Quantum-Mechanical Description of Physical Reality Shall Be Considered Complete

Zhonglin BO*

Dupont China Technical Center, 600 Cailun Road, Shanghai 201203, P.R. China
*Corresponding author: bill.b.bo@dupont.com

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Abstract After the deduction and comparison of wave motions of classical particles and quantum particles, we prove that there are two restrictions applied to both classical particles and quantum particles. Both restrictions are just to ensure energy conservation principle of the wave motion. The Heisenberg’s famous inequality was nothing to do with the measurements of particle’s position or momentum, the restriction of the inequality is just the lower limit of the wave motion. His uncertainty principle was not correct from both mathematical and physical perspective. Based on the mathematic analysis and logic reasoning process review, we conclude that all the Heisenberg’s uncertainty principle, Born rule and Bohr’s complimentary principle were not correct. Even for a quantum particle, at any time, it must be classically localized instead of non-local. Without the Copenhagen interpretations, the quantum mechanics shall still be considered complete according to EPR’s criteria which are used to verify the completeness of a physics theory. The particle-wave duality of quantum particles comes from their inner features of electric vector(s).

Keywords: Heisenberg’s uncertainty principle, Born rule, Bohr’s complimentary principle, physical reality, spin, particle-wave duality


1. Introduction

Let’s imagine a small ball with mass \( m \), moving along the x-axis, subject to some specified force \( F(x, t) \) as Figure 1. The program of the classical mechanics is to determine the position of the ball at any given time \( x(t) \).

Once we know it, we can figure out the velocity \( \left( v = \frac{dx}{dt} \right) \), the momentum \( (p = mv) \), the kinetic energy \( (E_k = \frac{1}{2}mv^2) \), or any other dynamical variables of interest [1].

How do we determine \( x(t) \)? We just need to apply Newton's second law, \( F = ma \). In a conservative system the force can be expressed as the derivative of a potential energy function, \( F = -\frac{\partial V}{\partial x} \), and Newton's law is described as Equation 1:

\[
m \frac{d^2x}{dt^2} = -\frac{\partial V}{\partial x}
\]

With appropriate initial conditions, typically the position and velocity at \( t = 0, x(t) \), the position of the ball at time \( t \) will be determined.

As the 20th century progressed, for many problems on the atomic scale, neither special theory of relativity nor classical physics could provide theoretical answers. Attempts to apply the laws of classical physics to explain the behaviors of matter on such tiny scale were consistently unsuccessful. For example, the emission of discrete wavelengths of light from atoms in a high-temperature gas could not be explained within the framework of classical physics. As physicists sought new ways to solve these puzzles, another revolution took place in physics in the early 1900s. A new theory called quantum mechanics was highly successful in explaining the behavior of particles of microscopic size. The first explanation of a phenomenon using quantum theory was introduced by Max Planck. Many subsequent mathematical developments and interpretations were made by many distinguished physicists, including Einstein, Bohr, de Broglie, Schrodinger, Born, Pauli and Heisenberg [2].
Quantum mechanics approaches this same problem with a quite different way for a particle in wave motion around a nucleus as in Figure 2. In this case what we're looking for is the wave function, $\Psi(x,t)$, of the quantum particle, and we get it by solving the Schrödinger Equation 2.

$$\frac{-\hbar^2}{2m}\frac{\partial^2 \Psi}{\partial x^2} + V\Psi = i\hbar \frac{\partial \Psi}{\partial t}$$

(2)

Despite the great success of the quantum theory, Einstein frequently played the role of critic of quantum mechanics, especially regarding to the manner in which the theory was interpreted, with uncertainty principle, probability rule and complimentary principle.

In attempting to judge the success of a physical theory, Einstein, Podolsky and Rosen [3] set up two criteria to verify the completeness of a physical theory, “1) every element of the physical reality must have a counter part in the physical theory. 2) If, without in any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity”.

Because the quantum mechanics claims that when the momentum of a particle is known, its coordinate has no physical reality due to the uncertainty principle. From this Einstein arrived at the conclusion that “either (1) the quantum mechanical description of reality given by the wave function is not complete or (2) when the operators corresponding to two physical quantities do not commute the two quantities cannot have simultaneous reality”.

Einstein’s argument of incompleteness of quantum mechanics directly triggered the research of hidden variable theories. However, John von Neumann [4] published a book in 1932, part of which claimed to prove that all hidden variable theories of quantum mechanics were impossible. This result was found to be flawed by Grete Hermann three years later, though this kept unnoticed by the physics society for more than fifty years.

