On G matter wave theory

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Abstract. The real and imaginary parts of the complex can well reflect the contradictions of unity of opposites and transformed into each other. The real part of the complex physical quantity reflects the nonlinear and non-superposition characteristics of the particle, the imaginary part reflects the fluctuation characteristics of material linear and superposition. The real part of the complex energy form the macroscopic Einstein mass energy equation, the imaginary part of the complex energy form Planck energy equation. Bosons and fermions are the same substance in different motion state in time and space. The peak of the matter wave form boson state typical; intersection of matter wave and the space formed fermions typical U (20) superunified group covers four kinds of forces.

1. Introduction

We learn from daily life that the law of elastic collision full represents particle properties, such as Compton effect etc. Reflection, interference and diffraction mainly show wave properties of matter, such as Davisson-Germer diffraction experiment, etc. de Broglie first introduced the concept of matter wave [1].

2. Vector form of G matter wave

Given that the complex vector of the matter field is E (E: complex vector matter field), we have: (see figure 1) \( \beta = \pi + \theta \) as the matter field intensity equals to the acceleration of gravity.

\[
E = E_x + iE_y = |E|e^{i\beta} = |E|(\cos \beta + i \sin \beta)
\]

\[
= -|E|(\cos \theta + i \sin \theta) = -|E|\sqrt{1 - \frac{v_x^2}{c^2}} + i|E|\frac{v_x}{c}
\]

(1)

Figure 1. G time-space accelerated.
The formula above is a right-handed rotation vector, the part reflects the nonlinear and non-superimposed properties of the particles, and the imaginary part reflects the linear and superimposed characteristic of the wave (see figure 2).

![Figure 2. Local propagation of G complex matter wave.](image)

When the real parts are equal in the formula above, we will have:

$$E_r = -|E|\sqrt{1 - \frac{v_r^2}{c^2}}$$

(2)

formula (2) the imaginary part will be:

$$E_i = |E|\frac{v_r}{c}$$

(3)

3. Material wave parameters

3.1. G complex matter wavelength function

$$\lambda = \lambda_r + i\lambda_i = \lambda|e^{i\theta}| = |\lambda|(\cos\theta + i\sin\theta)$$

$$= |\lambda|\left(\sqrt{1 - \frac{v_r^2}{c^2}} - i\frac{v_r}{c}\right)$$

(4)

The formula above is the right-handed wave

With the real part:

$$\lambda_r = |\lambda|\sqrt{1 - \frac{v_r^2}{c^2}}$$

(5)

The formula indicates that: wavelength decreases with an increase of velocity.

With the imaginary part:

$$\lambda_i = -\frac{|\lambda|v_r}{c}$$

(6)

When $v_r = 0$, we will have $\lambda = \lambda_r = |\lambda|$

We $v_r = c$, we will have: $\lambda = \lambda_i = -\frac{|\lambda|i}{c}$, which means that when the particle motion velocity is the velocity of light, its wavelength will be imaginary and equal to the negative wavelength mode.

3.2. Frequency of G complex matter wave

$$f = f_r + if_i = \frac{v}{\lambda} = \frac{c}{|\lambda|}(-\sin\theta + i\cos\theta) = \frac{v_r}{|\lambda|} + i\frac{c}{|\lambda|}\sqrt{1 - \frac{v_r^2}{c^2}}$$

(7)

When the real parts are equal, we will have:
When \( v_r = 0 \), we will have: \( f_r = 0, f = f_s = \frac{c}{|x|} \)

When \( v_r = c \), we will have: \( f_s = 0, f_r = \frac{c}{|x|} \)

The formula indicates that the real frequency increases with an increase of the motion velocity; it decreases with a decrease of the motion velocity.

3.3. G complex time function

\[
t = t_r + it_s = \frac{s}{\nu} = \frac{|s|}{c(-\sin \theta + i \cos \theta)} = \frac{|s|(\sin \theta + i \cos \theta)}{c(\cos^2 \theta + \sin^2 \theta)}
\]

\[
= \frac{\hbar}{c^2} v_r - i \frac{\hbar}{c} \sqrt{1 - \frac{v_r^2}{c^2}}
\]

The real part of the formula is:

\[
t_r = \frac{\hbar}{c^2} v_r
\]

The formula indicates that time increase with an increase of the motion velocity of an object (time dilatation). Time is speed

When \( v_r = 0 \), there will be no real time but imaginary time: \( t_r = 0, t = t_s = -i \frac{\hbar}{c^2} \)

It indicates that real time is a product of object motion.

When \( v_r = c \), there will be no imaginary time but real time: \( t = \frac{\hbar}{c} \)

3.4. Expression of G complex space-time

According to \( \sin \theta = -\frac{v_r}{c} \), when \( v_r = c \), \( \sin \theta = -1 \) will be obtained. In this case, \( \theta = 2k \pi - \frac{\pi}{2} \), which means that when the space H moves at the velocity of light, the projection of the space length on the static space S will be zero. That is to say that the space H is purely imaginary space (time) and perpendicular to the static space (purely real space) S. Therefore, the complex space-time can be written as the direct-sum of space and time, that is: The space-time complex number of particle at point Q can be written in the formula below:

\[
K = K_r + iK_s = |K| (\cos \theta + i \sin \theta)
\]

\[
= |K| \sqrt{1 - \frac{v_r^2}{c^2}} + i |K| \frac{v_r}{c}
\]

\( (K_r \) is the three-dimensional space with the attribute of Riemann's non-Euclidean geometry; \( Kx \) is the one-dimensional imaginary space (time) with the attribute of Lobachevsky geometry.)

