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Short Communication

The Mysteries of Quantum Physics

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This article examines how we can interpret, or understand, the most counterintuitive elements of Quantum Physics such as complementarity, entanglement, superposition, nonlocality, wave packet reduction, etc., using concrete concepts about particles (standing waves) and Superfluid (granular) Space-Time, which we have studied.

1. Introduction

Quantum mechanics owes its success to a fundamental reality, which is the omnipresence of waves in microphysics. Its problem is that it has never known what waves they are, or at least, has not sought to find out, judging that the resulting mathematical formalism was sufficient. This is how Physics gradually became a mathematical object that moved away from the understanding of things, despite the demonstration by David Bohm who had taken up the old ideas of Louis De Broglie [1,2]. The crux of the problem lies in what is called "wave-particle duality"; we have given a basic physical interpretation to this question, we will clarify it here in order to present a better understanding of the microscopic world [3].

2. Wave-Particle Duality

The vision we presented is based on two new concepts:
• The stationary wave nature of particles whose energy-mass value is the integral of the square of the wave amplitude, see [4].
• The "granular" nature of Superfluid Space-Time, composed of infinitesimal energy dipole vibrators (QFs) constituting a condensate in the "Bose-Einstein" sense.
It indicates that the vibrators in space will resonate with the particle wave through a reaction effect. The common properties (particle and space) are polarization and phase, hence the term "phase field" associated with the particle. Thus, an elementary moving particle is made up of the particle wave and its phase wave in space (*).
This association arises from the periodic capture of a fundamental quantum (QF) by the particle, a reaction necessary to maintain the particle, see [5]. (*) The movement of the particle creates a wave in the phase field, see below.

3. Phase Field and Phase Wave

We postulated that the capture of a QF by the corpuscle, at each rotation period of its vortex, led to the establishment of a polarization "line" of the vibrators of Space. The set of these lines constitutes the particle's phase field; each of the vibrators in this field is constantly in phase with the particle's own wave, which signifies an instantaneous transmission of polarization from one vibrator to another. This instantaneous transmission would be a property of the fundamental level of Space as a condensate possessing a unique wave function; it is only possible for quantities independent of energy, such as phase or spin, in addition to polarization. Conversely, all energy transport, like electromagnetic waves, is subject to a limited speed.

The phase field is of macroscopic dimensions, it expresses the resonance of Space-Time to the natural vibration of the particle. In this context, we can clarify what the phase wave of Louis De Broglie which is the wave taken into account by the Schroedinger equation [2]. From the above, it is clear that any change in the position of the corpuscle dx produces a phase shift d(ph), in a fixed frame, which falls within the phase field. We then have **d(ph) = 2pi dx/lambda**, which signifies the creation of a wave inside this field; we then show that its wavelength is **lambda = h/p** (1), h is Planck's constant and p is the angular momentum of the particle [2]. In the non-relativistic case, this wavelength is much greater than the corpuscle, dictated by the particle's own wavelength, conversely, any modification in the phase field by an "external" field, fixed or moving, will be transmitted to the corpuscle, instantaneously if the properties are energy-independent; this may concern the direction of displacement; we then have the De Broglie guide wave.

4. Back to Quantum Physics

Let us first consider what is called "**wave behavior**" illustrated by the Young slit experiment; it follows directly from the De Broglie wave in the phase field of the particle that guides the corpuscle. We have indicated that this occupies macroscopic dimensions, which integrates Alain Aspect's experiments known as "delayed choice" by a single particle (see Wiki page), since this field (or wave) exists, as we have seen, well before the arrival of the corpuscle at the interference device, due to its macroscopic dimension. Let us continue with Bohr **principle of complementarity**; it is clear that the experimental setup determines what we perceive of the dual aspect; the two are therefore exclusive (and therefore complementary) in the experimental domain, this fact replace that we call ”wave packet reduction”.

Let us now look at Heisenberg "**indeterminacy principle**"; let's take the example of angular momentum, relation (1) mixes this quantity (p), associated with the particle, and another associated with the wave (position x). These two quantities are, as we said, "exclusive", position x is related to lambda by the phase relationship dx = [lambda d(ph)]/2pi. Precise measurement of both quantities is therefore impossible according to quantum mechanics. Let us examine now the **principle of superposition**; it is worth recalling this principle, which is not always well understood: Within the same wave function (same quantum state), we cannot specify, for example, the exact position of the particle, or rather of the corpuscle. This is, in fact, another example of Heisenberg's indeterminacy, but here we must introduce the notion of probability, which tells us that the presence of the corpuscle in a specific location is dictated, in probability, by the value of the square of the wave amplitude, which is an additional precision due to the position/phase relationship. This is the phase wave, which covers a space much larger than the dimensions of the corpuscle and is a component of our phase field, the latter is subject to numerous perturbations in an environment in which particles, gravitons, and other moving fields circulate; it has been said that these perturbations of the phase field are transmitted instantaneously to the particle, which introduces a random character to its position within the wave; this brings us back to the rule of probability. However, as David Bohm pointed out, the particle always occupies a well-defined and variable position within the wave; external perturbations can be considered, here, as "hidden variables"...

5. The "Mystery" of Quantum Entanglement

This mystery has quite a history: from the controversy between Einstein and Bohr and Bell's inequalities to the experiments of Alain Aspect, not to mention David Bohm's position. All of this has had the great merit of raising the most fundamental questions about quantum physics. The phenomenon does not correspond directly to an experimental discovery, but stems from the very old intellectual opposition over Determinism, taken up here by the two great founding scientists of quantum physics.

Let us see how considering the phase field sheds new light on this great issue, which will allow us to better describe what entanglement is: First, the phenomenon only exists between particles that have a very strong kinship. If they are created at the same time, in the same atom, they have a common or correlated physical link, this link can be polarization or spin, and in all cases, the direction of propagation must be in the opposite direction (at creation). According to what we said previously, two entangled particles then have the same phase field since it is created "instantaneously" at gestation. Their trajectories can then be separated by devices that do not modify the energy, while their polarizations will remain correlated throughout the entire extent of the phase field. Any evaluation of this quantity on one will be correlated with that of the other. We can note the relevance of David Bohm's thinking who envisaged a delocalized "hidden variable" to explain the phenomenon, and this is precisely the phase field common to both particles [1].

6. Decoherence

Despite its macroscopic dimensions, the phase field is not of unlimited extent in Space-Time. Its maintenance at a point must depend on the activity of Space and the frequency of occurrence of the particle's specific bond. We then have the phenomenon of decoherence, which limits the scope of entanglement. It should be possible to approach these limits theoretically, but this probably requires a complete theory of the quantum fluid that constitutes Space. We strongly encourage this work; see our conclusion below.

7. Conclusion

We believe we have provided several avenues for better understanding the quantum world. These elements are based on the nature of elementary particles and on what matter-free space- time really is. May be main result is the explanation of his probabilistic character, opening a way towards Determinism, so giving right to Einstein ! Quantum Physics, until now, has never attempted to access these elements, contenting itself with purely mathematical exploitation, which explains the "mysteries" of its understanding. We believe it is very important to have a theory describing this quantum superfluid that is the Universe, we can probably use elements describing Bose-Einstein condensates, which also offer experimental possibilities. Theories on superconductivity and ferromagnetism can also be useful, and finally, the development of quantum thermodynamics can also provide interesting elements. The building blocks (QFs) are probably complex vibrators whose individual energy is extremely low (around 10^-51 J) while their numerical density is very high (around 10^42/m^3), they have the capacity to form rectilinear waves (photons, gravitons, neutrinos, etc.), and circular standing waves in the case of corpuscles [5].

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