

# Quantum Physics and Vedanta

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## Quantum Physics and Vedanta

On the surface Quantum Physics (QP) and Vedanta may look very different. One is part of the scientific tradition and the other in some ways is philosophy, some may even call it religion. Science is trying to understand the universe 'out there' and Vedanta is trying to understand the universe 'inside you'. Everyone will agree that there is only one universe; both 'out there' and 'in here' are parts of the same universe. If this is true, both must have the same underlying reality. If you are part of the universe then your underlying reality must be the same as the underlying reality of the universe 'out there'. There cannot be two independent realities for the same universe. Both science and Vedanta are looking for the same underlying reality. Besides, they share common ground which we'll explore in this article.

The goal is the same, but the approach of science and Vedanta are quite different. Science started out by looking at all the objects 'out there' in the universe, how they function, what they are made of. As scientific understanding improved, scientists wanted to learn more about these objects and to understand the building blocks of the universe. They started looking inwards from molecules, and then into atoms, into sub-atomic particles, into quarks, and strings; they are now looking for the unifying force which is the building block of the universe. Science now realizes that there is a unifying force, the 'The Theory of Everything' or a Singularity which is the underlying reality of the universe. What could this be? This is where science or quantum physics has reached a stumbling block, Vedanta takes a different approach, it started looking 'in here' and the ancient Rishis found that the single unifying force is within themselves. They understood that this single unifying force is also the underlying reality of the universe. Based on this, they posit that this single reality is then divided into an infinite number of diverse objects and this is the physical universe we see.

Basically Science started from 'out there' and then moved inwards to find the underlying reality. Vedanta started from 'in here' and then moved outwards to understand the universe. The ultimate goal for both of them is the same.

Physics, which is an important part of science, can be divided into 2 distinct divisions or phases

- Classical Physics
- Quantum Physics

Classical physics started with Newton, who made many different discoveries and formulated many different laws, which are relevant even today. Newton's laws did not focus on atomic level objects but on macro objects we can see around us. Based on these laws, people believed that the universe was a giant machine, where one can easily predict the motion of the planets

and the objects therein. This way they knew exactly what was happening in this universe and in some way could even predict all the future movements of celestial bodies. Physicists thought they knew everything in the universe and there was nothing new to discover.

In the early 20<sup>th</sup> century, things took a dramatic turn. As physicists started exploring atomic level particles, they found none of the classical laws were applicable to these particles. Classical physics became outdated at the atomic and sub-atomic levels. To understand and explain the happenings in the realm of the sub-atomic, quantum physics was born.

As we shall see in the coming section, sub atomic particles behave in unpredictable ways. Quantum physics is trying its best to provide a proper explanation which is rooted in science and supported by experiments. Sometimes, a particle is a 'wave' and at some other times it is a 'particle'. This discovery marked the starting point of quantum physics. Quantum physics has explored this contradiction over the past century. Many questions have been successfully answered, but with every answer new questions come up. And so the search for answers doesn't seem to end. Some of the questions cannot and will not be answered by science, because they are outside the scope of science. We will look at all these issues in this article.

In many ways this is quite similar to Vedanta. Vedanta teaches us that the mind is made of waves or 'vrittis' and these 'mind waves' become the objects which we see around us in this physical universe. Are the 'waves' described by quantum physics the same as the 'waves' in the mind? I strongly believe both are the same and this may be the common ground between quantum physics and Vedanta. The focus of this article is to show that this is true. This will help quantum physics to apply Vedanta principles, which, it must be said, follow rigorous logic, that any scientific mind will be satisfied. This will help resolve many of the unanswered questions being faced by quantum physics. And that's the main focus of this article.

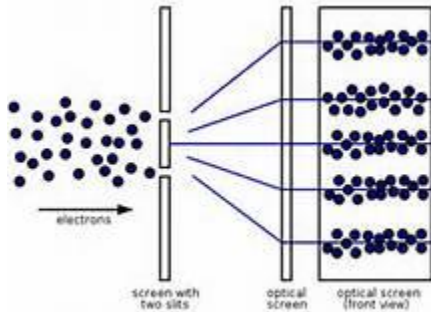
## **What is Quantum Physics – A Brief Overview?**

Quantum physics is the study of the behavior of matter and energy at the molecular, atomic, nuclear, and even smaller, microscopic levels. We'll give a quick overview of quantum physics by highlighting some of the key developments that are relevant to this article.

### **Light is a Wave:**

In 1805, Thomas Young demonstrated that Light was a wave. He used the famous double slit experiment. There was a light source and in front of it there was barrier and this barrier had two slits. On the other side of the barrier was a photographic plate to study the light's

propagation through the slits. The result on the photographic plate clearly showed that light



was not a particle but a wave. If it was a particle, there would be only 2 bands on the plate, but the plate showed multiple bands, proving that the light was a wave which passed through the two slits and then combined to form all the different bands. Watch the following video in YouTube <https://www.youtube.com/watch?v=DfPeprQ7oGc>

### **Light is a Particle**

In 1905 Einstein published a paper on 'Photoelectric Effect' phenomenon, which showed that light is a particle. In 1921, Einstein got a Nobel Prize for this discovery. It is surprising that he got the Nobel Prize for this discovery and not for the 'Theory of Relativity', for which he is better known. In this experiment, you shine light (which is a wave) on a photoconductive metal and you get light reflected on the other side. On studying or observing this reflected light, Einstein found that the reflected light was not a wave, but it was made up of packets of energy. Each packet is a unit of fixed energy and this packet is known as a photon and has all the characteristics of a particle.

Max Planck also found the emission of photons or discrete packets of energy when he tried to understand the emission of energy from a black body. Depending on the color of the heated black body, photons with different energy levels were emitted. The hotter the black body, the higher the level of energy in the photons emitted. Also, these higher energy photons had a higher frequency of light as compared to the lower energy photons which had a lower frequency of light.