If the three-dimensional space \( Kr \) is contracted to the one-dimensional \( x \), and assume that

\[
k = cT
\]

\( (k \) is vacuum distance, \( c \) is the velocity of photon in vacuum; \( T \) is the vacuum time; the velocity which the rest mass is not zero or of photon in the medium is \( v_r \) (or the projection of velocity of light on space). The time is \( t \) that is called dielectric or ordinary time). The relationship is:
Substituting (12) for (13) above in (11) to get:

\[
k = K_r + iK_\theta = |k|(\cos \theta + i \sin \theta)
\]

\[
= |k| \sqrt{1 - \frac{v^2}{c^2}} - i \frac{cct \times v_r}{v_r c}
\]

\[
= r - ict
\]

(c is the velocity of light; \( r \) is the spatial distance; \( t \) is dielectric or ordinary time) The formula above serves as the mathematical basis of complex space-time plan.

4. Wave-particle duality

4.1. Compton scattering experiment (particle properties)

The real part of the complex wave function will be used below to derive Compton Effect formula (see figure 3).

According to the real part of formula (4),

\[
\lambda_r = |\lambda| \cos \theta
\]

We have:

\[
\Delta \lambda_r = \lambda_0 - \lambda_r = |\lambda|(\cos \theta_0 - \cos \theta)
\]

\[
= -2|\lambda| \sin \frac{\theta_0 + \theta}{2} \sin \frac{\theta_0 - \theta}{2}
\]

Because \( \theta_0 = 0 \)

So we have:

\[
\Delta \lambda_r = 2|\lambda| \sin \frac{\theta}{2}
\]

According to de Polo’s mean wavelength formula [2]

\[
\lambda_c = \frac{h}{mc}
\]

Have [3]

\[
\Delta \lambda_r = \frac{2h}{mc} \sin \frac{\theta}{2}
\]

This formula is Compton Effect formula.

It should be noted that Compton’s formula is based on a complete elastic collision of light as light particles and electrons. Thus satisfying the conservation of energy and momentum before and after collision. On this account, the real part of the complex light function really reflects the property of complete elastic collision of light as particle.
4.2. Diffraction experiment (wave nature)
The relations between wavelength and diffraction angle in Davisson-Germer diffraction experiment, 
two-split diffraction experiment of electron by Jiang Sen and the experiment of diffraction of 
monochrome neutron on polycrystalline by Wollan-Shull meet Bragg relation that fully reflects the 
properties of wave.

The imaginary part of the complex wave function will be used below to derive Bragg relation 
expression [4].

According to the imaginary part of formula (4),

\[ \lambda = |\lambda| \sin \theta \]  \hspace{1cm} (20)

Supposing that

\[ |\lambda| = \frac{2d}{n} \]  \hspace{1cm} (21)

We will have

\[ \lambda = \frac{2d}{n} \sin \theta \]  \hspace{1cm} (22)

This formula is Bragg diffraction relation expression.

It indicates that the imaginary part of wave function fully reflects the wave nature of matter wave.

4.3. Wave-particle duality relationship
The formula of complex energy:

\[ E = mc^2 e^{i\theta} = mc^2 \sqrt{1 - \frac{v^2}{c^2}} - ic|\psi| \]  \hspace{1cm} (23)

made \( P = |\psi| \), as \( P = \frac{\hbar}{\lambda}, \lambda = \frac{v}{f}, f = \frac{c}{v}, f_c \).

So (23) have:

\[ E = mc^2 e^{i\theta} = mc^2 \sqrt{1 - \frac{v^2}{c^2}} - i \hbar f_c \]  \hspace{1cm} (24)

As \( h = 2\pi \hbar, f_c = 2\pi \omega_c \), so have

\[ E = mc^2 |e^{i\theta}| = mc^2 \sqrt{1 - \frac{v^2}{c^2}} - i \hbar \omega_c \]

\[ E = m_c c^2 - i \hbar \omega_c \]  \hspace{1cm} (25)

\( \omega_c \) is photon vibration frequency and photon circle frequency.

Formula (25) is the G complex energy formula. On the right side of the first type (real) reflects the 
state of particle (macroscopic properties), second (imaginary) reaction wave dynamic (quantum 
properties). The formula is closely linked with the unity of opposites and mutual transformation of 
particle and wave dynamics and macroscopic states and quantum state. Note: particle state (macrostate) 
and dynamic wave (quantum states) are different forms of the same substance.

