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Why Atomic and Subatomic Particles Have Wave Property and Satisfy the Schrodinger Equation? It Infers the Structures of These $\pm$ Charged Particles

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Abstract

Why electromagnetic radiations have quantum property? We have tried to find the answer.[1,3] Conversely, why the atomic and subatomic particles have wave property and satisfy the Schrodinger equation? Now let's try to see if there is a mechanism. Schrodinger equation as a differential wave equation must have a general solution of the type $f(z-Vt)+f(z+Vt)$. It logically infers the necessary condition for the particle and system to satisfy the Schrodinger equation: they must possess symmetrical helices structure of the complex number ($\Phi_x\ \Phi_y$), the modulus square is their mass density. The translation of such particle itself will be proved does form a wave it satisfies the Schrodinger equation. The practice has proved $\pm$ charged elementary particles and $\pm$ fermions satisfy the Schrodinger equation with - and + sign, it logically infers that (i) Since they must satisfy the necessary condition, so they must possess the helices structure of the plane vector(Φ_x , Φ_y) and mass density; (ii) These particles are divided into two categories: they have the same sign of charge $-e$ or $+e$, but different helical directions of mass density and charges, such as left-handed proton and right-handed proton, etc; (iii) The charge $-e$ and $+e$ will be proved are distributed double helically on the particles side boundary. It carries a circular polarized external **E**-field. The **E**-field becomes an **E**-wave when the particle moves along the z-axis. Then we will prove further that **E**-wave satisfies the de Broglie rela-

tion. So any particle mentioned above is composed of the particle itself and the probability wave it accompanies. Such particle-wave hybrid structure will show particle property and wave property simultaneously in the experiment. For the particle itself, the concept of definite orbit corresponding to a set of quantum numbers must be available. We think this research will make a better understanding to the quantum physics.

Keywords: inertia vector, “circular polarized structure”, particle- wave hybrid structure, right (left) handed particle

I. Introduction

Why the electromagnetic radiations have quantum property? We have tried to find the answer not long before. [1,3] Why the atomic and subatomic particles have wave property that makes them satisfy the Schrodinger equation? We try to find the mechanism and report in this paper.

Although $\pm$ charged elementary particles are not composed of other particles, they must have their mass and mass structure. For this purpose, we start from the general solution of the free Schrodinger equation pure mathematically. As a differential wave equation it must have a general solution of the type $f(z-Vt)+f(z+Vt)$. It will be proved is a circular polarized wave. It logically infers the necessary condition for the particle or system to satisfy the Schrodinger equation. Then, base on the facts that the practice have proved the $\pm$ charged elementary particles, atoms and molecules, including their nuclei, all satisfy the Schrodinger equations with - and + sign, it logically infers that (i) All particles mentioned above possess symmetrical helices structure of the plane vector (Φ_x,Φ_y) and mass density; (ii) All of them fall into two categories: they have the same sign of charge $-e$ or $+e$, but different helical directions of the mass density and charge $-e$ or $+e$, such as left-handed electron and right-handed electron, etc.; (iii) The charge $-e$ and $+e$ are distributed double helically on the particle side boundary and carries a circular polarized E-wave, the de Broglie wave. At last there are some discussions about the problems concerned and two particular relativistic properties for the mentioned particles in the equal energy process.

II. General solution and necessary condition of the Schrodinger equation

Owing to the translation motion along the z-axis, that is let $z=z-Vt$, the equation of motion of a sine curve $x=a\sin z$ like (infinite long) object is $x=a\sin(z-Vt)$.

Mathematically it is a plane harmonic wave. The equation of motion of a spring like $\vec{r} = x + iy = ae^{iz}$ object is $\vec{r} = x + iy = ae^{i(z-Vt)}$. It is a "helix wave". They are the special waves directly formed by the translation motion of an object it possesses periodic distribution of mass. Now, can we ask a question "Is there any object with certain periodic mass structure that can form the wave in translational motion to satisfy the differential wave equation, the Schrodinger equation? We try to find the answer.

