

## Determinative atom model and the nature of chemical bond

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### Determinative atom model

The most accepted atom model currently was proposed by Dr. Bohr and by Dr. Schrodinger and Dr. Dirac subsequently<sup>12</sup>. However, many phenomenon cannot be explained by Bohr's atom model. He used Coulomb electric force as the centripetal force to explain the rotation of electrons around nucleus. Another very important basic forces, magnetic force and frame-dragging force (spinnity), were neglected and not included in his atom model. In Schrodinger's atom model, there are problems limiting the formation of correct atom model such as principle of uncertainty, Schrodinger's cat, and EPR paradox<sup>345</sup>. In this study, a new determinative atom model is proposed to explain atomic phenomenon and to solve above puzzles.

According to a previous important research by Professor Ostuka T, protons and neutrons are rotating separately in an opposite direction in nuclear basal status<sup>6</sup>. This phenomenon can also be confirmed by the semi-empirical mass formula from liquid-drop nuclear model:

$$E_b = \alpha(v)A - \alpha(s)\frac{A^2}{3} - \alpha(c)\frac{Z(Z-1)}{A^{1/3}} - \alpha(a)\frac{(A-2Z)^2}{A} + \delta(A, Z)$$

In the asymmetric term, the difference of neutron numbers and proton numbers will decrease the nuclear binding energy. This can be explained only when protons and neutrons are packed separately. If they are packed together, there will be no difference in the binding energy. Thus, there are proton subplace and neutron subplace in the nucleus. In addition, when proton group starts to rotate in one direction in nucleus, neutron group will need to rotate in the opposite direction in nucleus based on the conservation of angular momentum. It is worth noting that magnetic moment of proton is  $+14 \cdot 10^{-27}$  J/T and the magnetic moment of neutron is  $-9.7 \cdot 10^{-27}$  J/T. Positive sign means any proton's magnetic moment is parallel to its spin, and negative sign means any neutron's magnetic moment is antiparallel to

its spin. Thus, when protons (proton line) and neutrons (neutron line) rotate in the opposite direction, there will be an attractive magnetic force between them. Thus, the nucleus will be stable and the rotation axis will be fixed. In addition, we know the strong force is represented by Yukawa potential which is related to charge. The formula is:

$$V(r) = \frac{-g^2}{r} e^{-\frac{r}{d}}$$

(d: mediator particle diameter =  $\hbar/mc$ , g: coupling constant)

The pion particle mediates the nuclear force between neutrons and protons. This is one of the reasons why proton groups and neutron groups attract each other in atomic nuclei. If proton lines and neutron lines rotate in opposite directions, only the middle proton or neutron will interact with each other via pion (tensor component of nuclear force). In addition, pion interaction also happens between proton and proton or between neutron and neutron. It explains why neutrons in nuclei don't decay into protons.

I propose that the arrangement of protons and neutrons in atomic nuclei should be in two lines like:

+--+--+--+--+      Protons

+--+--+--+--+      Neutrons

+ means clockwise spin and – means counterclockwise spin. Because there are Coulomb repulsive electrostatic forces between protons, only protons with opposite spin can stand in a line. Thus, there is no net force (Coulomb electrostatic force balances spin magnetic forces). It is also true for neutrons. Because neutrons have magnetic moments, only neutrons with opposite spin can attract each other to stand in a line. In addition, because of the Coulomb repulsive forces between protons, protons won't form a sphere-like structure and they can only form a line. And, neutrons' magnetic forces between each other also prevent neutron sphere formation. However, if there are too many neutrons, the gravity between neutrons will let neutrons tend to form a sphere-like structure. Thus, in a heavy nucleus, there are more neutrons needed to form an equal and opposite angular momentum as a proton line. Between proton and neutron, there is nuclear force mediated by pion. Proton line and neutron line rotate with their longest axis in opposite directions. Besides, if there is a proton sphere with some protons hidden in the sphere center, the net charges of protons will be canceled out due to the screening Coulomb effect. Thus, the two-line arrangement is the most reasonable arrangement. If the nucleus is static, it is like a prolate rugby shape. If the proton line and neutron line are rotating, the

nucleus will be like a oblate moon-cake shape. This new nuclear model solves the mystery of atomic nuclear shape.

The nuclear shell model is the current popular nucleus model. However, I think it is not correct. If nucleons are forming a circle, then the centrifugal force generated by these protons or neutrons will let them to accelerate to move out the nucleus. In addition, the atomic nucleus is compact due to Rutherford's experiment. Thus, nuclear shell model is wrong.

The mass of neutron and proton is almost equal. In light atom, proton mass numbers are equal to neutron mass numbers. Thus, proton group angular momentum should be equal to neutron group angular momentum. In heavy atom, more neutrons will tend to group into a sphere in nucleus. Thus, the total diameter (distance) in the proton groups will be larger than that in the neutron group. Thus, there will be more neutrons in nucleus to maintain the equal angular momentum between protons and neutrons.

Frame dragging force (spinnity) is a newly identified force. I propose here that "rest mass produces gravity, spinning mass produces spinnity; rest charge produces Coulomb electric force, spinning and moving charge produces magnetism". Frame dragging effect was derived by Dr. Lense and Thirring to describe the procession of an orbiting object using general relativity<sup>7</sup>. Nobel prize winner Dr. LD Landau also derived orbiting object's lagrangian around central spinning mass using general relativity<sup>8</sup>. However, these professors didn't point out that frame dragging is actually a new basic force which has close relation with gravity. When an object has mass, it will have gravity to attract its parts to the center. In order to overcome this continuously centripetal force, the object needs to spin to produce centrifugal force to balance gravity. When the object spins, spinnity occurs. I propose to call this new force "spinnity" because it is a combination of "spin" meaning origin of this force and "ity" meaning basic force. Frame dragging means a spinning mass can drag nearby space-time to rotate around the mass, so it is actually a force which can cause peripheral smaller object to orbit around the central mass according to the basic concept of general relativity. Below is the summary of Professor Landau's derivation from general relativity<sup>7,8</sup>:

$$\text{Spinnity } F = \frac{Sj}{r^4}$$

(S=2G/c<sup>2</sup>, J=central mass spin angular momentum, j=peripheral mass orbiting

angular momentum)

