ON THE NECESSITY OF INCLUDING THE OBSERVER IN PHYSICAL THEORY

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ABSTRACT: All statements describing physical reality are derived through interpretation of measurement results that requires a theory of the measuring instruments used to make the measurements. The ultimate measuring instrument is our body which displays its measurement results in our mind. Since a physical theory of our mind-body is unknown, the correct interpretation of its measurement results is unknown. The success of the physical sciences has lead to a tendency to treat assumption in physics as indisputable facts. This tendency hampers the development of new theories capable of addressing the foundations of mind.

To show the possibility that false interpretations of experimental results have lead to equally false projections onto physical reality may have happened, the double slit experiment and special relativity experiments are examined in detail. I will show that strongly held a-priori beliefs characterizing measurement instruments have led to unjustified but widely held concepts in physical theories. For example the assumption that material bodies have minds can change the interpretation of experiments to produce alternative physical theories.

Since some material bodies have minds this paper calls for a review of the conscious observer's role in the execution and interpretation of fundamental physics experiments in order to verify or challenge the basic beliefs adopted in standard physical theories.

KEYWORDS: Conscious Observer, Reality Projection, Cognitive Action Theory, Physical Correlates of Consciousness, Eddington's Fish Story, Special Relativity, Dual Slit Experiment

OUTLINE

1) REQUIREMENT FOR AN OBSERVER IN ANY THEORY OF PHYSICS

All information from which a theory of physical reality is built comes to us through measurements. Measurement instruments interact with reality and produce measurement results as observables. In order to make any statement about the nature of reality it is necessary to apply our knowledge of the operation of the measuring instrument. We must trace the signals backwards from the observables through the measuring instrument in order to identify the physical cause of our measurement results and explore its properties. Though scientific development has provided us with many sensory extensions the ultimate measuring instrument is the human Brain. Here I use capital first letters word "Brain" to symbolically label the mechanism which we assume carries out these calculations in order to avoid the "naïve reality" assumption that the observable brain (lower case) is actually the mechanism which performs these calculations. Figure 1 shows a diagram of a human observer who sees an apple in front of his nose shown in a thought bubble to the right of his Head. By applying his knowledge of his own measuring instrument he is able to conclude a real Apple actually exists in front of his real Nose. In order to achieve this conclusion he makes the "naïve reality assumption about his knowledge of his measuring instrument. This assumption is that objects are in reality exactly where they appear to be. In other words his Brain does nothing at all so that it acts like a unity operator on the observable data as shown in equation 1.

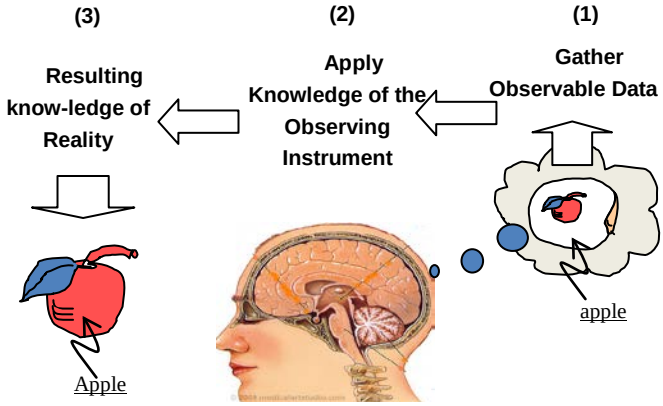

Fig. 1- Steps for calculating our knowledge of reality

Eq. 1 Apple = **1**·apple

Once this "naïve reality" assumption is made it is possible to identify reality as an empty space in which objects move about and develop a physical theory that defines what was believed to the nature of reality. Unfortunately today there is no knowledge of how the brain or its actual Brain counterpart produces the mental observables we normally see. This means our knowledge of reality is purely based upon a convenient assumption that can not be proven. Our actual situation therefore does not resemble

figure 1 but instead is more accurately shown in figure 2. We do not know how the Brain works. We do not even know whether the observable brain is in fact identical with the real Brain. All we know is that if we believe things are really where they appear to be and we act as though they where really there then this belief works well to guide our daily lives until it ends.*

