electron and free proton is the same as the field energy. I don't know why. In hydrogen the proton has a mass defect of 6.8 eV and in the $n=1$ state there is 6.8 eV stored in the electric field between the proton and the electron.

The mass defect gives rise to the **frustrated** force. In an electron at constant radius the **frustrated** and $-\nabla U$ forces are opposed and in competition. When in a free electron there is an inward indentation in the surface there is a small localized mass defect associated with that geometry and the **frustrated** force on that patch increases providing a restoring force. When there is an outward perturbation in the surface there is a small localized mass surplus associated with that geometry and the **frustrated** force decreases, allowing the somewhat constant $-\nabla U$ to provide the restoring force. This is the mechanism by which electrons and protons maintain constant radius so accounts for their geometric stability.

Free electrons: the N particle cycle in electrons

When an N particle as a point particle in an electric field strikes the surface of an electron at c it comes to a stop for an instant of time and exerts one quanta of momentum, p_N, as a repulsive force on the electron surface at the point of collision. I call this the **reception** force and will abbreviate it as **r**. Then the N particle expands from a small solid point-like particle to a growing membrane that accelerates at a constant rate until it coats the entire surface of the electron and is a sphere. When the leading edge reaches the point on the electron spherical surface opposite the collision point it has a velocity of πc. The average velocity on this expansion from point to sphere is $\frac{\pi c}{2}$. When the leading edge collides with itself at that point on the electron opposite the collision point it comes to stop for an instant of time and two quanta of momentum are imparted to the surface of the electron at that point and in the direction of the electric field so this is an attractive force. I call this attractive force $q\mathbf{E}$. Then the spherical N particle reverses direction and accelerates at a constant rate back to the point of collision, un-coating the electron, going from sphere back to point. When the receding edge reaches the collision point on the electron surface it has a velocity of πc and becomes a point particle again. The average velocity on this recession from sphere to point is $\frac{\pi c}{2}$. Then the point N particle is emitted from the initial point of collision in the electric field orientation at c and one quanta of repulsive force is applied to the electron surface at the point of emission. I call this the **emission** force and abbreviate it as **e**.

The net force on the electron, the simple vector sum of these three forces, from this cycle is zero:

$$q\mathbf{E} = -(\mathbf{r} + \mathbf{e})$$

Since the radii of all electrons are known and the average velocity is known we know how much time the N particle spends coating and un-coating electrons in this cycle. Now I said the N particle came to a stop for an instant in time when it collided with the electron and came to a stop again for an instant in time when it un-coated the electron and again became a point particle. Actually it spends a small interval of time as a point particle, not an instant.

Now this is the damnedest thing in all of physics! In a free electron with a radius of 2.645×10^{-11} m the N particle spends $\frac{1}{137.0359997^2}$ of that cycle time as a point and $1-\frac{1}{137.0359997^2}$ of that cycle time as a growing and shrinking dynamic membrane.

This is the reason or is the important factor that determines the energy stored in the electric field of a free electron is $\frac{1}{137.0359997^2}\times E_e$ where E_e is the rest energy of a free electron. The foam in the field also plays a role

$$\frac{1}{137.0359997^2}\times E_e = 27.2 \text{ eV}$$

Deriving the N particle flux from first principles

Observing this time meaning of the fine structure constant means we can calculate the flux of N particles by electrons from first principles. The flux can be expressed in N particle flux $\frac{dN}{dt}$ or Watts $e_N \frac{dN}{dt}$.

The time period of one complete N particle cycle in a sphere with radius R is:

$$\triangle t = \frac{2\pi R}{\frac{\pi c}{2}}$$

For an electron in hydrogen at the Bohr radius the time interval is:

$$\triangle t = \frac{2\pi\times5.29\times10^{-11}\text{m}}{\frac{\pi c}{2}} = 7.05\times10^{-19}\text{s}$$

There are 3.053×10^{40} N particles in an electron. Then in one second there are a total number of cycles of $4.33\times10^{58}\frac{\text{particle cycles}}{\text{s}} = \frac{3.053\times10^{40}}{7.05\times10^{-19}\text{s}}$ in an electron at the Bohr radius. In each complete cycle there is one reception and one emission event. So we have to put a factor of two in front of this equation to account this.

$$2\times4.33\times10^{58}\frac{\text{particle cycles}}{\text{s}} = 8.66\times10^{59}\frac{\text{emission} + \text{reception events}}{\text{s}}$$

Divide that by the fine structure constant squared to get to the flux. Therefore the flux of emission plus reception for an electron at the Bohr radius is:

$$\frac{dN}{dt}=\frac{\frac{\frac{2\times 3.05\times 10^{40}}{2\pi r_B}}{\frac{\pi c}{2}}}{137.036^2}=4.607\times 10^{54}\frac{N}{s}$$

The last modification that needs to be made is to put the factor $\frac{R}{r_B}$ in the denominator in front of the fine structure constant. This makes the equation general for any sphere of radius R. It means the N particle spends $\frac{1}{137.0359997^2}$ of the time as a point particle whatever the radius.

$$\frac{dN}{dt}=\frac{\frac{\frac{2\times 3.05\times 10^{40}}{2\pi R}}{\frac{\pi c}{2}}}{\frac{R}{r_B}137.036^2}$$

In atoms with a single outer electron at different radii AND in macroscopic spherical capacitors[3] with a single electron on the negative plate this equation applies.

This treatment can be extended to systems with more than one electron in a simple way.

Free electrons require a small modification of this formula. A free electron should have four times the flux of an electron at the Bohr radius. But the total power of emission plus reception flux by an electron at 2.645×10^{-11}m is the same at $e_N\frac{dN}{dt}=12.34W$. The mass defect is what's going on. When an electron or proton has a mass defect the flux decreases from the value predicted by Gauss's Law. For the free electron and free proton it reduces the flux by the factor $\frac{1}{4}$. So we must multiply the flux calculated by the above general equation by this factor for free electrons.

$$\frac{dN}{dt}=\frac{1}{4}\times\frac{\frac{\frac{2\times 3.05\times 10^{40}}{2\pi\frac{r_B}{2}}}{\frac{\pi c}{2}}}{\frac{\frac{r_B}{2}}{r_B}137.036^2}$$

[3] On all macroscopic capacitor plates the electrons are stretched out as membranes over the entire plate and therefore have the area of the plate. This means electrons can have macroscopic sized areas. Here we are talking about a plate with only one electron on it.

Deriving the power from energy and time

Since we can easily calculate the power of emission plus reception in atoms and parallel plate capacitors it is easy to verify these results. The energy in the electronic space of atoms is given by:

$$U = \frac{(q \times 1.602 \times 10^{-19})^2 (R_o - \frac{r_B}{2})}{8\pi\varepsilon_0 R_o^2}$$

Where R_o is the outer radius.

The time period in which the entire energy in that field is turned over once is:

$$\triangle t = \frac{R_o - \frac{r_B}{2}}{c}$$

Then the power of emission plus reception is:

$$\frac{dE}{dt} = \frac{U}{\triangle t}$$

For hydrogen in the $n = 1$ quantum state $U = 6.799$ eV and $\triangle t = 8.817 \times 10^{-20}$s so:

$$\frac{dE}{dt} = 12.34\text{W}$$

In macroscopic spherical capacitors the flux on the inner plate is higher than the flux on the outer plate so we can not determine the power of the plate by dividing energy stored in the spherical capacitor by the replacement interval. This is due to the capacitance property of the foam. The same is true for free electrons where the flux of the "outer" plate, at infinity, is 0. The power of any capacitor plate, microscopic or macroscopic, including free electrons and protons, can be determined from the force on the plate simply by multiplying the force by c:

$$\frac{dE}{dt} = cF = cp_N \frac{dN}{dt}$$

This calculation for free electrons and macroscopic capacitors, using the force on capacitor plates that is $F = -\nabla U = \frac{q\mathbf{E}}{2}$ where U is defined using Gauss's Law, agrees perfectly with that predicted from first principles using the fine structure constant.

Proof of the N particle model

The perfect quantitative agreement between calculating the N particle flux by using the fine structure constant and calculating the power using the energy in the field and the replacement time interval is physical proof of the validity of this model of the electron. This is mathematically proven by setting equal the total power of emission plus reception calculated these two separate ways and seeing this reduces to the fine structure constant identity. Here I use the power expression for atoms but the power expression for macroscopic capacitors could equally well be used and give the same result:

$$\frac{\dfrac{2\times e_N\times 3.053\times 10^{40}}{\dfrac{2\pi R_o}{\dfrac{\pi c}{2}}}}{\dfrac{R_o}{r_B}\times 137.036^2}=\frac{\dfrac{(1.602\times 10^{-19})^2\left(R_o-\dfrac{r_B}{2}\right)}{8\pi\varepsilon_0 R_o^2}}{\dfrac{R_o-\dfrac{r_B}{2}}{c}}$$

Cancel terms and viola:

$$\frac{1}{137.0359997}=\frac{e}{2c\sqrt{\pi\varepsilon_0 m_e r_B}}$$

And since $r_B=\dfrac{4\pi\varepsilon_0\hbar^2}{m_e e^2}$ this reduces to the standard definition of the fine structure constant:

$$\frac{1}{137.0359997}=\frac{e^2}{4\pi\varepsilon_0\hbar c}$$

The fundamental forces

There are I think precisely eleven fundamental forces that arise on electrons, quarks and protons due to interaction with electric and magnetic vectors of the N particles they emit or receive. Remember a force is a flux associated with the flux density vector field for force, a pressure vector field defined on the surface of electrons, quarks and protons.

1. **emission**
2. **reception**
3. $\mathbf{F}=q\mathbf{E}$
4. $\mathbf{F}=q\mathbf{v}\times\mathbf{B}$ where $\times$ is the cross product
5. $\mathbf{F}=q\mathbf{v}\times\dfrac{\mathbf{E}}{c}$
6. $\mathbf{F}=qc\mathbf{B}$
7. $\mathbf{F}=-\nabla U_{\text{Electric}}$
8. $\mathbf{F}=-\nabla U_{\text{Magnetic}}$
9. $\mathbf{F}=-\nabla U_{\text{Gravity}}$
10. **frustrated**
11. **The centrifugal force** $=m\dfrac{v^2}{R}$

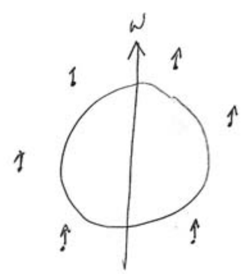
The e**mission** force and the **reception** force are associated with every emission and reception event of every point N particle by electrons, quarks and protons and these forces are applied to the surface of electrons, quarks and protons at the point of emission and reception. The magnitude of force associated with a single emission or reception event is the quantum of momentum of the N particle. These are always repulsive forces, into the surface of the electron, quarks or proton. They are due to the conservation of momentum and Newton's Third Law.

Later in this paper I introduce a treatment of the $q\mathbf{E}$ force from first principles. In capacitors the $q\mathbf{E}$ force is always attractive and is always equal in magnitude and opposite in direction to **emission** plus **reception** so the total force due to $q\mathbf{E}$, **emission** and **reception** is zero:

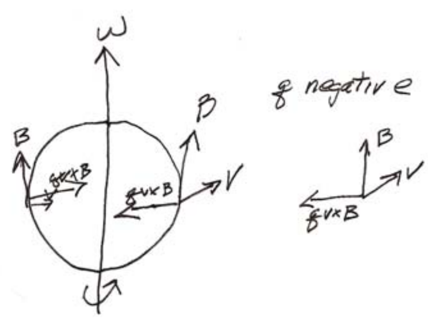
$$q\mathbf{E} = -(\mathbf{emission} + \mathbf{reception})$$

note these are vectors ergo the minus sign

A spinning electron, quark or proton emits N particles as a magnetic field in all directions equally with the $\mathbf{B}$ vectors parallel to the spin angular velocity for electrons and anti-parallel to the spin axis for protons so this is an electron.



