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In Causality Principle as the Framework to Contextualize Time in Modern Physics

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ABSTRACT : *Since the moment Boethius meditated on the nature of time in his fifth book on The Consolation of Philosophy, we have more tools to reflect on the subject. The onset of relativity and quantum physics provides us with the best insight, to date, that guides our reflections on the philosophical debates that attempt to theorize a definition of time. To clearly address the problems related to the theoretical models that account for the nature of time, adjustments to our interpretation of the contextual issues involved in special relativity are in order if we are going to preserve our notion of causal reality. As the construction of string theory emerges as the reigning theory for quantum gravity, a precise picture of causal reality can be accounted for through theories such as Dyson's Chronological Protection Agency, Hořava's theory of gravity, and new insight to how simultaneity is interpreted in relativity theory. With this model, the question about time in the philosophical debates can now be clearly defined through the Presentists' view of the universe. Thus, if we are going to accept the premise of quantum mechanics (QM) and the theory of relativity, we can safely say that string theory (ST) is a reasonable theory of quantum gravity and that its conclusions about time must be taken seriously.*
Keywords: *Causality Principle, Causal structure, time, Time travel, Gravity, General and Special Relativity, Presentism, Block Universe, Chronological Agency, String Theory, Quantum gravity, Lorentz Transformation*

I. Introduction

While the debate about how to account for the nature of time goes back far beyond Boethius in philosophical history, and while the earlier concerns were motivated by attempts to make sense of the relationship between human free will and divine foreknowledge, let's for the moment begin our reflection on this subject by investigating the ideas of Newton with regards to space. As the essay unfolds, we will articulate, in detail, what is implied in his ideas as it relates to time and our physical reality. First, notice that Newton formulated his conception of space and time as an objection to the views set forth by Descartes in the Principles of Philosophy (1644). For Newton, the idea of absolute or mathematical space becomes the precondition for offering a rational account of motion. Janiak[1] finds it helpful to interpret Newton's ideas by conjecturing his aims. Newton's Principia suggests that one must know the true motion of objects to understand the intrinsic drivers of their motion [1]. From this motivation, Newton tries to offer an account of space, independent of objects. This we will see, has fundamental significance for his notion of time. For Leibniz, however, space and time were interdependent, empirically muddled relational concepts. Rather than immediately representing space, Leibniz says that we actually represent space first through experience, which gives us a less convoluted mathematical vision of the matter under observation. When we add Kant's thoughts on this matter, a whole new paradigm in seeking to clarify what is meant by space and time is embraced. His model, to some extent, rejects both Newton's and Leibniz's notions of time. Kant [2] argues that space and time has a radical subjective element to it as shown by the following quote,

"Space is not something objective and real, nor a substance, nor an accident, nor a relation; instead, it is subjective and ideal, and originates from the mind's nature in accord with a stable law as a scheme, as it were, for coordinating everything sensed externally. p.403"

Dorato[3] argues that time and space for Kant are characteristics that are not inherent in the things in themselves, but only in their relation to our sensibility. Kant made a distinction between *phenomena* and *noumena*, in that, time is unreal as when referring to the noumena, or to the things in themselves, which are neither in space nor in time, but real whenever referring to the phenomena world. The proposition is that *time is empirically real but transcendentally ideal*. This accounts for how human beings must represent time in their reality. Nevertheless, Kant's philosophy was largely ignored by the philosophical community because it was influenced by Newtonian physics and not Einstein's theory of relativity, which offers a revolutionized way to think about space-time. Further, it was Godel's unification of Einstien's relativity, with the Kantian philosophy advocating for its transcendental nature that rescued it from the abandonment of Newton's *physical theory* of absolute space and time. Let's table for the moment Kant's concepts of the *ideal* and the *real* as later we will

show their influence on the relation between space, time, and the mind.
Once given its rightful place, Einstein's revolution changed the discourse of human thought and impacted the philosophical debate in a dramatic way. Space and time was now seen as something nonabsolute, nor was our universe without beginning; time and space from that point on adopted a changeable essence. This dramatic shift in thought postulates the idea of a timeless universe. Stephen Hawking's Brief History [4]echoes this sentiment,

"When Augustine asked: "What did God do before he created the universe?" Augustine didn't reply: "He was preparing Hell for people who asked such questions." Instead, he said that time was a property of the universe that God created, and that time did not exist before the beginning of the universe."

