Can we have an observer-independent description of physical reality?

Sunil Thakur

Classical physics assumes that the things exist independently of an act of observation; however, quantum theory suggests that the apparent form of quantum system emerges as a consequence of an act of observation. However, quantum theory is silent on the state of the systems prior to the act of observation. It assumes that the wavefunction collapses as a consequence of an act of observation but does not explain the mechanism of the collapse of wavefunction. Therefore, it is at least incomplete, if not incorrect.

In this paper, we have shown that our understanding of the nature of physical reality is based on the false premise that we observe the physical entities, but the mechanism of perception is such that we can only perceive the information generated by the physical entities, not the physical entities. As per the current understanding of the process of perception, the brain projects the information it receives from the sense organs in the physical forms. Therefore, the entity that generates the information must preexist before it can be projected in the physical form. We do not perceive the actual Moon. The apparent form of the Moon is only a projection created by our brain. The apparent form is only a manifestation of something that generates information, but that cannot be observed directly. In the light of this observation, it becomes necessary to examine if we can establish causal relationships between events assuming that the place and time and events are observer independent. Apart from using the criterion prescribed by the EPR paper, we have also used these two methods to determine if we can have an observer independent description of reality.

We have shown that an entity must have observer independent values of the physical quantities, but the act of measurement only reveals the observer dependent values of the physical quantities even in the macro world. We have confirmed our observations experimentally as well as through the observation of the natural phenomena.

Indeterminacy is a fundamental feature of the quantum world. Indeterminacy may be an outcome of our observational limitations. It may also be a result of the lack of the information required to make precise predictions. For example, if we throw a coin then we may not be able to predict how it is going to fall, but if we have the required information about the initial conditions and all other factors that may affect the outcome of our action then we can make precise predictions.

However, indeterminacy is a fundamental feature of the quantum world. Heisenberg explains, *"It is essential to appreciate that this uncertainty is inherent in nature and not merely the result of technological limitations in measurement. It is not that the experimenter is merely too clumsy to measure position and momentum simultaneously.* ***The particle simply does not possess simultaneously precise values of these two attributes."***

The assumption that a particle does not possess the precise values of complementary properties simultaneously is debatable.

Heisenberg explains, *"In classical physics, science started from the belief or should one say from the illusion, that we could describe the world or at least parts of the world without any reference to ourselves. This is actually possible to a large extent. We know that the city of London exists whether we see it or not. It may be said that classical physics is just that idealization in which we can speak about parts of the world without any reference to ourselves. Its success has led to the general ideal of an objective description of the world. Objectivity has become the first criterion for the value of any scientific result."* [1]

Heisenberg continues, *"....in the experiments about atomic events we have to do with things and facts, with phenomena that are just as real as any phenomena in real life. But the atoms and elementary particles are not as real; they form a world of potentialities and possibilities rather than one of things and facts."* [3]

To say that Einstein was not comfortable with the assertions of the quantum mechanics would be an understatement. Einstein questioned the completeness of the quantum theory on the ground that it was silent on the state of the system prior to an act of observation.

EPR paper argues, "*In attempting to judge the success of a physical theory, we may ask ourselves two questions: (1) 'Is the theory correct?' and (2) 'Is the description given by the theory*

complete?' It is only in the case in which positive answers may be given to both of these questions, that the concepts of the theory may be said to be satisfactory. The correctness of the theory is judged by the degree of agreement between the conclusions of the theory and human experience. This experience, which alone enables us to make inferences about reality, in physics takes the form of experiment and measurement. It is the second question that we wish to consider here, as applied to quantum mechanics. Whatever the meaning assigned to the term complete, the following requirement for a complete theory seems to be a necessary one: every element of the physical reality must have a counter part in the physical theory. We shall call this the condition of completeness. The second question is thus easily answered, as soon as we are able to decide what are the elements of the physical reality.

"The elements of the physical reality cannot be determined by a priori philosophical considerations, but must be found by an appeal to results of experiments and measurements. A comprehensive definition of reality is, however, unnecessary for our purpose. We shall be satisfied with the following criterion, which we regard as reasonable. 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 lo this physical quantity."