$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$ arises in spinning electrons, quarks and protons. The $q\mathbf{v} \times \mathbf{B}$ force provides the centripetal force necessary to keep the electron, quark or proton at constant radius instead of bulging at the equator due to centrifugal forces.



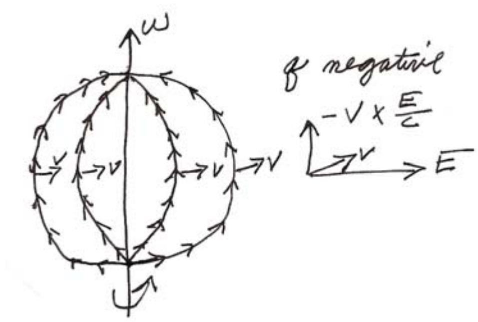
A spinning electron, quark or proton has a centrifugal force on it given by $m\frac{\mathbf{v}^2}{r}$. By setting $q\mathbf{v}\times\mathbf{B}$ equal to $m\frac{\mathbf{v}^2}{r}$ the relationship between the magnitude of the magnetic field at the electron, quark or proton surface and the angular velocity is derived:

$$\mathbf{B} = \pm\sqrt{\frac{m\mu_0 c\vec{\omega}}{4\pi R^2}}$$

B is in the direction $\vec{\omega}$ for electrons and in the direction of $-\vec{\omega}$ for protons.

$\mathbf{F} = q\mathbf{v}\times\frac{\mathbf{E}}{c}$ also arises in spinning electrons, quarks and protons and gives rise to emission of $\mathbf{E}\times\mathbf{B}\,\|\,\mathbf{v}$ N particles on the right hand end of the axis of a spinning electron or quark. $\mathbf{E}\times\mathbf{B}\,\|\,\mathbf{v}$ arises in covalent chemical bonds, mechanical forces, electricity and circuit generated electromagnetic radiation in addition to photons and gravitons.

The $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ force is the most important and interesting in Nature. Since the force is distributed over the surface of a spinning electron, quark or proton the force is the flux of a pressure vector field defined on those surfaces: $\text{pressure} = \frac{dF}{dA} = \rho_E\mathbf{v}\times\frac{\mathbf{E}}{c}$ where the surface charge density $\rho_E = \frac{q}{4\pi r^2}$. The electric field is normal to the surface and the velocity vector field associated with the angular velocity simply described this pressure vector field starts at one axis and grows along arcs parallel to the axis of revolution, like the slices in an orange.



The effect associated with the cause of this force is emission of the N particle as a point particle at one end of the axis, normal to the surface and at c. Repeated emission in a period of time results in photons. Of course a photon is a linear collection of N particles translating on a line.

Photons, gravity, mechanical forces, covalent bonds, electricity and circuit generated EM radiation all use the $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ force. All involve emission and reception of N particles on one end of the spin axis of an electron, quark or proton.

Mechanical forces flow through solids elastically. Every atom in a solid is affected and these forces fill mechanical conductors at c and transmit at c. They use the $\mathrm{q}\mathbf{v}\times\frac{\mathbf{E}}{\mathrm{c}}$ force. I have not studied them in much detail.

$\mathbf{F}=\mathrm{qc}\mathbf{B}$ is an attractive force analogous to $\mathrm{q}\mathbf{E}$ except with respect to the exchange of N particles as magnetic fields. Like $\mathrm{q}\mathbf{E}$ this force is equal in magnitude and opposite in direction to **emission** plus **reception** so the total force due to $\mathrm{qc}\mathbf{B}$, **emission** and **reception** is zero.

$$\mathrm{qc}\mathbf{B}=-(\mathbf{emission}+\mathbf{reception})$$

The $-\nabla\mathrm{U}$ forces exist when an electron or proton surface is adjacent to an electric, magnetic or gravity field and can move and the force is in the direction in which the field energy is maximally decreasing.

$\mathbf{F}=-\nabla\mathrm{U}_{\mathrm{Electric}}$ arises on the electron and proton due to electric fields defined on it's surfaces. To calculate this force we determine U as a function of the size, shape and charge and take the gradient of the field energy.

$\mathbf{F}=-\nabla\mathrm{U}_{\mathrm{Magnetic}}$ characterizes the attractive force between N and S magnet poles.

$\mathbf{F}=-\nabla\mathrm{U}_{\mathrm{Gravity}}$ arises on atoms in gravity fields. This is always an attractive force.

frustrated is a force I hypothesize to explain the stability of electrons, quarks and protons at their radii. It and $-\nabla\mathrm{U}_{\mathrm{Electric}}$ are the only two forces on electrons, quarks and protons since $\mathrm{q}\mathbf{E}=-(\mathbf{emission}+\mathbf{reception})$. **frustrated** arises on electrons and protons that have a mass defect or when and where a small mass defect arises. The mass defect is discussed later in this paper. **frustrated** is always a repulsive force. The radii of all electrons, quarks and protons is determined and maintained by the interaction of **frustrated** and $-\nabla\mathrm{U}_{\mathrm{Electric}}$ that point in opposite directions. In a free electron or free proton $-\nabla\mathrm{U}_{\mathrm{Electric}}$ points radial out and **frustrated** radial in.

$$-\nabla\mathrm{U}_{\mathrm{Electric}}=-\mathbf{frustrated}$$

When electrons, quarks and protons are distorted from simple spherical symmetry the balance of **frustrated** and $-\nabla\mathrm{U}_{\mathrm{Electric}}$ provide the restoring forces.

$$\textbf{The centrifugal force}=\mathrm{m}\frac{\mathrm{v}^2}{\mathrm{R}}$$

When an electron, quark or proton spins on its axis a centrifugal force is generated. This force is radial out on the thin shell spherical electron, quark or proton.

Electrons, quarks and protons remain in motion or change their state of motion as a result of the sum of these eleven forces. The balance of these eleven forces is the **Arrow of Time**.

All capacitors

Hydrogen, neutrons and atoms are simple spherical capacitors with an electron or stack of electrons as the outer, negative plate and a proton or stack of protons as the inner, positive plate. A stack is simply several thin shell spherical electrons or protons very close together, actually touching, at approximately the same radius. A hydrogen atom in the $n = 1$ quantum state is an electron on the outside at a radius of $5.29 \times 10^{-11}\,\mathrm{m}$ and a proton on the inside at a radius of $2.645 \times 10^{-11}\,\mathrm{m}$. I call the annular space between plates the electronic space of an atom. The electronic space is where the electric field is in atoms. A neutron is a proton on the outside at a radius of $\frac{5.29 \times 10^{-11}\,\mathrm{m}}{1836.15}$ and an electron on the inside at a radius of $\frac{2.645 \times 10^{-11}\,\mathrm{m}}{1836.15}$. In deuterium the neutron is trapped inside the annular space of the proton and for most purposes can be ignored.

Quarks

I define a quark as an integer fraction of an electron with integer fraction mass, integer fraction volume and integer fraction charge.[4] Are quarks important? Well chemistry is a quark dance. Quarks only occur inside atoms and are never seen alone.

Only four phenomena

Electrons and protons in atoms and neutrons can only undergo four transformations or exhibit four phenomena:

1. Be turned inside out.
2. Divide into integer fractional pieces or recombine back into one piece from fractional pieces.
3. Change radius.
4. Spin.

Electrons and protons can be turned inside out. I call a free electron or proton facing out because that is the direction in which the electric field is in. In hydrogen the electron has been turned inside out and I call that configuration facing in because that is the direction the electric field is in. In hydrogen the proton is facing out. In a neutron the proton has been turned inside out and I also call that configuration facing in because that is the direction the electric field is in. In a neutron the electron is facing out.

Inside atoms valence electrons can divide into an integer number of equal sized parts that are concentric thin shell spheres. I have named these fractional parts quarks. Each quark is an integer fraction of an electron. Quarks have integer fraction charge and integer fraction mass. Quarks can recombine to go back to an electron. The number of quarks a valence electron in an atom divides into is the principal quantum number in my quantum mechanics. I label this quantum number n where $n = 1, 2, 3, \ldots$. In neutrons the proton can also divide into quarks and recombine back into a proton

[4] Murray Gell-Mann hypothesized “quarks” as parts of protons and neutrons with a nod to James Joyce, whose novel *Finnegan's Wake* contains the passage: “Three quarks for Muster Mark!” My quarks are like Murray Gell-Mann’s quarks in that they have fractional charge, are never seen alone, existing only inside atoms and nuclei, and have a natural description as up, down, top and bottom. I could not come up with as good a term as James Joyce and Murray Gell-Mann so I’ll put their term to good use.

Electrons, protons and quarks can change radius. There are two radii possible: up and down. Up means at the outer radius of the atom that I label R_o. H is the smallest atom with $R_o = 0.529Å$ and Po is the largest at $R_o = 2.734Å$. A valence number of electrons are at the up radius in $n = 1$ quantum state atoms. The valence electrons divide into quarks at R_o. Down means at the inner radius that I label R_i. In all atoms $R_i = 2.645^{-11}m$. In all atoms there is an atomic number of protons in a stack at R_i. On top those protons are electrons where the number of electrons is the atomic number minus the number of valence electrons. And on top of the electrons are the down quarks. I call this stack of protons, electrons and quarks that is positively charged on its surface the nucleus. The mass of electrons and quarks at R_o is the rest mass. The mass of electrons, protons and quarks in the nucleus at $R_i = 2.645^{-11}m$ is less than the rest mass and due to the mass defect.

Electrons, protons and quarks can spin on an axis. When they do this they maintain spherical symmetry due to the magnetic field force. They are just thin shell spheres spinning.

Electrons and quarks can only be up or down. In a stack there is a top and bottom. There is a stack at $2.645^{-11}m$, the nucleus, the down stack and a stack at R_o, the up stack. The top in the stack is the electron or quark adjacent to the annular space. The bottom in the stack is the electron or quark at the other end, the one most removed from the annular space.

The quantum numbers

There are two quantum numbers and two quantum vectors associated with each valence electron: n, l, $\mathbf{m}_l$ and $\mathbf{m}_s$.

1. $n = 1,2,3,...$, the principal quantum number, is simply the number of quarks an electron divides into. In all of biological chemistry almost all atoms are in the $n = 2$ quantum state.
2. $l = 1,2,3,...,n-1$ is the number of down quarks.
3. $\mathbf{m}_l$ is a vector that represents the quantum of angular momentum of a spinning down quark at $R_i = 2.645^{-11}m$.
4. $\mathbf{m}_s$ is a vector that represents the quantum of angular momentum of a spinning up quark at R_o.

For non-bonded atoms that have perfect spherical symmetry these four quantum numbers fully define electrons and quarks.

H and H_2: the picture and an introduction to the quantum mechanics

Atoms are in steady states between photon emission and absorption processes. Photon emission and absorption processes are transitions between steady states. Photon emission and absorption take place over an interval or period of time $T=\frac{1}{\nu}$. The picture of the steady states of atoms is simple. All atoms in steady states are collections of thin shell electrons, quarks and protons. All the thin shell spherical electrons, quarks and protons in an atom have a common center point – they are concentric. In the steady state the only motion of the thin shell spheres that is allowed is angular motion, the thin shell spheres can spin on an axis. In the steady state the set of radii of the collection of thin shell spheres is constant. Specifying the radii and spins of the thin shell spheres fully describes the atom. My quantum mechanics has quantum numbers and quantum vectors. My quantum numbers describe the number of thin shell spheres and their relative radii. My quantum vectors are angular momentum vectors for spinning thin shell spherical electrons, quarks and protons.

A hydrogen atom in the $n=1$ quantum state is a spherical capacitor with a proton, a thin shell sphere facing out, with a radius of $R_i = 2.645\times10^{-11}\,\mathrm{m}$, as the inner plate, and an electron, a thin shell sphere, facing in, with a radius of $R_o = 5.29\times10^{-11}\,\mathrm{m}$, as the outer plate. The thickness of the thin shell spherical electrons, quarks and protons can be approximated as zero. In my theory of the atom the $n=1$ quantum state is the highest energy state, the opposite of conventional quantum mechanics, where the $n=1$ quantum state is the lowest energy state available to the atom. A classical spherical capacitor with these dimensions and charge would, using Gauss's Law, store $13.6\ \mathrm{eV}$ of energy in the electric field between the plates. The hydrogen atom, in the $n=1$ quantum state, actually stores $6.8\ \mathrm{eV}$ of energy in the electric field between the plates.