Let us consider the free Schrodinger equation in one space dimension

$$i\hbar\frac{\partial\Phi}{\partial t} = -\frac{\hbar^2}{2m}\frac{\partial^2\Phi}{\partial z^2} \qquad (1)$$

Mathematically speaking, as a differential wave equation, it must have a general solution of the type $\Phi(x,y,z,t) = \Phi_0(x,y)\Phi(z-Vt) + \Phi_0(x,y)\Phi(z+Vt)$. Take the one $\Phi(x,y,z,t) = \Phi_0(x,y)\Phi(z-Vt) \overset{let}{=} \Phi_0(x,y)\Phi(\zeta)$, ($\zeta = z - Vt$) as an example to consider, we have

$$i\hbar\frac{\partial\Phi(x,y,z,t)}{\partial t} = i\hbar\Phi_0(x,y)\frac{\partial\Phi(\zeta)}{\partial t} = i\hbar\Phi_0(x,y)\frac{d\Phi(\zeta)}{d\zeta}(-V) \qquad (\zeta = z - Vt) \qquad (2)$$

$$-\frac{\hbar^2}{2m}\frac{\partial^2\Phi(x,y,z,t)}{\partial z^2} = -\frac{\hbar^2}{2m}\Phi_0(x,y)\frac{\partial^2\Phi(\zeta)}{\partial\zeta^2}\left(\frac{\partial\zeta}{\partial z}\right)^2 = -\frac{\hbar^2}{2m}\Phi_0(x,y)\frac{d^2\Phi(\zeta)}{d\zeta^2} \qquad (\zeta = z - Vt) \qquad (3)$$

Let $B = \frac{d\Phi(\zeta)}{d\zeta}$ and eq. (2) = (3), we have $-i\hbar VB = -\frac{\hbar^2}{2m}\frac{dB}{d\zeta}$ and

$$B = \frac{d\Phi(\zeta)}{d\zeta} = B_0 e^{i\frac{4\pi mV}{h}(z-Vt)} \qquad (4)$$

Then $\Phi(\zeta) = \eta_0 e^{i\frac{4\pi mV}{h}(z-Vt)}$ $\qquad (\zeta = z - Vt) \qquad (5)$

The general solution of free Schrodinger equation, eq. (1) is the complex number:

$$\Phi(x,y,z,t) = \Phi_0(x,y)\,\Phi(\zeta) = \Phi_0(x,y)\,e^{2\pi i\left(\frac{2mV}{h}z - \frac{2mV^2}{h}t\right)} = \Phi_x + i\Phi_y \qquad \left(\Phi_0(x,y) = \Phi_0(r),\ \Phi(r \succ R) = 0\right) \qquad (6)$$

$\frac{2mV^2}{h} \overset{let}{=} \nu_V$ Is frequency; $\frac{h}{2mV} = \lambda_V$ is wave length, $V = \lambda_V \nu_V$ is phase velocity and $r \prec R$ is the radius of the wave surface. The object must be finite in radius, so we have $\Phi(r \succ R) = 0$.

Eq. (6) is a "circularly polarized wave" similar to the electric vector $E\,(= E_x + iE_y)$ in a bean of the circular polarized light. Direct verification shows eq.(6) satisfies the Schrodinger equation, but any component of it, the plane wave Φ_x or Φ_y does not. So the necessary condition of a function $\Phi(x,y,z,t)$ it can satisfy the Schrodinger equation is it must be a circular polarized wave (not plane wave).

Besides, if there is a special solution of the Schrodinger equation, it must be also the circular polarized wave, not plane wave.

Compare with the above mathematical examples, we come to a conclusion: In order to satisfy the Schrodinger equation, a moving object or system it must possess the helices structure of the complex number $\Phi_0(r)\, e^{2\pi i \frac{2mV}{h} z} = \Phi_x + i\Phi_y$ or their linear combination $\sum_j \Phi_j(r)\, e^{2\pi i \frac{2m_j V}{h} z}$. It forms itself a circular polarized wave when it moves ($\zeta = z - Vt$) along the z-axis. This is the necessary condition for the structure of the particle or system to satisfy the Schrodinger equation.