Schrödinger was another critique of the Copenhagen interpretation of the quantum mechanics. Almost ridiculing the Copenhagen interpretation, Schrödinger presents following thought experiment, "*One can even set up quite ridiculous cases. A cat is locked up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter, there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer that shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts.*

It is typical of these cases that an indeterminacy originally restricted to the atomic domain becomes transformed into macroscopic indeterminacy, which can then be resolved by direct

observation. That prevents us from so naively accepting as valid a 'blurred model' for representing reality. In itself, it would not embody anything unclear or contradictory. There is a difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks."[4]

A cat is dead and alive simultaneously until someone observes it. There is no way we can know the state of the cat until we open the door. But we interfere with the experiment the moment we open the door. Schrödinger's argument is that it is an absurd conclusion to draw because the cat cannot be alive and dead simultaneously.

One can also argue that the proposals of the quantum mechanics do not meet the criteria of falsifiability.

Einstein was pleased Schrödinger's arguments. He writes in a letter to Schrödinger, *"You are the only contemporary physicist, besides Laue, who sees that one cannot get around the assumption of reality, if only one is honest. Most of them simply do not see what sort of risky game they are playing with reality—reality as something independent of what is experimentally established. Their interpretation is, however, refuted most elegantly by your system of radioactive atom + amplifier + charge of gun powder + cat in a box, in which the psi-function of the system contains both the cat alive and blown to bits. Nobody really doubts that the presence or absence of the cat is something independent of the act of observation."* [5]

Einstein says that nobody really doubts that the presence or absence of the cat is something independent of an act of observation because we take it for granted that at least in the macro world, the things exists independently of an act of observation.

Heisenberg is not concerned by criticism of the Copenhagen interpretation. Heisenberg claims that only the mental block is preventing classical physicists from accepting the new reality. Heisenberg says, *"If one follows the great difficulty which even eminent scientists like Einstein had in understanding and accepting the Copenhagen interpretation of quantum theory, one can trace the roots of this difficulty to the Cartesian partition. This partition has penetrated deeply into the human mind during the three centuries following Descartes and it will take a long time for it to be replaced by a really different attitude toward the problem of reality."*[6]

Einstein could not refute the arguments of the Copenhagen interpretation, but was still not convinced about the validity of its claims.

Abraham Pais narrates following conversation with Einstein, "*In 1950 while accompanying Einstein on a walk from Princeton University to his home, Einstein 'suddenly stopped, turned to me, and asked me if I really believed that the moon exists only if I look at it.'* [8]

Classical physics assumes that the Moon exists even in the absence of an act of observation; quantum mechanics is silent on the state of the Moon prior to an act of observation.

This paper explains the state of not only the elementary particles but also the state of physical entities in the macro world prior to an act of observation.

Apart from using EPR paper's criterion, we will examine the process of perception to see if we can have an observer-independent description of reality.

If we can assume that the events have observer independent time, position and properties and can still establish causal relationships between the events then, we can say that it is possible to have an observer independent description of physical reality or else we must accept that it is not possible to have an observer independent description of reality.

All this confusion is created because of a fundamental false premise about our perceptions.

These observations of the eminent scientists show that we assume that we perceive physical entities, but the fact is that we only perceive the information generated by an entity. Our brain projects the information in the physical form. The measuring devices also respond only to the information generated by the physical entities, not to the physical entities directly.

The brain receives information from almost an infinite number of physical entities at any given time. It has no way of determining the time taken by the information to reach it from the source. It also has no idea whether information has undergone any changed during the course of its journey. The brain also does not have any idea of the place where the information originated.

In the absence of information, the brain simply projects the information it receives at any moment simultaneously. In other words, we are presented with a snapshot of how things appear

at any particular moment of time. The same logic applies to a camera or any other device that manifests information.