The electron in hydrogen is not stable in this $n=1$ quantum state. The electron is not in a low energy well but rather is on top of a high energy hill. What the electron does in response to this instability is at the heart of the quantum phenomenon of the atom. The electron splits into n equal size thin shell spheres that are concentric and at close to the same radius. I call these electron parts quarks. They have fractional charge $q=\frac{1}{n}e$, where n is a positive integer and $e=-1.6\times10^{-19}\mathrm{C}$. The undivided electron, $n=1$, has one part or one quark. I call this process n-ary fission. I am not sure how this fission occurs.

The first step in a quantum transition is the division of the electron into *n* quarks. This step occurs fast on the time scale of the time period of a photon $T=\frac{1}{\nu}$. The number of parts an electron divides into through an *n*-ary fission process, that is the number of quarks, n, is the first quantum number in my quantum mechanics. $n=1,2,3,\ldots$

Consider a configuration of hydrogen where there are n quarks at R_o. They are not at precisely the same radius but are in a stack at radii very close to R_o. I will refer to these as up quarks. The inner $n-1$ quarks are not stable at that radius. In a hydrogen atom in the second step of a quantum transition the inner $n-1$ quarks "shrink" down in size until they are at R_i. In the process a photon is emitted. Not only can the quark spin but the proton can spin also. The quark and proton intermediates in this shrinking process have angular velocity. The photon is emitted from one end of the axis of the spinning intermediates. Energy, the N particle, flows out of the electric field and into the shrinking quark. The N particle flows though the quark to one end of the axis and then is emitted as a one dimensional stream of the N particle, a photon. The shrinking process is governed by a force and torque balance. The key force in photon production is $\mathbf{F} = q\mathbf{v}\times\frac{\mathbf{E}}{c}$. The shrinking process takes $T=\frac{1}{\nu}$ seconds, the time period of emission of a photon.

When a quark has shrunk all the way to R_i I will refer to it as a down quark. The number of down quarks I will refer to with the letter l. It is the second quantum number in my quantum mechanics. In hydrogen all $n-1$ inner quarks shrink to R_i. So for hydrogen, the l quantum number, the number of down quarks, equals $n-1$.

The third quantum descriptor is a vector set. In atoms and molecules down quarks are usually in a steady state of angular velocity. The set of angular momentum vectors for these spinning down quarks is my third quantum descriptor. I will refer to the angular momentum vector of a down quark as $\mathbf{m}_l$. $\mathbf{m}_l$ can be the zero vector if a quark is not spinning. In hydrogen there are $n-1$ down quarks and one $\mathbf{m}_l$ vector for each quark so there are $n-1$ vectors in the set of $\mathbf{m}_l$ vectors associated with the electron down quarks. In the hydrogen steady states the down quarks do not spin, i.e. $\mathbf{m}_l$ is the zero vector for all down quarks. In hydrogen during transitions between steady states when the inner $n-1$ quarks have angular velocity the inner quarks all have the same angular velocity in both direction and magnitude. They move as one.

The fourth quantum descriptor is also a vector. In atoms and molecules up quarks may be spinning and then have an angular momentum vector. This vector is my fourth quantum descriptor. I will refer to this vector as $\mathbf{m}_s$. $\mathbf{m}_s$ can be the zero vector if an up quark is not spinning. There is only one up quark in a steady state configuration of hydrogen so there is only one $\mathbf{m}_s$ vector. In the hydrogen atom steady states the up quark does not spin, $\mathbf{m}_s$ is the zero vector.

In summary, the two quantum numbers, vector set, and vector associated with an electron in hydrogen are:

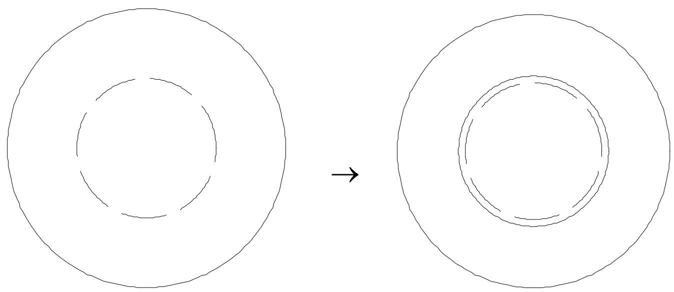
1. The number of quarks n, $n=1,2,3,\ldots$.
2. The number of down quarks l, $l=n-1$.
3. The angular momentum vector set for down quarks composed of $n-1$ $\mathbf{m}_l$ vectors.
4. The angular momentum vector for the one up quark $\mathbf{m}_s$.

These four quantum numbers and vectors give a description of the steady state configurations of the hydrogen electron.

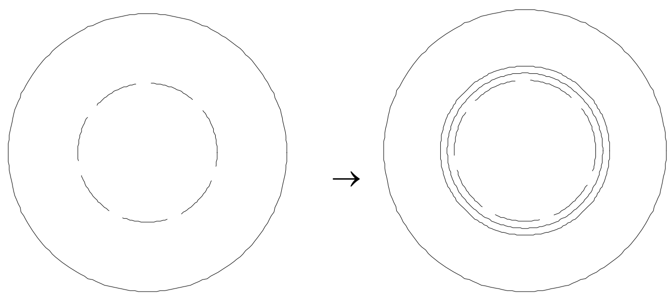
During transitions between steady states, time intervals of photon emission and absorption, the proton has angular momentum. The proton spin vector is an additional quantum descriptor. I will refer to its angular momentum as vector $\mathbf{m}_{proton}$. In steady states the proton of the hydrogen atom does not spin. $\mathbf{m}_{proton}$ is the zero vector. With the inclusion of the proton spin quantum vector the quantum description of the hydrogen atom is complete.

Consider a transition from the $n=1$ quantum state to the $n=2$ and $l=1$ quantum state. Each quark has fractional charge $q=\frac{1}{n}e$. The magnitude of charge on the outer surface of the down quark and on the inner surface of the up quark is $\frac{1}{2}e$. The potential energy, U, stored in a classical spherical capacitor according to Gauss's Law is $U=\frac{q^2}{8\pi\varepsilon_0}\left(\frac{1}{R_i}-\frac{1}{R_o}\right)$. Due to there being no foam in atoms the N particle flux is constant at all radii. The $n=1$ state according to Gauss's Law stores 13.6 eV. The energy stored in the electric field for a classic spherical capacitor with the dimensions and charge of the $n=2$ and $l=1$ hydrogen quantum state is $\frac{13.6\text{ eV}}{4}$. The difference in energy, 10.2 eV, is emitted as a photon. Consider a transition from the $n=1$ quantum state to the $n=3$ and $l=2$ quantum state. The magnitude of charge on the outer surface of the down quark adjacent to the cavity and on the inner surface of the up quark is $\frac{1}{3}e$.

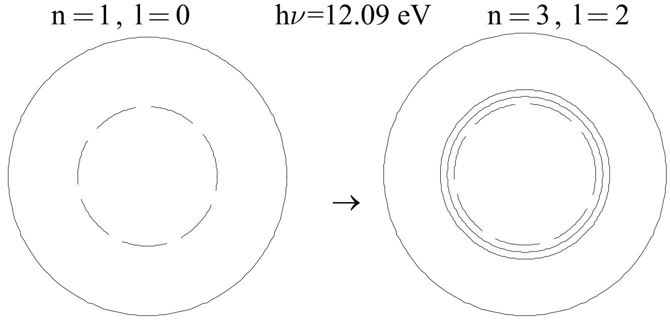
The n=1 state according to Gauss's Law stores 13.6 eV. The energy stored in the electric field for a classical spherical capacitor with the dimensions and charge of the n=3 and l=2 hydrogen quantum state is $\frac{13.6\text{ eV}}{9}$. The difference in energy, 12.09 eV, is emitted as a photon. As n goes to infinity the energy of the emitted photon goes to 13.6 eV. These transitions from n=1 to $n = 2,3,4,\ldots$ represent the Lyman (ultraviolet) series of the line spectra of hydrogen. The following graphs represent the initial and final steady states surrounding the quantum transitions associated with the first three lines of the Lyman series. The electron and quarks are solid lines. The proton is a dashed line. The graphs cannot be drawn to scale, if they where you would not be able to see any of the lines, they would be too thin. The down quarks and the proton should be at very close to the same radius. The energy of the emitted photon that accompanies the quantum transition is included.



$n = 1$, $l = 0$ $\quad$ $h\nu$=10.20 eV $\quad$ $n = 2$, $l = 1$

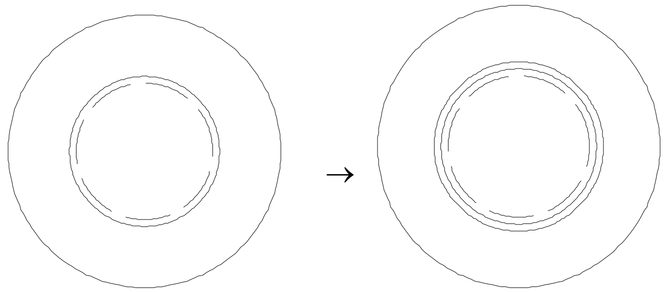


$n = 1$, $l = 0$ $\quad$ $h\nu$=12.09 eV $\quad$ $n = 3$, $l = 2$

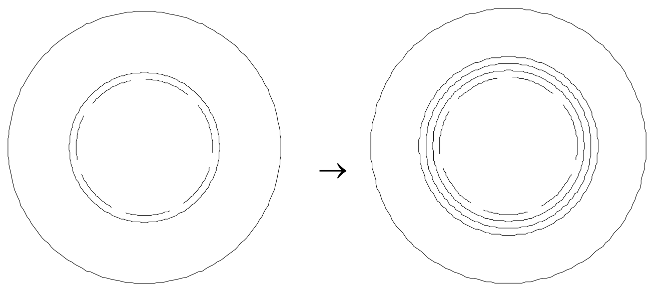


$n = 1$, $l = 0$ $\quad$ $h\nu$=12.75 eV $\quad$ $n = 4$, $l = 3$

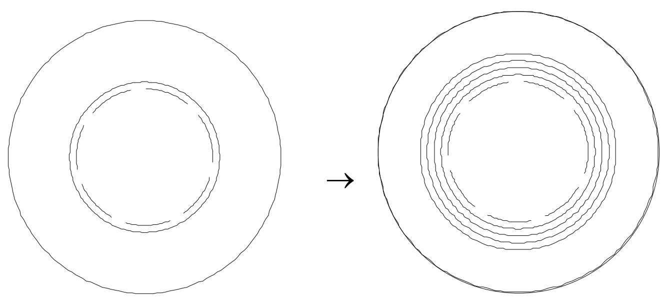
The Balmer (visible) series are transitions whose starting quantum state is n=2 and l=1. Transitions are to $n = 3,4,5,\ldots$ quantum states. The following graphs represent the initial and final steady states surrounding the quantum transitions associated with the first three lines of the Balmer series.