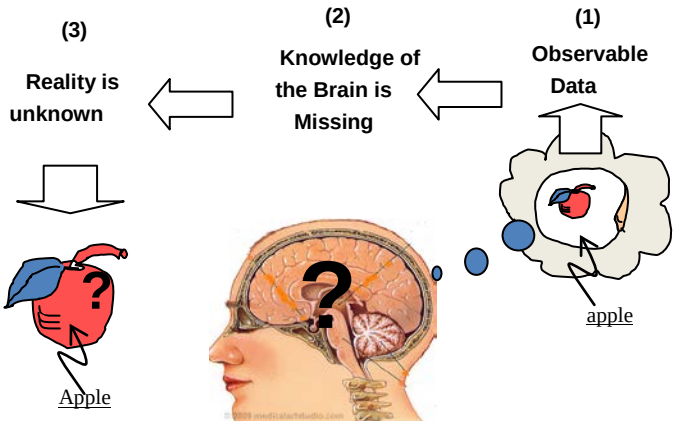

Fig. 2- Steps for calculating our knowledge of reality

The question - "Do we see reality as it is?" - asked by Don Hoffman must be answered with a question mark (Hoffman 2015). We cannot know until we know, or believe to know, how the Brain works. Equation 1 should be replaced with a general explanatory function,

Eq. 2 $$\text{Apple} = X(\text{apple}, \alpha,\beta,\gamma,\ldots),$$

where "apple" stands for observables and $\alpha,\beta,\gamma,\ldots$ are currently unknown structural Brain parameters.

Until the advent of quantum theory the implied assumption was that the Brain presents reality as it is. This X( ) reduces to the unity operator in classic physics mentioned earlier. Quantum theory has replaced objective reality with visualizations of wave functions and probabilities as a working assumption. The role of the observer is obliquely mentioned as the measuring instrument of last resort before the wave function colapses to produce conscious experiences (von Neumann 1955), however no explicit model of the observer is provided. What is provided by von Neumann is a definition of Process I, which is the mathematical Born rule for transforming wave functions into average measurement results. How such transformations are physically carried out is not specified. Instead it has been labeled the "measurement problem" (Wheeler 1983), which is a topic of ongoing debate that restricts itself to the operation

* What we actually experience is the result of calculation (1),(2),(3) which is projected into the apple sensation thus giving one the feeling of actionable reality, Thus figures 1 ,2 show a calculation processing cycle is a fundamental process underlying all theories.(Baer 2010,1013,2014, Chopra 2014)

of external measuring instruments not the Brain itself. Quantum theory simply assumes that once an external measuring device has reported its observable result the domain of quantum theory passes the baton back to classic theory in which the Brain of the observer then sees the reality of the data as it appears, i.e. objects in front of our noses. These observables are classically analyzed to extract their action function "S( )", measured in Joul•seconds, and then mathematically converted with Schrödinger's "Ansatz" definition (Schrödinger 1926) for what was to become the wave function of quantum theory,

$$\text{Eq. 3} \qquad \text{Apple} = \Psi_{\text{Apple}}(\text{apple}) = e^{i\cdot 2\pi\cdot S(\text{apple})/h} = X(\text{apple},\ldots).$$

Later Born identified Ψ with a probability wave replacing objective reality. Whatever our beliefs regarding the nature of reality are, they are based upon assumptions regarding the operation of the Brain, which are probably wrong. Therefore our physical theories, which implicitly incorporate such assumptions when interpreting experiments, are probably wrong or at least incomplete as Einstein believed. The arguments presented above show that some knowledge, right or wrong, regarding the operation of the Brain is necessary to have *any* concept of physical reality and to develop *any* physical theory. The basic physical theories available to date are classic, quantum, and relativity theory. These theories are each grounded by the interpretation of a series of crucial experiments. It is therefore reasonable to suggest that the interpretation of the set of foundational experiments be re-examined to determine whether or not implicit assumptions regarding the role and operations of the observer are valid and what changes to our theories must be made as new understandings of mental operations are discovered.

