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# NEW FUNDAMENTAL FINDINGS IN MODERN PHYSICS: WAVE NATURE AND COLLECTIVE MOTION ON MICRO PARTICLE

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## Abstract

In the present short communication, the theoretical evidence for wave nature of an arbitrary micro particle is discussed in accordance with the laws of Newton, regardless of the de Broglie hypothesis. Further, it is also discussed that not only the wave equation of Schrödinger but also the relation of matter-wave is reasonably valid.

## Introduction

The relativity and quantum mechanics known as the so-called modern physics have been developed since the beginning of 20th Century. The theoretical frame of Einstein's relativity was established by denying

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the absolute time in the Newton mechanics. On the other hand, the wave equation of a micro particle was derived by Schrödinger [1] from using the matter-wave relation proposed by de Broglie [2] as a hypothesis, regardless of the Newton mechanics. After then, the quantum theory has been developed by many physicists by making it correspond to the Newton mechanics as an afterthought. As can be seen in the following figure, recently the physical basis of quantum mechanics was reasonably reconstructed by denying the mathematical density theorem to the real time in the Newton mechanics [3, 4, 5, 6].

As far as a material is composed of micro particles such as an atom and/or a molecule, investigating their behavior is dominant and indispensable for the material science. The wave equation of

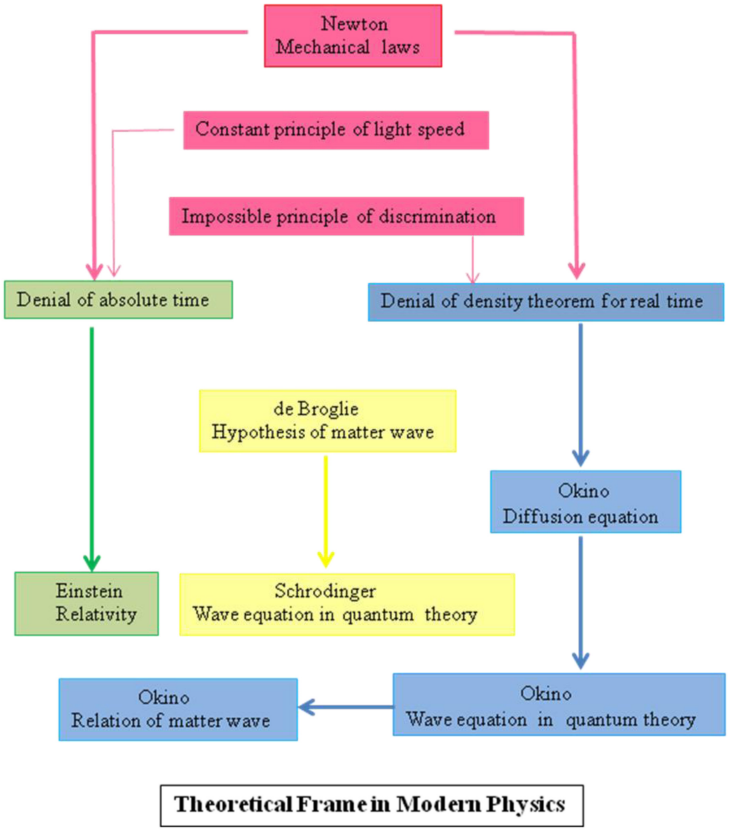
$$i\hbar \frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\langle \tilde{\nabla} | \nabla \rangle \psi \tag{1}$$

is used for basic problems of a single micro particle of mass $m$ or only a few of them. On the other hand, the diffusion equation of

$$\frac{\partial}{\partial t} C(t,\ x,\ y,\ z) = \langle \tilde{\nabla} | D\nabla \rangle C(t,\ x,\ y,\ z) \tag{2}$$

is used for a collective motion of them. Rewriting $D \to i\hbar/2m$ and $C \to \hbar\psi$ in equation (2) yields formally equation (1). In those days, therefore, the transformation from the diffusion equation relevant to a micro particle into the wave equation relevant to the wave nature of micro particle was theoretically investigated by Einstein, Bohm, and so on. However, their attempts ended in failure because of having accepted the diffusion equation as a law proposed by Fick [7].