If this analysis is correct then, we must observe both the presence and absence of time delay in any observed phenomenon. The time delay would be observed because the information takes time to reach the brain, but the time delay would disappear in the projection of events.

Since a measuring device can respond only to the information generated by an electron therefore, we have no option but to conclude that something that generates the information must exist even before an act of observation.

Heisenberg's argument that the particles in the quantum world do not possess ***precise values of*** *position and momentum simultaneously is scientifically untenable because if at any moment, we can measure either of these attributes then, we can say that the particles possess both these attributes simultaneously because the source of the information must exist for it for the generation of information.*

The nature of information may change even after it is generated. It may change just because an observer does not have 6/6 vision. In most cases, it is possible for us to explain the effects of change in the nature of information due to any reason whatsoever, but sometimes, the act of observation may affect the nature of information being observed or it may even disturb the other set of information that are not being observed by us in a particular act of observation. *It may or may not disturb the system.*

Heisenberg is only partially right when he says that the elementary particles only form a world of potentialities and possibilities.

A better description of the quantum world is that the elementary particles have a set of potential properties that may manifest in physical form as a consequence of an act of observation. Thus, an elementary particle is ***not*** a non-entity until it is observed.

The elementary particles exist in non-physical form. The non-physical entity has a set of potential properties that can manifest in physical form. These properties manifest only if an observer is present at the right time at the right place. Any entity that manifests information about any other entity is an observer.

The apparent form of particles is the combination of the properties of the particle and the properties of the observer. Therefore, it is not possible to have observer-independent values of the physical quantities.

The apparent form of an electron and its position both are observer dependent, but the electron and all its properties are observer independent.

Let us analyze the mechanism of atomic electron transition (also known as quantum jump or quantum leap) to confirm these observations.

The observations show that the electrons jump from one shell to another. A change of quantum state of an electron appears to be a discontinuous process because electrons manifest in one shell and then, manifest in another shell after a few nanoseconds. We cannot know anything about the state of the electron or the space between the two shells in the interim period.

Niels Bohr has already explained that this is because electrons absorb and emit energy only in discrete quanta.

It also means that the emission of energy cannot be a continuous process. Since we only perceive the information generated by a therefore absence of information blinds us momentarily.

If there is a change in the emission frequency then, we will feel that the entity has disappeared at one place and has appeared again at another place, but there is no way of knowing anything about the state of the electron in the intervening period. This feature must manifest even in the macro world, but the interval is so tiny that we do not feel the absence of information. However, this feature will manifest itself if we use a speed gun to measure the speed of a vehicle.

In fact, if we determine the state of motion of a galaxy by measuring the redshift then, we will find that galaxies also move in jumps of several hundred kilometers. The galaxies disappear at one place and appear at another place.

There is nothing unusual in this phenomenon. The measuring instrument only reacts to the information received by it. A change in the redshift and the brief period of blindness create the illusion that an entity is moving in jumps.

In the above case, the nature of the information is such that it manifests a peculiar type of motion that may not be real.

This analysis also resolves the mystery of quantum tunneling.

If we roll a ball up a hill, but ball does not have enough velocity because it does not have enough energy then, it will roll back towards us. However, in the quantum world, particles can break this barrier and roll over the hill without having the required energy.

This is the most simplified explanation of quantum tunneling.

The particle does not move physically from one point to another; therefore, it does not have to climb a hill to go to the other side. It simply disappears at one place and manifests at another place.

We will confirm these observations by analyzing some variants of the double-slit experiment.

Once quantum mechanics says that the elementary particles do not have any real existence until they are observed then, it cannot take a 'U-turn' and claim that photons and electrons pass through the slits physically.

In the normal double-slit experiment we observe interference pattern at the detection screen. In the next variant, the experiment is conducted with pairs of entangled partners. One of the particles of the pair goes directly to the detection screen. The other particle goes to a detector. It reaches the detector after its entangled partner has hit the detection screen. In this variant, the interference disappears even though the entangled partner reaches the detector after its partner has hit the detection screen. In this variant, a circular polarizer is used in front of the slits. The polarization is measured at the detector. This marking of the photons destroys the interference pattern.