### **Higher Frequency = Higher Energy of photon**

The double slit experiment explained earlier was updated slightly, instead of two slits, there was only one slit. Light was passed through a single slit and then onto a photographic plate. In the two slit experiment, they found a series of bands on the photographic plate, which suggested that light was a wave. When a single slit was used, they found only a single band on the photographic plate, suggesting that the light was a particle and not a wave. The curious part of this experiment is, what made light behave as a wave when there were two slits and then

behave as a particle when there was only one slit? This experiment was repeated again and again and the result was always the same. There was something which was telling light when to behave as a wave and when to behave as a particle. This dilemma was the birth of quantum physics.

### **Matter is both Wave and Particle**

So, light exhibits properties both of a 'wave' and of a 'particle'. In 1923, de Broglie, a French doctoral student made a bold assertion that not only light but all matter must have both 'wave' and 'particle' properties. Here matter means matter, including, you, me, planets, cars, in fact any living or nonliving object in this universe. The tree in front of you is a particle, and using the de Broglie formula; you can also calculate the wavelength of the tree based on its energy content. In 1927, the de Broglie hypothesis was proven experimentally - thus, all matter is both a wave and a particle. In 1929, de Broglie was awarded the Nobel Prize for his theory. He was the only one to ever receive a Nobel Prize based on his doctoral thesis.

How can we comprehend that everything that exists is both particle (matter) and a wave (non-matter)? Is this possible? The tree outside my window definitely looks like a particle, so the question is when is the tree a 'wave'. Is it ever a 'wave'? It must be a 'wave' otherwise the de Broglie theory would be wrong. Let's try to understand this. If I turn my back to the tree, is the tree still a 'particle'? Is the tree even there? You really cannot be sure, because you are not seeing the tree. Maybe the tree is now a 'wave'. This type of logic can be applied to all objects in the universe including any living being. For example you are talking to your friend sitting in front of you. You are sure he a 'particle' because he is right in front of you and you can see him. You now move to the next room and you cannot see your friend anymore. Is it now possible that your friend has become a 'wave'? When you come back to the room; your friend is once again a 'particle'. All this may sound strange, but this is what happens when you try and understand quantum physics. You now ask your friend 'were you a wave' a short time ago? He may think you've gone mad, but out of politeness he will confirm he has always been a particle. The friend may want to play the same game with you. He may say to you 'I did not see you when you went to the next room, were you a 'wave' till you came back to this room and till I saw you once again? He has a valid point. When you moved to the next room, you may think your friend is a wave and your friend would also think you are a wave.

Looking at the example of the tree and your friend, it would suggest that anything in your presence would always be a particle, but if something is not in your presence it could mean that it's a 'wave'. Your presence is necessary for anything to be a particle. This is the implication of the de Broglie theory.

Can something be a 'wave' and a 'particle' at the same time or must it be either a 'wave' or a 'particle' at any given time? If the tree is a particle, then it just cannot be a 'wave' at the same time, and vice versa. Science has no answer to this question. Here's some food for thought - if an object is a particle, then where is the wave residing? Is the wave also part of this space time framework or does the wave reside in another dimension?

There are so many questions which the de Broglie hypothesis generates about matter being 'wave' or 'particle'. Unfortunately, science has not answered them so far. In the coming sections we will try and understand these questions using the teachings of Vedanta.

### **Schrodinger's Wave Function**

Like Newton's law of motion is the heart of the classical physics, Schrodinger's wave function is the heart of quantum physics. To understand the 'wave' part of the de Broglie theory, Schrodinger formulated a complex equation for the wave function. Without being too technical, Schrodinger's wave equation is represented by the following

1. Schrodinger's equation represents a physical system and this physical system always consists of an observing system and the observed system. The observed system is a wave function, and this wave function is the wave component of the wave/matter duality as postulated by de Broglie. The de Broglie hypothesis says every object in this universe is both a 'particle' and 'wave', the wave part can be represented by the Schrodinger' wave equation and this wave is being observed by the observing system
2. The Schrodinger wave equation represents only 'standing' waves and not 'traveling' waves. We see traveling waves when we throw a stone in a pond and see the waves traveling outwards, or when we see waves in the ocean. Standing waves in turn are waves which propagate in an enclosed environment; they keep bouncing off the enclosed 'walls'. Electrons, as waves, are standing waves because they are enclosed within an atom. For the observing system to observe a standing wave it must be enclosed in some type of environment.
3. Schrodinger's wave equation is a generic equation which represents all the possible standing wave functions in the universe. The main variables of Schrodinger's wave equation are time and energy. If you input the correct variables for a particular observed system, the Schrodinger wave equation will represent that wave function. If you input the energy variables of the electron wave, the Schrodinger equation will represent the electron wave function over time. Understanding the energy structure of electrons, photons, molecules and other micro objects are simpler, therefore it is possible to apply the Schrodinger wave equations to these wave functions. Macro objects have more complex wave functions and it is much more difficult to input their variables to create the Schrödinger wave function. In conclusion, we may say that the Schrodinger wave equation is applicable in every wave function both simple and complex.

The only limitation is that science still does not understand the input variables needed for the complex waves representing macro objects like you, me or cars and planets.

4. You can convert the Schrodinger's wave function into a probability wave function by squaring the wave function. The probability wave function contains all the possible outcomes. There could be infinite possibilities. To explain this, the famous Schrodinger cat example is given. A cat is enclosed in a box which contains a veil of poison attached to an atomic trigger. The atomic trigger can randomly trigger the poison veil. One is never sure if the cat is dead or alive at any given time. As per the probability function yielded by Schrodinger's equation, the cat could be dead or alive and it could also be half dead or half alive,  $1/3$  dead or  $2/3$  alive and all the other different possible mix of ratios between dead and alive. It has infinite possibilities, but only a few logical possibilities. You cannot have anything  $1/4$  alive and  $3/4$  dead.

5. Another important aspect of the physical system for the Schrodinger wave equation is the observing system. When this observing system interacts with the observed system at any given time, the wave function of the observed system collapses to only one of the logical possibilities at that given time. In the example of Schrodinger's cat, if you open the trap door to see the cat, the cat will be alive or dead. If it is found alive all the other possibilities become zero. In other words, when the observing system interacts with the observed system, the wave collapses to one of the possibilities for that given time and then all the other possibilities have a zero chance of occurring. Till the trap door is opened, the cat is in a wave form with infinite possibilities and when the door is opened by the observing system the 'cat' wave collapses to being alive and then all the other possibilities became zero.