2) PROJECTING MEASUREMENT INSTRUMENT CHARACTERISTICS INTO REALITY

The central confusion that we must guard against when interpreting experimental results is the possibility that characteristics of the measuring apparatus are projected onto the system being measured. The colloquial effect is often called the "rose colored glasses" syndrome by which an observer wearing colored glasses falsely assumes the world is actually red. A more scientific version of the same difficulty has been immortalized by Sir. Arthur Eddington (Eddington 1929). Eddington believed in the existence of an external world but was convinced that our way of viewing it is limited by our the biology of our Brain. His defense of this unpopular view was an analogy known as the Fish Story.

Eddington imagined a team of scientists investigating ocean life. They throw a net, with gaps two inches wide, into the water. Each time they retrieve their catch, they find it full of creatures that have two basic characteristics. Each creature has gills and is more than two inches long. Eddington then asks which is a fundamental property? Are see creatures all larger than two inches or do they all have gills? By analogy, we retrieve from the sea of knowledge only what the mesh of our methodology allows. Our methodology could retrieve a sea creature without gills on the next try, but a net two inches in size will never catch creatures less than two inches. Hence team of scientist would conclude a two inch creature size is a fundamental property of the ocean world.

Since all knowledge is filtered through our Brain, which by analogy has characteristics, such as a two inch net spacing, it is very likely that some of its characteristics are inadvertently assigned to the reality we are trying to measure. Therefore interpretations of experimental results can project properties onto the real world that are actually unrecognized artifacts of the methodology we use to perform experiments. That such false interpretations may have happened in physics will be discussed in the following sections.

2.1) Do Bullet-like Photons Exist?

That the concept of bullet-like photons as particles of light may have been a false projection of experiments was pointed out in a paper analyzing the quintessential double slit experiment underlying the wave particle duality of quantum theory (Baer 2015). Figure 3 shows a graphic description of the typical dual slit experimental setup. A plane wave of wave length "λ" is incident on an a screen with two small slits. After the wave passes through the slits each one acts like a nearly point source of light which radiates toward the detector array located on the right. The light from both slit sources interfere with each other at the detector array so that an intensity pattern typical of interference fringes appear at the detector plane. If we reduce the intensity single light atomic absorption events happen in individual detectors at the

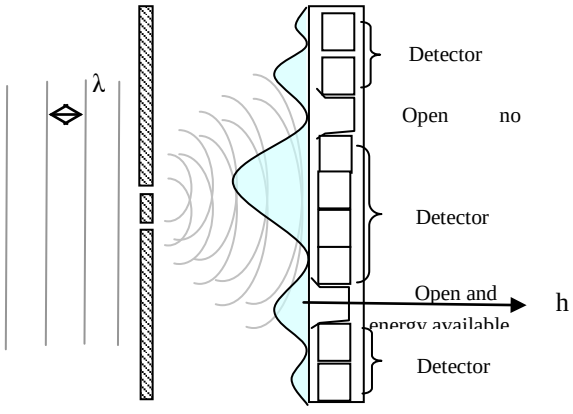

Fig. 3 – Dual slit experiment with random detector energy level fluctuations

detector plane. These events may be far apart in time and space but as many occurrences pile up the interference pattern re-emerges.