The amplitude square $\Phi_0^*(r)\Phi_0(r)$ must correspond to a physical scalar quantity related to the coordinates (x, y) on the wave cross section. For the translation motion in mechanics, the mass as a measure of resistance to accelerat is the most fundamental quantity of an object. So the amplitude square $\Phi_0^*\Phi_0(r)$ of the plane vector $\Phi = \Phi_x + i\Phi_y$ must be the mass density. Owing to this reason, we will call the complex number (Φ_x, Φ_y) as the inertia vector in the following.

The directions of the plane vectors $\Phi(x, y, z_0)$ on the $z = z_0$ cross section are $\frac{\Phi_y}{\Phi_x} = \tan z_0 = \tan 2\pi \frac{z}{\lambda_U}$. They are independent of the coordinates (x, y). All plane vectors (Φ_x, Φ_y) on the same cross section have the same direction, similar to the vectors **E** in the circular polarized light. Owing to this similarity and the consideration of intuition, sometime we will call such symmetrical helices structure of the object or system as "circular polarized structure" in the following. [1,3]

Quantity $2mV^2$ is an explicit function of V and has energy dimension. It must correspond to the kinetic energy of the non-relativistic object.

Now **the necessary condition to satisfy the Schrodinger equation** becomes that the object or system must possess the circular polarized structure of the plane vector $\Phi_0(r)\, e^{2\pi i \frac{2mV}{h} z}$. The modulus square $\Phi^*\Phi$ is their mass density.

There are two kinds of functions can satisfy the Schrodinger equation: (i) in this paper it is the equation of motion of the object it possesses "circular polarized structure" of the inertia vector $\Phi_0(r)\, e^{2\pi i \frac{2mV}{h} z}$ and mass density; and (ii) the state function $\Phi(x,y,z,t)$ in the quantum mechanics. Because the general solutions of Schrodinger equation must be the same complex number, the same circular polarized wave function, no matter we see the solution, eq. (6) as an equation of motion of the object with the structure $\Phi_0(r)\, e^{2\pi i\frac{2mV}{h}z}$ or as the state function in the quantum mechanics. In other words, the wave directly formed by the translation motion of the object with the structure $\Phi_0(r)\, e^{2\pi i\frac{2mV}{h}z}$ and the probability wave of the object are the same wave functions. So we have to answer how the probability wave is formed? Why two functions are the same? We will discuss these problems in the chapter **V.**

Above study tell us why the object itself in translation motion is actually a wave and satisfies the Schrodinger equation. We think this research will give us a further understanding of the quantum physics. Although there are currently something look different between this paper and the quantum physics, they are definitely complementary not contradictory or can be resolved in future research; because two results are from the same partial differential equation, it is impossible contradict each other except we commit here a technical mistake(s). For example, although the physical interpretations of the function $\Phi^*(x,y,z,t)\Phi(x.y.z.t)\Delta x\Delta y\Delta z$ look different at the first glance when we treat it (i) as the mass of the particle in the volume ΔV and (ii) as the probability that the particle is located in the volume ΔV ; we will show in the following discussion (i), they are equivalent when we use it to the atomic and subatomic system.

In order to avoid confuse in expression, since now on we only treat $\Phi = \Phi(x,y,z,t)$ as the equation of motion of the object it has circular polarized structure $\Phi_0(r)\, e^{2\pi i\frac{2mV}{h}z}$ in the following.

Let $d\vec{r}$ be the displacement of the object's mass center. And let us use the mass center to represent the object and call the object as "particle" (with structure) for intuition in the following. Then, the particle energy is $d\in = \vec{F}\cdot d\vec{r} = \frac{d\vec{p}}{dt}\cdot d\vec{r} = d\vec{p}\cdot\vec{U} \overset{\vec{p}\,//\,\vec{U}}{=} U\,dp$.