In the case of the two slit example described earlier, a light wave passes through the two slits, and it has all the possibilities of striking anywhere on the photographic plate on the either side. When the light wave touches the photographic plate at a particular location, the wave function of the light collapses at that point and that point is no longer a wave but shows the characteristics of a photon particle. Once the wave function collapses, at that point, the probability is one and the probability at all other points is zero. In this case the observing system is the photographic plate which collapses the wave function.

Here is a direct hint that the wave function only collapses in the presence of an observing system. If there was no observing system, the observed system would continue to be a wave function. Before interacting with an observing system, the observed system was a wave and the moment after interacting with the observing system, the observed wave function collapsed to become a particle.

With this proper understanding of the Schrodinger wave function, many further questions come to mind.

**Question 1:** The Schrodinger wave function represents the ‘wave’ aspect of the wave/particle duality as postulated by de Broglie. A prerequisite for the Schrodinger wave function is that it must be a standing wave. To be a standing wave it must be enclosed within some type of ‘wall’. We saw the electron wave function operates within an atom. But the atom is also a wave, so where are ‘walls’ for the atom – you might say the molecule. But the molecule is also a wave function, so where are the ‘walls’ for the molecule. As you keep moving from micro to macro, you can keep asking the same question for every macro object in this universe. Where is the ‘wall’ for the standing waves of the objects in this world?

**Question 2:** Besides the ‘wall’, there are many other questions one can ask about the wave function

- What are the waves made of? Nobody has seen a wave, but it must be made of something, it cannot be made of nothing. Some physicists say that there are no ‘waves’, only the Schrodinger wave equation represents the wave function.
- The waves need some sort of medium to propagate. What is this underlying medium? At one time, scientist speculated that there is some sort of ‘ether’ in which the light waves travelled. Experiments have proven that there is no ‘ether’ underlying this universe. So what is the medium through which waves travel?
- Where do the waves reside? ‘Out there’ or ‘in here’? One thing is clear: it cannot be within the particle object, because the particle objects only shows up when the wave function collapses in the presence of the observing system. The wave comes first and then the particle, therefore the wave cannot exist within the particle.

**Question 3:** Quantum physics provides very little understanding of the observing system. In the double slit experiment, it is suggested that the photographic plate is the observing system. The photographic plate interacts with the incoming light wave and this wave function collapses at the photographic plate. Science assumes that the photographic plate is the observing system. If you examine this closely, does a man-made photographic plate have the capacity to collapse a wave function to become a particle? What unique quality of the photographic plate allows the wave function to collapse? Another question to ask is - what is the exact meaning of the statement “collapsing wave function”?

If you take the broader viewpoint, you will realize that the photographic plate itself is matter and therefore it also has a wave function. So what observing system collapses the wave function of the photographic plate? The logical answer would be your eyes. But the eye is also matter and therefore it also has a wave function. So what observing system collapses the wave function of the eye? The answer would be your brain. Then brain is also matter and therefore it also has a wave function. So what observing system collapses the wave function of the brain? I



think that at this point, science has come to the end of the road; it cannot explain what, or which observing system collapses the wave function of the brain.

If we understand Vedanta properly, most of these questions can be answered. In the coming sections we will try to explain some of the key teachings of Vedanta that help answer these questions.

### **Multi - Universes**

Quantum Physics also speculates that there are multiple universes. This speculation is based on the collapsing of Schrodinger's wave function. We saw earlier that the probability wave function has all possibilities. However, in the presence of the observing system, the probability function collapses into only one of the possibilities. When this happens, then the probability of all the other possibilities becomes zero. The question Quantum physics asks is - what happens to all the other possibilities which were inherent in the probability wave function? They could not just disappear. Quantum physics speculates that all the other possibilities also collapse but not in this universe but in other parallel universes. For this reason physicists think that there are multiple universes. If a probability wave function has 100 possibilities. When this wave function collapses, one of the possibilities happens in this universe and remaining 99 possibilities happen in 99 parallel universes. In the Schrodinger Cat example, the probability wave function had two possibilities the cat being 'dead' or 'alive'. When you open the trap door in this universe and see the cat 'alive' then the speculation is that in the parallel universe the cat would be 'dead'.

Quantum physics definitely has a point, if one of the possibilities collapses over here, what happens to all the other possibilities? In the Schrodinger cat example there were only two logical possibilities, there are other wave functions that have an infinite number of possibilities. What happens to all these possibilities? We shall be discussing this later on. Every living being creates their own unique universe and each one of them collapses the probability wave function differently. If there is infinite number of living beings, then there would be infinite number of universes being created. This is the multi verse or parallel universes which quantum physics talks about, but Quantum Physics makes it sound almost mysterious.

### **Understanding $t$ (time) = 0**

To interpret quantum physics properly, it is important to understand what we mean by  $t$  (time) = 0. So, we can say that  $t=0$  means that it is not the past, not the future but the present. It means it is 'now'. Anything  $t = 0+$  or  $t = 0-$  is not 'now' but it is the future or the past.. Even a nanosecond more or less than  $t = 0$  is not 'now'; it would be past or future. For your

information, based on the Plank constant, the smallest possible time unit is  $t = 10^{-44}$ . Even the passage of this extremely small time unit would mean the event is not 'now', but the past or the future.

So, where is the  $t=0$  for the universe? Science tells us that the big bang is the  $t = 0$  for the universe. I do not think this is correct. The big bang is 13.7 billion years old, which means the  $t = -13.7$  billion years for the big bang. Only the location of 'now' can be  $t = 0$ . Therefore the big bang cannot be  $t=0$ . It may have been  $t = 0$  at the time of the big bang, but right now the big bang is 13.7 billion years old. It is an event from the past. So how do we explain  $t = 0$ ?

Any perception process must have the following two elements

1. Subject or Observer
2. Object or Observed

Without these two elements, the perception process would be incomplete. Even the physical system for the Schrodinger wave function must have an observed system and an observing system.

In the following sections we will analyze and show where we can locate the  $t = 0$  for the Subject/Observer and the Object/Observed. The proper understanding of  $t = 0$  will go a long way in explaining many of the shortcomings faced by science and quantum physics.