The quantum interpretation of these measured results is that light is composed of small bullet like particles carrying a concentrated load of energy that hits an atom and is thereby absorbed causing an amplification chain of events that results in recordable classic detector "hits". Bullet like particles should produce random events as uncontrolled bouncing of the slit walls. However the sum of many particle hits are not random but resemble the interference pattern of waves. The combination of these effects leads to the Quantum Theoretical assumption that light is composed of particles that also act like spread out waves. Further as particles light goes through both slits simultaneously and which detector is actually hit is due to an intrinsic uncertainty characteristic of Nature enshrined in Heisenberg's Uncertainty Principle. All these counter intuitive characteristics are projected into light.

The paper points out that an alternative interpretation can be achieved when we take the following into account.

1) Light always propagates as a wave at all intensities thus explaining the interference pattern.
2) Atoms only absorb light frequencies that exactly match energy differences between internal stationary energy eigen levels. Hence only the detector atoms at the exact light frequency level can absorb energy at any one time.
3) The eigen levels are perturbed by random long range inertial forces which alter the mass and hence centripetal force determining the energy level differences. Hence randomness is explained by the relatively random motion of distant matter as suggested my Mach's Principle.
4) Atoms absorb energy as resonant absorbers which expand their effective antenna cross section to a much larger size than the approximately one angstrom atomic size of the absorber. Hence atoms suck energy from a large area of the electromagnetic field which is not necessarily concentrated in bullet like Photons.

The alternative explanation of the double slit experiment uses classic near-field electromagnetic concepts and avoids such non-intuitive concepts as, the wave particle duality, intrinsic uncertainty, and bullet like photons. A second paper by Eric Reiter (2015) resurrects the "loading theory" originally introduced by Sommerfeld (1913) and presents the result of experiments he claims prove that the bullet like photon concept built into quantum theory is incorrect. Loading theory describes atoms as absorbing small amounts of energy reversibly from the spread out electromagnetic field until one of the detector atoms reaches an acceptable energy level at which point the amplification chain leading to a classic observable hit is reached. Reiter claims his experiments show single gamma-rays can generate more energy in scintillators than is

present in the ray suggesting that some of the energy released is stored from previous gamma–ray emissions. Though Reiter's experiment itself needs both verification and interpretation it is clear that knowledge of the measurement instrument operation is absolutely necessary if logical statements about the physical causes of our observations are to be made.

Knowledge regarding the operation of externalized equipment as discussed above may be argued within the context of conventional physics. However instances of false observer characteristics applied to the Brain may have severe consequences that effect the fundamental world view adopted by the scientific community. The next section considers the arguments leading to special relativity as an example of false projection that, once recognized, may lead to world view changes.

3) IMPLICATIONS OF OBSERVER MODELS IN SPECIAL RELATIVITY

The seminal paper introducing special relativity was published by Einstein (2005) in sufficient detail so that little change in the presentation has been made in the myriad of papers and textbooks on the subject for over one hundred years. Though Einstein did not use diagrams his description of two coordinate frames, shown in figure 4, were unambiguously described. Two coordinate frames with parallel x-axis are shown. One is stationary while the second one moves with a velocity "v" relative to the stationary frame. A standard meter "**m**" built of rigid material is used to measure the distance between two standard clocks as $\underline{\mathbf{\Delta}}=\Delta x\cdot\underline{\mathbf{m}}$. The clocks are synchronized by a light beam that is emited from clock "A" at time t_A that bounces off clock "B" at time t_B and returns to clock "A" at time t'_A. The clocks are synchronized when $t_B - t_A = t'_A - t_B$. In figure 4 this condition is met when the observer attached to each frame sees both clocks A and B such that the pointers on the B clock are delayed by $t'_A - t_B = \Delta x/c$ as shown in the thought bubble attached to the observers. Einstein used "*V*" for the speed of light which has since been replaced by "c" to indicate its role as a universal constant in special relativity.