Considering the angle  $\theta$  between orbiting object and the equator plane of central spinning mass, the formula can be adjusted into:

$$F = \frac{SmJ\omega\cos\theta}{r^2} = ma$$

Because neutrons or protons are rotating in a speed of  $10^{20}$ - $10^{21}$  1/sec, the spinnity produced by neutrons or protons cannot be neglected. While protons and neutrons are rotating separately in nucleus, we can deduct that all electrons are orbital-rotating in the middle of proton and neutron rotating plane due to the following major reasons:

Protons' or neutron's frame-dragging effect(force):

Because protons and neutrons are spinning, they will definitely produce frame-dragging force for the orbital-rotating electrons. The force is given by:

$F = SJmW/r^2$ . (S=frame dragging (spinnity) constant= $1.5 \times 10^{-27}$ , J=angular momentum of protons (neutrons)= $kMR^2Wc$ , M=protons(neutrons) mass, R=protons(neutrons) radius, Wc=protons(neutrons) angular velocity, W=electron orbital angular velocity, r=distance between electron and nucleus)

Thus, electrons will tend to rotate in the same direction as proton rotation or neutron rotation. Thus, it can help to maintain all electrons rotating in the middle plane of protons and neutrons rotating plane. We assume that electrons orbiting direction is the same as protons spinning direction first. Because protons and neutrons are spinning in opposite direction, there is no net spinnity field generated:

$$\text{Net spinnity field} = \frac{SJ}{r^3} - \frac{SJ}{r^3} = 0$$

Thus, orbiting electrons are not receiving any spinnity force from the atomic nucleus.

The frame-dragging effect of spinning protons or neutrons will provide acceleration on the electrons. Because protons and neutrons are rotating in the opposite direction, the only possibility that electrons won't be affected by frame-dragging is that electrons are in the middle plane of protons and neutrons rotating plane. Because of frame-dragging acceleration, electrons will finally escape from the atom if

the other neutron group or proton group doesn't provide the opposite frame-dragging force. Only when electrons rotate in the middle plane, the atom can maintain stable.

Thus, we know that all electrons are rotating in the middle plane of protons and neutrons rotation. According to Bohr's deduction, electrons are rotating around protons because protons provide electric force as centripetal force. And the centripetal Coulomb force is equal to centrifugal force produced by electron's orbital rotation movement. Viewing from an inertial reference frame, we find that there is a centripetal force during electron's orbital rotation. However, we know the example of general relativity's equivalence principle. Thus, the centripetal force observed from inertial reference frame is actually a centrifugal force acted on the electron itself (acceleration reference frame). In order to maintain the electron's orbit, the centripetal Coulomb force must be equal to the centrifugal force due to electron's orbit movement. There is a misleading that centrifugal force is fictitious force. The acceleration of orbiting or spinning is  $a=dV/dt$ . And,  $dV=Vd\theta$ , so  $a=V*d\theta/dt=V*w$ . Angular velocity  $w$  is not a vector, so the acceleration direction is the same as  $V$ . When the orbiting or spinning acceleration continues, the orbit tends to be enlarged. Thus, there seems to be an outward force which is so-called centrifugal force. The balance of centrifugal force and Coulomb's force is very important because the electron's net acceleration then is zero. Thus, the electron won't radiate energy and fall into nucleus. We can deduct net inward/outward force: Net  $F_{io}$ .

$$F_c = \frac{KQq}{r^2}$$

( $K$ =Coulomb constant= $9*10^9$ ,  $Q$ =proton charges,  $q$ =electron charges,  $r$ =distance between electrons and protons)

$$\text{Net } F_{io} = \frac{KQq}{r^2} - mr\omega^2 = \frac{KQq}{r^2} - m \frac{V^2}{r} = 0$$

( $W$ =electron's orbital angular velocity)(7)

When angular momentum is quantized, then the formula is given following:

$$r = \frac{nh'}{mV}$$

( $n$ =major quantum number,  $h'$ =reduced planck constant= $1*10^{-34}$ ,  $m$ =electron mass,  $V$ =electron orbital linear velocity)

Thus, we can get:

$$\frac{KQq}{r} = mV^2$$

$$\frac{KQq}{nh'} = V = V_e$$

For example: In hydrogen atom with  $n=1$  (innermost orbit) and

$Q=q=1.6 \times 10^{-19}$  coulomb, the value  $V_e$  becomes:

$$V_e = 2.3 \times 10^6 \text{ m/sec}$$

Thus, electron orbital linear velocity is less and close to light speed ( $3 \times 10^8$  m/sec).

Even the largest atom's electron linear velocity is smaller than lightspeed. For the atom 118, the  $V_e$  becomes ( $Q=118q$  and  $n=1$ ):

$$V_e = 118 \times 2.3 \times 10^6 = 2.7 \times 10^8 \text{ m/sec}$$

It is worth noting that the largest atom be possibly formed is Feynmanium ( $Z=137$ ).

Due to my modified Bohr atom model, the electron velocity will exceed light speed if atomic number is greater than 137. Based on Dirac equation, the largest atom should have Unseptinum  $z=173$ . It is wrong because Dirac equation is wrong.

Total energy emitted from orbiting electron is:

$$\text{Total } E = \left( \frac{-KQq}{r^2} + m \frac{V^2}{r} \right) r + \frac{1}{2} m V^2 = \frac{1}{2} m V^2 = \frac{13.6 \text{ eV}}{n^2}$$

It is important to compare my atom model to Bohr model. When the electron absorbs photon energy, it can increase its kinetic energy. Then, the linear velocity of the electron will enhance, and then the centrifugal force  $mV^2/R$  will increase to let the electron to jump to the outer orbit. The energy gap is  $\Delta E = E_f - E_i = hf = 1/2 m V k^2$ .

The orbiting frequency of the electron in the outer orbit is equal to absorbed photon frequency:  $f = 1/T$ . However, when the electron is in the outer orbit, there is force imbalance that centrifugal force is not equal to Coulomb electrostatic force. So, the electron will start to radiate with frequency  $f$  due to acceleration. Later, the electron will fall back to the original inner orbit due to reduced centrifugal force. It is like  $mgh = KQg/r_1 - KQq/r_2 = 1/2 m V k^2 = hf$ . The potential energy can be exchanged to kinetic energy or photon energy. The new atom model can also explain the Rydberg formula.

