

# REALITY AND INFORMATION: IT AND BIT

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## Abstract

The present understanding of the relation between reality and information theory is for the time being rather vague. There are many speculations about the fact that the understanding of reality may be beyond our capabilities. However the perception of our observed reality in relation to quantum physics and consciousness as per Wheeler's theories may lead to the exploration of some new branches of quantum physics and consciousness theory. For many physicists, this may be something rather troubling but what if non – computability was actually part of reality? What if there were some processes or some kind of information that cannot be understood through algorithms and needed new understanding. In this essay the relation between information, reality and consciousness will be briefly discussed.

## Introduction

Philosophy allows one to see far beyond the equations and this was clearly understood by physicist John A. Wheeler. He even coined the phrase [1]: “Philosophy is too important to be left to the philosophers.” Wheeler was very intrigued by the philosophical implications of the quantum world and did ask, which are today some of the most fundamental question in physics. The principle interpretation of quantum mechanics is the well – known Copenhagen interpretation – A probabilistic description of the microscopic events producing an un-deterministic reality at such level. Such a perception of reality was very troubling for many physicists but not for Wheeler. The latter implied that reality might actually be not completely a physical one but one which requires the act of observation in order to look like the way it is – he there implied the anthropic principle [2]. The link between information theory and physics was born. Wheeler even implied that consciousness has a very important role in the way we conceive our reality. It must be noted that there are numerous propositions for a model of consciousness however none of these theories have been definitely proven even though some may be consistent with the theories of quantum mechanics – one of such theories which is coherent with Wheeler's broad conception of the relation between consciousness and reality was the Orchestrated Objective Reduction of quantum coherence in the brain [3]. A theory described by Sir Roger Penrose and Dr. Stuart Hameroff. The former theory is itself very broad and many speculations have led it to be mostly rejected by the scientific

community because of the lack of experimental evidence of the existence of a new form of quantum object: a *self – collapse wave-function* [3]. However Wheeler was someone who was far ahead of his time, if he ever thinks of something, it did possess some decency scientifically speaking – He only lacked the appropriate tools in order to correctly present his findings. For this reason, I will try to explain briefly in this essay how all of these (reality, information and consciousness may be related) may be related thus describing the *it* and the *bit*.

## **The Thought Experiment**

After the introduction and establishment of quantum mechanics in the 1950s, information theory was being developed and its link with the quantum theory of matter was not very well understood and its philosophical implications were too farfetched. Thus in order explain the weirdness of quantum mechanics to the whole world, he described an experiment – the delayed choice experiment [2].

The experiment describes a wave packet interacting with a half-silvered mirror and splitting into two wave packet and will either be collected at the upper or lower detector as per the particulate nature of the photon. The experiment is then repeated except that this time a half-silvered mirror is placed at the intersecting point just before a signal is obtained on the detectors.

This experiment is a very interesting variation of Young's double slit experiment. Let's analyze what is happening in the above setup. When the wave packet is splitted by the first half-silvered mirror, half of the time it will collected either at the upper or lower detector exhibiting particle-like nature. However when an observer interferes with the experiment by placing a half-silvered mirror at the position shown on the lower right of the figure above, the results are very different and rather surprising. An interference pattern is produced and observed at the lower detector and nothing (due to destructive interference) is observed at the upper detector. The wave packet now behaved essentially as a wave. It looks like the observer's participancy [1] plays an important role on the results of the experiment. The question that one must ask: "In what state is the entity before being observed by a conscious being?" This question has been at the center of many debates as the results are indicating that the photon already knows what will be the choice of the experiment (observer). This result was reproduced and confirmed by numerous experiments. Is consciousness related to the results of this quantum experiment?

What is the relation between the observed reality and the information we are getting? Can the universe be described as “infocognitive” based on what has been described above? We are very far to establish new theories in this domain but the exploration is rather interesting.