$n=2\,,\ l=1$ $\quad h\nu=1.89$ eV $\quad n=3\,,\ l=2$

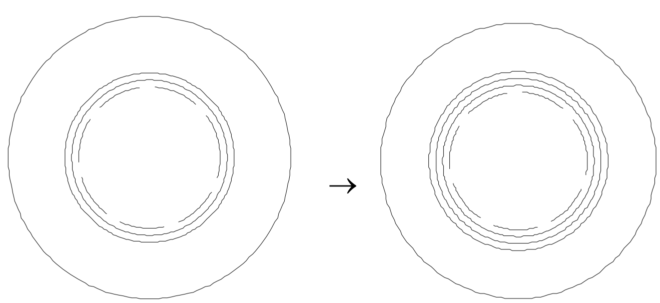


$n=2\,,\ l=1$ $\quad h\nu=2.55$ eV $\quad n=4\,,\ l=3$

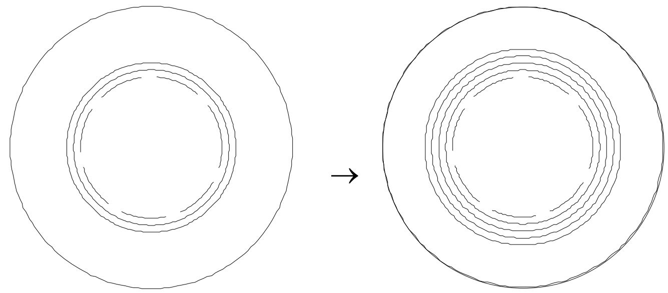


$n=2\,,\ l=1$ $\quad h\nu=2.86$ eV $\quad n=5\,,\ l=4$

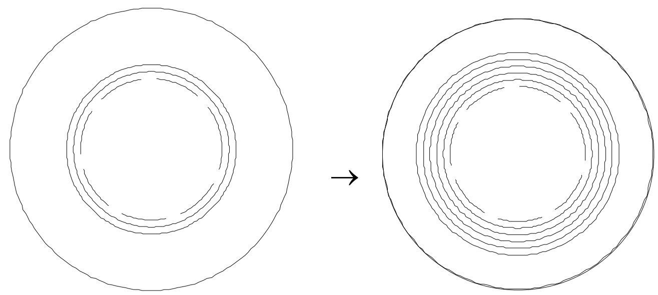
The Paschen (infrared) series are transitions whose starting quantum state is $n=3$ and $l=2$. Transitions are to $n=4,5,6,\ldots$ quantum states. The following graphs represent the initial and final steady states surrounding the quantum transitions associated with the first three lines of the Paschen series.



$n=3\,,\ l=2$ $\quad h\nu=0.66$ eV $\quad n=4\,,\ l=3$

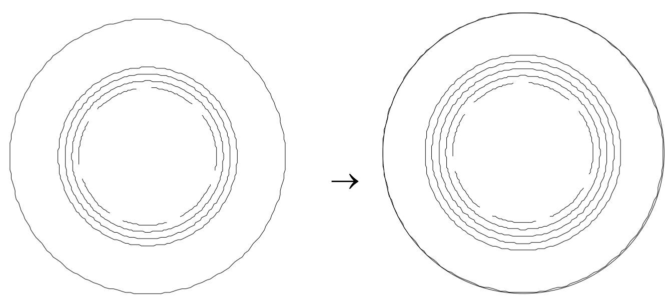


n = 3 , l = 2 $h\nu$=0.97 eV n = 5 , l = 4

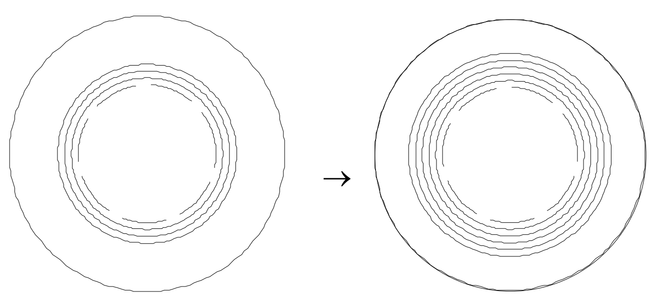


n = 3 , l = 2 $h\nu$=1.13 eV n = 6 , l = 5

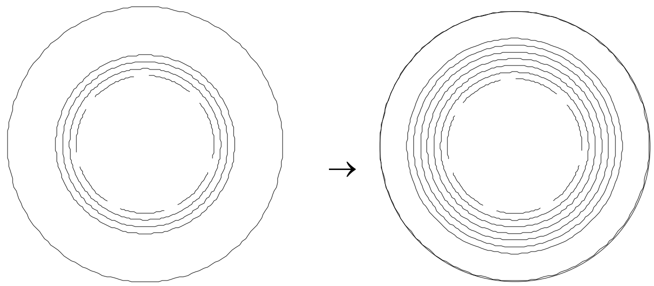
The Brackett (infrared) series are transitions whose starting quantum state is $n=4$ and $l=3$. Transitions are to $n = 5,6,7,\ldots$ quantum states. The following graphs represent the initial and final steady states surrounding the quantum transitions associated with the first three lines of the Brackett series.



n = 4 , l = 3 $h\nu$=0.31 eV n = 5 , l = 4



n = 4 , l = 3 $h\nu$=0.47 eV n = 6 , l = 5

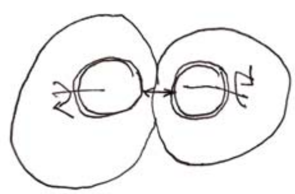


$n = 4$, $l = 3$ $\qquad h\nu$=0.57 eV $\qquad n = 7$, $l = 6$

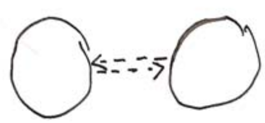
Similarly for the Pfund (infrared) series of the spectra of hydrogen.

The description of the hydrogen molecule depends intimately on the quantum mechanical description of the hydrogen atom. Consider pushing together a pair of hydrogen atoms in the n=2 and l=1 quantum state. The shape of the up quarks is no longer just spherical in the hydrogen molecule. Push the two atoms together so that up quarks distort and there is a flat circular area of each up quark facing each other, touching, at the midpoint of the bond, and the rest of the up quark is roughly spherical. The two up quarks push against each other, in the interface cross-section there are two opposing pressure vector fields. Space filling models give a good picture of the molecule. The down quark and the proton are still spherical.

In this simplest covalent bond both atoms are in the $n = 2$, $l = 1$ quantum state. Both quarks are spinning with their spins opposed, head to head. Each is emitting a stream of N particles in the $\mathbf{E}\times\mathbf{B}$ orientation aimed right at the axis of the opposing quark. There is a steady state of spin and N particle emission and reception. The net result of this, via the $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ force, is an attraction between the spinning quarks that pulls the atoms close together so their surfaces are deformed as they press together. The protons are spinning too, in the opposite direction, so that in each atom the sum of angular momentum is zero.



Each quark is emitting and receiving a linear stream of N particles and the N particle is so small that even in this configuration they do not collide, or at least I don't think they do. Real mathematical points would never collide because the cross-sectional area is zero.



In the covalently bound molecule the down quarks and protons of both atoms in the molecule are in a steady state of angular motion. The angular momentum vectors for the down quarks oppose each other. The angular momentum vector for one down quark is $\mathbf{m}_1$ and for the other it is $-\mathbf{m}_1$. They are anti-parallel and on the center to center vectors that describes the bond, they are head to head on the line between the atom centers. They point at each other. The protons are spinning in the opposite direction of the down quarks. The two proton spins in the hydrogen molecule point in opposite directions, both away from the bond. The angular velocity of the proton relative to the down quark is proportional to the inverse of the mass ratio. $\frac{\omega_{\text{quark}}}{\omega_{\text{proton}}} = \frac{\text{mass}_{\text{proton}}}{\text{mass}_{\text{quark}}}$. For the n=2 and l=1 quark this ratio is $\frac{1836}{1/2}$. Because of this the total angular momentum in each atom is zero. If each thin shell spherical electron, quark and proton in an atom has angular momentum $\mathbf{l}_i$, then in an atom with *k* shells $\sum_{i=1}^{k} \mathbf{l}_i = \vec{0}$. This is a very important principle of quantum mechanics. The periodic table is filled by geometric arrangements of $\mathbf{l}_i$ for down quarks of valence electrons and the nucleus such that the vector sum is zero. In this case for hydrogen atoms in a hydrogen molecule the angular momentum of the down quark is opposed in magnitude and direction by the angular momentum of the proton. $\mathbf{m}_{\text{proton}} + \mathbf{m}_l = \vec{0}$.

There is a magnetic field with very little volume, close to zero, between the spinning down quark and the spinning proton. The down quark and the proton are at next to the same radius, R_i. The magnetic field is confined to the inside of the down quark and the outside of the proton. I make the approximation that this magnetic field has zero volume and therefore there is zero energy stored in the field. There is no magnetic field on the outside of the down quark in the space between the down and the up quark. There is no magnetic field on the inside of the proton. The spins of the down quark and the proton are coupled through the magnetic field. Emission of a magnetic field by a thin shell spherical body or quark leads to a decelerating torque and a loss of angular momentum. Reception of a magnetic field leads to an accelerating torque and an increase in angular momentum. The net torque due to emission and reception is zero. This is a requirement for a steady state configuration. This is an important principle, spins must be paired. Angular momentum for spinning an individual electron, quarks or protons is not conserved, the momentum dissipates through emission of a magnetic field.

In a covalent chemical bond down quarks in each atom are spinning with their angular velocity vectors opposed and they are emitting a one dimensional stream of N particles, like a photon, along the axis and receiving a stream of N particles from the other quark. Like photons this stream has $\mathbf{E} \times \mathbf{B}$ parallel to the velocity vector for the N particle and on $-\vec{\omega}_{\text{quark}}$. Emission of a stream of N particles is on the LH end of the axis of a quark in matter and leads to loss of angular momentum of a quark. Reception of a stream of N particles at the LH end of the axis leads to an increase in angular momentum of a quark. In the steady state covalent bond there is a torque associated with emission of a stream that is balanced by a torque associated with reception of a stream. The net torque is zero. This is a requirement for a steady state configuration.

The periodic table

Higher atoms in the $n = 1$ quantum state are spherical capacitors with an atomic number of protons at 2.645^{-11}m in a stack, an atomic number of electrons minus the number of valence electrons are on top those protons and the valence number of electrons are in a stack at R_o. The net positive charge on the nucleus in an $n = 1$ atom is simply the sum of the charge of protons and down electrons that is the number of valence electrons.

All valence electrons in atoms at room temperature are in the $n = 2$ quantum state. This makes life very easy.

I will address the structure of the periodic table in a separate paper focusing on quantum chemistry.

The stack and charge

In the down stack at 2.645×10^{-11}m and up stack at R_o the bottom proton and the up bottom electron or quark have charge only on one side, that facing the annular space. All the rest of the electrons, quarks and protons have charge on both sides and the charge on the two sides differs by one quantum of charge for electrons and protons and by $\frac{1}{n}$ quantum of charge for quarks. The net charge at any interface in the down stack or the up stack is just the simple algebraic sum of the individual positive and negative charges. So in oxygen with six valence electrons with all valence electrons in the $n=1$ state there is a charge of $-1e$ on the inside surface of the bottom electron, a charge of $-1e$ on the outside surface of the second from bottom electron, a charge of $-2e$ on the inside surface of that electron, a charge of $-2e$ on the outside surface of the third from bottom electron, and so forth. On the bottom proton is a charge of $+1e$, and $+1e$ on the inside surface of the second from bottom proton, a charge of $+2e$ on the outside surface of the second from bottom proton, and so forth. The charge in the annular space of oxygen in the $n=1$ quantum state is 3. Charges add in a simple algebraic fashion.

Amplification and reduction

Consider a stack of two protons such as the nucleus of helium. The charge on the outer surface of the top proton is $q=2$. The energy in the field is a function of q^2 not q. The flux of the N particle on the second proton outer surface is 4 times the flux on a single proton. The bottom proton emits a flux of one unit into the outer top proton. That flux is transmitted through the top proton and the top proton adds 3 units of flux to that one resulting in 4 units of flux on the second proton outer surface. The number of units of flux is simply the sum of the odd numbers:

$$q^2=\sum_1^q 2n-1$$

I call this phenomenon amplification.

Consider a nucleus stack with eight protons and two down electrons such as the nucleus of oxygen. The highest positive charge, the highest flux, is on the outer surface of the top of the six proton stack, $q=8$ and there are 64 units of flux emitted by the outer surface. On the outer surface of the bottom down electron the charge is decreased by one, $q=7$ and there are 49 units of flux emitted by the outer surface of the down electron. It is the opposite of amplification. At the surface of the top down electron in the oxygen nucleus the charge is $q=6$ and there are 36 units of flux emitted by this surface. I call this phenomenon reduction.