In the next variant of the experiment, a linear polarizer is added after the detector. The linear polarizer erases the information. In this variant, the interference pattern is recovered. [4]

The outcome of the third variant of the experiment suggests that the future can affect the past.

The future can affect the past only if the information can flow from the future to the past, but for that to happen, information has to be generated before it can flow in any direction. The information about an event cannot generate until the event occurs. Obviously, this argument is scientifically untenable.

One of the most important features of the double-slit experiment is that the overall interference pattern is predictable even in the normal double-slit experiment, despite the unpredictable behavior of the individual photons/electrons.

The behavior of the whole cannot be predictable if the behavior of the parts is arbitrary. The particles do enjoy some freedom, therefore, the behavior of the particles is unpredictable, but the particles do not behave arbitrarily. Some mechanism controls the behavior of the particles to ensure the predictable behavior of the photons/electrons as a group.

The only explanation can be that all the possible paths photons/electron can take are created as soon as we setup the experiment. Some paths may be taken by say 30% photons, some other may be taken by only 7%, and some other may be taken by only 1%. Obviously, the first photon that goes through the slits can go through any of the paths. Finally, a photon will not have any choice. It has to go through the only available path. If we continue the experiment then, the next photon will again have all possible paths available to it.

Therefore, it does not matter whether we shoot one particle at a time or shoot multiple particles in one shot. It also does not matter if we mark the photons after the entangled partner has hit the detection screen. Similarly, erasing the information after the entangled partner has hit the screen also does not require backward flow of information from the future to the past because all possible paths are fixed the moment, we setup the experiment.

The fact is that no photon goes through the slits, detectors, or erasers. The pattern formed on the screen simply provides us the information about the setup and the entities involved in the setup.

If we assume that any physical entity in any form whatsoever goes through these paths then it would not be possible to explain the outcome of any variants of the double-slit experiment for the reasons already explained.

The detection screen manifests information about the experimental setup and the entities participating in the setup (the particles). The experimenter is not a participator in this experiment. Nature of the detection screen determines whether the information manifests as a particle or a wave.

Now, we will confirm these observations experimentally.

A team of scientists from the Massachusetts Institute of Technology (MIT) has developed a camera that captures one trillion frames/second. The team has recorded several movies to demonstrate the speed of the camera. We will analyze a part of a movie titled, 'multiple_scenes.mp4'.[1]

In this clip, a light source emits a pulse for 2 picoseconds. The light illuminates a fruit kept between the light source and the camera. The camera records these events in the sequence they occur. The camera developed by the MIT team captures only one-pixel vertical image. Therefore, the team rotates a mirror to scan the line across the field of view to create the entire scene.

Every frame is composed of many pulses, one for each vertical line of the image, which is stitched together to make the movie. However, we can analyze the movie assuming it is a normal video film. The team has recorded normal events to show the motion of light. The team slowed down the movie considerably to allow the viewers to make sense of the sequence of events.

The distance between the light source, fruit, and the camera does not affect the nature of the analysis because the camera would record the events in the same sequence as they occur irrespective of the distance of fruit and camera from the light source. Therefore, we can analyze the movie assuming that the distance between the light source and fruit is 5 feet and the distance between the light source and the camera is 10 feet.

The light source emits a pulse for only 2 picoseconds; therefore, the difference between the arrival time of the first set of photons and the last set of photons in any frame cannot be more than 2 picoseconds. Therefore, if the photons carry information then, the total length of the movie cannot be more than 2 picoseconds.

The sequence of events starting from the emission of the first set of photons by the light source to the illumination of fruit lasts for about 5 nanoseconds, but the difference in the arrival time of the first and last set of photons can only be 2 picoseconds.

Therefore, if the light carries information then the camera cannot record the entire sequence of events lasting 5 nanoseconds. All the photons travel the same path in *the same setup in identical condition* within a span of just 2 picoseconds; therefore, if photons communicate information then, the total length of the movie cannot be more than 2 picoseconds.

