Riding The Wave

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"The [quantum] theory reminds me a little of the system
of delusions of an exceedingly intelligent paranoiac."
— Albert Einstein

Introduction

It is quite wrong name – "quantum mechanics". It is neither mechanics, nor quantum, it is pure mathematics and completely deformed view of a reality.

Quantum mechanics is a probabilistic science. Everything is a matter of probability. Quite difficult to agree with such statement, chemical reactions, for example, flow always in predetermined way, no space for probability.

Talking about probability, imagine particle bouncing between two walls at constant speed. Obviously, it is equal probability for particle to be found at certain coordinate. But what is the value of such probability? The probability is the possibilities we are interested in over the total number of possibilities. Possibility to find particle at certain coordinate equals to one. And the total number of possibilities equals to infinity, the particle could be found at any position. Then the probability becomes zero! That is pretty much about the subject of quantum mechanics.

In this article I am going to examine the very foundation of quantum mechanics – Schrödinger equation.

Mathematics

The mathematics of modern physics is extremely complicated. I have a strong feeling that scientists never ever doubted mathematical formulas which are slightly above high school level even in peer review paper. The subjects of science are well hidden behind mathematical curtains. This days it is much more religion rather than science.

Other big issue is the credibility of mathematics. It my previous paper on Maxwell equations it was shown that the solution of Maxwell's equations is wrong. Not completely wrong, no, in some sense it's even right. The problem was that there are millions of functions which satisfy to Maxwell's equations, while mathematics is able to find only one out of those millions.

It comes to my mind that mathematics of Schrödinger equation have exactly same issue. And indeed, the quantum mechanics's solution is one out of many!

Schrödinger equation

Non relativistic Schrödinger equation for a single particle in one dimension:

$$i\hbar\frac{\partial}{\partial t}\psi(x,t)=-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi(x,t)+V(x,t)\psi(x,t) \tag{1}$$

where $V(x,t)$ is potential “that represents the environment in which the particle exists”, whatever that means.

“If the wave function is interpreted as a probability amplitude, the square modulus of the wave function is interpreted as the probability density that the particle is at x”. Quite confusing, isn’t it? That means that if wave function is not interpreted as a probability amplitude, the square modulus of the wave function is something completely different. There is no surprise that cat is half alive.

Physical formula should have dimensions. In that sense quite confusing imaginary unit i. Is it valid to multiply some dimensional constant by i? Could 2 square meters be multiplied by $\sqrt{-1}$? Is 2i square meters a valid value?

Particle in a box

Particle in a box is an example from textbooks how Schrödinger equation could be solved fully analytically. The model describes a particle free to move in a small space surrounded by impenetrable barriers. The solution to the problem could be found on Wikipedia.

Schrödinger equation for that case is the same as (1), but the function $V(x,t)$ is now potential energy instead of “representation of environment”.

$$V(x)=\begin{cases}0, 0<x<L\\ \infty, otherwise\end{cases} \tag{2}$$

The wave function of the particle in a box will be some sine function inside the well and zero outside the well. The solution inside the well described very well in the literature. Let’s write down Schrödinger equation (1) for the wave function outside potential well.

$$0=-0+\infty\cdot 0 \tag{3}$$

This equation is also a very good illustration on the subject of quantum mechanics. We were taught that if one multiply infinity by zero, the result is undetermined. Well, not in quantum mechanics.

Solution for free particle

Solution for particle in the box inside the potential well with $V(x,t)=0$ is the solution of Schrödinger equation for free particle in the absence of any potential.

$$i\hbar\frac{\partial}{\partial t}\psi(x,t)=-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi(x,t) \qquad (4)$$

The quantum mechanical solution of Schrödinger equation for free particle is the sine function oscillating over time. Something like:

$$\psi(x,t)=A\sin(k_n x)e^{-i\omega_n t} \qquad (5)$$

Constant

The simplest solution of Schrödinger equation is, of course, the constant.

$$\psi(x,t)=C \qquad (6)$$

Substitution of (6) to the original Schrödinger equation (4) leads to:

$$0=0 \qquad (7)$$

And any constant value perfectly satisfies to Schrödinger equation!

Another Function

A variety of functions which satisfy to Schrödinger equation could be constructed. I am going to demonstrate just one example. “If you wish to upset the law that all crows are black, you musn’t seek to show that no crows are; it is enough if you prove one single crow to be white”.

The solution of Schrödinger equation or wave function is complex value. Let write down the solution of the equation in the form:

$$\psi(x,t)=(A+iB)\omega t+(C+iD)(kx)^2 \qquad (8)$$

Then

$$\frac{\partial}{\partial t}\psi(x,t)=\omega(A+iB) \qquad (9)$$

And

$$\frac{\partial}{\partial x}\psi(x,t)=2k^2(C+iD)x \qquad (10)$$

$$\frac{\partial^2}{\partial x^2}\psi(x,t)=2k^2(C+iD) \qquad (11)$$

Substituting back to (4) gives:

$$i\omega(A+iB)=-\frac{\hbar}{2m}2k^2(C+iD) \quad (12)$$

This equation splits into two separate equations for real and imaginary parts:

$$-\omega B=-\frac{\hbar k^2}{m}C \quad (13)$$

$$i\omega A=-\frac{\hbar k^2}{m}iD \quad (14)$$

And

$$C=\frac{\omega m}{\hbar k^2}B \quad (15)$$

$$D=-\frac{\omega m}{\hbar k^2}A \quad (16)$$

Substitution back to (8) gives:

$$\psi(x,t)=(A+iB)\omega t+\left(\frac{\omega m}{\hbar k^2}B-i\frac{\omega m}{\hbar k^2}A\right)(kx)^2 \quad (17)$$

This function (17), as was just shown, is the perfect solution to Schrödinger equation (4). Coefficients A and B could take any values.

The solution (17) is a very strange solution. It is in proportion to coordinate squared. The most probable particle's position is the right end. Well, it could be also left end if you change the direction of your x axis!

The solution is also in proportion to time. The longer are you looking at the particle, the more probable it is!

Conclusion

A variety of different functions which satisfy to Schrödinger equation could be constructed.

The absurdity of the found solution is obvious.

With new solutions, the Schrödinger equation loosing its waving nature and does not make any sense. Wave function is not waving anymore!

Mathematical methods of solving equations similar to Schrödinger equation are wrong since not all of the solutions were found.