Where $\vec{U} = \frac{d\vec{r}}{dt}$ is the group velocity $\frac{d\in}{dp} = U$. It is also the particle velocity. $\in_U = \frac{mU^2}{2} \overset{p_U = mU}{=} \frac{p_U^2}{2m}$ Is the kinetic energy of the non relativistic particle. Two expressions of the kinetic energy must be equal $2mV^2 = \frac{1}{2}mU^2$, so $U = 2V$ and

$\lambda_V = \frac{h}{2mV} = \frac{h}{mU} = \lambda_U$. ν_U And λ_U are the frequency and wave length of the particle expressed by particle velocity U . Quantity $p_U = mU$ is particle momentum.

The general solution of the Schrodinger equation, the equation of translation motion of the particle it possesses circular polarized structure $\Phi_0(r)\, e^{2\pi i \frac{2mV}{h} z} = \Phi_0(r) e^{2\pi i \frac{mU}{h} z}$, can be rewritten as

$$\Phi(x,y,z,t) = \Phi_x + i\Phi_y = \Phi_0(r)\, e^{2\pi i(\frac{z}{\lambda_U} - \nu_U t)} \qquad \left(r = \sqrt{x^2+y^2} \le R \text{ , } \lambda_U = \frac{h}{mU} = \frac{h}{p_U} \text{ , } \nu_U = \frac{mU^2}{2h} = \frac{\in_U}{h} \right) \tag{7}$$

or

$$\Phi(x,y,z,t) = \Phi_x + i\Phi_y = \Phi_0(r)\, e^{\frac{2\pi i}{\lambda_U}(z-Ut)} = \Phi_0(r)\cos\frac{2\pi i}{\lambda_U}(z-Ut) + i\sin\frac{2\pi i}{\lambda_U}(z-Ut) \qquad (7)^*$$

Where

$$\lambda_U = \frac{h}{mU} = \frac{h}{p_U} \quad , \quad \nu_U = \frac{mU^2}{2h} = \frac{\in_U}{h} \tag{8}$$

The pitch of particle helix forms the wave length λ_U . The wave surface is particle cross section

Then, the necessary condition to satisfy the Schrodinger equation can be expressed as the particle or system must possess "circular polarized structure" of the inertia vector $\Phi = \Phi_0(r)\, e^{2\pi i \frac{z}{\lambda_U}}$, its modulus square is particle's or system's mass density.

The necessary condition of the Schrodinger equation logically infers the following inferences (A), (B), (C) and (D):

III. Circular polarized structure of $\pm$ charged elementary particles and fermions

(A) The practice has proved that $\pm$ charged elementary particles, composite particles and their nuclei satisfy the Schrodinger equation. Since they must satisfy the necessary condition, so we can judge theoretically they all possess circular polarized structure of the inertia vector (Φ_x, Φ_y) and mass density and have the equation of motion, eq. (7).

Besides, owing to these particles possess intrinsic spin, e.g. $\hbar/2$ simultaneously and because the frequency ν_U varies with the particle velocity $U \prec c$, there must be a constant and maximum frequency $\nu \ge \nu_U$ that the constant spin corresponds to. Then

(a) Where does the extra frequency $\nu - \nu_U$ of the particle come from? It is obvious only the intrinsic self-rotation of the particle can do that. So, according to the conservation law of angular momentum, there is a self-rotation frequency ν_{self} of the particle to make the relation

$$\nu_{self} = \nu - \nu_U \tag{9}$$

(b) The relation $h\nu \overset{let}{=} \in$ is a constant and has energy dimension. Compare to the particle's kinetic energy $\in_U = h\nu_U$, so the quantity

$$\in = h\nu \qquad (U \prec c) \tag{10}$$

must be the maximum energy (total energy) of the particle with intrinsic spin under any $U \prec c$.

(c) And then, the equation of motion of the particle or system that possesses both circular polarized structure of inertia vector (Φ_x, Φ_y) and intrinsic constant spin is

$$\Phi(x,y,z,t) = \Phi_x + i\Phi_y = \Phi_0(x,y)e^{2\pi i(\frac{z}{\lambda_U} - \nu t)} \qquad \left(\in = h\nu\,,\quad p_U = mU = \frac{h}{\lambda_U}\,,\quad U \prec c\right) \tag{11}$$

It implies if the particle possesses both circular polarized structure and intrinsic spin, $\in, p_U$ of the particle and ν, λ_U of the wave the particle forms naturally satisfy the de Broglie relation.