The reader can see in this movie that the light source illuminates for a brief period and then goes off. If photons carry information then, the total length of the movie cannot be more the period for which the light source illuminates.

It obviously means that the photons do not communicate information.

If we assume that photons emitted by the light source take 10 nanoseconds then, we also must assume that photons would reach the fruit 5 nanoseconds after they are emitted by the light source. The photons from the fruit should take another 5 nanoseconds to reach the camera because they have to travel a distance of only 5 feet. Therefore, all the photons must reach the camera simultaneously.

Therefore, if communication of information involves any real, local particles or any physical entity then we would not be able to record the above sequence of events. We would also not be able to establish the causal relationship between illumination of the light source and illumination of the fruit.

The theory of relativity assumes that the light communicates the information. The theory of relativity suggests that two observers located at different distances from an event would perceive the event at different times; therefore, it constitutes the failure of simultaneity. The theory of relativity does not explain why the observer must treat the time they perceive the event as the actual time of events.

However, if a scientist has all the information then he would be able to explain the reason why the observer perceived the same event at different times. Therefore, he will be able to prove that there is no failure of simultaneity.

In the above case, the light source illuminates at 10 nanoseconds past 00.00 hrs. and fruit illuminates at 15 nanoseconds past 00.00 hrs. for the camera located at a distance of 10 feet from the light source. If we assume anything else then, we won't not be able to establish causal relationship between these two events.

By the same logic, a camera located at a distance of 20 feet from the light source would record these events between 20 nanoseconds past 00.00 hrs. and 25 nanoseconds past 00.00 hrs. This will be the actual time of events for this camera.

It is possible for us to assign observer independent time to the events in the movie but we can establish the causal relationship between the illumination of light source and consequent illumination of the fruit only if we assume that the events occurred at the time the camera recorded these events.

The event occurs only at one particular time, but for every observer the time he perceives the event is the actual time of events.

This is the fundamental basis of proving the failure of simultaneity.

Let us see if the sound waves communicate information.

The zoom microphones can reduce and even eliminate the time delay in the communication of information. The number of mics and the direction of mics cannot reduce the time delay in communication of information. The trick is done by the condenser placed in the microphone. The condenser acts like a magnifying glass. Similarly, zoom lens reduces the time delay in the communication of information and wide-angle lens increases the time delay in the communication of information.[2]

This analysis rules out the possibility that the communication of information does not involve any real, local particles. Nothing physical travels from the source of information to the observer but nature of the information is affected by the nature of the path between the source and observer; therefore, we cannot ignore the nature of the path between the source and observer.

In this movie, we ***do*** find the evidence of both the time delay in the communication of information and also of the absence of time delay in the communication of information. The time

delay in communication of information depends on the distance between the source and observer at the time of initiation of communication. The same time delay is maintained even if the source and observer move closer to each other or move away from each other.

Doppler Effect predicts a change in the frequency/wavelength of the signals due to a change in the distance between the source of the signals and observer.

We simply have to hear the sound of a siren moving towards/away from us to realize that the received frequency is always the same as the emission frequency of the signals. In other words, a change in the distance between the source of the signals and observer does not affect the frequency and period of the wave.

Based on the above experimental evidence, we can say that the events do not have an observer independent time.

Now, let us see if the events have an observer independent position.

Let us analyze one of the most beautiful natural events – total solar eclipse.

We have a cause; namely, the apparent position of the Sun and Moon is in a straight line with the Earth. This cause has effect; namely, the eclipse, which results in the darkness in the areas affected by the eclipse.

Light takes 8 minutes 44 seconds to reach earth from the sun and it takes about 1 second for the light to reach earth from the moon. Sun moves about 2.18 degrees (15 degrees in one hour) in 8 min. 44 seconds and moon moves about 0.0006 degree in 1 second in the sky.

The apparent positions of the Sun and Moon may also change due to refraction.