Consider oxygen with all six valence electrons in the $n=2$ and $l=1$ quantum state. Then there are six down quarks on the nucleus stack on top of the two down electrons. The net positive charge on the nucleus is $q=3$. The net negative charge on the stack of six quarks at $R_o=1.555\times10^{-10}$m is $q=-3$.

With these rules for building atoms we can see the highest charge in the electronic space is the number of valence electrons. The number of valence electrons can be multiple for some atoms. Nitrogen can have a valence of three or five.

Neutrons and atomic mass

Neutrons, either free, bonded to each other or as higher structures are trapped inside the nucleus annular space. They make up the difference in mass between the atomic number of protons and electrons and the atomic mass. I have not studied neutron structure because I am interested in the chemistry of biology but there is some kind of quantum mechanics for neutrons like for atoms, so in iron it's not 30 loose neutrons or bonded neutrons in the annular space but rather a "neutron atom" with stacks of 30 electrons and protons in a single structure. The neutron and neutron atoms give rise to gamma rays and are important in NMR.

The radii of atoms

There are only three energies, sources and sinks of energy, in atoms:

1. The mass defect of electrons, protons and quarks.
2. The electric field energy in the electronic space.
3. The energy of rotation of electrons, protons and quarks.

In free atoms the electrons, quarks and protons are not spinning, all $\mathbf{m}_l$ and $\mathbf{m}_s$ quantum vectors are zero. Then the energy of free atoms only involves the mass defect and the electronic space electric field energy. Free atoms are perfect spheres. The radii of non-metal atoms, except for hydrogen and helium, can be calculated from the first ionization energy. The positive ion that results from emission of an electron by the neutral atom is the same size as the neutral atom. The following equation describes the relationship between ionization energy, valence number and radius:

$$\text{Ionization Energy} = \frac{(q\times1.6\times10^{-19})^2\left(R_o-\frac{r_B}{2}\right)}{8\pi\varepsilon_0 R_o^2}\left[\frac{\left(q+\frac{1}{2}\right)^2}{q^2}-1+\frac{3}{4}\frac{(2q)^2}{q^2}\frac{1^2}{\sum\limits_{x=1}^{x=v}x^2}\right]$$

where v is the number of valence electrons, q is the charge in the electronic space of the atom between down quarks and up quarks and in neutral atoms $q=\frac{v}{2}$, R_o is the outer radius of an atom, and r_B is the Bohr radius. Everything is known except R_o so there is one equation with one unknown, a quadratic equation in R_o. Solving for R_o and choosing the larger root gives the radii. Carbon has a radius of 1.365Å. Nitrogen is 1.190Å. Oxygen is 1.555Å. Phosphorous is 1.809Å. Sulfur is 2.160Å. Chlorine is 1.918Å. Hydrogen is the smallest atom at 0.529Å and Polonium is the largest atom at 2.734Å.

I will break this equation into two parts:

$$U_c = \frac{(q\times1.6\times10^{-19})^2\left(R_o - \frac{r_B}{2}\right)}{8\pi\varepsilon_0 R_o^2} \text{ and } \mathrm{PsiD} = \frac{\left(q+\frac{1}{2}\right)^2}{q^2} - 1 + \frac{3}{4}\frac{(2q)^2}{q^2}\frac{1^2}{\sum_{x=1}^{x=v} x^2}$$

Atoms are spherical capacitors with the inner positive plate at r_B and the outer negative plate at R_o. In the annular space between r_B and R_o, the electronic space, the electric field strength at radius R between r_B and R_o is given by Degner's Law for the electric field inside atoms, not Gauss's Law for the electric field.

$$E = \frac{q\times1.6\times10^{-19}}{4\pi\varepsilon_0 R_o R}$$

There is no foam inside atoms so the flux of the N particle is constant at all radii. For free electrons, free protons, ions and dipoles there is the foam in the surrounding space that reflects the N particles back to the source giving rise to Gauss's Law.

U_c is the electric field energy stored in a spherical capacitor using Degner's Law to describe the electric field in the electronic space where the charge on the plates is q units of elementary charge. U_c is also the energy stored in a parallel plate capacitor with a plate area of $4\pi R_o^2$, a plate separation of $R_o - r_B$, and a charge of q quantum's of elementary charge on each plate. Note that Degner's Law approaches Gauss's Law for the electric field asymptotically as R approaches R_o and when $R = R_o$ Degner's Law and Gauss's Law are identical. Outside of atoms and in macroscopic capacitors Gauss's Law always applies. Inside atoms in the electronic space Degner's Law always applies.

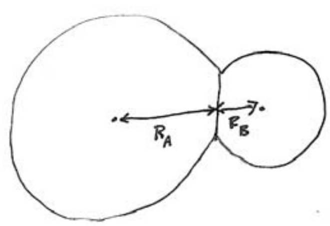
PsiD describes a transition in a spherical capacitor where the electric field is defined by Degner's law from a charge q to a charge $q+\frac{1}{2}$. $U_c\left(\frac{\left(q+\frac{1}{2}\right)^2}{q^2}-1\right)$ represents that charge transition. The $\frac{3}{4}\frac{(2q)^2}{q^2}\frac{1^2}{\sum_{x=1}^{x=v} x^2}$ part of PsiD describes the additional energy that must go into an atom to get it to oxidize due to the mass defect of the down quarks. Consider the valence number electrons in the $n=2$, $l=1$ quantum state. $U_c \times \frac{3}{4}\frac{(2q)^2}{q^2}$ is the total mass defect in the valence number of $n=2$, $l=1$ down quarks that is realized when all the valence electrons divide into two quarks and one quark from each electron shrinks down to the nucleus and an atom goes from charge v to charge $\frac{v}{2}$ in the electronic space. The sequence $1^2, 2^2, 3^2, \ldots, v^2$ reflects the relative magnitude of the mass defects in the v down quarks. The 1^2 $\frac{1^2}{\sum_1^v x^2}$ mass defect is associated with the top down quark, the $\frac{2^2}{\sum_1^v x^2}$ mass defect with the second from top down quark, the $\frac{3^2}{\sum_1^v x^2}$ mass defect with the third down and the $\frac{v^2}{\sum_1^v x^2}$ mass defect with the bottom down quark. The mass defect in a single quark, the top quark in the nucleus, that is lifted from down to up radius, from the $n = 2$, $l = 1$ to the $n = 2$, $l = 0$ quantum state, is $U_c \times \frac{1^2}{\sum_{x=1}^{x=v} x^2} \times \frac{3}{4} \frac{(2q)^2}{q^2}$.

The radii of metals

The radii of metal atoms are calculated from the unit cell dimensions or density, atomic mass and lattice packing efficiency and based on the assumption the metal atoms are perfect spheres that do not interpenetrate and deform in metallic bonds. Metal atoms in metal crystals are perfect non-interpenetrating spheres. Introductory chemistry students make this calculation but its simple meaning has not been understood.

The radii of bonded atoms

Since electrons, protons and quarks are liquid state they deform from perfect spherical symmetry in covalent, electrostatic, covalent/electrostatic, and dipole/dipole interactions such as hydrogen bonds. Bond lengths are known for a great many molecules. The deformation, interpenetration, means the bond length is less than the sum of the free radii in bonded configurations.



The higher the charge in the electronic space the "harder" the atom is. The larger the radius the "softer" the atom is. In a covalent and/or electrostatic bond the interface between bonded atoms is described physically and mathematically by the following relationship:

$$\frac{R_A}{R_B} = \frac{q_A^2/R_A^2}{q_B^2/R_B^2}$$

where R_A is the distance along the bond axis to the interface of atoms A and B in atom A and R_B is the distance to the interface in atom B, q_A is the charge in the electronic space of atom A and q_B is the charge in the electronic space of atom B. The relationship allocating the bond length into R_A and R_B holds for covalent, electrostatic, covalent/electrostatic and dipole/dipole bonds.

The bond length is:

$$\text{Bond length} = R_A + R_B$$

We have two equations with two unknowns. The solution is:

$$R_A = \frac{\text{Bond length}}{(q_B^2/q_A^2)^{1/3} + 1} \text{ and } R_B = \frac{\text{Bond length}}{(q_A^2/q_B^2)^{1/3} + 1}$$

Atoms deform in bonds. In a covalent bond where the two bonded atoms are the same element the interface surface is flat. In a covalent bond between different kinds of atoms the interface surface is convex in one and concave in the other. Determining R_A and R_B allows one to know which atom has a convex deformation and which atom has a concave deformation. In electrostatic bonds such as those in salts significant deformation of spherical symmetry occurs and in NaCl the atoms are somewhat cubic.

Photons

The highest energy state of an atom is the $n = 1$ state. In quantum transitions from higher energy states to lower energy states a photon is emitted. In quantum transitions from lower energy states to higher energy states a photon is absorbed. The energy of an emitted photon is derived ½ from the change in energy in the field of the electronic space and ½ from the mass defect of a quark going from up to down. Similarly, in photon absorption, ½ the photon energy goes into the field in the electronic space and ½ goes into the mass defect to lift a quark from down to up and restore it to rest mass.

Photons are emitted by spinning quarks that are changing radius from R_o to 2.645^{-11}m. Photons are emitted at the RH end of the spinning quark axis. The force that gives rise to photon formation is $q\mathbf{v} \times \frac{\mathbf{E}}{\mathbf{c}}$. Photons are of length λ and are emitted in the time interval $T = \frac{1}{\nu}$. Quarks that emit photons are both changing radius and spinning. A photon is emitted in precisely one revolution of a quark. When the quark begins to change radius it starts to spin. It accelerates rapidly to the maximum frequency ν_{max}, then decelerates back to $\nu = 0$, then accelerates again to ν_{max}, and then decelerates back down to $\nu = 0$. Since the energy in a photon follows $E_{max} \sin^2\theta$ over $0 \le \theta \le 2\pi$ for a single photon the ν is given by $\nu = \nu_{max} \sin^2\theta$. The ν in $E = h\nu$ is therefore an average frequency of an electron or quark and the relationship is really $E = h\overline{\nu}$ where $\overline{\nu}$ is the average frequency of an electron or quark over the one revolution it takes to produce a photon. A simple integral shows the relationship between $E = h\overline{\nu}$ and ν_{max}:

$$\overline{\nu} = \frac{1}{2\pi}\int_0^{2\pi} \nu_{max} \sin^2\theta d\theta = \frac{1}{2}\nu_{max}$$

I do not have a set of differential equations to describe at a fully analytical level the photon emission or absorption process although I believe that is possible. Photon emission is asymmetric. The atom starts out with an up quark and in the process of shrinking while spinning to become a down quark a symmetric photon is emitted although the initial and final quantum stets are different, asymmetrical.

Photons can be multi-quark processes in higher atoms.

The electromagnetic spectrum

Infrared photons associated with thermal motion are emitted and received by the up quark stack. These can be viewed as "breathing" modes. IR photons extend from the smallest possible all the way up to the ionization energy that is in the ultraviolet. When all valence quarks are in the $\mathbf{m}_s = 0$ quantum state the temperature is absolute zero, 0 degrees Kelvin. Rotational and vibrational spectra of molecules are really thermal breathing of IR photons. At constant temperature a molecule is emitting and receiving numerous IR photons, defined by the geometry of the up quarks, rotating and vibrating in space as these events occur. This is very important phenomena because the repulsive force in water and in proteins is this breathing of thermal photons, like a repulsive radiation pressure. These spectra are continuous over various different ranges of the spectrum.

IR, visible and UV are emitted by atoms in transitions of quarks going from up to down. IR, visible and UV are absorbed by atoms in transitions of quarks going from down to up. These are line spectra for single atoms but more complicated and contain continuous spectra for molecules.