### **Where is $t = 0$ for the Observer/Subject?**

Even before we start understanding  $t = 0$  for the Observer/Subject, the question which must be answered is – what do we mean by an Observer?

1. All perception takes place only in the mind. Even science agrees with this – the outside image falls on the retina, which is converted into an optical signal and sent to the brain for processing. Science never explains what happens after that but it does state that the final perception takes place in the mind. Also, science never explains who the observer of the image within the mind is. Who is watching the movie being played in the mind?

According to Vedanta, Atma is the Observer which witnesses everything that is happening in the mind and we know the mind is full of activity. This Atma is the Real 'I' and it is our underlying reality. Atma is merely an Observer and it never influences, neither is it affected by what is happening in the mind. It is like a witness to a movie which is running in your mind. Though in real life a sad movie can make someone cry, in the case of Atma, it is never affected by the movie running in the mind.

2. To locate the  $t = 0$  for Atma/Observer let us study the external objects out there. If we can see a faraway star, say, 5 million light years away, it takes light from that star 5 million years to reach us. Now we see the sun, the light from the sun takes 8 min to reach us. We look at the moon; light takes 3 sec to reach us. We look at the plane flying in the sky, at 30,000 feet; light takes about 300 milliseconds to reach us. As the distance of the object being viewed is reduced, the time taken for light to reach us is much smaller. I now look at the tree outside the window; the time taken for light to reach me is 10 microseconds ( $10^{-6}$ ). I am looking at the computer screen 1 foot away while typing this article, light takes about 1 nanosecond ( $10^{-9}$ ) to reach me. You even watch your thoughts, they too take some time to form; they are not instantaneous. As the distance reduces the time taken for the light to reach our eyes, reduces. If you extrapolate this backward, the only logical location for  $t$  to be equal to 0 is in the Observer, who is watching all these objects. Atma is the Observer, so Atma is  $t=0$  within you. This  $t=0$  is beyond time, it is always 'now'.

If you or anyone else looks around at the objects in the universe and uses the same reasoning as above, each one will reach the same conclusion: that the Observer within us is the  $t = 0$ . Everyone will have their own  $t=0$ , which is within themselves. This will apply to every living being in the universe. It would therefore seem that I have my own  $t=0$ , you have your own  $t=0$  and every living being in the universe has its own  $t=0$ . The only way to understand this is that each and every living being creates their own universe and also the  $t = 0$  for each and every one of them. Does this mean that there are multiple  $t = 0$ , one for each and every living being? Vedanta teaches us that Atma is the common Observer/Subject for every living being and therefore there is only one  $t = 0$ .

3. So how does Atma create the illusion of being a different Observer within each and every living being? To explain this, the classic example given by Vedanta is the example of buckets filled with water. Picture the sun shining over an unlimited number of buckets filled with water. What would you see? The sun reflected in each and every bucket. You will not see a partial image of the sun, but the complete image of the sun in each and every bucket. Now imagine the bucket represents our body and the water in the bucket is our mind. There are an unlimited number of living beings with a mind in this universe. The shining sun is the Atma. This one, and only one, Atma is reflected in the mind of each and every living being. So, you can see how, Atma/Observer within each one of us is the  $t = 0$ .

### **Where is $t = 0$ for the Observed/Objects?**

If you look closely, you would agree that whatever we see out there is all dated or past stuff. The far way star is 1 million years old, the sun is 8 min old, the moon is 3 sec old, the plane in the sky is 300 milliseconds old, the tree outside my window is 10 microseconds old, and the computer in front of me is 1 nanosecond old. We do not see any 'now' objects where  $t = 0$ , we

only see 'memory objects', which are no longer current. The universe is only made up of 'memory objects'. It is just impossible to find a 'now' object in the physical universe. It must be understood that 'memory objects' means both living and nonliving objects.

The question is, does there exist a 'now' version of any memory objects, where  $t = 0$  for the object? Intuitively you would think there should be a 'now' object somewhere. But where is this 'now' object?

Science adds to the confusion, when it talks about memory objects, it makes it seem as if they are talking about 'now' objects. When a planet is discovered 5 million light years away, it is referred to as if it is a 'now' object, but in reality it is a memory object. They are talking about an object which is 5 million years old, no one knows where that planet is 'right now'. Does it even exist, has it already been destroyed by meteor. No one can be certain. One certainty is that the 'now' object cannot be in the same location where 'memory' object is 5 million years back.

It almost feels as if there are two different universes - one is the 'now' universe and the other is the universe of memory objects. We know where the universe of memory objects is - it is right in front of us. So the question is - where is the universe of 'now' objects? You will never find the 'now' universe by looking at memory objects, those are all in the past, with old content. You cannot extrapolate memory objects to the future to understand the 'now' objects/universe. In a way, memory objects and 'now' objects have no connection whatsoever. Therefore, I wonder if science is on wild goose chase when it is looking for the Singularity, by studying and analyzing memory objects.

So where is the universe where everything is 'now' and where there are no memory objects? This is just not possible in the space time framework as we know it. To be in the 'now' universe, every object in this universe must be at  $t=0$ . If  $t$  is not  $=0$ , then it is not a 'now' object, it is a memory object. We know the  $t = 0$  for the Observer is within you, but where is the  $t = 0$  for the 'now' object.

We know that the sun we see is 8 minutes old and it is a memory object. Let us play around with this. Now for whatever reason, the sun is only 3 minutes old; it would mean the sun has moved closer to the Observer (and much hotter). In the same way, if the sun is only 30 seconds old, it would mean the sun is extremely close to the Observer, but it's still a memory object. If you keep extrapolating this and finally if  $t$  becomes 0 for the sun, it would only mean that the sun is within the Observer/Atma. We have seen earlier  $t=0$  is the coordinate for the Observer/Atma. For the sun to be a 'now' object, it must be within Observer/Atma.

At  $t=0$ , the sun is a 'now' object, and this 'now' object is beyond the space time framework and is within Atma. The only way to understand that for anything to be outside the space time

frame work, it must be in its 'un-manifest' or 'potential form' or 'seed form'. There is no actual sun, but there is only the potential to become the sun. Just Playdo used by kids has the potential to be manipulated to become different objects, in the same way Atma has the potential to become any object in the universe.