The detailed descriptions of theoretical development can be shown in the previous works [3, 4, 5, 6]. The logical necessity of quantum theory itself will be then reasonably understood in accordance with the causality of the Newton mechanics, regardless of the de Broglie hypothesis.




[A]

In the collision between two particles of the same kind, we cannot principally discriminate each of them. This indicates that the discrimination between micro particles of different kinds is also principally impossible in a local space. Here, we accept the matter as an impossible principle of discrimination. As far as we accept the impossible principle of discrimination, there is a minimum time $t_0$ for a real time $t$, corresponding to the concept of "刹那 (setuna)" in the oriental idea of ancient times. In other words, the mathematical density theorem is not valid for the real time in the Newton mechanics, compared to the validity of density theorem for the space in physics. As a result, the matter

discussed here leads us to accept that the differential operators $\partial/\partial t$ and $|\nabla\rangle$ in the Newton mechanics should be rewritten as

$$\begin{cases} \partial/\partial t \rightarrow i\partial/\partial t \\ |\nabla\rangle \rightarrow -i|\nabla\rangle \end{cases} \tag{3}$$

of the imaginary ones in the quantum mechanics.

[B]

As far as we accept the diffusion equation as a law proposed by Fick [7] the diffusivity is only a mathematical operator in the differential equation (2), and we cannot understand its physical meaning. Then, Okino [8, 9, 10] theoretically derived the diffusion equation from analyzing the Markov [11] process in mathematics. It was then theoretically revealed that the diffusivity correlates to the angular momentum of micro particle itself in a local space. The diffusivity of a micro particle of mass $m$ was thus reasonably obtained as

$$D = \hbar/2m \tag{4}$$

in an isolated local space.

Here, if equations (3) and (4) are substituted into equation (2), equation (1) is reasonably obtained in accordance with the causality of the Newton mechanics. It is then revealed that $\psi(= \hbar C)$ becomes a complex value function [6]. The wave nature of an arbitrary micro particle was thus revealed at this point for the first time in the physical history. In relation to the minimum time $t_0$, we cannot observe a motion of micro particle at the time between $0 < t < t_0$. It was thus theoretically revealed that the momentum $|p\rangle$ should be accepted as a differential operator of $-i\hbar|\nabla\rangle$ then, i.e., $|p\rangle \rightarrow -i\hbar|\nabla\rangle$. It was also revealed that the wave length $\lambda$ of matter-wave is theoretically expressed as $\lambda = \hbar/\sqrt{\langle\widetilde{p}|p\rangle}$ for $t \geq t_0$. Thus, the relation of matter-wave proposed by de Broglie is now not a

hypothesis but a basic equation valid in the theoretical frame of physics.

In future, the descriptions of existing fundamental textbooks relevant to the quantum theory should be rewritten in accordance with the causality of the Newton mechanics, if we take account of the education for younger people.

[C]

In relation to the derivation of diffusion equation, the diffusivity of universal expression yielding

$$D = \hbar/2m \exp[(U - Q)/k_B T]$$

was obtained for a collective motion of micro particles in the state of an activation energy $Q$ and a potential energy $U$ at an absolute temperature $T$ in the diffusion region, taking accout of the diffusion field effects around each local space. At the same time, the diffusion equation proposed by Fick is now not a law but a basic equation valid in the theoretical frame of physics, judging from the reasonable derivation. Further, it was found that the fundamental theory of diffusion has been misunderstood for a long time in the concerned fields. The analytical method of diffusion problems for an arbitrary many elements system was thus theoretically established by applying the general solutions obtained recently for a nonlinear diffusion equation to them [8, 9, 10]. In accordance with the theory of mathematical physics, therefore, the new fundamental theory relevant to the collective motion of micro particles is also reasonably developed in the previous works [8, 9, 10].

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