Direct verification shows the wave function, eq. (11) not only satisfies the non-relativistic Schrodinger equation, eq. (1), but also satisfies the Klein-Gordon equation

$$\frac{\partial^2 \Phi}{c^2 \partial t^2} = \frac{\partial^2 \Phi}{\partial z^2} - \frac{m_0^2 c^2}{\hbar^2}\Phi \qquad \left(\Phi = \Phi(x,y,z,t)\right) \tag{12}$$

So eq. (11) satisfies the Schrodinger equation in the whole speed region $0 \prec U \prec c$.

There are two kinds of equation of motion, eq. (7) and eq. (11), they can satisfy Schrodinger equation. Eq. (7) is for the particle or system it just possesses circular polarized structure of the inertia vector (Φ_x, Φ_y); and eq. (11) is for the one it possesses both circular polarized structure and intrinsic constant spin simultaneously.

(B) Long time ago, someone have ever thought that the elementary particle's spin is totally dependent on the self-rotation. But, it leaded to the superluminal difficulty. Using pure self-rotation to explain elementary particle spin is unavailable. So, if a particle possesses intrinsic spin, it must have circular polarized structure simultaneously. Intrinsic constant spin is really a sufficient condition for the particle or system to satisfy the Schrodinger equation.

IV. Right handed and left handed charged elementary particles and Fermions

(C) It is evident that the positive sign non-relativistic Schrodinger equation $i\hbar\frac{\partial\Phi}{\partial t}=\frac{\hbar^2}{2m}\frac{\partial^2\Phi}{\partial z^2}$ has a left handed general solution $\Phi(x,y,z,t)=\Phi_0(x.y)\,e^{-2\pi i(\frac{mU}{h}z-\frac{mU^2}{2h})}$. The practice has proved that the $\pm$ charged elementary particles and fermions satisfy both - and + Schrodinger equations, so we can judge theoretically that any one of these particles has two directions of structures. These particles fall into two categories: they possess the same sign of charge $-e$ or $+e$, but different directions of inertia vector (Φ_x,Φ_y), mass density helices and double helices charge $-e$ or $+e$, like left handed charged particle and right handed charged particle, etc.

Owing to the **B** effect, we can imagine that a pair of left-handed and right-handed charged elementary particles can become “entanglement”, if they are placed closely parallel to each other and become a "B neutral pair". Because the spin direction is decided by the direction of helices structure, so the “entanglement” is like a pair of gloves; left -handed particle is still left-handed; right-handed is still right–handed independent of how far the distance they are.

Owing to the **B** effect, two categories of charged elementary particle are distinguishable. They satisfy F-D statistics. As for the photons, according to the papers e.g. [1, 6], the far field **E, B** of a photon will offset each other, they are undistinguishable and obey B-E statistics.

V. $\pm$ Charged elementary particle is composed of the particle itself and a de Broglie probability wave it accompanies. They form particle- wave hybrid structure

(D) For the charged particle mentioned above, it possesses circular polarized structure of the inertia vectors (Φ_x,Φ_y), eq. (11) and charge $-e$ (or $+e$) simultaneously. Repulsion between the same sign of charge will split the charge element dq on every cross section into two $2\times\frac{dq}{2}$ and locate at two ends of the cross section diameter. According to the similarity among the cross sections, charge $-e$ (or $+e$) will become a pair of charged double helices on the particle's side boundary. It makes particle inside material symmetrically polarized and brings a double helically distributed external **E**-field. The **E**-field becomes a circular polarized **E**-wave when the particle moves along the z-axis. The **E**-wave and circular polarized structure of the particle have the same velocity U, same wave length λ_U and same frequency v, so the equation of motion of the particle and the **E**-wave have the same form of wave function except amplitude.

The charged elementary particle itself and the **E**-wave it brings form a particle-wave hybrid structure. E-wave is outside and covers the particle(s). The particle and the **E**-wave move together with the same phase in the free space until they meet the obstacle.