The first hidden-variable theory was the pilot wave theory [5], presented firstly by Louis de Broglie in 1927. In 1952, David Bohm, dissatisfied with the prevailing orthodoxy of quantum mechanics, rediscovered de Broglie's pilot wave theory. Bohm developed pilot wave theory into what is now known as the de Broglie–Bohm theory [6,7]. The de Broglie–Bohm theory might have gone unnoticed by most physicists, if it had not been championed by John Bell, who also countered the objections to it. In 1987, Bell rediscovered Grete Hermann’s work [8], and thus showed the physics society that Pauli’s and von Neumann’s objections “only” showed that the pilot wave theory did not have locality.

Although the quantum mechanics has held up to rigorous and extremely precise tests in an extraordinarily broad range of experiments. And it has been the core of our understanding of nature for almost one century. The views of interpretation on fundamental questions as whether quantum mechanics is deterministic or stochastic, which elements of quantum mechanics can be considered real, and what the nature of measurement is, have never been reached consensus among physicists and philosophers of physics [9]. Copenhagen-type ideas were never universally embraced, and challenges to a perceived Copenhagen orthodoxy [10,11] gained increasing attention.

As realists, we try to re-analyze the principles of quantum mechanics and try to illustrate the completeness of quantum mechanics and intrinsic physical nature of any particle in wave motion, because the Copenhagen Interpretations are too counterintuitive and anti-realistic.

2. Theory Deduction

2.1. Heisenberg’s Uncertainty Principle

2.1.1. Inequality Basics

The uncertainty principle introduced first by Heisenberg’s in 1927 states that the more precisely the position of some particle is determined, the less precisely its momentum can be predicted from initial conditions, and vice versa [12]. Since the uncertainty principle relies on an inequality, so let’s review the basic properties of inequality first. Suppose there are three real numbers $a, b,$ and $c$ with domain greater than zero. Both $a$ and $b$ are variables and $c$ is a constant. Their relation of the first scenario is as following inequality 3.

$$ab \geq c$$

(3)

1) If both $a$ and $b \uparrow$, the inequality is always true
2) If both $a$ and $b \downarrow$, the equality could be true or false
3) If $a \uparrow$ and $b \downarrow$ or $a \downarrow$ and $b \uparrow$, the inequality could be true, but not imperative

Therefore the conclusion that if $a$ increases and $b$ has to decrease is incidentally true but not imperative for inequality 3. If their relation of second scenario is as inequality 4,

$$ab \leq c$$

(4)

1) If both $a$ and $b \downarrow$, the inequality is always true
2) If both $a$ and $b \uparrow$, the equality could be true or false
3) If $a \uparrow$ and $b \downarrow$ or $a \downarrow$ and $b \uparrow$, the inequality is imperatively true.

Thus the conclusion that if $a$ increases and $b$ has to decrease is imperatively true for inequality 4 and vice versa.

2.1.2. Classical Particle

Before we explore the physical meaning of the uncertainty principle, let’s check a classical wave motion first, the simplest wave function as Equation 5. We all know that a wave motion is a combination of uniform linear motion and an oscillation, $y$ represents the displacement of an oscillator deviating from its oscillating balance position, $A$ as the amplitude of the oscillation, $u$ as the wave speed, $m$ as the mass of the particle in oscillation.
\[ y = A \cos x \]
\[ dy = -A \sin x \, dx \]
\[ \frac{dy}{dt} = v_y = -A \sin x \frac{dx}{dt} = -Av_x \sin x = -uA \sin x \]
\[ v^2 = v_x^2 + v_y^2 = u^2 + (-u \sin x)^2 = u^2 + u^2 A^2 \sin^2 x \]
\[ p = mv = mu \sqrt{1 + A^2 \sin^2 x} \]
\[ dp = mdv = \frac{mu^2 A^2 \sin x \cos x \, dx}{\sqrt{1 + A^2 \sin^2 x}} \]
\[ E_k = \frac{1}{2} mv^2 = \frac{1}{2} mu^2 \left(1 + A^2 \sin^2 x\right) \]
\[ dE_k = mu^2 A^2 \sin x \cos x \, dx \]

