

Memory as The Observer in Quantum Mechanics.

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A short and informal essay proposing that the amount of memory, required for any given observation, be added to Special Relativity as a means to encompass *The Observer* in Quantum Mechanics into Relativity Theory. The amount of memory required for any given observation is considered as a key hidden variable versus Quantum Mechanical phenomena. This memory amount is proposed as the fundamental aspect of any given reference frame and, thus, separates all reference frames into “slices” or individual Universes where conscious observers move between them for any given observation.

"Time is but memory in the making"
-- Vladimir Nabokov

"Do you really believe the moon is not there when you are not looking at it?"
-- Albert Einstein in a conversation with Abraham Pais

In his *Special Theory of Relativity*, Albert Einstein began a trend of dividing reality into “slices.” In his theory, observers with different velocities “exist” in different “reference frames” to their motion where, while the speed of light remains constant, much else does not, including the simultaneity of events. Even the rate of time, as measured by clock rates, changed in different reference frames where, as observers moved at higher velocities, their clock rate slowed (time dilation calculated with Lorentz Transformations). While existing within the same reality as other observers, for all intents and purposes, their slice of reality is its own “Universe” (in terms of clock rate at least). Note that our descriptions of course are relative (literally) and based on a given observation or measurement as velocities, and thus clock rates relative to others, can change. But how does one delineate an observation or a measurement in a reality where any change in velocity (speed and direction) changes reference frames?

Let us first examine the classic Quantum Mechanics experiment of the dual-slit. Assuming the reader is familiar with the setup, let us call our attention to the fact that lacking “which path” information and observing only the photon detection screen, we will need a given amount of memory (literally bits of information of the result, pattern, or answer stored for a given amount of time for observer processing or analysis of evidence) to describe or record the measurement. But if we setup a second detector identifying the “which path” information related to the test photon i.e., which slit it traveled through, we not only change the pattern observed on our photon detection screen, but we also now need basically twice the amount of memory to describe this new observation or measurement i.e., two detectors worth of data as seen in Figure 1. We can see here how a default reference frame with near the lowest amount of memory involves a simple wave pattern. While increasing our knowledge, information, and net amount of memory of the observation to include “which path” information we also have additional memory needed to now describe particle attributes like location, size or mass, momentum, and possibly spin.

Based on this simple scenario, can we perhaps add another “axis” to our model of Special Relativity, as in Figure 2, where the amount of memory required for the experiment or observation is another critical variable in addition to the relative velocity and three spatial dimensions. Note the proposed framework is only theoretical at this stage but does not seek to modify or change the mathematics of Relativity Theory in any way but, rather, to suggest that another critical factor is missing in its framework that may allow us to merge the observer aspect of Quantum Mechanics into the framework of Relativity Theory. One of the historical problems of Quantum Mechanics has been the inability conceptually and mathematically of including the observer in the theory. Another is uniting the discrete aspects of Quantum Mechanics with the continuous mathematics of Relativity Theory. The goal here is to present a very outside-the-box proposal to attempt to solve both of these problems.

Perhaps standard models of time-cones involving a three-dimensional physical Universe with one dimension of time, needs to be modified. In essence, each time-cone might be part of a unique reference

frame determined not only by relative velocity (clock rate) but also by observer or observation required memory. In this framework every reference frame with a unique relative velocity and amount of observation memory or “depth” becomes its own “existential slice” or, for all practical purposes, its own Universe.

Regarding the dual-slit experiment, one can consider that, with no “which path” information, we exist on a slice with a wave pattern of fuzziness i.e., a slice with a very low “depth” of memory. However, when we have “which path” information, as the observer we are now in a slice of reality (a “now”) where the entire experiment requires a larger amount of memory and thus we are no longer in the same slice as before but, rather, in a slice with a “depth” of perhaps double the previous memory. In this slice exists every and all events requiring that same amount of observational memory. The memory is not stored somewhere but rather is the size or depth of that entire unique reference frame “Universe.”

The puzzles of the Delayed-Choice Quantum Eraser experiment vanish in this model as well as, once the removal of the “which path” information occurs, the observer “falls” to a Universe slice with lower “depth” memory and, thus, is back to the slice with the minimal wave pattern. Just as an observer cannot feel when she changes between reference frames, she cannot feel as she changes between slices or Universes with different observation memory depths.

Philosophically a puzzle arises “if anything that contains memory is then defined to be conscious,” but having a memory alone does not produce consciousness or intelligence but, rather, the ability to be aware of the context and utilize or analyze the data in that memory. This implies that perhaps the core aspect of reality is a form of “processing” at various depths of memory.

In this framework the entity being observed, e.g., an apple, does not move between slices but, rather, like in Special Relativity it is the conscious observer that moves up-and-down the reference frames that now also includes these same reference frames with unique memory scales – Figure 3. In the dual-slit experiment, it is not the photon pattern that has altered, it is the conscious observer that has moved to an entirely different Universe slice with a minimum of memory and thus a simple or the simplest pattern is observed.

We can speculate that Quantum Entanglement itself is defined additionally as observing two entities at a given reference frame and memory depth. This may in essence “address” or “lock” that relationship at that level where, once encountered, by a conscious observer, remains thus entangled i.e., the Quantum Mechanics phenomena of Quantum Entanglement – Figure 4.