When they meet a double slit, since the particle itself can not split, so only the particle with its E-wave beam and another E-wave beam from the second slit can form the probability distribution pattern of the particle on the screen. As to the particle itself, uncertain momentum $\pm\Delta p_x$ of the Heisenberg uncertainty principle at Δx just makes the particle(s) symmetrical and uncertain deflection; the particle itself is just a spot locates randomly at the pattern. The distribution of the particle(s) forms the interference pattern as same as the probability distribution pattern at last. So E-wave is the probability wave. Its modular square Φ^2 is the probability distribution function or probability density of the particle. The behavior of the particle(s) is under the control of the de Broglie probability wave.

In quantum mechanics the state of a quantum system is completely specified by the state function $\Phi(r,t)$; in this paper what the wave function represents is just the probability wave, it descript the probability behavior of the atom or atomic system. Although the differences between them do exist, they can be resolved in future research we think.

VII. Discussion

(i) Let us consider the expression $\Phi^*(x,y,z,t)\Phi(x.y.z.t)\Delta x\Delta y\Delta z=\sigma(x,y,z,t)\Delta x\Delta y\Delta z$ for the elementary particle. In this paper, $\sigma(x,y,z,t)$ is mass density of the particle. Above expression originally represents the mass of the particle that is located between x and $x+\Delta x$, y and $y+\Delta y$, z and $z+\Delta z$ at time t. Because only when the size of ΔV is smaller than the volume of the particle, we can talk about how much mass $\sigma\,\Delta x\Delta y\Delta z\Delta t$ of the particle that locates in the space ΔV at time t. But in reality, ΔV that we can take is far greater than the volume of the elementary particle. Under this circumstance, $\sigma\,\Delta x\Delta y\Delta z\Delta t$, the mass distribution of a moving particle in the volume $\Delta x\Delta y\Delta z$ between t and $t+\Delta t$ is proportional to the times (or the number) that the particle passes through (or located) in the volume $\Delta x, \Delta y, \Delta z$ between (t , $t+\Delta t$). If the inertia vector Φ is normalized, the result is a percentage. $\Phi^*\Phi\Delta x\Delta y\Delta z = \sigma(x,y,z,t)\Delta x\Delta y\Delta z$ Is just the probability that the particle is located between x and $x+\Delta x$, y and $y+\Delta y$, z and $z+\Delta z$ between t and $t+\Delta t$ **.** The interpretation is similar to the state function in quantum physics. Then $\Phi^*\Phi = \sigma(x,y,z,t)$, can be also referred to the probability density or probability distribution function.

(ii) A charged particle mentioned above is consisted of the particle itself and the de Broglie wave. The de Broglie wave exhibits all the possible states and its probability that the particle can take. As to the particle itself, it can not split into two parts, so it can take only one basis state, e.g. in an eigen state of the atom (or molecule) or at a point in the interference pattern at the moment t . The superposition principle here is just to bring in the integral constants and general solution. [7] Depending on the given conditions, like the normalized condition, boundary condition and initial condition etc. the state of the electron in the atom or molecule can be decided definitely by its quantum numbers. So, for the particle- wave hybrid structure, the idea of electron orbit corresponding to a set of definite quantum numbers is available.

As to the interference, uncertain momentum $\pm\Delta p_x$ of the Heisenberg uncertainty principle at Δx makes the symmetrical and uncertain deflection of the particle(s), so the position of the particle(s) at the pattern is just random. The distribution of the particle(s) forms interference pattern at last.

(iii) If there are two electrons of different categories reside in the same orbit in the atom or molecule, the repulsion between opposite directions of **B** will make two electrons into stable equilibrium; if two electrons are of the same category, attractions from two sides of the electrons will make the equilibrium unstable and broken. In other words, two or more electrons of the same category can not form the stable equilibrium in a quantum state. Similar reason is also available to the fermions. It seems it is very likely the reason for the Pauli Exclusion Principle.