Magnetic force plays an important role in the new atom model. In this new atom model, electric force and magnetic force are serving as two balanced force to control electron movement.

According to Coulomb's magnetic law, the magnetic force induced by two spinning charges is:

$$F_m = \left(\frac{\mu}{4\pi}\right) * qV_s * \frac{qV_s}{r^2} = \left(\frac{K}{c^2}\right) \frac{q^2}{r^2} V_s^2$$

If the paired electrons are spinning in the opposite direction, the magnetic force between them is attractive.

We can deduct net in-between force  $F_{ib}$ :

$$\text{Net } F_{ib} = F_c - F_m = \left(1 - \frac{V_s^2}{c^2}\right) \frac{Kq^2}{r^2} = 0$$

( $V_s$ =electron spin linear velocity)

Electron spin velocity ( $V_e$ ) is light speed to overcome the repulsive electric force. Thus, the net force between the two electrons is close to zero. Because the two paired electrons spin in the different direction, they can be coupled together like two small magnets. Because the paired electrons need specialized spin direction, it is more difficult to pack them compared to unpaired electrons. Thus, it can explain Hund's law why unpaired electrons are arranged in an atom first. Since the paired electrons are spinning in light speed, one might argue that spinnity produced by paired electrons could affect each other. Here, I need to propose an idea called "cutting gravity line" which is similar to saying magnetism is cutting electricity line. Spinnity is induced by cutting gravity line. Thus, when two electrons with same size are spinning, they won't cut each other's gravity line. Thus, they won't produce spinnity to affect each other.

Pauli's exclusion principle is saying that no two electrons have the exactly the same quantum number. If two electrons are in the same position, their spinning direction must be different. However, Pauli's exclusion principle suffers from EPR paradox even the principle is effective. The EPR paradox is saying that: If we move away one of two paired electron to a far away distance. If we check one electron's spinning direction, the other electron's spinning direction can be decided at once. Thus, it disobeys the principle of locality of physics. In this new atom model, we infer that two electrons are in the same orbital position rotating around the nucleus. In addition, one electron is a little bit left of the electron orbital rotational plane and the other one is a little bit right of the electron orbital rotational plane.

Electron spin will let them become a small magnet. The spinning direction can decide the direction of magnetism. Thus, the two electrons have different spinning direction, so they can couple together as two small magnets. Thus, EPR paradox is solved. The different spinning direction of two electrons is because they use it to couple each

other in the same orbital position. If the two electrons are separated, the spinning direction of the two electrons will be changed. It can explain why Pauli's exclusion principle is effective.

From Bohr's deduction:

$$E_{\text{total}} = \frac{R_e}{n^2} = \frac{-13.6\text{eV}}{n^2}$$

From the  $E_{\text{total}}$  equation, we can infer that the relationship between radius and major quantum number ( $n$ ). When  $n=1$ ,  $r$  is called Bohr radius ( $r=1^2$ ). When  $n=2$ ,  $r=2^2=4$  Bohr radius. When  $n=3$ ,  $r=3^2=9$  Bohr radius. When  $n=4$ ,  $r=4^2=16$  Bohr radius. We can also infer the radius of electron rotation. From inner to outer orbit, the radius should be like 1, 4, 9, 16, 25, 36. Two electrons can be in the same orbital position. The circumference is  $2\pi r$ , so the magic numbers can be predicted: 2, 8, 8, 18, 18, 32, 32. It is because that one paired electrons are arranged in a  $2\pi$  distance, and then another paired electrons are arranged in resulting  $\pi$  distance. It is worth noting that electron can propagate in standing wave. The formation of standing wave is due to opposite propagating wave with same frequency and amplitude. For examples: In  $2\pi$  distance, electrons are rotating in clockwise direction ( $n=2$  orbit, totally 8 electrons). In subsequent final  $\pi$  distance, electrons are rotating in counterclockwise direction and in the same plane ( $n=2$  orbit, another 8 electrons). It is because only this can let formation of standing wave. Thus, there is no energy loss and atom can be extremely stable. Current quantum mechanics model assume standing wave formation, but it didn't have two equal waves propagating in opposite direction. Thus, current quantum mechanics theory cannot generate standing wave actually. Thus, we can explain the origin of diamagnetism. For example, Ar with its electron configuration: 2,8,8. In  $n=2$  orbit with two nodes, Argon's electrons are both rotating in clockwise direction and counterclockwise direction. Thus, there is no net magnetic moment generated by these orbiting electrons. So, Argon is generally diamagnetic. It can also explain why there is only 2 electrons in  $n=1$  orbit. In the  $n=1$  orbit, only a round circle wave can be formed. Thus, if there are two waves propagating in opposite direction. These two waves will collide each other to prevent to form a standing wave. Thus, in  $n=1$  orbit, electron wave can only propagate in single direction. Because electron movement is like transverse wave, there is a node in  $\pi$  distance of electron wave. Thus, electrons can be located in  $\pi$  or  $2\pi$  distance. However, packing in  $\pi$  distance may not be used in an atom. For example, Gold atom (Au) 's electron configuration is 2,8,18,18,32,1. In the  $n=2$  orbit, only 8 electrons are packed once. Electron's movement wavelength should match orbital length. It should



be noted in n=1 orbit, the minimal length of n=1 orbit is just  $2\pi$ . Thus, only one paired electrons can be packed in n=1 orbit. The standing wave produced by paired electrons in n=1 orbit is just a full circle. In n=1 orbit, packing electrons in pi distance is not allowed. It is worth noting that one paired electrons are located in the node of the standing wave. The paired electrons are receiving opposite and equal force from other electrons located in the right side and left side of the paired electrons. Thus, no net force and no net acceleration are generated. My atom model can also explain why Al (2,8,3) atom radius is less than Li(2,1) atom radius. Although Li atom has less orbiting electrons, both Li atom and Al atom's outer orbit electrons are in the n=2 orbit which can maximally include 8+8 electrons. Thus, it is not surprising that Li atom radius is slightly larger than Al atom radius since the outer unpaired electron of Li receives less Coulomb attractive force from the Li nucleus. This phenomenon cannot be explained by quantum mechanics.