When an X-ray is absorbed some of the down electrons in the nucleus are picked up and raised to the Bohr radius. The largest X-ray is to pick the pile up at the penultimate to the bottom down electron, raising $Z-1$ down electrons, where Z is the atomic number, to a radius of $5.29 \times 10^{-11}\,\mathrm{m}$. Then those electrons emit an X-ray from that excited state in the process of shrinking back down to $2.645 \times 10^{-11}\,\mathrm{m}$. Moseley's Law for the energy of the K-alpha line is $E = 10.2\ \mathrm{eV} \times (Z-1)^2$. The above transition mechanism accounts for this law in a simple way. The $10.2\ \mathrm{eV}$ photon is the $n=1$ to $n=2$, $l=1$ transition in hydrogen and is the smallest X-ray.

Continuous EM radiation generated by electronic circuits extends from next to 0Hz up to the microwave range, the maximum frequency that can be produced by electronic circuits.

Gamma rays are emitted by some kind of neutron structure.

The moment of inertia of electrons, quarks and protons

The moment of inertia is an important property of electrons, quarks and protons. Naively we might assume it is $\frac{2}{3}mr^2$, the moment of inertia for a thin shell sphere. The actual moment of inertia is mr^2, like for a ball on a string. But for electrons, quarks and protons it is for a zero thickness line, a circle, on the equator with mass m. If this was not true Bohr's model of hydrogen would never have worked so well. Bohr's famous second equation, the quantization equation, $mvr = n\hbar$ should really have been written as $mr^2\omega = n\hbar$. Since $\omega = \frac{v}{r}$ these are equivalent. The same assumption about the moment of inertia is made when Bohr set the Coulomb force as the centripetal force, $qE = \frac{mv^2}{r}$. To see the reason the moment of inertia is like a zero thickness circle with mass m will require a fully mechanical model of the electron. The non-relativistic energy of rotation is given by $E=\frac{1}{2}mr^2\omega^2$ and this is an excellent approximation for angular velocities small compared with $\omega_{max}=\frac{c}{r}$. The relativistic equation for spinning electrons, quarks and protons at constant radius is $E=\frac{1}{2}m(\gamma)\, r^2\omega^2$ where $m(\gamma)=\frac{m}{\sqrt{1-\frac{\omega^2}{\omega_{max}^2}}}$ and the increase of mass with ω is clear.

The size of the N particle

The energy of an electron at the Bohr radius spinning with the angular velocity of $\frac{2\pi}{137}\frac{rad}{s}$ has the energy of one N particle:

$$\frac{1}{2}m_e r_{Bohr}^2\left(\frac{2\pi}{137}\right)^2=2.68138\times10^{-54}\,J$$

To prove this result we need to go into the symmetries of photons. The largest photon that can be emitted by an electron has the full energy of the electron:

$$5.11\times10^5\ eV=h\times1.23^{20}Hz$$

$$\text{Note } 1.23\times10^{20}=\frac{137c}{2\pi r_{Bohr}}.$$

The smallest photon possible is one with two N particles:

$$2\times2.68\times10^{-54}\,J=h\times8.09\times10^{-21}\,Hz$$

$$\text{Note } 8.09\times10^{-21}=\frac{1}{1.23\times10^{20}}=\frac{2\pi r_{Bohr}}{137c}.$$

Dividing the largest photon by the smallest gives the number of N particles in an electron divided by two:

$$\frac{N_e}{2}=\frac{1.23\times10^{20}}{8.09\times10^{-21}}=1.52\times10^{40}$$

We want to know if this is true, if it can be proven. There are no assumptions that went into this equation. It is known the largest photon an electron is capable of is its own energy and by the definition of photons the smallest photon has precisely two N particles so it would seem to be no more than an identity. But is the size of the N particle correct?

Consider an electron spinning at the Bohr radius. The angular velocity associated with one quantum of energy of the N particle is $\frac{2\pi}{137}$ and the maximum angular velocity is $\frac{c}{r_{Bohr}}$. The correct expression, but not the relativistic equation, for the angular energy of an electron at the Bohr radius spinning at $\frac{c}{r_{Bohr}}$ is:

$$m_e r_{Bohr}^2 \left(\frac{c}{r_{Bohr}}\right)^2 = 5.12 \times 10^5 \, \text{eV}$$

Dividing the maximum angular energy by the minimum angular energy gives the number of N particles in an electron:

$$N_e = \frac{m_e r_{Bohr}^2 \omega_{max}^2}{\frac{1}{2} m_e r_{Bohr}^2 \omega_{min}^2} = \frac{\left(\frac{c}{r_{Bohr}}\right)^2}{\left(\frac{2\pi}{137}\right)^2} = 3.04 \times 10^{40}$$

The assumptions that went into this are that the angular velocity of an electron at the Bohr radius with energy of the N particle is $\frac{2\pi}{137}$, the maximum angular velocity is $\frac{c}{r_{Bohr}}$ and the energy of revolution is given by $\frac{1}{2}mr^2\omega^2$. We want to know if all those assumptions are true. To prove everything we set two expressions for $\frac{N_e}{2}$ equal to each other:

$$\frac{\omega_{max}^2}{\omega_{min}^2} = \frac{\nu_{max}}{\nu_{min}}$$

$$\frac{\left(\frac{c}{r_{Bohr}}\right)^2}{\left(\frac{2\pi}{137}\right)^2} = \frac{\frac{137c}{2\pi r_{Bohr}}}{\frac{2\pi r_{Bohr}}{137c}}$$

This can be seen to be true since this expression reduces to $1 = 1$. So that means the maximum photon frequency by an electron is $1.23 \times 10^{20}\,\text{Hz}$, the minimum frequency is $8.09 \times 10^{-21}\,\text{Hz}$, the non-relativistic energy of rotation is given by $\frac{1}{2}mr^2\omega^2$, the angular velocity of an electron at the Bohr radius with the energy of one N particle is $\frac{2\pi}{137}$ and the maximum angular velocity is $\frac{c}{r_{Bohr}}$.

Chemistry

Chemistry is my primary interest. Chemistry is just a quark dance. I want to reduce chemistry to an engineering science. I hope at this point the reader has ascertained that my theories are largely the correct theories. I wrote a first edition of a book titled **The N-particle Model** back in 1999 and a second edition in 2000 that are available through resellers on Amazon. Since I do not want to write a textbook on chemistry at this time I am going to include here two chapters from those books that contain my chemistry such as it was back then. The one major error I had at that time was I had a two particle model, the N particle and what I called Right Hand and Left Hand branes. That was before I realized the membrane nature of the N particle in electrons and protons and the foam. So when I wrote those books I thought the fields were made of point N particles and that electrons and protons were branes plus an inventory of N particles. Also I had not yet figured out the size of the non metal atoms. This also serves as an important statement about the human process of discovery, of sifting order from disorder. We can see many mistakes are made along the way and there are intermediate levels of understanding on the pathway to the final correct model. Here are the two chapters complete with all the nutty mistakes:

Chapter 11 The Covalent Bond

The hydrogen molecule

Consider a pair of hydrogen atoms in the $n = 2$ and $l = 1$ quantum state. In the covalently bound molecule the down quarks and protons are in a steady state of angular motion. The angular momentum vectors for the down quarks oppose each other, i.e. $\vec{\mathbf{m}}_l$ for one is equal in magnitude and opposite in direction to $-\vec{\mathbf{m}}_l$ for the other. They are parallel with the center to center vectors that describes the bond, i.e. they are head to head on the line between the atom centers. The protons are spinning in the opposite direction of the down quarks. The angular velocity of the proton relative to the down quark is proportional to the inverse of the mass ratio. $\frac{\omega_{\text{quark}}}{\omega_{\text{proton}}} = \frac{\text{mass}_{\text{proton}}}{\text{mass}_{\text{quark}}}$. For the $n = 2$ and $l = 1$ quark this ratio is $\frac{1836}{1/2}$.

Magnetic field in the stack

There is a magnetic field with very little volume, close to zero, between the spinning down quark and the proton. The down quark and the proton are at next to the same radius, R_i. The magnetic field is confined to the inside of the down quark and the outside of the proton. I make the approximation that this magnetic field has zero volume and therefore zero energy stored in the field. There is no magnetic field on the outside of the down quark in the space between the down and the up quark. There is no magnetic field on the inside of the proton.

$q\mathbf{v} \times \mathbf{B}$

All the pressures on bodies and quarks in atoms without angular velocity are present and in balance for bodies with angular velocity. In addition are pressures that arise when the surface of a body has velocity relative to the adjacent electric or magnetic fields. For magnetic fields generated by spinning bodies the pressure vector field $\frac{d\vec{\mathbf{F}}}{dA} = \pm\frac{\vec{\mathbf{v}}}{c}\times\frac{1}{2\mu_0}B^2\hat{\mathbf{B}}$ is of central importance, where $\vec{\mathbf{v}}$ is the vector field for velocity of a spinning thin shell spherical body or quark, where + is for positive surfaces and − is for negative surfaces. $\frac{d\vec{\mathbf{F}}}{dA} = \pm\frac{\vec{\mathbf{v}}}{c}\times\frac{1}{2\mu_0}B^2\hat{\mathbf{B}}$ provides the centripetal pressure, $\frac{d\vec{\mathbf{F}}}{dA} = -\rho_m\frac{v^2}{r}\hat{\mathbf{r}}$, where $\hat{\mathbf{r}}$ is the normalized axial radius perpendicular from the axis to a point on the surface of a thin shell spherical body, so a spinning body can maintain constant radius while spinning as opposed to expanding in the $\hat{\mathbf{r}}$ direction. Without a centripetal pressure the radius of a spinning thin shell spherical body would not be constant over time. $\vec{\mathbf{B}}$ is parallel to $\vec{\omega}$ for RH bodies and $\vec{\mathbf{B}}$ is parallel to $-\vec{\omega}$ for LH bodies so $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ are perpendicular and $\pm\frac{\vec{\mathbf{v}}}{c}\times\frac{1}{2\mu_0}B^2\hat{\mathbf{B}}$ is in the direction $-\hat{\mathbf{r}}$ for both RH and LH inside and outside surfaces of bodies and quarks where a magnetic field exists. For steady states of angular motion $\pm\frac{\vec{\mathbf{v}}}{c}\times\frac{1}{2\mu_0}B^2\hat{\mathbf{B}} = -\rho_m\frac{v^2}{r}\hat{\mathbf{r}}$ where $v=\omega r$ and ρ_m is the surface mass density of a quark. This equality rearranges to give the relation between angular velocity and the magnetic field at the surface of a quark. $B^2\hat{\mathbf{B}} = \pm\frac{m_e\mu_0 c\vec{\omega}}{4\pi R^2}$ where m_e is the mass of the electron. + is for negative surfaces and − is for positive surfaces. $B^2\hat{\mathbf{B}} = \pm\frac{m_e\mu_0 c\vec{\omega}}{4\pi R^2}$ and the assumption that in the steady state $\frac{d\vec{\mathbf{n}}}{dt}_{r,B} = -\frac{d\vec{\mathbf{n}}}{dt}_{e,B}$ leads to $\frac{\omega_{quark}}{\omega_{proton}} = \frac{mass_{proton}}{mass_{quark}}$.

e + r = qc**B**

Associated with the flux of the magnetic field are the pressures emission $\frac{d\vec{\mathbf{F}}}{dA} = -p_N\frac{d\vec{\mathbf{n}}}{dt}_{e,B}$, reception $\frac{d\vec{\mathbf{F}}}{dA} = p_N\frac{d\vec{\mathbf{n}}}{dt}_{r,B}$, and one of the four electromagnetic pressures, $\frac{d\vec{\mathbf{F}}}{dA} = \pm\frac{1}{2\mu_0}B^2\hat{\mathbf{R}}$, where + is for brane or quark outside surfaces and − is for brane or quark inside surfaces and $\hat{\mathbf{R}}$ is the spherical coordinate radial unit vector. For steady states $p_N\frac{d\vec{\mathbf{n}}}{dt}_{r,B} - p_N\frac{d\vec{\mathbf{n}}}{dt}_{e,B} = -\frac{1}{2\mu_0}B^2\hat{\mathbf{R}}$, where the sign is chosen so $\pm\frac{1}{2\mu_0}B^2\hat{\mathbf{R}}$ opposes and exactly balances e + r. In symbolic form this is $e+r = qc\mathbf{B}$. This means that for steady states $\pm\frac{1}{2\mu_0}B^2\hat{\mathbf{R}}$ is always an attractive pressure, out of and normal to the surface of a body.

