Quantum Entanglement and Holographic Universe

Sunil Thakur
www.norlabs.org

A hologram is a three-dimensional image, created through laser beams, each part of which individually contains the entire image or information contained in the whole hologram. Are you confused? Let me explain it through an example, if a hologram of say a lovely pink rose is cut into small pieces then each piece of the hologram shows a three-dimensional image of the whole rose!!! Normally, if we cut any image then each piece of the image projects only a part of the image. If you were to tear a photograph a person into the pieces then each piece shows different parts of the body i.e. each piece projects only a part of the information but each piece of the hologram projects the entire body of that person. This is the beauty of the hologram.

Does each part of our universe contain the information about the rest of the universe? The scientists like David Bohm believe that universe is a hologram or in other words, each part of the universe contains information about the entire universe.

Before we proceed with our analysis of whether or not universe is a hologram, we must specify what we mean by information.

Information is one of the most important phenomenons of nature and yet it is probably the least analyzed concepts of physics.

There is no universally accepted definition of information. We cannot relate information with something that is created by us like the data in our computer. Our idea of information must relate to something physical in nature and something that is available to all the physical entities and not just the human beings who use computers.

In my view, simple definition of information has to be,

'Information is any form of radiation that communicates one or more properties of a physical entity to another physical entity.'

Rest all is data.

Data cannot be transmitted even at the speed of the light but information can be communicated instantly. Data does not give us direct perception of the information. The data stored in a computer or in a book or in CD gives us indirect information about a third entity whereas information gives us direct information about the properties of a physical entity. When we see the moon, we are receiving the information about it directly from the moon itself but when we see the image of moon in a computer or in a photograph or in a

book then we do not get any direct information about the moon. By looking at an image of the moon we can recognize it only because we have observed the moon directly.
As we know, we cannot perceive an object directly, we can only perceive the information generated by an object and therefore universe is nothing but a pool of information for us.

One of the problems with the information is that it is never self-evident nor it is self-explanatory. Information exists only as a potentiality till a medium is in place that can manifest it.

Cosmic Microwave Background Radiation is our biggest source of information as we get the information about the entire universe at one place. Our satellites that collect the information are placed at special location in order to reduce the noise and not because CMBR is available only at specific locations. Of course, there are numerous other considerations that we take into account to decide the exact location of the satellite meant to trace the CMBR.

CMBR is rightly regarded by most scientists as the biggest discovery of science at least in the last century and yet we have not realized the importance of the CMBR in furthering our knowledge of the universe around us and not just the farthest corners of the universe.

CMBR gives relative information and not the absolute information about a point as the projection of temperature at one point affects the temperature at other points. This feature itself suggests that everything in the universe is affected by everything else.

The second most important feature of the CMBR is that it gives us instant information about even the farthest points of the universe. When we say that temperature of the universe is -2.73 K then we mean the current temperature of the universe. Big bang theory needs to resolve its internal conflict regarding CMBR. If it suggests that the current temperature of the CMBR across the universe is same except some slight variations as identified by us CMBR anisotropies, then we have to believe that information we receive through the CMBR is instantaneous and reflects the current state of affairs at any given coordinate of space irrespective of its distance from us.

On the other hand, if big bang theory believes that information we receive through the CMBR reaches us at the speed of the light then all its predictions go wrong. If the temperature of the CMBR was same 13 billion light years back as it is today at the point outside the atmosphere of the earth then big bang theory gets invalidated. Its suggestion that temperature of the universe after about 4 million years was much higher than it is today and that CMBR is cooling constantly since it came into existence also gets invalidated.

However, the two most important features of the CMBR from the point of view of understanding the quantum entanglement are:

The CMBR shows that universe functions as one unit and that all coordinates of space are directly connected to all other parts without any apparent physical link between them.

Without the validity of this premise we cannot have instant information about all points of the universe simultaneously at one place.

CMBR shows that information about all points of universe exists at all points simultaneously. This is what makes the universe a hologram.

We may probably require a small correction in the above statement because nature entertains communication only between the systems. One of the most important features of a system is that it has an internal communication mechanism in place that allows the system to function as one unit. When sun moves in the Milky Way galaxy, all its constituent sub-systems like earth move with it at the same velocity irrespective of their distance from the sun; similarly, all the stars in a galaxy move at the same velocity as the galaxy itself irrespective of the distance separating the stars from each other. Apparently, the force that carries the constituents of a system along is communicated instantly and without the loss of the magnitude of force to all the constituents of the system.

Therefore, we may say that information about all systems in the universe exists as a potentiality in every system. However, because any given system in the universe manifests information in a specific range only therefore it cannot manifest all the information that is available to it.

Medical science suggests that our sense organs can manifest the information in a specific range only but this range is not fixed and gets adjusted depending on the conditions we are living in. In other words, we too have potential to manifest all the information but at any given time we can manifest information only in a specific range that depends on the conditions we live in. The detection threshold of our eyes and all our sense organs can be adjusted to suite our requirement albeit such adjustment takes time.

CMBR shows that we and all other entities are intrinsically and physically connected with each other.

Let us look at this fact from a different perspective. We have not yet arrived at a uniformly accepted theory about the structure of the universe or about the total number of fundamental particles or basic building blocks of the universe but there is no dispute about the fact that everything in the universe is composed of a few fundamental particles. At least as of now, we have no evidence that requires us to take string theories seriously.

If this is so, then everything in the universe is a combination of a few building blocks or the fundamental particles of the universe and therefore as pointed out by Einstein, matter can only exist as pockets where density of these particles varies. All objects together constitutes the universe in the same manner as different parts of our body constitute our body. Universe like our body is nothing but a unified whole system the constituents of which function as one unit.

The basic idea of quantum entanglement requires a re-look because it suggests that two objects can exist in the universe without being affected by each other. None of our

structural theories or even gravitational theories allows us to conceive a situation like this. There cannot be any entanglement because there is only one.

CMBR provides the causal explanation not only for the quantum entanglement but also for the holographic nature of the universe.