It is worth noting that the status of multiple electrons in the same orbit. Because of the Coulomb repulsive force, all electrons in the same orbit will repulse each other to maintain equal mutual distances in the same orbit. There is no net Coulomb repulsive force and acceleration. It is because each electron or one paired electrons can have equal and opposite Coulomb force from its two sides. Thus, electrons in atomic orbits are stable.

For many-electron atoms:

$$\text{Total E} = \frac{(Z - j)^2 R_e}{n^2}$$

The number Z is the total proton numbers in any given many-electron atom. The number j is the total electron numbers of any given many-electron atom without the valence electrons. Because the inner shell electrons provide an obstacle for valence electrons to obtain protons' electrostatic force, the inner shell electrons should be subtracted during total energy calculation. After doing this, the centrifugal force from valence electrons' orbital movement is still balanced with the centripetal force from the net proton charges. The estimated total energy for many-electron atoms is quite accurate. It is worth noting that electrons will expel each other in the valence orbit. Thus, the valence electrons in the outer orbit remain in the electric balance situation. We can use this formula to calculate individual electron in different orbit position. It means that this new atom model is also suitable for many-electron atoms.

According to the previous researches, four "quantum numbers" have been identified

in atom model. Our new model is also consistent with the four quantum numbers. The first major quantum number is used above to describe the electron radius. The second angular momentum quantum number could be explained by the degree of ellipse orbits of our new atom model. The magnetic quantum number  $m$  should be replaced because electrons are rotating in the same plane. Thus, it is not necessary to quantize space of electron orbiting. The four spin quantum number  $s$  is because electron is spinning in lightspeed  $c$  and the radius of electron is  $h'/2mc$ . Our new model has the advantage without the disadvantage of quantum mechanics.

Because electron's linear velocity is near lightspeed, we should use relativity to adjust the energy formula. Thus,

$$E = mc^2 * \left[ \frac{1}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}} - 1 \right]$$

$$\frac{v}{c} = \frac{\text{alpha} * Z}{n}$$

This formula is very similar to Dirac's formula. I think Dirac's formula is only an approximation. Actually, electron spin won't affect the radiation spectrum. My energy formula is the correct exact answer.

Here, I would also like to explain why Klein-Gordon equation derived by Schrodinger equation is correct in many atomic experiments. It is not because Schrodinger equation is correct but because there is screened Coulomb potential. In many electron atoms, we need to consider screen effect of non-adjacent electrons at same orbit. The Klein-Gordon equation is:

$$\left[ \nabla^2 - \frac{m^2 c^2}{h'^2} \right] \varphi(r) = 0$$

, which can be derived from relativistic version of Schrodinger equation:

Here, I don't want to derive it again. If we consider the concept of screened Coulomb potential, we can still get the Klein-Gordon equation.

The screened Coulomb equation function is:

$$[\nabla^2 - k^2] \varphi(r) = \frac{-Q}{\epsilon} \delta(r)$$

$$\varphi(r) = \frac{Q}{4\pi\epsilon r} e^{-kr}$$

$\delta(r)=\infty$  if  $r=0$  or  $\delta(r) =0$  if  $r>0$

Since the distance between non-adjacent electrons are not zero

Thus,

$$[\nabla^2 - k^2]\varphi(r) = 0$$

$$kr=r/r_0$$

Since electron diameter= $h'/mc=r_0$

$$kr=r/(h'/mc)=(mc/h')*r$$

Thus,  $k=mc/h'$

Thus,

$$\left[ \nabla^2 - \frac{m^2 c^2}{h'^2} \right] \frac{Q}{4\pi\epsilon r} e^{-mc/rh'} = 0$$

Using my atom model, I can still derive Klein-Gordon equation. The solution of Klein-Gordon equation is very similar to Dirac equation. Because Klein-Gordon equation is very successful in many atomic experiments, it is assumed that Dirac equation and Schrodinger equation are correct. However, it is not so. The satisfactory experimental results can be merely due to the screened Coulomb potential of non-adjacent electrons.

( $r=10^{-11}$  meter,  $r_0=10^{-13}$  meter)

$e^{r/r_0}=10^{-44}$  which is really small compared to usual Coulomb potential.

Thus, the force between two non-adjacent electrons in the same orbit can be neglected.

Electron radius:

$$r=h'/2mc$$

Electron diameter:

$$D=h'/mc$$

We can also use the concept of Compton scattering to obtain particle radius. The Compton scattering equation is:

$$\lambda' - \lambda = \frac{h}{mc}(1 - \cos \theta)$$

During scattering, there is a phase delay which is the difference between input wave and output wave. It means the delay that photon is passing through a particle sphere.

The phase delay is:

$$\frac{2r(n-1)2\pi}{\lambda}$$

r is particle radius, n is refraction index. When photon is going straight through the particle, the input angle  $\theta_i=0$

$$n = \frac{\sin \theta_i}{\sin \theta_r} = 0$$

It means that there is no refraction. Thus, the phase delay during Compton scattering is:

$$\frac{4\pi r}{\lambda} = \frac{\Delta\lambda}{\lambda} = \frac{\lambda' - \lambda}{\lambda}$$

Comparing the Compton scattering equation, we let:

$$4\pi r = \frac{h}{mc}$$

Thus,

$$r = \frac{h'}{2mc}$$

So, there is relation between Compton wavelength ( $h'/mc$ ) and particle size. My deduction is well correlated with experimental observation.

Thus,

$$r * mc = \frac{1}{2} h'$$

Comparing to Heisenberg's position-momentum uncertainty principle, we can view  $mc$  as the invariance of momentum:

$$\Delta X * \Delta P \geq \frac{1}{2} h'$$

We can find out the great similarity!

My atom model can also successfully explain Zeeman effect. There is no need of electron spin quantization. Following is my deduction:

$$W=U*B=(U_a+U_b)*B$$

For orbital magnetic moment:

$$U_a=U_o*J \quad (U_o=q/2m, J=nh') \quad (h' \text{ is plank constant})$$

For spin magnetic moment:

$$U_b=U_s*S \quad (U_s=q/m, S=lw) \quad (r=\text{electron radius, } m=\text{electron mass, } v=\text{electron spin speed})$$

J is proximally  $10^{-34}$

$m=10^{-31}\text{kg}$ ,  $v=\text{lightspeed}=10^8\text{m/s}$

If  $r\approx 10^{-13}\text{meter}$ , there will be spin-orbit coupling. (electron spin angular momentum  $S=l\omega=1/2h'(r=h'/2mc, v=c)$ ; this explains why electron spin is quantized)

Thus, Zeeman effect is observed. It is worth noting that classical electron radius ( $10^{-15}\text{meter}$ ) is underestimated. Thus, my deduction should be correct.