And
\[ E_k = \frac{p^2}{2m}; \quad dE_k = \frac{dp \, dp}{m} = mu^2 A^2 \sin x \cos x \, dx \]
\[ dp = \frac{mu^2 A^2}{p} \sin x \cos x \, dx \]
\[ p \, dx = mu \sqrt{1 + A^2 \sin^2 x} \, dx = mu \sqrt{1 + A^2 \sin^2 x} \, dA \]
\[ = \frac{xmu^2 A^2 \sin x \cos x \, dx}{\sqrt{1 + A^2 \sin^2 x}} = x \, dp \]
\[ dx \, dp = \frac{mu^2 A^2}{p} \sin x \cos x \, dx \]
\[ dx \, dp = \frac{pdx \, dp}{x} \]

Because at any time for a particle during its wave motion
\[ p \geq p_x; \quad p_x = mu. \]

If we always take absolute value for \( dx \) and \( dp \) then
\[ dx \, dp \leq muA^2 |\sin x \cos x \, dx| \] (6)
\[ dx \, dp \geq \frac{p_x \, dx \, dp}{x} \] (7)

because any oscillation is a periodic motion, in the whole periodic interval \([0, 2\pi]\), the oscillation in interval \([\pi/2, 2\pi]\), is just the same oscillation in interval \([0, \pi/2]\) or \([\pi/2, \pi]\), but with different oscillation directions, then
\[ \int_0^{\pi/2} dx \, dp \leq muA^2 \left| \int_0^{\pi/2} \sin x \cos x \, dx \right| \]
\[ \int_0^{\pi/2} dx \int_0^{\pi/2} dp \leq muA^2 \left| \int_0^{\pi/2} \sin x \, dx \int_0^{\pi/2} \cos x \, dx \right| \]
\[ \Delta x \Delta p \leq muA^2 \left| \int_0^{\pi/2} d(-\cos x) \int_0^{\pi/2} d(\sin x) \right| \]

\[ \Delta x \Delta p \leq muA^2 \left| \int_0^\pi f(x)^2 \, dx = \langle f|f \rangle \right| \]
\[ \sigma_x^2 = \int_0^\pi |f(x)|^2 \, dx = \langle f|f \rangle \]
\[ \sigma_p^2 = \int_0^\pi |g(x)|^2 \, dx = \langle g|g \rangle \]

The Cauchy-Schwarz inequality asserts that
\[ \sigma_x^2 \sigma_p^2 = \langle f|f \rangle \cdot \langle g|g \rangle \geq \langle f|g \rangle^2 \]
The modulus squared of any complex number \( z \) can be described as:

\[
|z|^2 = \text{Re}(z)^2 + (\text{Im}(z))^2 \geq (\text{Im}(z))^2 = \left(\frac{z - \bar{z}}{2i}\right)^2
\]

If we define \( z = f|g \) and \( Z^* = (g|f) \) and substitute these into the above equation to get

\[
|\langle f|g \rangle|^2 \geq \left(\frac{\langle f|g \rangle - \langle g|f \rangle}{2i}\right)^2
\]

Because the derivative operation to the quantum wave function is canonical commutation,

\[
\langle f|g \rangle - \langle g|f \rangle = xdp - pdx = i\hbar
\]

and

\[
\text{Re}\left(\langle f|g \rangle\right) = \text{Re}\left(\langle g|f \rangle\right); \text{Im}\left(\langle f|g \rangle\right) = -\text{Im}\left(\langle g|f \rangle\right) = i\hbar
\]

\[
\sigma_x^2 \cdot \sigma_p^2 \geq \left(\frac{\hbar}{2}\right)^2
\]

(12)

It was the above inequality that Heisenberg concluded the uncertainty principle that the measurement of both position and momentum at the same time is impossible.

Based on the basic properties of inequality, even position and momentum \((x, p)\) are conjugate variables, this conclusion is only incidentally true, but not imperative. Apparently, the uncertainty principle from mathematical perspective is wrong and the restriction of the inequality, Equation 12, is nothing to do with the measurements of position and momentum at all.