This reasoning and logic will be applicable to every memory object in the universe. The  $t=0$  for all the memory objects in this physical universe is present within Atma/Observer in its 'potential or seed form'. There is no actual universe within Atma, but the only the potential to become the universe. We are going to explain later on what we mean by 'potential or seed form'

### **T = 0 Is Pure Awareness**

We just saw that the  $t = 0$  for the Observer is within each one of us. We also saw the  $t = 0$  for all the 'now' Objects is also within us. At  $t = 0$  both Subject and Object are the same. They are completely unified and homogeneous with no separation whatsoever. What does this mean? THIS is the singularity which Science talks about. It is the unity of the subject and object.

Vedanta teaches us that the essential nature of Atma is Self-Awareness; that is, it is aware of itself. If you look at Awareness more closely, you will realize Awareness must always have the following two elements.

1. If you are aware, then there should be someone who is aware. Awareness needs a subject
2. To be aware, there must be an object which you are aware of. Awareness needs an object.

Subject and object are needed to complete the Awareness process. To be Self-Aware, the subject and object must be within Awareness itself, with no separation. This is Pure Awareness. In our daily perception, we always feel that the subject is here, while the object is out there, there is separation; we are therefore not Self Aware.

Earlier, we saw that  $t = 0$  has both the Subject and Object as non-separate from each other. The only conclusion we can reach is that  $t = 0$  is not only Aware, but it is Self-Aware. Vedanta teaches us that Atma is Self-Aware. Therefore  $t = 0$  is Atma, and this  $t = 0$  is the underlying reality of the universe, including for every living being.

$t = 0$  is a concept which science can understand. If science does properly understand  $t = 0$ , it must reach the conclusion that  $t = 0$  is no different from Atma, which is the underlying reality of this universe.

## Understanding Vedanta Cosmology

Science tells us that the Big Bang took place 13.7 billion years ago. One of the foremost questions is - what was there before the big bang? What was there at  $t = 0$ ? Based on our previous discussion we can say that Self Aware Atma was present at  $t = 0$ , in fact Atma is  $t = 0$ . It is therefore logical to conclude that the big bang was born out of this Self Aware Atma. All the matter and energy, all the space was born out of this Atma.

Fast forward to 'now', 13.7 billion years after the big bang. There is a  $t = 0$  'now' also. We have seen that I have a  $t = 0$  within me, you have a  $t = 0$  within you, in fact every living being has a  $t = 0$  within each of one us. The  $t = 0$ , which is Atma is always present within each one of us. 13.7 billion years back the universe emerged out of this Atma. In exactly the same way, right 'now' also, the universe is born out of  $t = 0$ , which is within each one of us. In other words, each one of us has our own big bang. We all create our own personalized universe. 13.7 billion years back the big bang created a baby universe, but right 'now' the big bang will create a more mature universe which is 13.7 billion years old. Your universe is a lot different from mine. I am color blind, so I am sure that what I take as the universe is different from what your universe looks like. Each one of us has our own personalized universe.

It would seem that the big bang takes place whenever we want to perceive the universe. The Big bang is not a 'one off' event which took place 13.7 billion years ago, but it takes place every time the Observer has a desire to perceive. Whenever the Observer has a desire to perceive, the Observer creates the universe anew.

How does the Observer create this universe? Vedanta teaches us that it is a 3 step process:

1. Creation of the Seed Body
2. Creation of the Subtle Body
3. Creation of the Gross/Physical Body

Due to ignorance, Atma becomes the seed body. The seed body creates the subtle body. The subtle body creates the gross body. This process of creation is not only true for each one of us, but it is also true for the cosmic body. The cosmic body is the sum total of all the individual bodies or objects in the universe. The cosmic body is also a combination of the 3 bodies mentioned above. Let us discuss each one of them in little more detail

### 1. Seed Body:

The seed body very similar to a seed from which a huge tree, with branches, leaves and fruits, comes out. A seed already has the potential form of the tree built into it. You could say that the tree is in an un-manifest condition inside the seed. The seed body is also called a causal body,

because it is the cause for the tree to grow from the seed. For us humans, too, the individual seed body will become an individual human being with all its genetic character traits, or tendencies (called Vasanas). These are also the blueprint of that person's life including all the karmas that one will exhaust in this life.

We saw earlier at  $t = 0$ , that all the memory objects are in potential form. In other words  $t = 0$  is the seed body, it has everything in potential form. It has the tendencies to create all the physical objects in the universe. The cosmic seed body has the potential form for all the possible objects in the universe. You, I and all living beings have a much smaller seed body; we are a small sub-set part of the cosmic seed body. Our potential form is limited in scope as compared to the potential form of the cosmic body.

Under the right conditions, this causal body or the seed body germinates and grows into the subtle body and the gross body to play out the blueprint that is contained within. The seed body is the driving force and is the cause for the creation of the subtle body and the gross body.

## 2. Subtle Body

The subtle body in a human being is that part of us which is not physical. Our thought, emotions and feelings, in short, our mind is the main component of the subtle body. We saw the seed body is  $t = 0$ . The subject and objects are unified and homogenous. The mind or the subtle body breaks down this unity of the seed body and creates a duality by the separation between the subject and object. According to Vedanta, the following are the two main components of the mind:

**Buddhi or Intelligence:** This is the seat of the Subject part of the seed body. Buddhi being the subject, it gives you the feeling of being 'I am'. Buddhi is the doer of actions and also the experiencer of actions.

**Manas:** This is the seat of the Object part of the seed body. The objects in the Manas are represented by waves or 'Vrittis'. These waves are made of "mind stuff" or subtle elements. The waves in the mind are like the waves or ripples we see in a swimming pool. They are standing waves bouncing within the mind. These waves are still in the potential form. The waves or 'vrittis' in the Manas come from different sources.

- The seed body germinates itself and creates waves within the Manas
- The Cosmic Mind is the sum total of all the waves in the universe. The individual mind only perceives a part of the universe and only those waves are in the individual manas.
- When you are thinking or day dreaming, waves come from your stored memories.