## **An Infocognitive Universe**

If the universe behaved in the same way as does the delayed choice experiment under the action of a conscious observer (humans) then this would imply that the reality we are observing might not be a completely physical one as described by Wheeler. Furthermore in what state is the universe before we observed it? Is it even part of what our neural architecture describes as real? These are very deep philosophical questions which I am raising in this essay. It is rather difficult to get a good grip on what may actually be the relation between reality (in the mind) and information (what is observed). So, basically we are creating the universe we live in by choosing to observe it – this brings us to the anthropic principle which describes that the universe is the way it is in order for life to evolve in it. The anthropic principle may actually be a “primitive” description of the relation between reality and information and the missing link could be consciousness (non- computability in the brain). However before explaining the former; I would like to explain one of Wheeler’s famous hypothesis; the self-excited universe.

This is interesting description of the relation between reality and information. As Misner, Thorne and Zurek describes it in there article [1]: “Starting small (thin part of “U” at upper right) the universe grows “ loop of U” and in time gives rise to observer participancy (Upper left) which in turns imparts “tangible reality” to even the earliest moments of the universe.”

The above implies an intelligent, conscious observer (the eye) acting upon the universe deriving the necessary information from it. One may ask but what actually happens in the brain for a being to understand that the space-time it is observing has a geometry that is consistent to reality. How does it understand that the Bit come from the It?

## **Consciousness – The Missing Link**

It is usually very difficult to discuss such theories among the scientific community because of the lack of experimental evidence; furthermore the theories are rather superfluous and do not relate to quantum physics or any other

branches of physics nor relate to conventional neuroscientific theories. However there is a very interesting paper on the subject produced by Penrose and Hameroff in the 90s which do give some sensible explanation on the subject but since no attempt of experimentation is given in the paper this makes it now difficult to follow. For this reason I will simply explain the findings.

While reading the paper I realized that the link between reality and information could be how consciousness occurs in the brain (Penrose and Hameroff research) – Orchestrated Objective Reduction in the Brain Microtubules. So, according to Hameroff and Penrose, consciousness occurs in the microtubules of the brain. Why is this? This is because in the structural configuration of the latter allows for high electron density [3] enabling some sort of entanglement related to consciousness to occur. In order to understand what is happening mathematically, Penrose introduces a novel quantum phenomenon known as the “self-collapse wave function”. That is a function which reduces on its own (Objective Reduction [3]) without the intervention of a physical observer like in the normal interpretation of quantum mechanics – Copenhagen interpretation. Basically what is said in the paper is that units of the microtubules, tubulins, in their own space-time geometries are in superpositioned states – quantum coherence in the microtubules. This occurs until the mass – energy difference in the tubulins lead to the separation of the space-time geometries forcing the system to collapse into a single universe state [3], which we observe. Now Penrose and Hameroff implies that this quantum event is “tuned” or “orchestrated” by entities associated with the microtubules – the Microtubule Associated Protein (MAP). The threshold of 500 ms corresponds to the threshold in quantum gravity (time taken before self-collapse) according to Penrose and Hameroff. This is very interesting but unfortunately no experiment evidence has been mentioned. Furthermore how can the phenomenon of “self-collapse” know that it must be reduce to this universe with that geometry? At that level Penrose’ answer is that some non-computable events takes places which gives rise to this supposedly new quantum phenomenon of “self-collapse.”

## **Conclusions**

The relation between reality, information and consciousness is a rather complicated one to figure out using conventional physical and mathematical approaches. Maybe Penrose and Hameroff are right – that non-computability is at the very heart of a proper description of reality by a conscious observer. But since there is no way to completely determine the truth all possibilities remain

valid. They do however extend Wheeler view on reality and the conscious observer. However the information described above is only the tip of the tip of the ice berg and there are more routes to explore before being sure of producing a final description of the relation between the It and the Bit.

## References

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- [3] S. Hameroff, R. Penrose, Orchestrated reduction of quantum coherence in brain microtubules: A model for consciousness (Mathematics and Computers in Simulation 40 (1996) 453 – 480).