Before investigating the real meaning of this inequality, now let’s verify if the quantum particle is with same measurement of position and momentum at all. According to Equation 11, we can get,

\[
\frac{\partial y}{\partial x} = \frac{ip\psi}{\hbar}; \frac{\partial y}{\partial p} = \frac{ix\psi}{\hbar}; \frac{\partial y}{\partial t} = \frac{-i\psi}{\hbar};
\]

\[
dy = \frac{\partial y}{\partial x}dx + \frac{\partial y}{\partial p}dp + \frac{\partial y}{\partial t}dt
\]

\[
dy = \frac{ip\psi}{\hbar}dx + \frac{ix\psi}{\hbar}dp + \frac{i\psi}{\hbar}dt
\]

Due to \(\text{Re}(xdp) = \text{Re}(pdx)\)

\[
dy = \frac{2ip\psi}{\hbar}dx - \frac{i\psi(2pu - E)}{\hbar}dt
\]

\[
v_x = \frac{dy}{dt} = \frac{2ip\psi}{\hbar}dx - \frac{i\psi(2pu - E)}{\hbar}
\]

\[
dy = \frac{i\psi(2pu - E)}{\hbar}dt
\]

If we define \( u \) the wave speed and

\[
B = \frac{2pu - E}{\hbar}; B_x = \frac{2up_x - E}{\hbar}; B_x \leq B
\]

Then

\[
dy = d\psi = iB\psi dt; v_y = iB\psi
\]

Because the \( \psi \) is a complex number, their squared modulus relation is as follows:

\[
|\psi|^2 = |v_x|^2 + |v_y|^2 = u^2 + (iB\psi)(-iB\psi) = u^2 + B^2\psi^2
\]

\[
dv = \frac{B^2\psi d\psi}{\sqrt{u^2 + B^2\psi^2}} = \frac{B^2\psi d\psi(\text{Bi})}{\sqrt{u^2 + B^2\psi^2}}
\]

\[
dv \leq iB^2\psi dt; dp = m\psi \leq imB^2\psi dt
\]

Where \( m \) is the mass of the particle

\[
dxdp \leq imB^2\psi dtdx
\]

because any wave motion is a periodic motion, an oscillation combined with a uniform linear motion, in the whole periodic interval \([0, T]\), the oscillation in interval \([T/4, T]\), is just the same oscillation in interval \([0, T/4]\), but with different oscillation directions, then

\[
\int_0^{T/4} \int_0^{T/4} dx dp \leq imB^2\psi dxdt
\]

\[
\int_0^{T/4} \int_0^{T/4} dx dp \leq imB^2\psi dxdt
\]

\[
\Delta x\Delta p \geq \frac{mT(2up_x - E)^2}{4\rho \hbar}
\]

(13)

From the above deduction, it is apparent that there are two restrictions applied to a quantum particle in wave motion too, but nothing to do with the measurements of its position and momentum.

\[
\frac{\hbar}{2} \leq \Delta x\Delta p \leq \frac{mT(2up_x - E)^2}{4\rho \hbar}
\]

(14)

If we directly apply the \(\text{Re}(xdp) = \text{Re}(pdx)\) in the range of real number, and always take absolute values for them, then we can get.

\[
xdp = pdx; dp = pdx
\]

\[
dxdp = \frac{pdx}{x} \geq \frac{p_x dpdx}{x}
\]

\[
\int_0^{T/4} \int_0^{T/4} dx dp \geq \left| \int_0^{T/4} \int_0^{T/4} \frac{p_x dpdx}{x} \right|
\]

\[
\Delta x\Delta p \geq \int_0^{T/2} \int_0^{T/2} p_x dp dx dxlnx | | T/4 T/4
\]

The boundary conditions of integral are: \( x_1 = \frac{\pi \hbar}{2p} \) when \( t = T/4 \); \( x_2 = \frac{\pi \hbar}{p} \) when \( t = T/2 \)
\[
\Delta x \Delta p \geq p_x \frac{\pi \hbar}{2p} \ln 2 = \frac{\pi p_x \ln 2 \hbar}{2p}
\]

Finally based on Equation 12, we get

\[p \leq \pi ln2 p_x \text{ or } \nu \leq \mu \pi ln2\]  \hspace{1cm} (15)

From Equation 14 and 15, we can conclude that there is some speed restriction applied to a quantum particle, an electron, to ensure a wave motion, and the speed of the particle is directly proportional to the wave speed. Both restrictions of Equation 14 are applied to the quantum particle too. One restriction is for the wave upper limit, the other is for the wave lower limit.