In the steady state of rotation the twistture vector fields for emission and reception are opposed so the net torque on a body is zero:

$-\vec{\mathbf{r}}\times p_N(\sin\theta)\frac{dn}{dt}_{e,B}\left(\hat{\mathbf{B}}\times\hat{\mathbf{r}}\right) = \vec{\mathbf{r}}\times p_N(\sin\theta)\frac{dn}{dt}_{r,B}\left(\hat{\mathbf{B}}\times\hat{\mathbf{r}}\right)$. Angular momentum is only conserved when spins are paired through the magnetic field with angular momentum vectors opposed. For all steady states of the atom $\sum_i \vec{\mathbf{l}}_i = 0$ where $\vec{\mathbf{l}}_i$ is the angular momentum vector for a body or quark. So for steady state configurations spins must be paired. Furthermore, for steady states, the paired spinning quarks or bodies must be at the "same" radius, i.e. the volume of the magnetic field must be next to zero. This means that $l = 0$ or s intermediate quarks cannot be spinning. $\vec{\mathbf{m}}_l$ is the zero vector for intermediate quarks.

$q\mathbf{v} \times \mathbf{E}/c$

I have now discussed all the pressures and twisttures associated with the electric and magnetic field except one, $\frac{d\vec{\mathbf{F}}}{dA} = \frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$, or in symbolic form $q\mathbf{v} \times \frac{\mathbf{E}}{c}$, for both RH and LH branes and quarks. This force is only observed in the atom. For electrons or protons moving in a macroscopic field this force is next to zero because the field next to the electron or proton does not have velocity relative to the surface of the bodies. All the pressures and twisttures are important in that there would not be a universe as we know it if any one where missing. However, $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ is the most important in determining the structure of physical reality. $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ plays a key role in $E \times B$ and $B \times E$ emission and reception. $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ is generated in spinning quarks or bodies that have a velocity vector field, $\vec{\mathbf{v}}$, associated with them. The electric field $\vec{\mathbf{E}}$ is normal to the surface. $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ is tangent to the surface and projects only a parallel component onto the axis. The direction of this force wraps around a sphere from axis to axis like section interfaces of an orange. This force leads to a tangential flow of N-particles from one end of the axis to the other end where emission occurs. For reception the N-particles enter one end of the axis and flow tangential to the surface according to this force into the quark. This is a new concept, the idea of a force tangent to the surface of a brane or quark that leads to N-particle flow inside the brane or quark. Another example of this will be in the planar equatorial up quark surfaces touching each other in a bond. The local contribution of $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ is zero at the axis and is a maximum at the equator. For a down quark there is an electric field on both the inside and the outside. The difference is what determines the $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 E^2 \hat{\mathbf{E}}$ force. So for a down quark the pressure vector field is $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 (\Delta E)^2 \hat{\mathbf{E}}$ associated with the difference in electric field magnitude between the inside surface and the outside surface. $\Delta E = E_i - E_o$ where E_i and E_o are in the same direction. $\Delta E = \frac{\Delta q}{4\pi\varepsilon_0 R_o R}$ where $\Delta q = q_i + q_o$ because q_i and q_o have opposite signs. Integrating this pressure over the surface of a spherical quark or body:

$F_{total} = \int_{\theta=0}^{\pi}\int_{\varphi=0}^{2\pi} \frac{v}{c}\frac{1}{2}\varepsilon_0 (\Delta E)^2 R^2 (\sin\theta)\, d\varphi d\theta$ where $\frac{v}{c} = \frac{\omega R \sin\theta}{c} = \frac{\omega}{\omega_{max}}\sin\theta$ yields the expression for the total force:

$F_{total} = \frac{\omega}{\omega_{max}} \frac{(\Delta q)^2}{32\varepsilon_0 R_o^2}$. Integrating the pressure in direction $\pm\vec{\omega}$ yields $F_{axial} = \frac{\omega(\Delta q)^2}{\omega_{max} 12\pi\varepsilon_0 R_o^2}$, the component of F_{total} parallel to the axis. $\frac{F_{axial}}{F_{total}} = \frac{8}{3\pi} \cong .849$. The $\frac{\vec{\mathbf{v}}}{c} \times \frac{1}{2}\varepsilon_0 (\Delta E)^2 \hat{\mathbf{E}}$ pressure vector field gives rise to emission of a photon from one end of the axis of a spinning quark or body and provides the covalent bond force. The F_{axial} force on a spinning down quark provides the covalent bonding force. In a covalent chemical bond down quarks in each atom are spinning with their angular velocity vectors opposed and they are emitting a photon along the axis and receiving a photon from the other quark. Emission of a photon leads to loss of angular momentum of a quark. Reception of a photon at one end of the axis leads to an increase in angular momentum of a quark. In the steady state covalent bond the torque associated with emission of a photon, $\vec{\tau} = \pm l_N \frac{dN}{dt}_{e,\,E\times B}$, is balanced by the torque associated with reception of a photon, $\vec{\tau} = \pm l_N \frac{dN}{dt}_{r,\,E\times B}$. The net torque is zero. In addition to the torque associated with flux as a photon is a force associated with emission, $\vec{\mathbf{F}} = -p_N \frac{dN}{dt}_{e,\,E\times B}$, and reception, $\vec{\mathbf{F}} = -p_N \frac{dN}{dt}_{r,\,E\times B}$. Both of these are repulsive. All four of these fluxes are one dimensional, meaning the N-particles are emitted and received from the same very small surface area of a quark at one end of the axis. These forces and torques may be thought of as vectors. Each spinning quark in the hydrogen molecule pushes towards the other with a bonding force F_{axial}. The atoms are squeezed together. There is a deformation in up quarks between the bonded atoms. The net forces and torques must be zero in the steady state molecule. For a bond there must be two equal and opposite pressure fields associated with the outer surface of the up quarks in the bond cross-section between planar surfaces.

Proton/down quark coupled through q**v** × **E**/c

There is a F_{axial} associated with the spinning proton, anti-parallel to the F_{axial} for the spinning down quark because their spins are opposed, but it is small compared to F_{axial} for the down quark due to $\frac{\omega_{quark}}{\omega_{proton}} = \frac{mass_{proton}}{mass_{quark}}$. The force on the proton leads to $E \times B$ emission opposite the bond direction. That N-particle emission is absorbed and added to the N-particle flow in the down quark. Not only does the quark emit $E \times B$ on the bond axis it emits a small $B \times E$ opposite the bond direction, emitted from the inside surface, that is absorbed by the proton. This forms a cycle of N-particle flow around the coupled system of down quark and proton. This flow is $\frac{1}{2 \times 1836}$ that of the covalent bond flow so it is not significant quantitatively. When there is a cycle of flow between opposed spins like this there is a pressure vector field between the down quark and the proton due to the tangential flows of N-particles. Because the surfaces are frictionless there is no loss of energy in the system when these surfaces move over each other while there is a pressure field between them.

The quantitative hydrogen bond

The hydrogen molecule bond energy is $4.47\ \text{eV}$. Assuming that each atom stores $2.23\ \text{eV}$ in angular velocity energy it is possible to determine the angular velocity of the bodies and quarks. Very little energy is stored in the proton due to its low angular velocity relative to the down quark. $E = \gamma E_0$ where $\gamma = \frac{1}{\sqrt{1 - \frac{\omega^2}{\omega_{max}^2}}}$ and $\omega_{max} = \frac{c}{R}$. For the $n = 2$ and $l=1$ down quark $E_0 = \frac{.511\text{MeV}}{2} - 5.1\text{eV}$ and $E = \frac{.511\text{MeV}}{2} - 5.1\text{eV} + 2.23\text{eV}$ where 5.1eV is the mass defect of the down quark. This yields a quark angular velocity of $3.35\times10^{16}\,\frac{\text{rad}}{\text{s}}$. The non-relativistic angular velocity would be $4.10\times10^{16}\,\frac{\text{rad}}{\text{s}}$ so the correction for increase of moment of inertia with angular velocity is significant. This leads to a magnetic field strength between down quark and proton of $3.62\times10^{4}\,\frac{\text{A}}{\text{m}}$. The force that balances emission and reception is $F=\oiint\frac{1}{2\mu_0}B^2dA=4.58\times10^{-6}\,\text{N}$. That is over 111 times the electrical force $F=\oiint\frac{1}{2}\varepsilon_0E^2dA=4.11\times10^{-8}\text{N}$. This corresponds to a power as a magnetic field emission plus reception of 1374W. The net covalent bonding and photon emission force $F_{\text{axial}}=\frac{\omega}{\omega_{\max}}\frac{(\Delta q)^2}{12\pi\varepsilon_0R_o^2}=2.02\times10^{-11}\,\text{N}$. If one assumes that one-half of this force goes into photon emission than the power of the photon emission is $.003\text{W}$ that is the same power as a continuous stream of end to end 6.25 eV photons. The magnitude of the centripetal force on the down quark is $F=\oiint\rho_m\frac{v^2}{r}\,dA=\oiint\frac{vB^2}{2c\mu_0}\,dA=5.3\times10^{-9}\,\text{N}$. The centripetal force on the proton is $\frac{1}{2\times1836}$ of the value for the down quark.

Between and on

There is an on force on each up bonded quark from the inside. On the outside, between the quarks, is a between force that annihilates with the on force from the inside. When branes and quarks touch their surface are smooth and frictionless so they can slide past each other in contact without loss of energy.

Chirality of photon emission

The direction of $\frac{\vec{\mathbf{v}}}{c}\times\frac{1}{2}\varepsilon_0E^2\hat{\mathbf{E}}$ determines whether $E\times B$ and $B\times E$ emission is right handed or left handed. The scheme if the electron is really negative is:

	Matter $E\times B$	Anti-matter $B\times E$
Electronic	LH	RH
Nuclear	RH	LH

Electronic refers to the stack—the proton in hydrogen or nucleus in higher atoms and down and up quarks. Here the photons are emitted by electron quarks in matter. Nuclear refers to the neutron dimension structure that is loose in the annular space of the nucleus or for the case of hydrogen of the proton. Here the γ-rays are emitted by proton quarks in matter. Perhaps it is experimentally possible to determine if the spin of a quark emitting a photon is right handed or left handed. Then one could determine if the electron is really negative. Once the sign of the electron is assigned the N/S assignment for the magnetic field and the chirality of photon emission is fixed.

One revolution

A photon is produced by exactly a 2π rotation of a quark. The quark angular velocity starts out at zero, accelerates following $\omega_{quark} = \omega_{max}\sin^2\theta$ to ω_{max} at $\frac{\pi}{2}$, returns to zero at π, accelerates again to ω_{max} at $\frac{3\pi}{2}$ and returns to zero at 2π. In this process a photon is generated. The classical frequency, $E = h\overline{\nu}$, is the average of the variable frequency of the quark in this process. The relation is the following:

$$\nu = \nu_{max}\sin^2\theta \text{ after } E \propto \sin^2\theta$$

$$\overline{\nu} = \frac{1}{1}\int_0^1 \nu \text{ dcycle} = \frac{1}{2\pi}\int_0^{2\pi} \nu_{max}\sin^2\theta \, d\theta = \frac{1}{2}\nu_{max}$$

Chapter 12 Higher Atoms

N = 2 and $R_{inner} = 2.645\text{x}10^{-11}\text{m}$

The most important symmetry in atoms higher than hydrogen is $n = 2$ symmetry where each valence electron divides into two quarks. Atomic line spectra are single electron phenomenon where n goes higher. But the room temperature chemistry so important to biology is all (or just about all) $n = 2$ principal quantum number of valence electrons.

