Chapter 1. The Mysteries Of Quantum Theory Are The Mysteries of Nonduality

There are a number of mysteries about quantum theory that have perplexed the greatest minds of our scientific age, but once you understand what the holographic principle of quantum gravity is telling us about the nature of reality, these mysteries are not really that mysterious. Although not fully appreciated by either the scientific or nonduality communities, the holographic principle also allows for a scientific understanding of the nature of nonduality, which is another way of saying that the mysteries of nonduality are the mysteries of quantum theory.

What exactly are these mysteries?

The first mystery is most succinctly stated as Who am I? What is the true nature of individual being or existence? What does the self-designation of I or the Self, which is often referred to as the I Am, mean in terms of being? Who or what is this being called the Self or I Am?

The second mystery can most succinctly be stated as What is the nature of the world? A closely related question is What is the nature of a person in the world? What is the nature of the body and mind of a person that lives a life in the world?

The third mystery is most succinctly stated as What is the nature of life? We don't just want to know what is the nature of living a physical embodied life in the world, but also what is the nature of a mental life consisting of thoughts, memories and other forms of mental imagination?

The reason modern physics and quantum theory have something to say about the first mystery is because everything that can be perceived in the world, which quantum theory refers to as an observation or measurement of the world, occurs in a subject-object relation. The subject, which is called I or the Self, is perceiving, observing or measuring some property of the object. The subject, which is the perceiving I, is observing some property of the observable object. In quantum theory, the perceiving I or subject is called the observer. Relativity theory also has something to say about the nature of the observer. In some sense, unifying quantum theory with relativity theory is the problem of making sense of the observer in both theories.

We'll have to come back to this problem a little later, but as a preview, relativity speaks about the observer observing or measuring the relativistic properties of its objects in an accelerated frame of reference, while quantum theory speaks about the observer observing or measuring the quantized properties of its objects as those properties arise from a quantum state of potentiality. The key point is that these observations always occur in the subject-object relation of perception.

Neither quantum theory nor relativity theory really have anything meaningful to say about the nature of the observer, only that the observer observes some observable property of its object in a subject-object relation. The most obvious interpretation of the observer is that the observer or perceiving I is the nature of perceiving consciousness, whatever that is. Perceiving consciousness is the perceiving subject or I that perceives the perceivable properties of its objects.

Quantum theory really has nothing to say about the nature of consciousness, so physicists mostly just ignore this question about the nature of the observer. Although physicists often claim that quantum theory is a description of an objective physical reality, this claim is patently false, since whatever property of physical reality is being measured or observed, that observation can only occur in a subject-object relation, and the subject is the observer. An objective physical reality cannot be defined independently of the subjective observations of an observer, since whatever property of physical reality that is being observed is always observed in a subject-object relation. Physical reality is just as much a subjective reality as it is an objective reality. The relation between the perceiving subject and its perceivable object is always perception.

Physicists want to obscure this issue by claiming that a quantum state of potentiality is an objective physical reality, but again, this is a false claim. A quantum state of potentiality by the nature of its mathematical construction is a superposition or sum over observable states, and to actually observe some observable property of an object, this quantum state of potentiality must be reduced to a single observable state. In quantum theory, this is called the collapse of the wavefunction. The observable states are always defined as eigenstates, which are solutions of some eigenvalue equation. The observable properties of the object are the eigenvalues, which in quantum theory are measurable quantities that take on discrete or quantized values. For example, the location of a point particle in space and time or the spin state of the particle are measurable quantities that take on quantized values. All possible measurable quantities of the particle arise as eigenvalue solutions of an eigenvalue equation, which is often referred to as the wave equation, and each solution defines an eigenstate, which is a measurable state of the particle. The most general wavefunction is a sum or superposition over all possible eigenstate solutions. When some actual value of the particle is measured, this sum is reduced to a single eigenstate, and the measured value is the eigenvalue that corresponds to that eigenstate. That's what the collapse of the wavefunction means. To measure a specific value of some property of an object, like the location of a point particle in space and time, the most general wavefunction that corresponds to that object, which is constructed as a quantum state of potentiality by summing over all possible eigenstate solutions of the wave equation, has to be reduced to a specific eigenstate. The eigenstates are the measurable states. This measurement or observation always occurs in a subject-object relation, as the observer observes the observable value.

The claim that physicists often make that the quantum state is an objective physical reality is simply a false claim. The quantum state of potentiality only describes all possibilities about what can be observed in physical reality, not what is actually observed. What is actually observed requires a quantum state reduction or collapse of the wavefunction, and that observation always occurs in a subject-object relation as an observer observes the observable value. There is no way to take the subjective observer out of observation. Whatever the observer observes is as much a subjective reality as it is an objective reality. By its very nature, the quantum state of potentiality is an unobserved state until it is observed, at which point it becomes reduced to an observed state of actuality. It simply makes no sense to speak of the quantum state as an objective physical reality. The quantum state is only a state of potentiality. It only describes what can possibly be observed from the point of view of any particular observer and not what is actually observed.

