A Solution to Schrodinger Cat Paradox and Uncertainty Principle of Quantum Theory

Anil Jayram Dixit

Abstract-Electrons are only particles and they create waves in the medium through which they travel. The waves are of particles of the medium and electrons being light get mixed up and carried away with them. The same thing applies to all subatomic particles. As the subatomic particles do not possess wavelike qualities, the uncertainty principle and Schrodinger cat, no more remain paradoxes.

Index Terms- Electron, Quantum Theory, Schrodinger's cat, Uncertainty principle, wave

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1. INTRODUCTION

"The more success the quantum theory has the sillier it looks. How non-physicists would scoff if they are able to follow the odd course of developments?" -- Albert Einstein [1]

Quantum Theory is founded on two principles,
Energy is not continuous but occurs in discrete bundles 'quanta'
Subatomic particles have both particle and wavelike qualities.

There arise paradoxes like uncertainty principle of Heisenberg and Schrodinger's Cat paradox in quantum theory.

2. UNCERTAINTY PRINCIPLE

The more precisely the position is determined, the less precisely the momentum is known and vice versa.The same is the case with time and energy. Heisenberg's uncertainty paper 1927(founded on wave function of particles) mathematically,

Δq - Uncertainty of the position measurement
Δp - Uncertainty of momentum measurement
ΔE- Uncertainty of Energy measurement
Δt - Uncertainty of time measurement
h - Plank's Constant

The two uncertainty relations are

$\Delta p \Delta q \geq h / 4\pi$ ……………………………………………(1)

$\Delta E \Delta t \geq h / 4\pi$ ……………………………………………..(2)

Hence $\Delta p \geq h / 4\pi\Delta q$

It means that if Δq is zero i.e. position is precise, then Δp is infinity i.e. Uncertainty in momentum is infinity completely undefined.

In the same way, when

$\Delta E \geq h / 4\pi\Delta t$

It means that if Δt is zero i.e. time is precise,then ΔE is infinity i.e. Uncertainty in Energy is infinity i.e. completely undefined. This seems to be unrealistic. In science, we expect certainty in results.

3. SCHRODINGER'S CAT PARADOX

In this thought experiment, a cat is placed in a box, along with a radio-active substance, a very small amount, that is connected to a vial containing a deadly poison. If the radioactive substance decays, it causes the vial to be smashed and the cat to be killed. When the box is closed, we do not know whether the atom is in decayed or non-decayed state at the same time. Therefore the cat is also both dead and alive at the same time. The wave interpretation of the quantum theory seems to allow particles to be in two places at once.In the double slit experiment of wave duality, for example, a single particle seems to pass through both slits to create interference pattern on the screen. The Austrian physicist devised this thought experiment to show the absurdity of the dual nature of particles. This is known as Schrodinger Cat paradox.

These two 1. Uncertainty Principle and 2. Schrodinger's cat Paradoxes have resulted from the assumption in quantum theory of dual particle-wave nature of subatomic particles. The uncertainty principle is proved mathematically, based on this assumption. Mathematics is a tool, a best tool, when applied properly on proper assumptions. Mathematics is an exact science and it cannot be wrong. Hence the only alternative remains is that assumption of dual nature of subatomic particles must be wrong. Hence it is necessary to examine by experiment whether subatomic particles are only particles, only waves or are of dual nature.

4. EXPERIMENTAL REFERENCE

For that purpose we will examine the results of the experiment "Demonstration of Single - Electron buildup of an interference pattern". by A.Tonomura, J.Endo, T.Matsuda, T.Kawasaki and H.Ezawa.[2]

This experiment is performed to prove the wave particle duality of electrons. In this experiment, electrons incident on wall with two slits and are detected one by one on a screen behind them. Accumulation of electrons detected at the screen, builds up an interference pattern.
Abstract:"The wave particle duality of electrons was demonstrated in a kind of two slit interference experiment using an electron microscope equipped with an electron biprism and position -sensitive electron counting system.Such an experiment has been regarded as a pure thought experiment that can never be realized. This article reports an experiment that successfully recorded the actual buildup process of interference pattern with a series of incoming single electrons in the form of a movie."
In this experiment, electrons are emitted from a field-emission tip, after collimation, sent to an electron biprism, the biprism interference is enlarged by an electron lenses and detected on the fluorescent film. It is seen that electron after emission up to detection pass through vacuum.In Ultra high vacuum[3] conditions, there can be 100 air particles/cm3. Electron Biprism has inner volume of many cubic centimeters and so we can safely assume that there are at least millions of particles, if not more, of air are present through which electron passes.
There are five photographs[4] of electrons striking on the screen, which are reproduced below.