For the composite neutrinos and photons (abbreviation photons zygote) when the vacuum speed of 
light, real part (particle characteristics) is zero, the zygote into the photon, mainly reflects the volatility; 
when the interaction between light and material, the real part of the zygote (particle characteristics) is 
no longer, the zygote is transformed into neutrinos, show particle characteristics. This is root cause of 
wave-particle duality.

The real part of formula (25) is:
\[ E = mc^2 \sqrt{1 - \frac{v^2}{c^2}} = mc^2 \]  

The upper form is the famous Einstein equation of energy, which reflects the real (static) energy of the substance, that is, the internal energy.

The imaginary part of the form of formula (25) is:

\[ \epsilon_i = -ic[mv] = -ih\omega \]  

The upper formula is the famous Planck energy formula, which is the kinetic energy of the particle.

It can be said that neutrino and photons are the different forms of the same particles photoneutrino, the neutrino form the real parts of photoneutrino, the photons form the imaginary part of photoneutrino.

According (23)

At that time \[ v \rightarrow 0 \], have

\[ E = E_i = \left| mc^2 \right| \]  

At that time \[ v \rightarrow c \], have

\[ E = iE_i = -ih\epsilon_i \]  

Namely

\[ iE = hf \]  

Type G wave energy equation (volatility). On the approximation and Planck equation, but g wave equation can be left with the imaginary unit \( i \): Compared with \( mc^2 \) energy, the energy is virtual energy.

According to the virtual energy (24) and complex rules, there are:

\[ E^2 = E_i^2 + (hf)^2 \]  

Type G wave energy equation.

5. Supersymmetry

Note: Fermion and boson are antagonistic and unified and mutually transformational and reflects different existential state in complex space-time of the same particle. Drut from Seattle University in Washington State, U.S. and Piotr Magierski from Warsaw University of Technology cooperated with each other to provide a new mixed-state super-flow with properties of both fermion and boson for scientists. The research paper is published in Physical Review Letters in March 10.

Bulgac said that “You can change the boson system into fermion system through simple change of temperature. So far, this phenomenon is not common in any other systems.”

See figure 4, Supersymmetric model. Fermion and boson are different forms of existence of the same particle GY in complex space-time [5].

![Figure 4. Supersymmetric model.](image1)

![Figure 5. GY particle fiber bundle.](image2)
See figure 5, GY particle fiber bundle (i.e. movement track in complex space-time).

Projection of movement track of GY particle in complex space-time is splayed in real space and circle in bundle space. Fermion is in A point and antiparticle of A fermion in $\bar{A}$, boson in B point and $A'$ and $\bar{A}'$ are projection of fermion and its antiparticle in base space (real space), $B'$ is projection of boson B in base space and $B''$ is projection of boson B in bundle space (time). During GY particle rotates from A point to B point, the space is positive, after it moves along the time, the GY particles present electronegative at this time. When it comes to B point, it is transformed into boson with no electrical property at the time; during it rotates from B point to $\bar{A}$ point, the space is negative, after it moves against the time, GY particle is takes on electropositive at the time; when it reaches $\bar{A}$, it rotates 360 degrees and is transformed into antiparticle of fermion A; when GY particle rotates from $\bar{A}$ points to B point again, the space is negative still and at the time it moves clockwise, the particle takes on electronegativity again; when it comes to B point, it is transformed into boson (without electrical property) again; during the movement from B point to A point, the space is positive and after moves against the time, the particle takes on electropositive at the time again. When it comes to A point, it is transformed into original fermion A again; till now, fermion returns to original point after rotation of 720 degrees in total. It can be seen that GY particle in B point (which is boson at the time) returns to B point (electric charge and rest mass is 0 still while the chirality changes at the time) after rotates 360 degrees through A point, and returns to B point again after rotation of another 360 degrees through $\bar{A}$ point; therefore, boson returns to original point after rotation of 360 degrees. The fermion returns to original point after rotation of 720 degrees (see figure 6).

6. Matter waves (Time-space ripples)
Gravitational waves exhibit different isospin values in space. For the typical fermions falling on the spatial axis, the isospin values are just $-3/2, -1/2, 1/2, 3/2$ (the larger the number of spins, the more peaks appear on each turn i.e. the shorter the wavelength).

Figure 6. G complex time-space 3 d model.

Figure 7. Gravitational wave diagram (the space-space ripples).
Figure 8. Gravitational wave diagram (the space-time ripples).

The states whose isospin values are -2.-1.0.1.2 are typical boson states. Typical boson states form the peak of gravitational waves in complex space-time. Gravitational waves in time show the expansion and contraction of space with time (see figure 7 and 8).

7. Conclusions
The real and imaginary parts of the complex can well reflect the contradictions of unity of opposites, and transformed into each other. The real part of the complex physical quantity reflects the properties of the particle material nonlinear and non-superimposing, the imaginary part reflects the fluctuation characteristics of material linear superposition. The real part of the complex energy form the macroscopic Einstein mass energy equation, the imaginary part of the complex energy form Planck energy equation, bosons and fermions are the same substance in different complex motion state in time and space. The peak of the matter wave form boson state typical; intersection of matter wave and the space formed fermions typical U (20) superunified group covers four kinds of forces

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