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 to Abraham Pais

In his *Special Theory of Relativity*, Albert Einstein began a trend of dividing reality into "slices." In his theory, observers exist in "reference frames" 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). While existing within the same reality as other observers, for all intents and purposes, their slice of reality was 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 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 screen, we also 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.

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. 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. One of the historical problems of Quantum Mechanics has been the inability 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 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 puzzles of the Delayed-Choice Quantum Eraser 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 we are back to our 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 depths. Philosophically a puzzle arises "if anything that contains memory is then 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 an entity will exist in every slice or Universe where each Universe represents the amount of historical knowledge of the system being observed. Also note that the entity being observed, i.e., an apple, does not move between slices but, rather, like in Special Relativity it is the conscious observer that moves up and down the slice memory scale – 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.

It is likely that every entity at a given memory depth or slice gets addressed or locked at that level, once encountered, and that this leads to Quantum Mechanical phenomena like 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 leading to phenomena like Quantum Superposition. 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 position or velocity is now shifted to a variance in value as a form of conservation or required Uncertainty. In observations requiring very little memory fundamental isolated particles thus behave in strange manners.

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 framework the specific example is no longer a challenge. The moon is a very large object (how much time or memory alone is required to even make a single observation of that size even at a distance) and it is far enough away that it takes almost 1.4 seconds for it to reach us as an observer on Earth (a large amount of time and memory compared to the scale of our 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 will not 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 funny phenomena attributed to Quantum Mechanics. But even here, if one never stops staring at that photon 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 cannot exhibit 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 extermely precise instrumentation it would be interesting to see how changes in velocities or minimum observational memory impact the results of Bell inquality Quantum Entanglement tests – again Figure 4.

Credit must also be given to other theorists, like Julian Barbour in his book *The End of Time*, where they too have speculated on if the Nature of Reality involves slices of reality or multiple Universes where time does not exist. But this proposal does not attempt to eliminate time but, rather, to note that we possibly do exist in a mulitude of Universes. 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 describled not only by its 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. In essence, in an aside to another Copernican Revolution, every observation, as it requires a specific amount of memory (excluding extremely precise laboratory examples as noted), 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 them for any given observation based on the amount of memory needed for any given observation.

References

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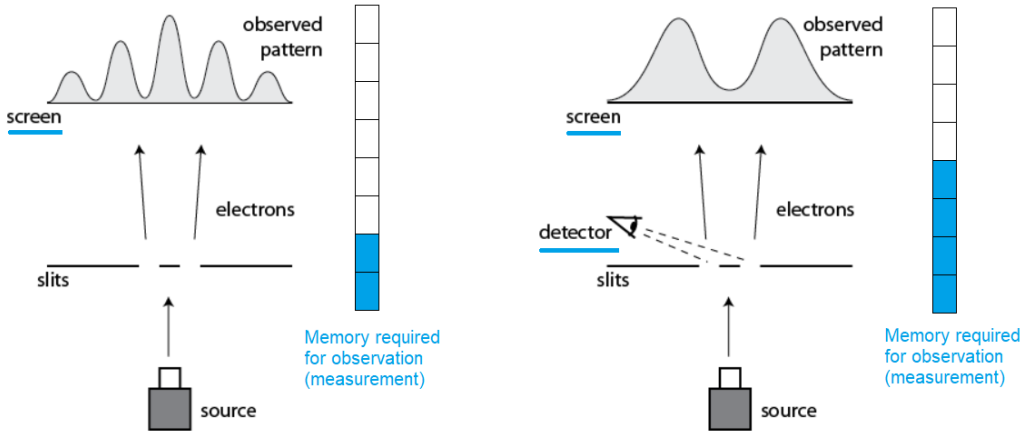
Figure 1.