(a) Number of electrons = 10

(b) Number of electrons = 100

(c) Number of electrons = 3000

(d) Number of electrons = 20000

(e) Number of electrons = 70000

5. ANALYSIS OF EXPERIMENTAL RESULTS

For up to 10 electrons, no pattern at all can be discerned. Electrons are scattered randomly all over the detecting screen due to collisions with the few air particles in biprism as discussed above.For 100 electrons also, they are scattered randomly all over screen. At 3000 electrons, we see all particles scattered at random, but with a pattern. At 20000 electrons, again electrons are scattered, but a somewhat pattern of light and dark bands is seen. At 70000 electrons, the pattern of light and dark bands almost becomes distinct. But even in the bands, we can see where electrons have struck the detecting screen. So that electron was a particle when it was emitted and was a particle when it hit the detecting screen and got absorbed. It is the prevailing notion that the particle became a wave after emission and leaves its wave character when it strikes a detecting screen. The wave character is an inference obtained because of the formation of interference bands. Experiment reveals particles and hence represents reality.

Matter can exist in three states solid, liquid and gas and moves through the sequence with increase in temperature. A solid is most ordered state of matter. Its constituent particles held fast in a regimented lattice and has a fixed volume. A liquid is a form of matter holding clumps of atoms or molecules together, maintain some degree of order, but rigidity of structure is gone. It has fixed volume, takes shape of a container. In gases, no organization of atoms or molecules, takes shape and volume of container. In solids, atoms or molecules do not move freely, no waves are formed. In liquids, atoms or molecules move to some extent and waves are formed. In gases, atoms or molecules move freely and waves are formed. In the experiment, the explanation of forming interference bands is required. Brownian Motion is random motion of particles suspended in a fluid (a liquid or gas) resulting from their collision with the fast moving atoms or molecules in gas or liquid. Robert Brown,a botanist observed movement of pollen grain particles in water in 1827.The renowned scientist Albert Einstein published a paper in 1905 that explained precisely the motion that Brown had observed as a result of pollen grain being moved by individual water molecules. This phenomenon was experimentally verified by Jean Perrin in 1908. The direction of the force of atomic bombardment is constantly changing and at different times the particle is hit more on one side than another leading to the seemingly random nature of motion. The electrons while passing through slits and up to detecting screen collide with air molecules which are roaming freely inside. Due to the collisions, the air molecules form waves. The electrons being very light (mass of electron is 9× 10 -28 gms, mass of oxygen molecule is 2.657×10-23 gms., mass of nitrogen

molecule is 2.326×10-23 gms)[5] get mixed up and are carried away with the waves of air molecules. It must be noted that about 20 minutes are required in this experiment to form interference fringes. To explain the interference bands, wave nature of particle is not at all necessary. Even Richard Feynman by his 'Path Integral Method'[6] has shown how a particle from the moment of his birth till the moment of death, remains a particle and traverses the path.
Furthermore if the particles were having a wave character, we could have seen diffraction, interference fringes straightway when light passes through a glass slab.
Once we come to the conclusion that subatomic particles do not have wave character, the uncertainty principle and Schrodinger's Cat Paradox which are founded on dual character of subatomic particles vanish automatically.
Lastly, I am tempted to reproduce here unpublished poem about quantum theory by the celebrated American scientist John Wheeler[7]

Behind it all
Is surely an idea so simple,
so beautiful,
so compelling that when--
In a decade, a century,
or an millennium--
we grasp it,
we will all say to each other,
how could it have been otherwise?
How could we have been so stupid
For so long?

6.CONCLUSION

The subatomic particles are particles only. There is no wave character in subatomic particles.

7. REFERENCES

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4. Reproduced from [American Journal of Physics 57,117 (1989);doi: 10.1119/1.16104. Page 120], with the permission of the American Association of Physics Teachers.

5. Wikipedia

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7. Quoted by Kitty Ferguson in 'Stephen Hawking' Quest for a Theory of Everything '(New York:Bantam,1992) on pg.21