Quantum mechanics hypothesizes that electron's phase velocity is not equal to group velocity. However, there is no dispersion phenomenon in atom. Thus, how can we say electron wave's phase velocity is different from electron wave's group velocity.

Actually, I think electron's group velocity is exactly the same as electron's phase velocity. If we accept the fact that electron group velocity is phase velocity, then Schrodinger and Dirac equation has severe defects. The principle assumption of Schrodinger and Dirac equation is that electron wave energy can be described by Plank law:

$$E=hf \text{ (f=electron wave frequency)}$$

According to DeBroglie's hypothesis, the matter wave wavelength is:

$$\lambda=h/p, p=\gamma mv$$

$$\text{Thus, } E=hf=hv/\lambda=\gamma mv^2$$

According to Einstein's special relativity, the total energy of a moving mass is:

$$E=\gamma mc^2$$

We can see the discrepancy of these two equations. Electron moving speed is not equal to lightspeed  $c$ . Electron wave energy cannot be described by  $E=hf$ .

How about the situation of rest electron? Then,

$$E=hf=h*0=0$$

That is totally disobeying special relativity's result for rest particle  $E=mc^2$ . Even we use the Dirac equation, we still get wrong result  $E=\pm mc^2$ . The negative energy is totally wrong.

Thus, Schrodinger and Dirac equations underestimate electron's total energy. The  $i\hbar d\Psi/dt$  of Schrodinger and Dirac equation is from the assumption  $E=hf=h'\omega$ . The basic assumption of Schrodinger and Dirac equation is totally wrong. Thus, quantum mechanics is totally wrong! Different situations use different equations.

Based on the Lorenz invariance of four momentum:

$$E = \sqrt{(mc^2)^2 + (pc)^2}$$

When rest mass  $m=0$  such as in photon:

$$E=pc=hc/\lambda=hf=h'\omega$$

When rest mass  $m$  is not zero such as electron:

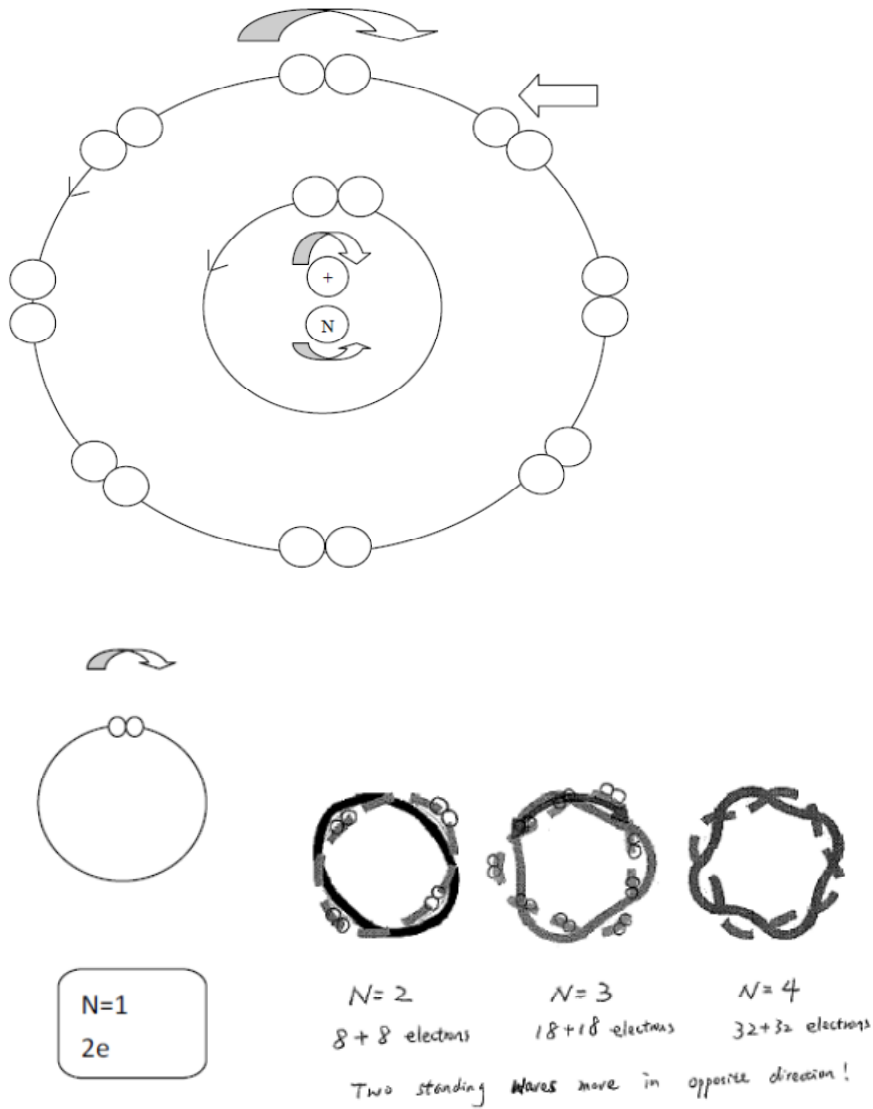
$$m=E/c^2=p/v \text{ Then } pc=Ev/c,$$

$$E=γmc^2$$

In addition, it is proved recently that Heisenberg's matrix mechanics is not equal to Schrodinger's wave equation. Thus, there is inconsistency between Heisenberg's formula and Schrodinger's formula. This is a major defect in quantum mechanics. And, an important phenomenon called Bremsstrahlung suggested that electron can emit continuous electromagnetic radiation with continuous emission spectrum. It is directly against Schrodinger's and Dirac's equation saying that electron only has discrete energy. In Schrodinger's equation, the symbol  $\Psi^2$  is defined as probability or wave amplitude. However,  $\Psi$  is actually used in Schrodinger's equation and it is a complex number.  $\Psi$  is not  $\Psi^2$ . How can a complex number describe probability wave amplitude in Schrodinger's equation? Quantum mechanics is wrong!