Every living and nonliving object has a wave form; it could be from your seed body, a part of the cosmic mind or your memory. I have a wave form, you have a wave form and every living and nonliving being in the universe has a wave form. These wave forms operate within the confines of the mind, either the individual or the cosmic mind. All the different waves representing different things superimpose on each other to form complex wave patterns. This is the same way when you see multiple ripples in the swimming pool combining to form different wave patterns.

It must be clearly understood that there is fully functioning subtle universe. This subtle universe is in vritti or wave form. Different wave patterns represent different living and non-living objects.

We saw earlier the main role of the Atma is to observe what is happening in the mind. We have seen the mind is full of complex wave 'vritti' patterns. So how does Atma 'read' the wave patterns in the mind? Vedanta teaches that that this is a 2 step procedure. This is like the collapsing of the wave function.

**Step 1: Vritti Vyapti:** This means "wrapping" of the vritti or wave by the mind. When a vritti is formed in the mind, the mind goes into its "memory database" and checks what this vritti represents. The mind then takes the shape of that object. At this stage it only takes the shape of what the wave represents. It does not have any content. It is like a wire diagram with no content.

**Step 2: Phala Vyapti:** Phala means fruit but a better translation would be the yielding of a result from the wrapping. The shape of the mind object comes in the presence of Atma, which is the light of Awareness. When anything comes in the presence of Atma it becomes conscious and this "wire diagram" of the mind object is now filled with Consciousness. You can be aware of something only when it is conscious. With this step Atma/Observer is now fully aware of the subtle objects in the mind.

### **3. Gross Body**

According to Vedanta, these subtle objects in the mind are projected out as the physical universe by Maya Shakti. This way the subtle objects become gross objects. Maya Shakti is the creative power of Atma and it is resident within the Manas part of the mind. This powerful Shakti is within each one of us. It first creates the space time framework and then places all gross objects within this framework. This is the physical universe we see around us. As we have mentioned earlier this physical universe is only made up memory objects.

There is a fully functioning subtle universe and also a fully functioning gross universe. The subtle universe operates in the 'potential form', while the gross universe is made up of memory



objects. The main role of Maya Shakti is to convert the 'potential form' into memory objects. It must be understood that each one of us observes a different set of memory objects. Let us take an example, suppose that, for whatever reason, you are milliseconds closer to the sun. The sun created by your mind is different from the sun being created in other people's minds. Your sun is milliseconds younger than anyone else's. In this way, we can see how the physical universe out there is unique for each and every one of us.

We can all see the gross universe, but the subtle world is really where all the action takes place. The gross universe is only a projection of the subtle universe. The subtle universe is like the software program, which in the presence of the projector, projects the movie on the screen. The gross universe is totally dependent upon the subtle universe.

## **Correlating Quantum Physics and Vedanta**

Now that we have a much better understanding of what we mean by  $t = 0$  and also a basic understanding of Vedanta cosmology, I think we are ready to tackle the questions which were raised while discussing the highlights of quantum physics.

### **Time vs. Space**

In classical physics, space and time were considered completely different and independent of each other. Newton considered space to have 3 dimensions and a separate single dimension for time. Einstein with his Theory of Relativity showed that space and time were interlinked and he changed the terminology from 'space and time' to 'space time' and this space time had 4 dimensions. But, it's hard to understand 4 dimensions, it's not intuitive. We can only visualize 3 dimensions, so where is the 4<sup>th</sup> dimension? Neither Einstein nor science has given a proper explanation for this.

1. If we look at the teaching of Vedanta, this confusion between space and time becomes quite clear. Einstein showed Time and Space are one and the same thing, the only difference is that Time is subtle while Space is gross. Space and Time are referring to the same thing. Space is the gross version of Time. Space is gross; we can see Space out there. No one has seen Time, but we can certainly experience time. From our discussion earlier on Subtle and Gross bodies, we can understand that Time is non-physical or subtle. We have seen that anything subtle is an activity that happens in the mind. As we saw, mental activities are made up of waves or 'vrittis'. Since Time is nonphysical, subtle, it must be a mental activity and it must be made up of waves or 'vrittis'.

Also we saw earlier that the subtle body creates the gross body. Time is subtle and Space is gross, it only correct to conclude that Time creates Space. How to understand this? Science tells us that the universe is 13.7 billion years old. If a photon has to travel from beginning of the universe, it will take the photon 13.7 billion light years to reach us. 1 light year is the amount distance light travels in one year. The size of the universe will be the distance travelled by the photon from the big bang. This distance travelled by the photon is the outer limit of the Universe, because there was no universe before the big bang. If you assume the universe is 13.7 billion years old 'right now'. After one second, the age of the universe will be 13.7 billion years + 1 sec. The photon now has to travel an additional 186,000 miles to reach us, which means the size of the universe has grown by 186,000 miles. After 10 seconds, the size of the universe would increase by  $186,000 \times 10 = 1,860,000$  miles. After one year from now, the size of the universe will increase by 1 light year. From this reasoning it is quite clear that Time is creating the expansion of the universe. Every year the universe is expanding by 1 light year. As more Time is passing, the Space of the universe is expanding. It is therefore only correct to conclude that Time (which is subtle), creates Space (which is gross).

2. If Time is subtle, it must be a 'vritti' or wave which is present in an individual mind and also in the cosmic mind. This wave has the power to create Time. It is quite difficult for us to understand or visualize the composition of this waveform, but one thing is certain that Time is subtle and therefore it is a waveform and is present in everyone's mind. If you are looking at the sun, the sun will also be present in your mind as a 'vritti' or waveform. Let us try and visualize how the 'vritti' of the sun combines with the Time 'vritti'. It will generate a superimposed waveform in the mind. The time factor is now added to the sun. It is like a mathematical waveform with time as a variable. If you think about it, this superimposed waveform will now provide a history of the sun. Since Time has been superimposed on the sun waveform, the new waveform will have the 'potential' to show the sun in all its stages of growth from its birth 4.6 billion years to right now. All the different Suns in the historical time line is present in the Vritti in its 'potential' form. For example you are on earth and you want to see the sun. Your mind will have a superimposed vritti of (Sun and Time). When this waveform collapses in the presence of the Observer, you will see an 8 min old Sun. This 8 min old Sun is present in the potential form in the combined Sun + Time 'Vritti'. Also when the subtle Time becomes gross, it would automatically mean that the position of the sun will be 8 min away from you. It will take light 8 min to reach you.