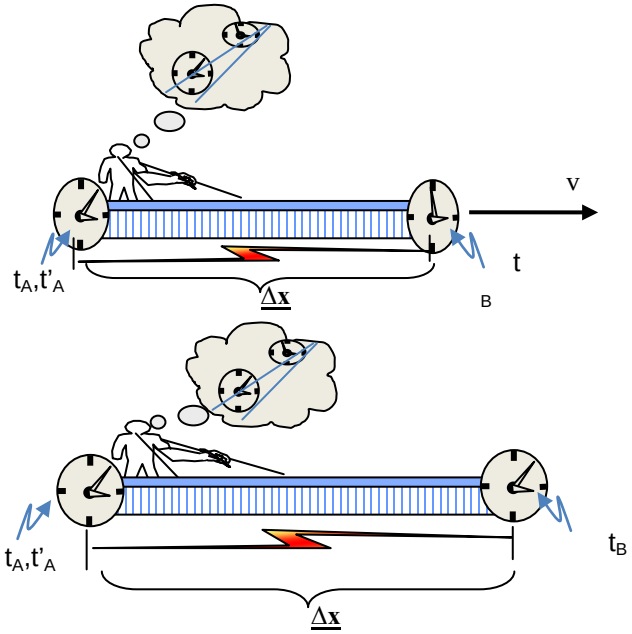

Fig. 4 – Einstein's Special Relativity

If the same protocol is used to synchronize the clocks in the moving frame, with the assumption that clocks, rods, and the speed of light is identical in each frame, then the same numerical values of time differences and distances

would be assigned by the observer attached to the moving frame as shown in figure 4. Of course the left hand clocks "A" in each frame has to be set to the same clock pointer position when the two clocks pass each other. However if the observer in the stationary frame looks at the distances and clocks in the moving frame he will see their rod length will be shorter and the clocks are slower than those seen in the stationary frame. This difference in distance contraction and time dilation was first noted by Lorentz as a consequence of Maxwell's Equations describing the Electromagnetic Field. Einstein popularized a visualization of these apparent effects.

We are not interested in the well established formulation of Special Relativity, which are well documented in texts and the internet, but rather in the role of the observers whose characteristics have been implicitly assumed and never been questioned.

3.1) Standard Critiques of Special Relativity

It should first be emphasized that Special Relativity is a theory that needs to be grounded in experiments in order to claim the right to be called a physical theory. The most obvious challenge to the logical consistency of the theory is known as the "Twin Paradox". If two twins in identical rocket ships in inter galactic space accelerate in opposite directions, coast for a while, turn around and accelerate in their respective ships in the reverse directions , coast till they meet and then accelerate to a stop. Each twin will experience exactly the same forces but find themselves moving with respect to the other for an arbitrarily long period of time. Each twin according to special relativity would say the other's clocks, including their biological clocks. should slow down and therefore each one would claim the other is younger. This proof by contradiction is a standard tool of mathematics used to prove the validity of logical conjectures. Since the experiment is completely symmetric both twins claims cannot be simultaneously correct therefore Special Relativity must be wrong. No satisfactory explanation of this paradox has been made although many attempts have been made (Luebeck 2008). A possible error in Einstein's assumptions regarding the role of the observer is described in the following sections.

Before examining the observers role an interesting but often neglected difference between wave and group velocity will be briefly mentioned. Special Relativity experiments define distances by counting the phase of 1,650,763.73 wavelengths of a specific hyperfine transition of Krypton-86. The second is defined as 91,92,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the Caesium 133 atom. The phase of light is not directly observable by the human observer. Its use is primarily justified by the extreme accuracy with which phase wavelength can be measured through interference fringes.