The reason physicists make this mistake is because they've mistakenly assumed that there is a God's eye view of physical reality that can observe all possible observable states of physical reality all at once. The problem is, there is no such thing as this God's eye view. In the sense of relativity theory, the observer is only a point of view that arises at the origin of its own coordinate system, which is called a frame of reference. In that frame of reference, the observer observes one possible version of physical reality as the quantum state is reduced to an actual observable state, but in another frame of reference, another observer observes another possible version of physical reality as the quantum state is reduced to a different observable state. The observable states observed by different observers do not necessarily have to agree with each other. One observer can observe one observable property of an object while another observer observes a different observable property of what's apparently the same object. That's basically what the wave-particle duality of quantum theory means. From one point of view, a photon looks like a point particle. From another point of view, a photon looks like an electromagnetic wave. Which is it? It depends on your point of view. Objects can appear to be different from different points of view. What we observe depends upon our own point of view, which is another way of saying that there is no such thing as an objective physical reality out there that is the same for all observers. Each observer observes its own version of physical reality.

Physicists argue about the Copenhagen interpretation of quantum theory versus the Many Worlds interpretation versus the Hidden Variable interpretation versus all other kinds of interpretations, but at the end of the day, the simple idea of an observer observing the observable properties of its own observable world in a subject-object relation of perception cuts through the nonsense of all possible interpretations. At the end of the day, there is only an observer, the subjective perceiving I, observing the observable properties of its own observable objects. Those observable objects all appear within the observer's own observable world. The hard thing to wrap your mind around is that everything you can perceive is just some observable property of some observable object that appears in your own observable world. Who are you? You are the subjective perceiving I.

This brings us to the second question about the nature of the world. Theoretical physics attempts to answer this question in terms of concepts like space and time and matter and energy. Relativity theory is the part of theoretical physics that attempts to describe the nature of the space-time geometry of the world. The most sophisticated description of the space-time geometry of the world is given in terms of Einstein's field equations for the space-time metric. The space-time metric is a field that gives a mathematical representation of how space-time geometry is measured. Just like in quantum theory, Einstein's field equations can be understood as a wave equation and the space-time metric can be understood as a wavefunction.

Quantum field theory is the part of theoretical physics that attempts to describe the nature of matter and energy in the world. In any specific quantum field theory, there is always a wave equation, like Maxwell's equations for the electromagnetic field. The electromagnetic field is the wavefunction that gives a mathematical representation for how electromagnetic phenomena are measured, just like the space-time metric gives a representation for how space-time geometry is measured. When the electromagnetic field is quantized, we speak of those measurements in terms of the quantized properties of a quantum particle called the photon. For example, we can measure the location of a photon in space and time in the sense of the space-time coordinates of a point particle, or we can measure the spin state of the photon, which is referred to as a polarization state in the sense of polarized light. In the sense of quantum theory, the wave equation has eigenstate solutions that specify the measurable states of the particle, and the most general wavefunction is a sum over all possible eigenstate solutions. When we actually measure some specific state of the particle, we have to reduce the wavefunction to a specific measurable state, which is called the collapse of the wavefunction.

At first glance, there is really no good reason why we shouldn't treat Einstein's field equations for the space-time metric the same way we treat Maxwell's equations for the electromagnetic field when we quantize the photon field. Since Einstein's field equations give a representation for gravity, if we did that, we would quantize the gravitational field in terms of a quantum particle called the graviton. Just as the quantized electromagnetic field gives a representation for the quantum point particle called the photon, a quantized gravitational field should give a representation for the quantum point particle called the graviton.

Actually, there is a good reason why we shouldn't do this. When we quantize the electromagnetic field, we have to assume that the photon propagates through some fixed background space-time geometry, which is usually taken to be flat Minkowski space. The problem is, gravity is understood as the dynamical curvature of space-time geometry. The only way we can understand the quantization of the gravitational field along the lines of quantum field theory is if the graviton as a point particle propagates through some fixed background space-time geometry, like flat Minkowski space, but that would be a logical contradiction, since by its very nature a theory of gravity must give a representation of the dynamical curvature of space-time geometry.

The problem isn't quantizing gravity. The problem is with quantum field theory. There is no way to understand gravity as a quantum field theory, since we'd then have to assume that the graviton propagates through a fixed background space-time geometry, like flat Minkowski space, which contradicts the very idea of gravity as the dynamical curvature of space-time geometry.

The problem with theoretical physics is with quantum field theory as a representation of the nature of matter and energy in some space-time geometry. Quantum fields represent matter and energy in terms of point particles. Those point particles have to propagate through some fixed background space-time geometry. There is no way to represent gravity in this way because a theory of gravity must give a representation of the dynamical curvature of space-time geometry.