Let us suppose a person in a planet 1 million light years away is looking at our sun through a telescope. He will also have the same combined waveform of the Sun and Time in his mind as we do on the earth. However, when his waveform collapses, he will see a 1 million year old Sun. These two examples show that the combined Sun + Time waveform has the potential of all the

historical Suns. Depending upon the Observers location in the universe, Suns of different ages will be observed. Depending upon the age, it will be placed that many light years away in space.

This logic is not only applicable to the Sun but to each and every object in the universe, both living and nonliving. The Time vritti will combine with the waveform for each and every object in the universe, and this combination will contain the 'potential' history in time for all the objects in the universe. It would seem that the Time vritti or waveform is extremely powerful and it has the ability to create objects of different ages. It is indeed very powerful and this power can only be derived from Maya Shakti, the creative power of Atma. Atma is all powerful and it gives its power to Maya Shakti and Maya Shakti passes it on to the Time Vritti. The Time waveform (or vritti) can create objects of all ages by superimposing itself on the vritti of different objects. What is most wonderful is that Atma is the underlying reality for all of us.

Just like Time is subtle and Space is gross, the same logic can be used for Energy and Mass. The famous Einstein equation  $E = mc^2$  is self-explanatory. Energy is subtle and Mass is gross, they are both interlinked. Mass is the gross version of Energy. Just like Time is a vritti, in the same way Energy also is a vritti and is present as a waveform in an individual mind and also in the cosmic mind. This Energy vritti when it superimposes with any object vritti, will provide the required energy to the object and when this object becomes gross, it will have the required mass. This is another intriguing power of Maya Shakti and Atma.

If you examine it closely, you'll find that the Schrodinger Wave Equation applicable to any object has two variables - time and energy. We have just seen that any Vritti or waveform of any object in the mind also has two variables –time and energy.

### **De Broglie Hypothesis**

We saw earlier that de Broglie, the French physicist, asserted that matter is both a wave and a particle. There was no clear explanation as to why this is so. Neither was any explanation offered as to the logical interaction between the wave and particle.

After understanding the seed, subtle and gross aspects of the universe from Vedanta, I think we are ready to answer the questions raised by the de Broglie hypothesis. The waveform of matter belongs to the subtle universe and the particle form of matter belongs to the gross universe. They both represent the same thing. Every living and nonliving physical object in this universe exists as a wave and as a particle. Vedanta teaches us that there is the fully functioning subtle universe where the different waveforms interact with each other to form complex waveforms. For example, the JPEG file for an image is in a subtle form, while the actual image you see on your on computer is the gross version of the JPEG file. This is a good way to understand the connection between the subtle and gross universes. The subtle universe creates the gross

universe. The subtle universe operates within the individual and cosmic minds. We saw earlier that Maya Shakti converts the subtle waves to gross objects.

In conclusion, we may say that de Broglie proved the existence of the duality of physical objects in the Universe in the form of waves and particles. Vedanta completely agrees with this fact, but it fills in the blanks by explaining the relationship between the 'wave' universe and 'particle' universe.

### **Schrodinger's Wave Function**

The Schrodinger wave function represents a system which consists of an observed system and an observing system. The observed system is a waveform representing micro or macro objects. In the presence of the observing system, the observed collapses to become a particle. If you now look at what is happening in our minds. The mind is the observed system and is made of 'vrittis' or waveforms representing complex objects and includes variables of time and energy. Atma is the observing system looking at what is happening in the individual mind. In the presence of Atma, the observed waveform in the mind collapses to project the world out there as a 'particle'.

It would seem that the Schrodinger's wave function is representing the wave function of what is happening in your mind. They are so similar in every way. This is the only correct conclusion. Schrodinger's equation only deals with waveforms. We know from Vedanta that the wave forms operate in the subtle universe and this subtle universe resides either within the individual mind or the cosmic mind. The waveforms cannot operate 'out there' in an as yet non-existent physical entity; they can only operate within the mind. The locus of wave forms is in the mind. Simple wave functions for electrons, protons and other micro objects reside within the mind and also the complex wave functions for you, me and other macro objects also reside within the mind.

With this understanding, let us see if we can answer the questions which were raised earlier in the overview of the Schrodinger Wave Equation.

**Answer 1:** For the Schrodinger's wave equation to operate, the waveforms must be standing waves and not traveling waves. Standing waves need 'walls' to operate. As we saw earlier, we won't find the 'walls' for the standing waves 'out there'. The only place you find 'walls' for the standing waves is the individual mind or the cosmic mind. The waveforms bounce within this wall. Therefore the only place for Schrodinger's wave equation to operate is the individual mind and the cosmic mind. This means that Schrodinger's wave equation represents the 'vrittis' or waveforms operating within the mind.

**Answer 2:**

- What are the waves made of? According to Vedanta, the 'vrittis' in the mind are made up of mind stuff. Mind is part of the subtle body and is made up of subtle elements. Vedanta teaches us that the universe is made up 5 elements – Space, Air, Fire, Water and Earth. These 5 elements come in both subtle form and gross form. The individual mind and the cosmic mind are made up of the subtle form of the 5 elements. Even the food we eat has a gross form and subtle form. The gross form of the food nourishes our body, while the subtle part of the food nourishes the mind or the subtle body.
- Atma is the light of Awareness. When the mind comes in touch with this light of Awareness, the mind becomes Conscious. The mind is completely filled with this Consciousness. This Consciousness is the underlying material of the 'vrittis' within the mind. In the presence of this consciousness, the 'Vrittis' become active or 'conscious', in a manner of speaking.
- We saw earlier that standing waves cannot operate 'out there' in the space of the universe. The only place the 'vrittis' can operate is within the individual mind or the cosmic mind. In the wave/particle duality, it is quite clear that the wave creates the particle. The underlying cause of the 'particle' universe is the 'wave' universe. Maya Shakti projects the 'wave' universe as the 'particle' universe or the physical universe that we see.