According to the harmonic oscillator model [15], the energy levels of an electron’s orbit motion are described as follows:

\[E_n = \left(n + \frac{1}{2}\right) \hbar \omega\]

When \(n = 0\), the ground state

\[E_0 = \frac{1}{2} \hbar \omega = \omega \Delta x \Delta p\]

Apparently there is an energy band to ensure the motion of an electron on its orbit. The Equation 14 sets both the lower limit and the upper limit. If the value of \(\Delta x \Delta p\) is less than the lower limit, the electron will crash into the nucleus or will be de-excited to the lower energy orbit; If the value of \(\Delta x \Delta p\) is higher than the upper limit, the electron will be excited to the higher energy orbit. The middle of the interval must be the orbit of the motion of the quantum particle. Both limits ensure not only the energy conservation with same logic as to classical particle but also its motion on its orbit.

### 2.2. Born Rule

The Born rule was a key postulate of quantum mechanics which gives the probability that a measurement of a quantum system will yield a given result [16].

The Born’s logic reasoning process we once summarized in our previous work is as follows [13]:

**Born’s premise:** A particle’s motion was defined as wave function \(\psi\).

**Born’s deduction:** Given a wave function \(\psi\) for a single structureless particle in position space, implied that the probability density function \(P(x,y,z)\) for a measurement of the position at time \(t_0\) is \(P(x,y,z) = |\psi(x,y,z,t_0)|^2\).

**Born’s conclusion:** The particle was not moving as wave function, it could present anywhere in the area corresponding to the \(\psi^2\).

Apparently, Born’s conclusion denied his own premise. His premise and conclusion were in self-conflict. From logic reasoning perspective, either his deduction process, or his conclusion was false. Since the premise was the fact that a particle behaved as a wave, that was why we used wave function to describe the quantum particle’s motion. The premise must be right.

Even though we can use Born’s normalization technique to estimate the presence probability of a quantum particle, we can never deny its intrinsic nature of wave motion from any logics.

The Born’s probability technique was based on the assumption that a quantum particle is structureless in the position space. Let’s review and verify if the structure of quantum particle has any impacts on its physical reality and its phenomena observed or experimented.

In our previous work [17,18], we once configured the inner structures of a proton, a neutron and an electron. Here we just simplify an electron as a thin plate with a negative point-charge fixed at plate center. The plate is with diametric pinholes, so the negative point-charge forms a monopole pair or dimetric vectors as Figure 3.

![Figure 3. The inner structure of an electron](image)

If the electron spins and moves as a free particle, the trajectory of each vector head will form as a wave as Figure 4, at any time or in any time interval, each wave component of the wave packet will offset each other as Figure 5.

![Figure 4. The moving trajectory of the dimetric vector heads in separate mode](image)

![Figure 5. The moving trajectory of the dimetric vector heads in combined mode](image)
Or the wave function of the wave packet is as Equation 16,

$$\Psi(x,t) = \psi - \psi = 0$$ (16)

If we have the test result of probability density, $P(x,y,z)$, for a measurement of the particle position at time $t_0$, there are always two positions for its dimetric vector heads.

$$\psi(x,y,z,t_0) = \pm \sqrt{P(x,y,z)}$$ (17)

Even for the same probability density, $|\psi(x,y,z,t_0)|^2 = |1 - \psi(x,y,z,t_0)|^2$ as Figure 6, it seems we will always neglect one of the trajectories of the dimetric vector heads. And it would be hard to for us predict the accurate position of the particle if we didn’t realize the feature of the electron’s dimetric vectors. Actually the wave function describes the trajectory of the electric vector header instead of the actual motion of an electron. This is the reason why Born Rule supported each other with Heisenberg’s uncertainty principle.

We once developed a new theory [17] that a spin vector in motion will automatically behave with particle-wave duality. Imagine a drum is with an arrow mark on its side, and it is rolling at speed $u$ along $x$ axis in one dimension, at starting point the arrow-header is on the $y$ axis as Figure 7. When you watch the drum’s rolling process, you will find the trajectory of the arrow-header is a wave while the trajectory of the side center of the drum is a straight line.

![Figure 7. A rolling drum with an arrow mark](image)

When a quantum particle embedded with an electric vector(s), moving while spinning, the trajectory of the electric vector will form a wave automatically. When it is totally static, it is absolutely a particle; When it is in motion(moving and spinning), its vector in motion behaves as a wave, the particle in motion is automatically with particle and wave duality at same time. That is the intrinsic nature of all the quantum particles with particle-wave duality. The inner structures of the quantum particles ultimately determine their unique duality. The structureless assumption is really a black curtain preventing us from discovering the nature of the quantum realm.