What is the solution for the quantization of gravity if we throw out the idea of point particles propagating through some fixed space-time geometry? The answer is weird, but it seems to be the only possible answer. The answer is called the holographic principle of quantum gravity.

This is the reason we have to throw out the idea of quantum field theory as a representation of point particles propagating through some fixed space-time geometry. That is not a fundamental idea. A quantum field may still have value in an approximate sense as an effective field theory, but not as a fundamental idea. It's still ok to think of the world as having a space-time geometry, but point particles propagating through that space-time geometry are not fundamental things. Even the idea of the space-time geometry of the world is not a fundamental idea because the world is not a fundamental thing. The idea of quantum field theory as giving a representation of matter and energy in terms of point particles existing inside and propagating through the space-time geometry of the world is not a fundamental idea. Neither the idea of the world, nor the idea of the space-time geometry of the world, nor the idea of point particles existing inside and propagating through the world are fundamental ideas. None of these ideas are fundamental.

What is the fundamental idea? The idea of energy is still a good fundamental idea, but we have to throw out the idea of matter as being fundamental. Actually, modern theoretical physics has pretty much moved beyond the idea of matter as being fundamental in the sense of mass. Modern physics assumes that all point particles are fundamentally massless, and that all mass arises through a mechanism called spontaneous symmetry breaking. The bigger problem is, although the idea of energy is still fundamental, the idea of point particles is not. What about space and time? Are the ideas of space and time fundamental? This is where things get a bit tricky.

In all modern theories of quantum gravity, energy is still fundamental, but the only other fundamental thing is information. The idea of space and time in the sense of a space-time geometry, like the idea of point particles that exist within and propagate through a space-time geometry, can always be reduced to energy and information. The tricky part is understanding how that energy arises and how the information is encoded.

Actually, there is one more thing, in addition to energy and information, that needs to be included with the fundamental things, to understand this explanation, but paradoxically, that extra thing is not really a thing. That extra thing is called the void, which physicists call the vacuum state. The vacuum state is the ground state of existence in which nothing is perceived. It is a state of zero energy and no information, and yet in some mysterious way, it is the source of all energy and information. It is the source of everything that can be perceived. In absolute terms, the vacuum state can only be described as a void of absolute nothingness.

Physicists often make the claim that the vacuum state can be understood in terms of quantum field theory as a boiling cauldron of virtual particles, but again, this is a false claim based on the idea that quantum field theory is fundamental, which it is not. It's not even possible to understand the vacuum state in terms of space-time geometry. Neither the idea of point particles nor the idea of space-time geometry is fundamental. To try to characterize the vacuum state in terms of either virtual particles or some kind of space-time geometry that virtual particles can exist within and propagate through is a mistaken assumption. The reason this is a false assumption is because both the concept of point particles in quantum field theory and the concept of space-time geometry in relativity theory can be reduced to the more fundamental concepts of energy and information, and the vacuum state is the source of all that information and energy.

To fully appreciate the mystery of the vacuum state, you need look no further than the idea that everything perceivable arises from the vacuum state as some kind of excitation of energy and information. The big problem that physicists seem to be unwilling to face is that everything perceivable also arises in a subject-object relation as the perceiving subject perceives some observable property of its perceivable object. The only logical conclusion that can be drawn is that not only does the perceivable object arise from the vacuum state as an excitation of energy and information, but the perceiving subject also arises from the vacuum state as the perceiving consciousness present at a point of view. If we understand the perceiving subject or observer as the perceiving consciousness that arises at a point of view, the only conclusion we can draw is that the perceiving consciousness of the subject arises from the vacuum state simultaneously as its perceivable object also arises from the vacuum state. The subject and its object must arise together in the relationship we call perception. Both subject and object arise together from the vacuum state in a relationship of perception.

This fundamentally tells us that the vacuum state is not only the source of all energy and information inherent in objects, but also is the source of the perceiving consciousness that perceives the perceivable properties of all objects. The subject-object relation of perception is the result of both energy and information arising from the vacuum state, which gives the perceivable objects their perceivable properties, and the perceiving consciousness of the subject arising simultaneously from the vacuum state, which perceives those perceivable properties. The triad of energy, information and perceiving consciousness all have to arise together in a subject-object relation of perception, and they all arise simultaneously from the vacuum state. In other words, the vacuum state is not only the source of the perceivable objects, but also the source of the perceiving subject. The difficult part of understanding how this triad of energy, information and perceiving consciousness all arise simultaneously from the vacuum state is the mystery of understanding the vacuum state in absolute terms as a void of absolute nothingness.

The mystery of how the perceiving I, subject or observer arises from the vacuum state will be discussed later. Let's just assume that the observer arises from the vacuum state in some mysterious way, and focus our attention on how energy and information simultaneously arise from the vacuum state in the subject-object relation of perception. This is where the holographic principle of quantum gravity has pretty much solved the mystery.