**Answer 3:** Science must clearly understand that the measuring system like the photographic plate in the double slit experiment does not have the power or mechanism to collapse the light wave into a photon. The photographic plate itself has a 'wave' component operating within the mind. Who collapses the waveform of the photographic plate? The only correct answer to that is Atma. Atma is the observer of all the activity within the individual and cosmic mind and Atma is only source with the power to collapse a wave function.

The other question which needs to be answered is, what is meant by collapsing of the wave? Science suggests that when the wave changes from a 'wave' to a 'particle', the wave collapses. As we have seen earlier, Vedanta has a 2 step process

- Vrtti Vyapti
- Phala Vyapti

In Vedanta, this two-step process does not mean that the waveform collapses, but Atma becomes aware of what the vritti or waveform in the mind really means and represents. When science says that the waveform collapses, it really means that the observer is aware of what the waveform represents. For the observer to be aware of the observed, than both the observer and the observed must be conscious. If either one of them is not conscious, the observing process is not complete. Atma is the Self Aware Observer and the mind with its content is also conscious in the presence of the observer. This completes the cycle and therefore the Atma is

aware of what is happening in the mind. This also means that the process of observing can only happen in the mind.

The only conclusion from all these answers is that Schrodinger's Wave Equation represents the wave functions operating within the mind. In this regard both quantum physics and Vedanta are exactly the same.

### **Multi – Universes**

We saw earlier, when the Time waveform combines with the waveform of any object, for example, the Sun, they will form a superimposed wave function of the Sun and Time. This combined waveform will have the potential timeline of the Sun. It will have the potential of the sun as of now, the sun which is 8 min old, and the sun as it was at its birth 4.6 billion years ago. The entire history of the sun is available in its potential form.

If 100 people from all over the universe are looking at the sun at the same time. What will happen? Each one of the 100 people will have the same combined vritti of the Sun and Time in their respective minds. Atma in each of the minds will be looking at the same combined waveform. For example person 1 in New Jersey, the combined wave form will collapse and he will see the Sun, which is 8 min old. His view of the Sun is unique; none of the other people can have the same view of the sun. It is only logical because Person 1 can occupy this unique space time position. The probability of this unique viewpoint is now one, the probability of any other person to have this unique viewpoint is now zero. This reasoning follows the collapsing of the Schrodinger probability wave function. If person 2 is in India, although the sun he is looking at is also around 8 min old, his perspective of the sun is unique, no one else can have the same view. The probability wave function for that viewpoint now collapses to one and the probability for anyone else to have the same view is zero. If person 50 is in a planet which is 1 million light years away from the Sun. He will also have the combined vritti, but when his probability wave function collapses he will be see the sun which is 1 million year old. If person 100 is in a planet which is 4.6 billion light years away and is looking at the sun through a powerful telescope. He will also have the same combined vritti of the Sun and Time. When his probability wave function collapses he will see the sun at its birth 4.6 billion years back. Each of the 100 people are creating their own universe with a unique look at the Sun. No two people can have exactly the same view of the sun.

The impression you get from quantum physics is that a wave collapses only once in this universe and all the other waves are collapsed in multiple universes. There is an inexplicability and mysteriousness here. This is a wrong impression created by quantum physics. We have shown that each individual person creates their own unique universe. If 100 people are looking at the same Sun, 100 parallel universes are being created, each with a unique view of the sun. If

1 million people are looking at the same exploding star, then 1 million parallel universes are being created.

This is correct understanding of what Multiple Universes means.

### **Classical Physics vs. Quantum Physics**

Science tells us that the laws which operate in the classical world do not work in the quantum world and laws which operate in the quantum world do not work in the classical world. From this statement, it would seem both of them are functioning in different worlds. Why does this happen? What is the difference between these two worlds? According to Vedanta, there is a fully functioning subtle universe and a fully functioning gross universe. We saw earlier that the subtle universe is made up of 'vrittis' or waveforms operating with the individual mind and the cosmic mind. The gross universe is the universe which is made of 'memory' objects. In the gross or physical universe you only find 'memory' objects, you will not find any 'now' objects.

The focus of quantum physics is on understanding the wave/particle duality. This would mean that the focus of quantum physics is on the subtle universe, while the focus of classical physics is on the gross world. We know that the gross world is made up of 'memory' objects only, while the subtle universe is made up of 'now' objects. Therefore the focus of quantum physics is on 'now' objects while the focus of classical physics is 'memory' objects.

'Memory' objects and 'now' objects are very different. By studying the 'memory' objects, there is no way classical physics can learn about 'now' objects. A good example is viewing a recorded baseball game on your DVR. The recorded game being watched is like watching 'memory' objects on your TV. The players on the TV are all 'memory' objects. Now you are curious and you want to find out what these 'memory' players in the TV are being made of. By studying these 'memory' players you can never find out the players actually have 206 bones and all the other internal organs of the players. Only discovery you will make that the recorded players you are watching on TV are made of pixels and not the 206 bones. The 'memory' objects have this limitation and are completely different from 'now' objects.

It is for this reason that the laws of quantum physics do not apply to the gross/physical world, only the classical laws will work in the physical world. The same reasoning will apply to the subtle universe; the classical laws will not be suitable, only the quantum laws will work in the subtle universe.

## Conclusion

De Broglie had posited that any physical object has the wave/particle duality. It is both a wave and also a particle. This is exactly the same as the subtle/gross duality referred to in Vedanta. The subtle body, which is the mind is nothing but a pool of waves, while the gross body is the physical universe. Even Schrodinger's wave equation is really talking about 'vrittis' or waves in the mind. The only place you can have waves is in the mind, there are no waves in the physical universe. The observing system which collapses the Schrodinger probability wave function is nothing but Atma, which is the underlying reality of everyone. All the waves in the mind collapse in the presence of Atma. From this we can conclude that Quantum Physics and Vedanta are talking about the same underlying reality.

It will be a good idea if Quantum Physics can incorporate these concepts from Vedanta, it will help Quantum Physics make a quantum leap in the right direction!