What the observers might directly see is shown in the thought bubbles attached to them in figure 4. These are clock pointer locations on a clock dial. The transportation of pointer information within a wave front travels at the group not the phase velocity of light. The speed of light is related to the group and phase velocity of light by the equation

Eq. 4 $c^2 = \underline{\mathbf{v}}_{gr} \bullet \underline{\mathbf{v}}_{ph}$

Since the group and phase velocity of light are identical according to Maxwell's theory in an idealized empty space with no gravitational effects this distinction may not make a difference. What should be pointed out is that the intuitive method of transporting time information in wave front features rather than phase of light has not been verified by experiment. The possibility that the twin paradox could be resolved, or shown to be non-existent, was explored (Seleri 2002). If clock information and synchronization were transmitted by Fax machine, i.e. wave front features, no paradox would be predicted. This shows how much the predictions of Einstein's theory are dependent on the exact definition of the phase synchronization methodology used. As suggested by Eddington's Fish story cited in section 2 above our view of reality may be shaped by our methodology and it's a-priory assumptions. This example shows how the clock synchronization method as well as the constancy of the speed of light postulate may be an example of how characteristics of the thinking processes incorporated in our Brain- in this case the belief in a single observer independent objective universe- may cause us to project those characteristics onto reality.

3.2) The issue of absolute space

A more subtle and profound effect on the formulation of physics by relativity theory is illuminated not by considering the observers riding along with the two coordinate frames but rather by considering the role of Einstein himself as a third observer. The derivations he carried out were thought experiments in which his imagination was employed to provide a background space within which the two coordinate frames appear. Figure 5 shows the thought experiment in the 1st Person view. (Baer 2011) The nose of Prof. Einstein and all who have followed his thinking is shown on the right of the diagram. The coordinate frames are clearly visualizations in his mind, shown here as the content of a thought bubble.

Einstein was a realist. He never accepted the principles of quantum theory and retained the classic belief that the space in front of his nose represented a common, independent of the observer, reality. The observers pictured riding along with their coordinate frames therefore experience the same independent reality. The content of the thought bubbles attached to each of the observers was simply a different view of the same independent space. Hence Einstein implicitly assumed the light pulses in front of the noses of all three observers was the same observer-independent-reality and therefore, being the same entity, moves at the same speed for all observers. Given a belief in a single observer independent objective universe all characteristics of that universe must be identical to all observers. The speed of light is merely one such characteristic. Once this assumption is made it was quite easy to calculate that a wave feature leaving clock A in the moving frame at time t_A would take longer to reach the moving clock B at a later time than clock B in the stationary frame unless the moving frame distance Δx was shorter than the stationary distance. The moving frame appears to be a bit shorter in figure 5 to give the moving clock B time to reach the position of the stationary clock while the light phase is . The clock pointers are also retarded to give the moving clock time to catch up during the travel time. Both effects are incorporated in the Lorentz transformations which relate the position and time of events as measured by the moving frame to the measurements of the stationary frame. The time dilation and distance contraction properties described by these transformations are then projected into the sensations of space and assumed to be actual p

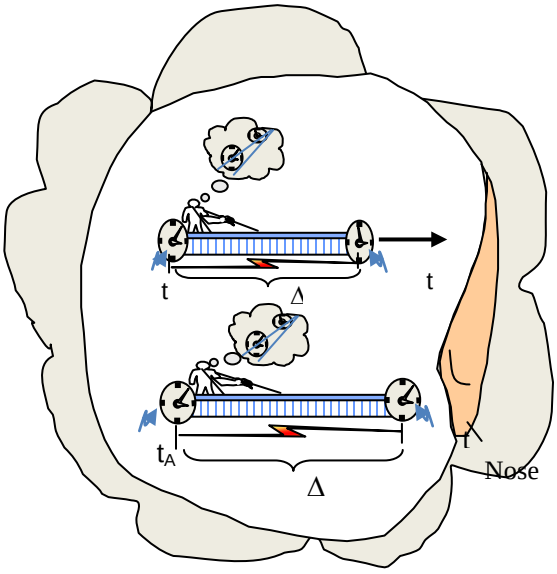

Fig. 5 –Special Relativity in the 1st Person perspective

To make this potentially false projection clear we must explicitly recognize that the 1st Person view shown in figure 5 must be generated by some physical real material just like the thought bubbles of the two observers attached to the observed coordinate frames are attached to the material of their bodies and their extensions. Figure 6 shows how Einstein's body and its coordinate extensions along with explicit light flash

interactions with the two other physical coordinate frames relate to each other when we explicitly acknowledge the difference between mind and body. In other words if we assume other beings have mental experiences that are produced by physical causes, which are different from those experiences, then our own 1st Person mental experiences must also be produced by appropriate physical causes.