In a slice with minimum, or near-minimum, amount of memory where there is no external influence on the observation, measurement, or system, strange phenomena like superposition no longer seem so unexpected. Such behavior occurring when we are limiting the amount of a critical variable, in this case memory, hints at effects like that of the Heisenberg Uncertainty Principle where, the more we try to reduce the system to as little as possible memory bits required to describe it, a “minimum wall” is hit and Nature pushes back to avoid have a complete description of position and momentum of any particle or wave thus leading to phenomena like Quantum Superposition where at this low memory depth the variation is thus moved to position or value. Note how in Quantum Mechanics, the computational bit (0 or 1) is now a “qubit” with an indistinct value. Reaching the minimum value of observable memory (of descriptive context), we do not find the most precise photon (or bit) but, rather, the least. It is as if the natural variance in history, path, or velocity is now shifted to a variance in value as a form of conservation or noted required Uncertainty. In observations requiring very little memory fundamental isolated particles, thus, behave in a “strange” or atypical manner. Note this logically follows as experiments with no relative velocities and extreme isolation and consistency of temperature and observation are not what is seen in the vast majority of conscious experience but rather almost always exclusive to the laboratory environment.

A famous quote attributed to Albert Einstein asks if the moon exists if no one is there to look at it. The quote calls attention to the gap in Quantum Mechanics where it requires an observer. Note, however, that in this proposed framework this question is no longer relevant. The moon is a very large object that thus requires a larger amount of time (memory) to even make a single observation of an object of that size which will also involve a large amount of time for photons to even travel from a distance to make the same observation (approximately 1.4 seconds for it to reach us as an observer on Earth). This is a large amount of time (observational memory) compared to the scale of our smaller Universe slices thus any possible observation of an entity like the moon must, by definition, fall into a slice with a larger memory depth. Therefore, Quantum Mechanical phenomena like superposition and wave patterns that occur in low memory reference frames will never take place for the moon versus any possible observer.

On the opposite extreme, the smaller you go down to the sub-atomic level, like a photon, you can observe all of the entity with the minimal amount of knowledge or depth memory. Thus, at this scale we

encounter the strange fuzzy phenomena attributed to Quantum Mechanics – superposition and wave interference patterns. But even here, if one never stops observing that specific photon or particle and it (and us) are never disturbed during our experiment, then one will remain at that same low-memory depth slice and same relativistic velocity Universe, and that photon will not (cannot) exhibit other Quantum Mechanical behaviors like Quantum Tunneling.

An interesting challenge to experimenters involves the classic Bell inequality tests associated with debunking “hidden variable” models of Quantum Mechanics that this proposal, to some extent, is. Here with extremely precise instrumentation it would be interesting to see how changes in velocities or minimum observational memory impact the results of Bell inequality Quantum Entanglement tests – again Figure 4.

Credit must also be given to other theorists, like Julian Barbour in his book *The End of Time* and David Deutsch in his book *The Fabric of Reality* where they too have speculated on if the Nature of Reality involves slices of reality or even multiple Universe slices where time does not exist. This proposal does not attempt to eliminate time but, rather, to note that we possibly do exist in a multitude of Universe slices. However, these Universes are synonymous with the Special Relativity reference frames as discovered by Albert Einstein, but that every Universe “slice” or reference frame is described not only by its relative velocity but also by the amount of memory required to describe a measurement or observation. A natural question arises as to what and where is this memory “stored,” but the answer is that the “where” is in a given slice or Universe of that exact specific memory depth. The entire Universe slice has the depth of that needed memory and the relative velocity. In essence, in an aside to another Copernican Revolution, every observation, as it requires a specific amount of memory will thus occur in a different and unique Universe (slice of reality). Like in Julian Barbour’s model, the Universes “are already there” and in this proposal a consciousness (*The Observer* in Quantum Mechanics) seamlessly jumps between the slices for any given observation based on the amount of memory needed for or associated with any given observation.

References

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Figure 3

Each reference frame in Special Relativity (with its unique velocity (and clocking rate)) can also be divided into unique parallel "Universes" using the memory required for a given observation as the key label for each Universe. Consciousness, thus, traverses seamlessly between slices of reality that are actual Universes defined as relativistic reference frames with each frame having a specific depth of measurement memory.

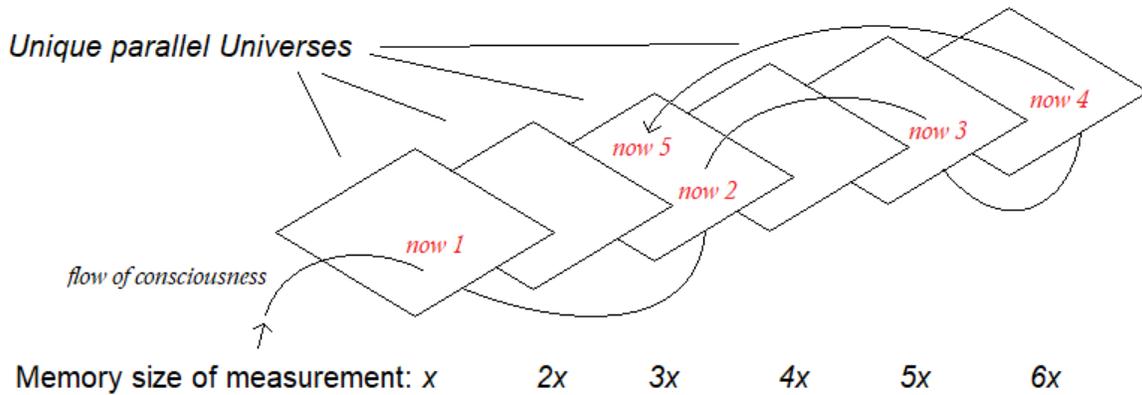


Figure 4

A quantum entangled particle pair when measured at a different reference frame (velocity or memory – number of sensors - or type of experiment) could be the "hidden variable" versus Bell inequalities.