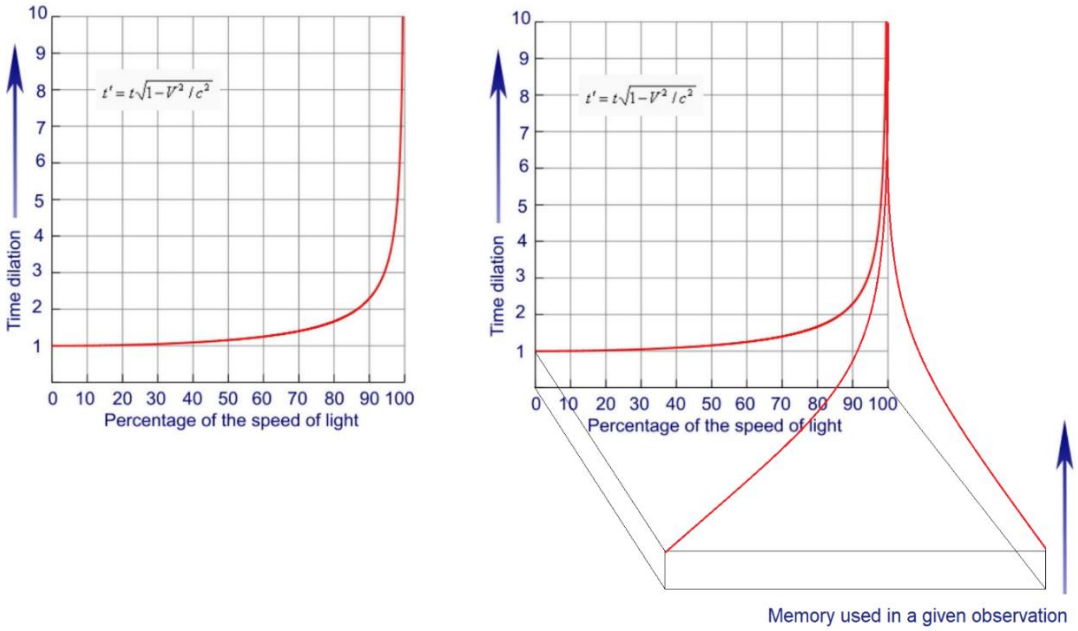
Observations obtaining "which path" information, require twice the amount of memory of data from two detectors (screen and slit detector).



Source: https://www.preposterousuniverse.com/blog/2019/09/21/the-notorious-delayed-choice-quantum-eraser/

Figure 2.

Memory as an added axis to move beyond a reference frame into given "observation coordinate" with each coordinate existing in a unique Universe (slice).



Source: https://www.emc2-explained.info/Time-Dilation/#.YifT8XrMK3A

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.

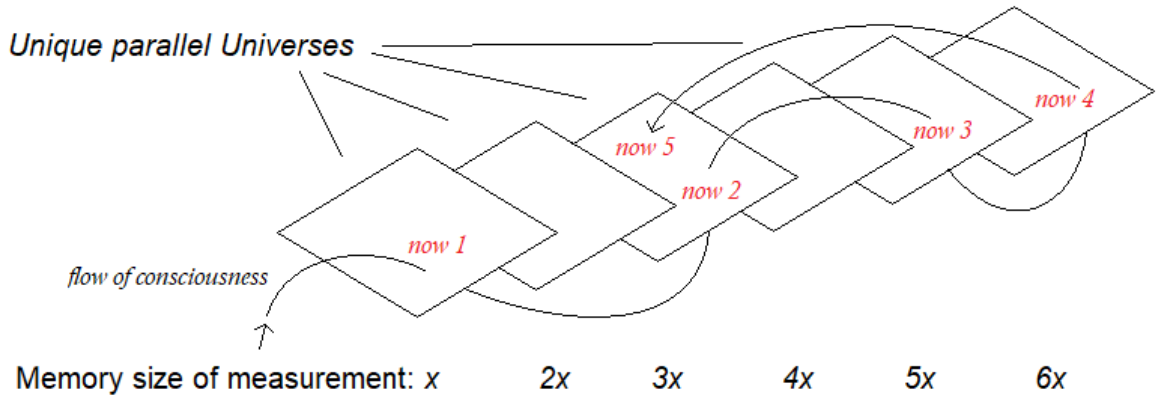


Figure 4

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.