Of course hard core materialists may deny the existence of mind and consciousness all together and I do not wish to argue about the detailed beliefs of individuals in this paper. The point I wish to make is that the observer characteristics, whatever they are, can effect our concept of reality and when those characteristics are projected onto reality different physical theories naturally arise. I am providing an example of how the assumption that material bodies have minds can change the interpretation of experiments to produce alternative physical theories.

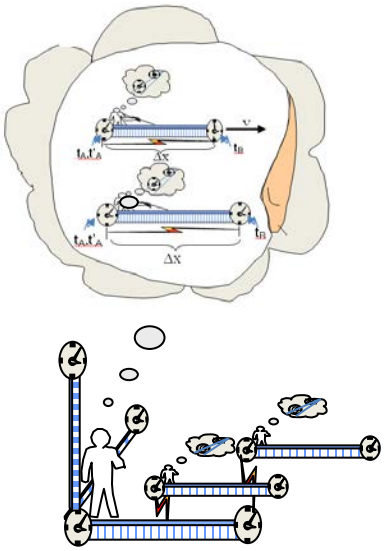

Fig. 6 –Einstein looking through his coordinate frame

In this case the classic assumption that what one sees in front of ones nose is the observer-independent-reality leads naturally to the universal constant speed of light, rod contraction, and time dilation. If however as shown in figure 6 each material structure from which an observer system is composed generates its own perceptive space then the speed of light is determined by the composition of that material, which may differ from observer to observer. In this case the speed of light is dependent on the material in which the electromagnetic disturbance propagates. A universal aether, as Einstein pointed out, is not necessary since all effects are explained by interactions between coordinate frames. This means in the diagram in figure 6 does not support a universal constant electromagnetic propagation in the empty spaces provided by the page upon which the material and minds of the three observers are drawn. However each observer consisting of both physical material and mental experiences is associated with his own aether. Light propagates at a constant speed within each observer system and it is the *appearance of rods and clocks* in each observer's personal space that undergoes contraction and dilation. Again we have an example of how the projection of observer

characteristics upon the reality that is supposed to be measured will modify the physical theory.

3.3) Looking through a Coordinate Frame

The reader may very well look at figure 6 and say that two of the coordinate frames are stationary while the third upper one is moving with velocity "v" and should contract and dilate. This opinion however is based upon the same potentially false assumption attributed to Einstein in the above paragraphs. If the reader, like Einstein, assumes that what he/she sees in front of their nose is the observer-independent-reality then all places out there would support electromagnetic disturbance propagation and light in that reality moves at a constant rate. However if the reader recognizes that what he experiences is his own personal interpretation of sensor stimulation then figure 6 is not a model which can be mapped into his own experiences but only the content of the thought bubble attached to the model of his real Body can be thus mapped. The bodies of the observers riding along with the coordinate frames cannot take on a transcendental gods eye view and look down upon him/her self but must remain attached to their material and only experience what that material can support.