Moseley's Law requires R_{inner} is the same for all atoms and $R_{inner} = 2.645\times10^{-11}\text{m}$. This is required so that the square root of frequency is linear with the number of electrons in the stack. X-rays are produced when a down electron in the stack is first lifted to up by collision of an external electron. The energy in the electronic space will be the energy of the emitted X-ray when the stack collapses back.

The most important goal of chemistry will be to determine R_{outer}, $\vec{\mathbf{m}}_l$, $\vec{\mathbf{m}}_s$, and $\vec{\mathbf{m}}_{nucleus}$ vector sets for many chemical species. This will require the interplay of theory and experiment. The end result will be a computer model in virtual three dimensional space and over virtual absolute time, a static and a dynamic simulation. I believe these computations will be vitally important to our ability to design proteins and cells.

The self-bond

The second element in the periodic table is He. The stack in He is two protons at the bottom facing out at $R_{inner} = 2.645\times10^{-11}\text{m}$ to form the nucleus. The two valence electrons each are in the $n = 2$, $l = 1$ quantum state. There are two down quarks and two up quarks. There are two electrons and two protons as neutrons or a helium neutron that are inside the nucleus. These form a stack with size $\frac{1}{1836}$ that of the nucleus, down, and up stack, that I will call the nuclear stack. I will ignore this nuclear chemistry. So all we will be interested in is the atomic number, z, and the number of valence electrons. The atomic number is the number of protons facing out at the bottom of the stack. The number of down electrons is equal to $z - \#\text{valence electrons}$. This entity I call the nucleus. It has positive charge equal to the number of valence electrons on it's outer surface. In the hydrogen molecule the down quark spin was coupled to the proton spin through a magnetic field. In He the two down quarks spin with spins opposed by 180°. The magnetic field is confined to between the two down quarks. What happens to the $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ force in the two down quarks forms that I have named a self-bond? The self-bond is the basis of the Pauli Exclusion Principle. The inside quark emits an $E\times B$ flow on axis into the opposite end of the axis of the outer quark. This N-particle flow starts at one end of the axis and wraps around the quark to the point of emission at the other end of the axis. That $E\times B$ is absorbed by the outer quark on axis and reverses direction and flows to the opposite end of the outer quark where it is emitted to the **inside** as a $B\times E$ flow. So there is a loop of $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ N-particle flow between the two quarks. This establishes a pressure vector field of attraction **between** the two self-bonded quarks, similar to the pressure field between equatorial faces of up quarks in covalent bonds. Because the two quarks are self-bonded they are not available to participate in covalent bond formation, hence the inertness of the noble gases. Self-bonds only form with 180° between the $\vec{\mathbf{m}}_l$ of the participating quarks. This is due to the fact N-particle emission and absorption is on the axis of the spin.

The Nest

The set of $n=2$ down quarks and the nucleus form a nest of spinning quarks and branes that are coupled through magnetic fields and on axis $E\times B$ and $B\times E$ self-bond flows. Magnetically coupled sets can have $2,3,4,\ldots$ members in the set whereas self-bond force cycles have only 2 partners that are at 180°. The two partners in a self-bond are the physical basis of the Pauli exclusion Principle. The integer geometry of chemistry is due to these sets of angular momentum vectors: 2—180°, 3—120°, 4—109.47°. In the nest the most important number of spins that can be coupled magnetically is four to eight. This is the basis of the octet rule. When the spins in the nest are coupled through magnetic fields the sum of angular momentum for the nucleus and down quarks is zero, $\sum_l \vec{\mathbf{m}}_l + \vec{\mathbf{m}}_{nucleus} = 0$.

First consider tetrahedral carbon, perhaps CH_4. The four down quarks each have their angular velocity vectors pointing out on tetrahedral axis. There is a magnetic field between each quark but no field inside the bottom quark and outside the top quark of these four down quarks. The fraction of the magnetic field that is absorbed between two quarks is a function of the cosine of the angle between them. $\cos 109.47^\circ = -\frac{1}{3}$ is the most profound inner relation in chemistry. This is just an observation of the dot product properties. For tetrahedral symmetry this is why $\sum \vec{\mathbf{m}}_l = 0$. When interpreted vectorialy it is the basis of tetrahedral carbon and along with the Pauli exclusion principle the basis of the octet rule. Trigonal symmetry $\cos 120^\circ = -\frac{1}{2}$. Linear symmetry $\cos 180^\circ = -1$. In CH_4 there is no nuclear spin. $q\mathbf{v}\times\frac{\mathbf{E}}{c}$ that drives $E\times B$ covalent bond flow is for each down quark out on tetrahedral axis. Coming in on those same axis is flow from the hydrogen down quarks. There is a force **between** carbon and hydrogen up top quark outer surfaces. There is two-way N-particle flow perpendicular to the equatorial plane of the bond that is transmitted through those surfaces.

The $E\times B$ flow from the quarks that forms the N-particle flow of the covalent bond is transmitted through the other quarks and through the up quarks. Absorption of $E\times B$ flow occurs on axis, and perhaps a surrounding cone of a few degrees. When the angle between the $E\times B$ flow and the angular momentum vector is greater than this value the flow is transmitted through quarks. So I will assume transmission for off axis flow and absorption for on axis flow.

Now consider neutral nitrogen. Like carbon it has a nest of four innermost down quarks coupled through magnetic fields, with no field outside the fourth down quark in the stack. There is a fifth down quark adjacent to this tetrahedral nest of four. It is magnetically coupled to the nuclear spin. It is self-bonded to one of the innermost four down quarks. There are three quarks available for covalent bonding, and one self-bond of two down quarks that are at 180°. An example of this is NH_3.

Now consider neutral oxygen. Like carbon and nitrogen it has a nest of four innermost down quarks coupled through magnetic fields, with no field outside the fourth down quark in the stack. Like nitrogen there is a fifth down quark adjacent to this tetrahedral nest of four. It is self-bonded to one of the innermost four down quarks. Then there is a sixth down quark that is magnetically coupled to the fifth and the nucleus and is self-bonded to another of the innermost four down quarks. There are two quarks available for covalent bonding, and two self-bond of two down quarks that are at 180°. An example of this is H_2O.

The structures of fluorine and neon follow directly. Neon is fully self-bonded, hence it's chemical inertness. In neon, like carbon, there is no nuclear spin, the quark magnetic fields are fully coupled in two nests of four.

Ions

The importance of ions to biology and chemistry cannot be overstated. I define oxidation and reduction as changes in the ion state of the atom by removal or addition of electrons. I do not use the standard chemistry definition that assigns electrons to the more electronegative atom and derives an oxidation state that is a bookkeeping assignment not based on the actual electron removal or addition phenomenon. The importance of oxidation/reduction reactions to biology and chemistry cannot be overstated. Oxidation/reduction couples are both transfer of an electron and N-particle flow from the reduced atom to the oxidized atom. Proton transfers are also oxidation/reduction reactions. Oxidation/reductions can be intramolecular, intermolecular while in contact or touching, and intermolecular but separated in space and coupled through a conductor, like a battery, electrochemical cell, or fuel cell. I give examples of intramolecular, O_2 and CO, and intermolecular, $2H_2O \rightarrow HO^- + H_3O^+$, in the next chapter.

A positive ion is missing an electron and has positive charge on the surface at R_{outer}. A negative ion has an extra electron on top the stack at R_{outer} facing out. The key realization for ion quantum structure is: $\#\text{down quarks} = \#\text{up quarks}$, where the outfacing $n = 1$ electrons count as two up quarks. With this rule one can determine the important ion quantum configurations. C^+ has three down quarks, an electronic space with $q=2.5$, three up quarks, and an external charge of positive one. C^- has five down quarks, an electronic space with $q=1.5$, three up quarks, and a facing out electron surrounding the three up quarks so the external charge is negative one. Similarly for other atoms. Certain down quark configurations are preferred, especially the important tetrahedral geometry. Positive ions are at higher electronic space energy, negative ions are at lower electronic space energy. Both store energy in the external electric field. The electronic space and external field energies are fixed by R_{inner} and R_{outer} net of interactions with the surrounding atoms in the field. In gas phases ions can become capacative by neutrino/anti-neutrino shells. In liquids and solids surrounding atoms/molecules in the field and other ions at other lattice sites allow the fields to become capacative. Fields have to become capacative fast, $\sim 10^{-15}\,s$, or the N-particles all escape from an ion. There is no such thing as a naked isolated charge just as there is not an uncoupled spin. It has to be capacative.

The following is a list of # down:# up quarks in a few important atoms.

Trigonal (important in –COOH):

C^+	3:3 three covalent bonds, no self-bonds

Tetrahedral:

C	4:4 four covalent bonds, no self bonds
C^-	5:3+2 three covalent bonds, one self-bond, possible trigonal with three covalent bonds and self $\perp$ plane
N^+	4:4 four covalent bonds, no self-bonds
N	5:5 three covalent bonds, one self-bond
N^-	6:4+2 two covalent bonds, two self-bonds
O^+	5:5 three covalent bonds, one self-bond
O	6:6 two covalent bonds, two self-bonds
O^-	7:5+2 one covalent bond, three self-bonds
F	7:7 one covalent bond, three self-bonds
F^-	8:6+2 no covalent bonds, four self-bonds
Ne	8:8 no covalent bonds, four self-bonds

Thermal, up quarks, and phases

Up quarks can bond like down quarks. When they bond to other up quarks these bonds determine the phase of a substance. Most substance, not all, have solid, liquid, and gas phases. The phase is a function of temperature. In a solid there are up/up bonds between atoms and molecules. In liquids there are dynamically made and formed up/up bonds being made and broken with high order, here meaning the % of bonded ups is high. In gases the up quarks in the atoms and molecules are self-bonded. The metallic bond is an up quark bond. N-particle flow as photons flow in and out of breathing modes of up quarks. These thermal photons can have energies from zero Hz up to the ionization energy of a substance. In solid water the oxygens are at tetrahedral vertices, four tetrahedral bonded up quarks.

Up quarks in metals can bond with down quarks from organic portions of molecules such as Fe^{2+} to the 4 surrounding N in heme. The transition metal complexes are difficult chemistry and I do not have a complete theory for them.

Diamagnetic, Paramagnetic, and Ferromagnetic

I do not have a theory of these important phenomenon but I believe they can be accounted for by the geometry and strength of self-bonds and bonds. That information is included in the $\vec{\mathbf{m}}_l$, $\vec{\mathbf{m}}_s$, and $\vec{\mathbf{m}}_{nucleus}$ vector sets. I do not know what in my quantum mechanics corresponds to paired and unpaired electrons. A non-bonded down quark is a free radical, not an unpaired electron.

Three kinds of quantum mechanical bonds

There are three kinds of structural quantum mechanical bonds:
1. **down/down**, that are classical covalent.
2. **up/up**, that are phases, metallic, and thermal.
3. **up/down**, that are organic/metal.

There are also electrostatic bonds between ions and dipoles. These are $-\nabla U_{electric}$ driven.

Gravity

I will leave gravity as an exercise for the reader to work out. It's analogous to the electric field and is pretty simple, after all Einstein figured it out about 100 years ago.[5]

Biology

Are atomic dipoles important? Well biology is a fancy dance of fancy dipoles. That's what I work on.

In closing

A major revolution in science is accompanied with a new technological capacity, an ability to solve important problems that previously did not have solutions. I believe in fundamental science the problems always have simple solutions. That's not true about technology. The protein folding, designing and understanding problem is difficult and will have a complex solution like adjusting the clock in a GPS satellite is not a simple calculation. But atoms are relatively simple. The complexity possible in technological design and so evident in biology ultimately rests on the almost infinite combinatorics of atomic arrangements possible. In biology this is done with covalently bonded molecules primarily composed of H, C, N, O, P and S. We can see now what an exciting new possibility there is in computer simulations of atoms and molecules and interactions between atoms and molecules based on my new quantum mechanics. All computer simulations will have to use my set of atomic radii in that process. I have a patent pending in the US for the use of my set of radii for atoms in physical models and computer simulations.

[5] Hint $F = G\frac{m_1 m_2}{R^2}$.