We shall also remember that in 8 minutes 45 seconds, the moon moves 0.0073 degrees (about 525 Kms) in its orbit and earth moves 0.0055 degrees (about 15000 Kms) in its orbit in 8 min. 45 seconds. Therefore, the photons emitted by the Sun when its actual or even apparent position is in a straight line with the Moon and the Earth would miss the Moon by a long distance.

The actual positions of the Sun and Moon cannot be in a straight line with the Earth if their apparent positions appear to be in a straight line with the Earth. Therefore, the Moon cannot

block the photons emitted by the Sun when the Sun, Moon, and Earth appear to be in a straight line.

It is not possible to establish any relationship between the cause and effect mentioned above unless we treat the apparent positions of the Sun and Moon as their actual position.

If we treat the apparent positions of the Sun and Moon as their actual positions (we have no other option) then, we once again have the evidence of both the presence and absence of time delay simultaneously and in the same event.

We will confirm these observations by analyzing one of the simplest phenomena - refraction.

We know that the light bends if the medium of its propagation changes. This effect is known as the refraction.

We would first place before the reader two indisputable facts about this phenomenon.

It is an indisputable fact that a change in the medium of propagation causes a change in the velocity of the electromagnetic waves. The second important established fact is that the refraction does not cause any change in the received frequency.

If the reader examines these two facts then he would realize that if everything else remains the same then, these two features cannot coexist because a change in the velocity must cause a change in the received frequency, but it does not. It means that something else changes to negate the effect of the change in the velocity of light.

Since the object does not move from its position therefore, the only possible explanation for the simultaneous existence is that the length between the source and observer contracts if the source of the signal is located in optically denser medium and observer is located in relatively rarer medium (object appears to have moved closer to the observer) and expands if the source is located in the optically rarer medium and observer is located in relatively denser medium (object appears to have moved away from the observer).

Since received frequency does not change, therefore, even the transit time of light cannot change despite the slowing down of the light. We can confirm this observation using the sound waves instead of electromagnetic waves.

We can explain these results only if we treat the apparent position as the actual position of the objects, but we know that the object has not moved from its position. *Then, how do we explain these results?*

If the object has not moved from its position and the velocity of light has reduced but there is no change in the received frequency then we can be sure that the distance between the object and source has reduced.

This is real length contraction. The length between the source and observer contracts; therefore, the object appears to have moved closer to the observer. Nothing actually contracts but this effect is real because the transit time of light does not increase despite the reduction in the velocity of light.

The length expands if the observer is located in an optically denser medium and object is located in relatively rarer medium.

Even in this case, the transit time of light would not increase, and the apparent position of the object would be its actual position for the observer.

Since apparent position of the objects depends on the angle of refraction therefore, the same object would appear at different places to different observers and for each observer the apparent position of the object would be its actual position.

One can see that it is not possible to have an observer independent position of the events because it will not be possible to establish the causal relationships between the events.

Now, let us see if physical entities have observer independent properties?

We can say that the events do have observer-independent place and time, but if the observer wants to make sense of the information then, he must disregards the observer-independent position and treat the apparent place and time of events as the actual place and time of events.

We have already explained that the brain does not know anything about the source of the information or the nature of the path and our distance from the source. It simply presents a snapshot of all the information it receives at a particular moment.

Therefore, every observer must have his own place and time of events. The observer also must regard the form he perceives as the actual form of the physical entities. In other words, the observer must assume that the things are the way they appear to him at the time of observation.

There definitely something that exists at the observer-independent position of the Sun and Moon. The observers may perceive the Sun at different places, but if all the observers use scientific methods to determine the position of the Sun then they would reach the same conclusion. However, it is obvious that the Sun cannot exist at its observer independent position in the form we perceive it. If it does then, the light must originate from this position.

We have already noted that the communication of information does not involve any real, local particles. Therefore, we can say that the information is communicated in non-physical form. It means that not only our sense organs but also all the instruments that manifest information are sensors, not receptors.

We cannot even say that information, not the light, originates from the observer-independent position of the Sun or from the light source because we create a theoretical chaos the moment we say that something has been created and has moved in the direction of the observer.