Heisenberg's principle of uncertainty said that we cannot predict the exact electron position in the atom because photo will interfere with electron's orbit. Then, Dr. Schrodinger proposed his atom model by using wave probability function. However, the probability has severe limitation. It causes a paradox like Schrodinger's cat that saying the strangeness and logical problems of the quantum mechanics. And, it is very difficult to imagine electrons can really rotate in strange orbital shapes such as dumbbell or double donut from Schrodinger's atom model. It is more reasonable that electrons are rotating in a circular or ellipse shape. Quantum mechanics needs Copenhagen interpretation saying that wave function collapse during observation. It says that subject's measurement affects object's physical law and fact (positivism). It is not realism and is not truth. Because the wave function collapse Copenhagen interpretation cannot be accepted by most scientists, there are other quantum mechanics interpretations such as Consistent histories, Many worlds, Ensemble interpretation, Decoherence, Consciousness causes collapse, Objective collapse theory, Many minds, Quantum logic, Bohm interpretation, Incomplete measurement, and Relational quantum mechanics. These theories attack each other and none of them is generally accepted in scientific world. I think none of them including Copenhagen interpretation is correct. In addition, quantum mechanics is required to assume absolute and discontinuous time which should be discarded according to special relativity. Quantum mechanics treats space and time separately and differently (differentiate once or twice), not treating space-time as a four dimension structure. Quantum mechanics is also allowed to disobey conservation of energy which is the most fundamental law of physic. This new atom model proposed here let the atom go back to the classical physics. Principle of uncertainty is a limitation of observational physics, but it cannot be viewed as a law to governing real atom orbit. I believe this new atom model will provide an important insight into the current

physics.



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## The Nature of Chemical Bonds

Then, I would like to discuss this new atom model and its relation to chemical bonds. Quantum mechanics has its own way to explain the chemical bond formation. This new determinative atom model can explain chemical bond formation better. There are two major chemical bond formations in this new atom model. Traditional chemistry called them ionic bond and covalent bond. In traditional covalent bond, electrons can be "shared" in the two adjacent atoms by forming a quantum molecular orbit. I think this concept is incorrect. In this new model, the distinguishing of these two bonds should be revised. First, chemical bond can be formatted that recipient atom accept redundant electrons from donor atom. For example: NaCl. There is an additional electron in the outer orbit of Na atom. And, there are 7 electrons in Cl's  $n=2$  orbit. Thus, the additional electron of Na atom will go into the outer orbit of Cl atom when these two atoms are approaching. This can explain the origin of Octet rule by Dr. Lewis because the full  $n=2$  orbit needs 8 electrons. Then, the electron donor Na atom is relatively positive and the electron recipient Cl atom is relatively negative. Thus, Na atom and Cl atom can bind each other. We can also see the example of  $O=C=O$  ( $CO_2$  molecule). Each of the two O atom donates two electrons to the central C atom, so the central C atom can have a full 8 electrons in its outer orbit. It is worth noting that all the 8 electrons in C atom's outer orbit must rotate in the same horizon of C atom. Thus, each of the O atom should be in the same horizon as C atom when they donate two electrons to the C atom. This can explain why  $CO_2$  molecule is linear in shape. In my new atom model, there is no pi bond nor delta bond nor sigma bond. There is neither molecular hybrid orbit nor hyperconjugation. Atoms are in the same plane is only because all the final electrons of recipient atom should be all in the same horizon to orbit the central recipient atom. Thus, it can explain why all double bond and triple bond always formed in the same plane.

In the second mechanism of chemical bond formation, atom and atom can form a link by one paired electrons with opposite spin direction. The two electrons are attracted by equal force by the two linking atoms and are in the central position between the two linking atom nucleuses. The new atom model can also explain other chemicals such as  $CH_4$ . In this molecule, each H atom donating one electron and the central C atom donates four unpaired electrons. Each electron of the C atom can make a pair with the one electron from each H atom to make a chemical bond. Totally, four chemical bonds will be formed. Then, according to VSEPR theory, all the four H atoms will repel each other. Thus, the  $CH_4$  molecule will become a pyramid



shape with 109 degree bond angle. It can help to explain why CH<sub>4</sub> has a not 90 degree bond angle. You may ask why CH<sub>4</sub> cannot be formed in a plane by 4 H atom's donating 4 unpaired electrons to the central C atom. Because 109 degree is larger than 90 degree, the pyramid shape is more favorable than planar shape due to VSEPR theory. It is worth noting that only one paired electron with opposite spin direction can be formed between two adjacent atom nucleuses. It is because electron radius (10<sup>-13</sup>meter) is larger the proton or neutron radius(10<sup>-15</sup>meter). Thus, there cannot be four electrons or six electrons between the two linking atomic nucleus. That is why double bond or triple bond must be formed in the same plane by donating redundant electrons from donor to the outer orbit of recipient to fulfill octet rule. However, there are a few exceptions. For example, the stable H<sub>2</sub><sup>+</sup> ion. There is only one electron between the two adjacent H atoms. The one electron is attracted by both H atomic nucleuses by Coulomb force. Thus, this ion can still be formed. However, the frame dragging force generated by this single electron cannot be balanced. Another example is He<sub>2</sub><sup>+</sup> ion. There are totally three electrons with one unpaired electron and two paired electrons in He<sub>2</sub><sup>+</sup> ion. The paired electrons are belonging to one He atom. The one unpaired electron forms the chemical bond of the two He atom. Thus, He<sub>2</sub><sup>+</sup> is paramagnetic. Thus, both the bond order of H<sub>2</sub><sup>+</sup> and He<sub>2</sub><sup>+</sup> is 0.5. My atom model can easily explain strange molecule such as CH<sub>5</sub><sup>+</sup>, CH<sub>6</sub><sup>2+</sup>, B<sub>2</sub>H<sub>6</sub>, Al<sub>2</sub>(CH<sub>3</sub>)<sub>6</sub>, or B<sub>6</sub>H<sub>7</sub><sup>-</sup>. They are called three center two electron or four center two electron compounds. It is because there is only one single electron to form chemical bond between adjacent atomic nucleuses.