Bohr’s complimentary principle was deduced from both Heisenberg’s uncertainty principle and Born rule. Apparently, his principle cannot be right without these fundamental supporting bases.

### 3. Discussions

#### 3.1. Spin

As the name suggests, spin was originally considered as the rotation of a particle around some axis. It is an intrinsic nature carried by elementary particles. Spin is described mathematically as a vector for some particles such as photons. The existence of electron spin angular momentum is inferred from experiments, such as the Stern–Gerlach experiment [21,22].

Spin obeys the same mathematical laws as quantized angular momenta do. It implies that the phase of the particle depends on the angle, for rotation of angle around the axis parallel to the spin S. This is equivalent to the quantum-mechanical interpretation of momentum as phase dependence in the position, and of orbital angular momentum as phase dependence in the angular position.

Because elementary particles were treated as structureless and point-like particles, their self-rotation has not been well-defined for them yet. However, Photon spin is the quantum-mechanical description of light polarization, where spin $+1$ and spin $-1$ represent two opposite
directions of circular polarization. Thus, light of a defined circular polarization consists of photons with the same spin, either all +1 or all −1. Spin represents polarization for other vector bosons as well.

Those elementary particles with half-integer spins are known as fermions, while those particles with integer spins, are known as bosons.

We would just define the monopole and dipole vector with s=1, while the diametric (or monopole pair) vectors with s=1/2. Because when a photon’s dipole vector spins 360°, the dipole vector will turn into itself, while the diametric vectors as Fig. 7 spin 180°, the half round, the diametric vectors will turn to itself.

3.2. Particle-Wave Duality

When we developed the theory [17] of spin vector in motion with particle-wave duality automatically, we adopted the equivalent principle two times. 1) the rotation or spin of a vector field is equivalent to a vector’s oscillation. 2) the trajectory of a particle moving as a wave is equivalent to the actual classical wave motion.

But behind the equivalent principle, there are big differences between the particle moving along a wave and the classical wave. For any mechanical wave, we all know that the mass point on the wave is not moving in the wave spreading direction, but only oscillating up and down in a direction perpendicular to the wave spreading direction. The mass point is just transferring the energy to the next mass point. That is why there is media required to spread the mechanical wave. While a particle moving along the wave, it is the actual motion of the particle.

For the light, a photon’s electric dipole vector head is actually moving as a wave. And the changing electric vector will induce the magnetic vector automatically. That is the intrinsic nature why there is no media required to spread the light and electromagnetic wave. According to Equation 15, if the quantum particle is a photon, then the photon’s velocity in wave motion shall be equal to $c\pi/n2$, much higher than the light speed c. It seems this kind of motion exceeds the velocity limit of light speed, specified by special relativity. Based on Figure 7. It is easily for us to understand that the light travels in straight line as particles while the electric dipole vector of a photon moves as an electromagnetic wave at same time.

4. Conclusions

Based on our deduction, we prove that there are two restrictions applied to a quantum particle when it is in wave motion. Both upper and lower limit are just to ensure the energy conservation principle. Heisenberg’s famous inequality is just the lower limit of the two limits. It is nothing to do with the measurement of the particle’s position or momentum. The uncertainty principle is not correct from both mathematical and physical perspective. As to Born Rule, it could be a technique to estimate the presence of a quantum particle. But from any logic reasoning process, the probability rule could never deny the particle’s original motion mechanism. Apparently the structureless assumption prevented us from discovering the nature of the quantum world. According to EPR’s criteria, without in any way disturbing a system, even for a quantum particle, it is still as a localized, classical, and mechanical particle but not non-local. Without Copenhagen’s interpretation quantum mechanics shall still be considered complete.

Any similar interpretations introduced with measure or observation, wave function collapse, quantum particle probability, wave function superposition, were all counter intuitive and not physical interpretations. These interpretations must be wrong from physics point of view.

As realists, we strongly believe that the nature follows its own philosophy and principles, and it is independent to any of our observations and measurements, just as Einstein once said, “The moon is always there, no matter we see it or not”.

References

[18] Zhonglin BO, “The Intrinsic Nature of Strong Force to Bind Proton(s) and Neutron(s) to Form Nucleus and the Exploration of Nuclear Reaction.” International Journal of Physics, 10(3): p137-143 (2022).


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