If the Sun at its original position does not emit light then, it cannot have all those reactions going on within it that ultimately results in the emission of light, at least not in the physical form. At the same time if information is generated from this position then, the cause that generates the information must also exist at this position.

The non-physical form generates the information, but if we have to measure the value of any of its properties then, we have no option but to examine its apparent form. Since apparent form is observer dependent projection of the information; therefore, the measured value of the properties cannot be observer-independent.

A scientist equipped with the best of the instruments also cannot examine the non-physical form. He has no option but to observe the apparent form.

At the same time, we also have to realize that the observer-independent form has observer-independent properties.

Therefore, we can say that the apparent properties of an entity are the actual properties of the observer. In the macro world, we can use different methods of observation to determine the actual properties of the entity; for example, we can determine the diameter of the Sun without actually measuring it with a ruler but in the quantum world, it is not possible to form a coherent view of the observed entities by combining outcomes of different observations made using different methods of observation because an act of observation affects the value of the quantity being measured and even of the quantities that are not being measured.

An entity has to acquire the potentiality to manifest a particular property in physical form, and the observer must have the potential to manifest these properties in the physical form for that entity to emerge in the physical form.

"An entity may have 'n' number of properties that it can manifest in physical form, but the observer also must have the potentiality to manifest these properties in physical form. One observer may manifest one set of properties and other observer may manifest another set of properties of the same entity simultaneously. In some cases, these properties may even be mutually exclusive." [10]

Light is neither a wave nor a particle; it only has the potential to manifest both as a wave as well as a particle.

If we use a method of observation that could manifest the photons/electrons as waves then it would manifest the photons/electrons as waves and if use a method of observation that could manifest photons/electrons as particles then it would manifest the photons/electrons as particles.

The Sun emits light constantly, but the light source in the MIT movie does not emit light constantly. If the camera senses the information then, it must find the light source in the illuminated state at 10 nanoseconds past 00.00 hrs. If we have a series of cameras located at all possible points then, the light source should remain in illuminated state continuously, but the light source obviously does not remain in illuminated constantly because its illumination also depends on a cause (supply of electricity).

The fact is that the light source does not illuminate at 00.00 hrs,; ***it only acquires the potentiality to manifest in the illuminated state at 00.00 hrs***. This potentiality manifests in the physical form only if an observer is present at the right time at the right place.

Similarly, the Sun only has certain potential properties that it may manifest in the physical form. The manifestation of these properties is observer dependent. The Sun in its non-physical form exists at the observer-independent position. It generates information, not the light.

All the physical entities exist only in the non-physical form. The properties of the non-physical form of the entity keep on changing constantly.

Even the galaxies exist in non-physical form.

The merger of galaxies has to be the most amazing phenomenon of the physical world because even a bird hit can cause substantial damage to an aircraft, but the merger of galaxies does not cause much damage to the galaxies.

The collision of massive objects such as galaxies moving at velocities close to or even greater than the velocity of light must annihilate the colliding galaxies and cause massive destruction in the nearby regions as well. However, the merger of galaxies is a remarkably smooth process.

Two galaxies are attracted towards each other. They meet and lovingly embrace each other. The stars make way to allow the black holes to merge. In turn, the black holes promise not to swallow any star on their way. The black holes shake hands and disappear into each other. Finally, the stars rearrange themselves, and everyone lives happily thereafter.

What a lovely fairytale it is! No fiction can match this love story.

If galaxies exist physically even in the absence of an act of observation then, there is no way galaxies can merge with each other without destroying each other.

The merger of galaxies is a physical impossibility. Galaxies can collide and destroy each other but cannot merge, but we know that galaxies merge with each other through a very smooth process.

This is possible only if galaxies exist in non-physical form. They merge as non-physical entities. If galaxies do not exist in physical form then, a sub-system of a galaxy definitely cannot exist in the physical form.