We can also explain the C<sub>2</sub>H<sub>4</sub> molecule. We can rewrite this molecule 2HCCH<sub>2</sub>. There is a double bond between the two C atoms. As we said above, double bond must be formed in the same plane. Thus C=C is in the same plane. In addition, the two H atoms for one C atom donate two electrons. In this one C atom, it fulfills the octet rule for its outer orbit. Thus, both two H atoms and this C atom are in the same plane. In the other C atom, each of the H atom forms a chemical bond with two paired electrons with the C atom. We know the frame dragging force formula is  $F = \frac{Sj\omega r \cos\theta}{r^2}$ . And, we need to know that only proton part of the atomic nucleus can attract electrons. Since C=C is in the same plane, the proton parts of these two C atoms are also in the same plane. Thus, when the two H atoms form a chemical bond with the second C atom, they must be also in the same plane with this second C atom. It is also due to the VSEPR theory. If the other two H atoms are in the same plane, the bond angle will be 120 degree and 180 degree. If the two H atoms and the adjacent C atom want to form a pyramid-like shape, the bond angle will be less than 120 degree and 180 degree. Thus, pyramid-like shape is not likely. This can explain

why C<sub>2</sub>H<sub>2</sub> molecule is a planer molecule. It can also be explained why benzene C<sub>6</sub>H<sub>6</sub> is a planer molecule.

Thus, we don't need molecular hybrid orbit, or pi bond/sigma bond/delta bond to explain the shape of a molecule. There is no hyperconjugation, so the bond rotation barrier of ethane is totally due to steric hinderance. We can also use this new atom model to explain why O<sub>2</sub> molecule is paramagnetic. The Lewis format of O<sub>2</sub> is O=O. In my prediction, there are full 8 electrons in one O atom. In the other O atom, there are four unpaired electrons which cause O<sub>2</sub> paramagnetism. In one single O atom, there are two paired electrons and two unpaired electrons. When two O atoms are meeting each other, the fastest way to make one O atom to fulfill the octet rule is to transfer the two paired electrons from donor to recipient atom. Thus, one O atom has four paired electrons and the other O atom has four unpaired electrons. We can also predict the structure of NH<sub>3</sub>. The N atom has five electrons which include one paired electrons and three unpaired electrons. When, the three H atoms are meeting N atom. Each of the unpaired electrons of N atom will go to form a chemical bond with each unpaired electron from the H atom. Thus, the NH<sub>3</sub> structure is a pyramid shape. It is due to the pre-existing electron configuration of N atom, the new NH<sub>3</sub> molecule is not a planer molecule.

We can explain the hypervalent molecules which cannot be explained by Lewis octet rule such as PCl<sub>5</sub>, SF<sub>6</sub>, or PO<sub>4</sub><sup>3-</sup>. There are ten electrons around central atoms which cannot be explained by Lewis octet rule. Their existence is a long term paradox. In each P atom, there are five unpaired electrons. Thus, it can formed five chemical bonds (one paired electrons with opposite spin direction) with each Cl atom donating one unpaired electron. So does SF<sub>6</sub>. Due to VSEPR theory, all the Cl atom or F atom will repel each other to form a tetragonal or octahedral structure. It is also the same for phosphate. P=O can form a double bond in the same plane(P atom donate two electrons for O atom to let O atom to fulfill total eight electrons in O atom's outer orbit). In addition, the three unpaired electrons of P atom can form the second type of chemical bond with the other three O atoms. Thus, phosphate can form a tetrahedral structure. The perplex of hypervalent molecules is solved.

Here, I would also like to talk about the origin of chemical polarity. The chemical polarity can be originated from the nature of chemical bond. For example: NaCl. An electron from the Na atom is donated to the outer orbit of Cl atom to make full 8 electrons. Then, Na atom loses one electron to become Na<sup>+</sup>, and Cl atom gets an electron to become Cl<sup>-</sup>. So does HF. In the NaCl molecule, this causes the chemical polarity inside the molecule. In the other type of chemical bonding such as CH<sub>4</sub>, C

atom provides 4 unpaired electrons to bind with 4 H atom providing one electron each. Finally, it forms a pyramid structure. Both C atom or H atom gains one extra electron and there is symmetry of this CH<sub>4</sub> structure, so there is no chemical polarity for CH<sub>4</sub>. In other example such as CO<sub>2</sub>(O=C=O), the central C atom gets 4 unpaired electrons from the two O atom. Thus, the central C atom should be negative. However, the CO<sub>2</sub> molecule is linear, so the right side dipole cancels out the left side dipole. The net chemical polarity of CO<sub>2</sub> is still zero. Finally, we can look at the molecule O<sub>2</sub>(O=O) and N<sub>2</sub>(N≡N). Currently, scientists think these two molecules are non-polar. However, by my new chemical bond theory, one O atom donates two electrons to the other O atom to form 8 full electrons in its outer orbit. And, one N atom donates three electrons to the other N atom to form 8 full electrons in its outer orbit. Thus, there is a gain or loss for the O atom or the N atom. Thus, O<sub>2</sub> is O<sup>2+</sup>O<sup>2-</sup> and N<sub>2</sub> is N<sup>3+</sup>N<sup>3-</sup>. In my model, I predict that O<sub>2</sub> and N<sub>2</sub> molecules have chemical polarity. A new research confirms my hypothesis. A laser induced extra electric field can cause the molecular alignment of N<sub>2</sub> or O<sub>2</sub> molecule. Even the laser is removed, this alignment can also revive. This suggests that my model is right.<sup>1</sup>

My atom model can also be used in several aspects in modern chemistry. First, metal's color can be explained. Based on my atom model, Au (gold) configuration is 2,8,18,18,32,1. It has 2 electrons in n=1(r=1) orbital, 8 electrons in n=2(r=4) orbital, 36 electrons in n=3(r=9) orbital, 32 electrons in n=4(r=16) orbital, and one single electron in n=5(r=25) orbital. Thus, when the single electron jumps from n=5 to n=6 orbital, it gives out the golden color. No S or D orbital in quantum mechanics is needed.