VIII. For the equal energy process, there are two particular relativistic properties of the $\pm$ charged elementary particles and the particles mentioned above

For the ordinary particles, mass m in the formula $\in=\frac{mc^2}{\sqrt{1-\beta^2}}$, $p=\frac{mU}{\sqrt{1-\beta^2}}$ and $\in=\sqrt{p^2c^2+m^2c^4}$ is constant irrelevant to the velocity U. But for the $\pm$ charged elementary particles and fermions or in general, for the systems they possess circular polarized structure of the inertia vector (Φ_x,Φ_y) (and mass density) and intrinsic constant spin simultaneously the situation is different.

For the equal energy process, let us consider the formulas

$$\in=\frac{mc^2}{\sqrt{1-\beta^2}}\overset{let}{=}Mc^2=\text{constant} \tag{13}$$

$$\in=\sqrt{p^2c^2+m^2c^4}\overset{(8)}{=}\sqrt{\frac{h^2c^2}{\lambda_U^2}+m^2c^4}=h\nu=Mc^2 = \text{constant.} \tag{14}$$

If velocity U increases, $p=\frac{mU}{\sqrt{1-\beta^2}}$ will increase and mass m will decrease; if velocity U decreases, the situation is reverse. So for the particles mentioned above, equal energy process is really a transformation process between p and m. Mass m is no longer a constant. It varies with velocity U is under the meaning of the transformation between p and m. The pitch λ_U, it is also the wave length of the particle with circular polarized structure varies with velocity U is also owing to this relativistic effect, eq. (14), not owing to elastic deformation of the particle.

Since p is a function of U, frequency ν_U is formed by the translation motion and direct depends on U, so p of the particle is a measure of ν_U. Compare eq. (9) and (13), m must be a measure of the self rotation frequency ν_{self} at velocity U. Equal energy process is also a transformation process between the frequencies ν_V and ν_{self}. Maximum ν_{self} happens at $U=0$, then $\in=Mc^2$. M As the rest mass, it is a measure of the maximum self rotation frequency ν_{self}.

For the stationary state in the atom or molecule, energy is constant, so electron mass varies with U $m = M_0\sqrt{1-\beta^2} \le M_0$. Then the reduced mass of the electron and nucleus is $\mu = \frac{mM_{nucleus}}{m+M_{nucleus}}$. It will make a perturbation with a small amount to its energy $E_n = -\frac{\mu e^4}{8\varepsilon_0^2 n^2 h^2}$ (we take hydrogen $Z=1$ and Bohr orbits here). It will shift the magnitude of E_n of any energy levels and makes an energy difference between any two energy levels in the atom and molecule. The mass $m = M_0\sqrt{1-\beta^2}$ may influence the physical chemical processes in the atom and molecular.

For the stationary state, mass m of the moving electron in hydrogen varies periodically except the circular motion. Probably, the periodic change of m may make electron trajectory in the hydrogen no longer a simple ellipse but a processing ellipse so called a rosette.

IX. Conclusion

Since the general solution of Schrodinger equation is a circular polarized wave, to satisfy this equation being proved need a necessary condition: the particle or system must possess a circular polarized structure of the plane vector (Φ_x, Φ_y), the modulus square is their mass density. Because the practice has proved $\pm$ charged elementary particles, atoms and molecules all satisfy the Schrodinger equations with - sign and + sign, we can theoretically predict or assert that: (i) they all possess circular polarized structure of the inertia vector (Φ_x, Φ_y) and mass density.

Translation motion makes the particle itself form a circular polarized wave it satisfies the Schrodinger equation; (ii) Every one of them falls into two categories: it has the same sign of charge $-e$ or $+e$, but different directions of mass density and charged helices, like left handed electron and right handed electron etc; (iii) Charge $-e$ (or $+e$) is distributed double helically on the particle side boundary. It carries a circular polarized de Broglie wave. The particles mentioned are all consisted of the particle itself and the probability wave it accompanies. Such hybrid structure shows particle property and wave property simultaneously in the experiments. The problem "why the atomic and subatomic charged particles have wave property and satisfies the Schrodinger equation?" have been answered.

It is obvious this paper is a complement to the quantum physics, not the opposite.

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