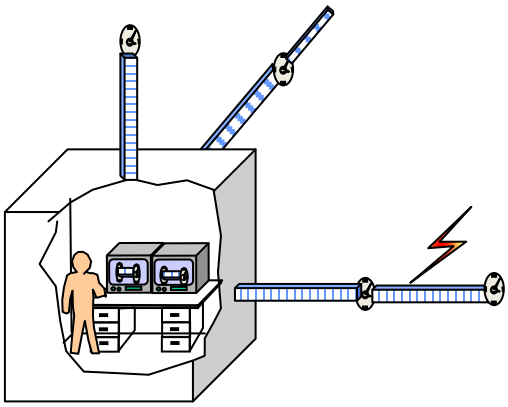

Fig. 7 – The little man inside analogy of an observer

This means the suggestion that each of these observers can look out into the world and synchronize their clocks using light in some universal space outside of the rods and clocks that make up their coordinate frame, as shown in figure one, is not physically possible. Light travels in an aether medium that is attached to, or perhaps better stated, is the media from which the observer and his extensions are built. A more heuristically appropriate picture for such a system is shown in figure 7. Here the observer we can heuristically identify with our bodies is located inside the control room of the coordinate frame and cannot get out. Stimulation to the detector cells located on the coordinate axis are sent through communication channels inside the material of this system and the interpretation of these sensations are interpreted as displays on internal monitor screens.

This is nothing more than the "little man inside" analogy of a conscious being. Obviously such a little man cannot be found inside the brain and this picture is only an analogy useful until a better understanding of the conscious observer can be

developed. However the restriction that the only evidence the little man has of the outside comes through his measuring apparatus is identical to the restriction underlying quantum theory. We can only know the structure inside atomic particles by measurements made through our measuring instruments we cannot directly get inside anymore than the little man can get outside. Our knowledge of atoms are interpretive projections from data reported by such instruments. Here the knowledge our observer has of external reality is likewise an interpretive projection based on the recordings displayed inside the coordinate frame. The empty space in these displays are not empty but rather built of material that happens to be in a non excited state and does not radiate. There is a finite speed of influence propagation in this empty display material. It is these displays and the coordinate frames shown on them that Einstein identified with Lorentz transformations. It is the construction of apparent features in an electromagnetic background structure that exhibits contraction and dilation.

4) SUMMARY

I again remind the reader that I am not presenting or defending any specific theory of the conscious observer or physical reality in this paper. The exact nature of consciousness awareness is an unresolved research topic in physics and science in general. I am showing by example that a model of the observing mechanism, I've called the Brain, is necessary in any theory of reality and such a model exists for all theories whether explicitly or implicitly stated in the theory. Fundamental beliefs are characteristics built into our Brain as processing elements. If the physical interpretations of experimental results are influenced by the fundamental beliefs held by physicists who perform such interpretations, then it is likely that at least some of these interpretations and the resulting concepts of physical reality are wrong. Since our knowledge of how the Brain generates conscious experiences, which are the final result of all experiments, it is likely that some false projection has occurred.

I provided examples in which the implicit assumption of an *observer-independent-reality* of objects in empty space is discounted in favor of an *observer-dependent* perceptive space associated with all material. Such a non-classic world view is associated with Bishop Berkeley's philosophy, Whitehead's events , and Wheelers self perpetuating measurement-explanatory cycle. It follows closely Everet's assumption (Everet 1957) that all systems are observers and therefore suggests a pan-psychic event oriented world view described as the "Conscious Universe" (Kafatos 1990) and elaborated in my references cited below. Adopting an observer dependent realization of our classic objective world can in the examples described above eliminate complexity and logical paradoxes in main stream theories.

The example's discussing in this paper are not the only ones that deserve scrutiny. That there has been a misinterpretation of the Michelson-Morely experiment, effecting our notion of absolute space and the meaning of both special and general relativity, has long been publicized (Cahill 2003). An examination of Bell's Theorem (Walker 2000) and its violation leading to "spooky action at a distance" may equally well be a candidate for projecting the characteristics of the inner workings of our Brain onto reality that should be examined. In fact Heisenberg himself called all of quantum mechanics the physics of the system that knows the world not the physics of the world itself. If true any of the many counter intuitive characteristics quantum theory projects onto reality may be due to as yet unrecognized artifacts present in our own thought processing equipment. This paper concludes with a suggestion that the interpretation of all fundamental experiments need to be examined for the possibility that physical properties projected onto reality are not inadvertently due to our own characteristics and methodology.

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