Second, transitional metal's structure can be explained. Here, I will use four acceptors of one complex to be an example to explain their structure difference. One is pyramid, and the other is square planar. For example:[Ni(CN)<sub>4</sub>]<sup>2-</sup> is a square planar. Ni configuration is 2, 8, 8,10 based on my atom model. Thus, Ni<sup>2+</sup> is 2, 8, 8, 8. It has 8 (=2\*4) unpaired electrons in the outermost orbit. Remember that all electrons are in the same plane. And, CN<sup>-1</sup> provides two unpaired electrons for binding. Thus, each Ni<sup>2+</sup> with each CN<sup>-1</sup> will form 2 chemical bond in the same plane of Ni atom. Since this is a double bond, these bonds can only be formed in the same plane. In the n=4 orbit of Ni atom, there are totally 16 electrons in the outermost orbit. And, the CN<sup>-1</sup> group will expel each other to achieve a maximal distance between them. Thus, the resulting structure will become square planar. [CoCl<sub>4</sub>]<sup>2-</sup> is a pyramid. Co configuration is 2,8,8,9 in my atom model. Co<sup>2+</sup> is 2,8,8,7 or 2,8,15. It has 7 unpaired electrons in the outermost orbit. Co<sup>2+</sup> doesn't

use the 7 unpaired electrons for binding to  $\text{Cl}^{-1}$ . And,  $\text{Cl}^{-1}$  provides two paired electrons for binding. Since  $\text{Co}^{2+}$ 's 7 unpaired electrons are not for binding, chemical bond between Co and Cl is not restricted to Co atom's plane. All  $\text{Cl}^{-1}$  will expel each other to form a 3D pyramid structure. And, since  $[\text{CoCl}_4]^{-2}$  still has 7 unpaired electrons, it is ferromagnetic. You can play this with other metal which can form square planar structure such as  $\text{Pd}^{2+}(2,8,18,16)$ ;  $\text{Pt}^{2+}(2,8,18,32,16)$ ;  $\text{Au}^{3+}(2,8,18,32,16)$ . They all use 16 unpaired electrons for binding to form a square planar in  $n=4$  orbit.

Third, my atom model can also explain band structure. You only know a concept called metallic bonding. In metallic bond, strong positive charged nucleus attract few (one or two) electrons to form bond. For example, Cu, Ag, Au all have one free electron in the outermost orbit. These free electrons form electric sea. Similar to  $\text{H}_2^+$  molecule, the only one free electron forms the chemical bond between two metal atoms. However, this single electron receives only weak Coulomb attractive force from the metal atom since there are a lot inner electrons cancel the attractive force. In addition, the single free electron is easily affected by external force or external radiation (photoelectric effect). Thus, the single electron is freely movable and is called free electron. When external electric current is applied, the free electrons can conduct electricity. Thus, it can explain why metal is conductive. We can also explain why diamond is non-conductive and graphite is conductive. Each C atom from the diamond uses four unpaired electrons to bind other unpaired electrons from other four C atoms to form a pyramid shape structure. There are one paired electrons in each chemical bond and the electrons receive strong Coulomb attractive force from the two adjacent C atoms. Thus, this kind of chemical bond is very stable. No free electron is generated. Thus, diamond is non-conductive. However, in graphite, only three electrons from each C atom are used to bind other three adjacent C atoms to form a tri-polar shape structure flat layer. Within the layer, this kind of chemical bond is formed by one paired electrons. Between layer and layer, one single electron is used for chemical bonding for different layers. This single electron is very similar to the free electron of metals. Thus, graphite is conductive. This new atom model can well explain the conductivity of different molecules! My atom model and chemical bond theory can replace the current electronic band structure theory. There is no need of conduction band or valence band. The most important concept is the single free electron!

Finally, I would like to discuss about quantum chemistry. The principle of quantum mechanics was used by Drs. W. Heitler and F. London to explain the formation of  $\text{H}_2$

molecule. However, they didn't get the true exact value of H<sub>2</sub> bonding energy and they only got approximation. Using quantum mechanics wave function to explain atom-atom binding is wrong. Here, I will propose a new mechanism to explain atom-atom binding. For example, there are two H atoms. One H atom is near resting status, and the other H atom is linearly moving. Once the second H atom is approaching the first H atom, the orbiting electron of the second H can collide with the orbiting electron of the first H atom. After the collision, these two electrons can be moving together to form a chemical bond between the two H atoms. It is worth noting that the collision is complete inelastic collision, so there will be energy loss during the electron-electron collision. But, it must fulfill the conservation of linear momentum. The two bumped electrons can then move together if their spin direction is opposite that magnetic force cancels the Coulomb repulsion force between them. And, the two H atoms will then move together to form a stable H<sub>2</sub> molecule. We need to know that the coefficient of restitution of the two collide electrons should be zero. In addition, there will be a specific angle between the two electrons and the bonding energy released by H<sub>2</sub> molecule formation is a fixed value. This mechanism can also be used to explain more complicated molecule formation. Quantum chemistry is completely unnecessary! We can calculate the inelastic collision below:

$$M_1V_1 + M_2V_2 = (M_1 + M_2)V_f$$

Since  $M_1 = M_2 = \text{electron mass}$ ,  $V_1 = V_2 = \text{electron initial linear velocity}$ ,  $V_f = \text{final speed}$   
 $V_f = 1/2(V_1 + V_2)$

If the  $V_1$  and  $V_2$  has 90 degree apart, then  $V_f = 0.7V$ .

If the  $V_1$  and  $V_2$  has 0 degree apart, then  $V_f = V$

We can calculate the  $V_f$  by using H-H bonding energy = 436 KJ/mol at 298K

436 KJ/mol → 4.55 eV/per molecule

H atom electron energy = 13.6 eV

Thus,  $13.6 * 2 - 4.55 = 22.65 \text{ eV}$

$22.65 \text{ eV} = 0.5(2M)V_f^2$

$V_f = 0.9V$  ( $V = \text{electron linear velocity in H atom} = 2.2 * 10^6 \text{ m/s}$ )

Thus, the collision angle between the two electrons of two H atoms is between 90 degree and 0 degree. After the complete inelastic collision, one H<sub>2</sub> molecule is formed.

I strongly suggest to use this new determinative atom model to replace Schrodinger and Dirac's quantum mechanics. In addition, further researches are required to

confirm and extend this new atom model.

#### Reference

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