Based on this analysis we can say that the wavefunction of a physical entity is the sum of all its potential properties that it can manifest in physical form. An act of observation does not cause collapse of a wavefunction.

An act of observation manifests the wavefunction partially; it does not cause collapse of the wavefunction. The wavefunction remains unaffected by an act of observation.

EPR paper argues, *"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 lo this physical quantity."*

We have shown that even this condition is not required. It may not be possible to predict the value of a physical quantity because of any reason whatsoever, but it still does not prove that *an element of physical reality corresponding lo this physical quantity does not exist.*

Now, let us open the container sealed by Schrödinger to see if the cat is still alive or dead.

The cat does not exist in physical form in the absence of an act of observation, but it continues to exist in non-physical form. The potential properties of the non-physical form changes constantly with time. At some point, the non-physical form loses the potentiality to manifest and function as a physical system. The non-physical entity loses the potentiality to manifest mass.

This event manifests as death in the physical world. The non-physical form of the cat and the information associated with it continue to exist even after its death.

This is the meaning of death.

The cat may still appear to be alive, which means it may still manifest as a functional physical system to an observer, but only because of the time delay in the communication of information. For example, if a cat is located at a distance of 10 feet from an ultrafast camera. Suppose the cat dies at 5 nanoseconds past 00.00 hrs. In the frame of this camera, the cat will be alive until 15

nanoseconds past 00.00 hrs. At the same time, the cat would manifest in dead state at 5 nanoseconds past 00.00 hrs. to an observer located in the same frame.

The state of the apparent form of the cat would be the actual state of the cat for both the observers.

The cat is the name given by us to a particular physical form. The non-physical entity is formless.

It may not be possible for us to measure the value of a physical quantity without disturbing the apparent form, but every physical quantity has the potential to manifest in physical form and has a definite physical value.

John Bell observes, *"Making a virtue of necessity, and influenced by positivistic instrumentalist philosophies, many come to hold not only that it is difficult to find a coherent picture but that it is wrong to look for one – if not actually immoral then certainly unprofessional. Going further still, some asserted that atomic and sub-atomic particles do not have any definite properties in advance of observation. There is nothing, that is to say, in the particles approaching the magnet, to distinguish those subsequently deflected up from those subsequently deflected down. Indeed even the particles are not really there."* [11]

We have no option but to have a coherent picture of nature of physical reality because the universe functions as an indivisible whole. The universe is a system. At the same time it may not be wrong to say that there is nothing, that is to say, *in the particles approaching the magnet, to distinguish those subsequently deflected up from those subsequently deflected down, but it definitely does not mean that even the particles are not really there.*

Heisenberg says that we do not observe nature, but nature exposed to our method of questioning. Einstein felt that *the (quantum) theory had abdicated the historical task of natural science to provide knowledge of significant aspects of nature that are independent of observers or their observations.* [12]

Neither of them presents a real description of the physical world. Nature definitely is not the sum of all the physical or even non-physical entities. Nature is the sum of all the laws that govern the physical world.

These laws are observer independent.

Quantum mechanics is not only incomplete but partially wrong even in its description of what it observes. Einstein and all other physicists who believed that we can describe the world independently of the observers are nowhere close to explaining the nature of even physical reality. Copenhagen interpretation does present an image of reality even if it is an out-of-focus blurred image. We have just presented a clearer image of the nature of physical reality.

The most beautiful aspect of this new paradigm is that we need not change our theoretical structure a great deal and yet these findings open up a whole new world to every human being in general and scientists in particular. We cannot even imagine what all is possible in this universe. In fact, it will not be an overstatement if we say that nothing is impossible in the physical world.

Isn't it strange that we do not even know that we are a non-physical entity that assumes physical form only as a consequence of an act of observation?

Think about it!

This paper highlights uncertainty of a very different nature. The uncertainty highlighted by us is inherent in nature. We have shown that the behavior of the particles is unpredictable but not arbitrary. This observation is bound to change our understanding of the concept of free will. We obviously, do not have absolute free will, but we are also not just puppets in the hands of nature.

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