Hawking goes on to say that space-time did not exist before the big bang. Time and space have a starting point in the big bang model. To ask what happened before the big bang is nonsensical. The concept of 'before' is a notion of passed time. If the big bang came from the point of singularity, as put forth in Hawking's model, then there entails a conceptual contradiction; in that this picture poses a chronological paradox. After all, this point of singularity necessarily exists before the subsequent big bang and consequently space-time was created in the big bang. This highlights the fact that with our very grammatical structure, we are faced with the dilemma of how to model the universe. Adler [5]poses the quandary as a disjunctive; is our universe in a steady state (i.e., is it eternal) versus did our universe have an absolute beginning (one that exnihilated into the point of singularity [5])? On the one hand, time in the Steady State description of the universe has always existed. On the other, the absolute beginning "begins" with the passing of an aeon or age before time as we know it. That age occurs outside of the big bang, which we can establish as a logical impossibility.
Not only is science faced with the challenge by what we mean by time, but theologians also have their own struggles. Together both science and theology wrestle with the framework of time to build a definite picture of the cosmos: one with a divine cause or one without a cause. Trying to understand or make sense of the cosmos raises such questions as how old is the cosmos or does it have cause? Naturally, what we refer to as time does not really inform us about what it is. However, we hold the belief that philosophy sets the stage for which these questions can be put in some kind of framework to clarify what we meant by the various things.
There is a continuous debate in philosophy that is fueled by the results of modern physics that categorizes the interpreters of time into one of two camps: Presentists or Eternalists. The difficulties in finding a concrete definition of time has raised the question of whether material objects extend through space by having different spatial parts in different places, or how do these objects persist through time? In the question of persistence, philosophy is preoccupied by whether things persist by perduring or enduring. A number of objections comes against Endurantism from Special Relativity (SR). Hawley[6] proposes the following three main arguments from SR to say that the Endurantists way of thinking does not support reality:

1. SR shows space to be much like time: objects extend in space by having spatial parts, so objects persist through time by having temporal parts.
2. According to SR, for many events there is no absolute fact of the matter as to whether those events are simultaneous with now. That's to say, at any moment, there is no absolute fact of the matter as to which events are present.
3. Instead, the claim is that SR highlights a phenomenon, which can better be explained by Perdurantists than by Endurantists.

If we adopt that SR is true and assume that Endurantism needs Presentism in order to understand change, then SR, which suggests that things have temporal parts, must rule out Endurantism[6]. The question then, does SR really pose such a challenge to the Presentists view about reality, or does our interpretation of SR need revision? It is such question that we will explore in this essay.
A review of the earlier development of the understanding of time identifies a debate that is far from settled, and as such, we will analyze time in this paper by moving between a number of physical theories such as causality, time travel, relativity of simultaneity, Lorentz transformation, and close time curves - in order to see whether the belief in objectively becoming in the sense of the Presentists reality and flow of time are supported by relativity. Through the emerging of current physical theories we propose a way forward in the context for the Presentist's view of reality. The goal of this paper is to provide a framework for how to think about time in the context of Presentism in connection to Einstein's theory of special relativity through the conclusions of modern physics. In section II, we start off by defining time in relation to the causal principle in order to provide a more appropriate construction of time. In section III and IV, we will argue that if we accept the causality structure, then we have no allowance for time travel and must accept the one-directionality of time. Further, we will discuss the implications of certain experimental results on our notion of time in terms of its direction and the allowance of time travel. The goal is to show the impossibility of time travel due to the inaccessibility of the past and future which does reflect the Presentist's reality. In Section V, we will present evidence by discussing various physical

theories as they relate to the discussion of time to subscribe to the argument as to why the Presentist view is not in opposition to the implication of modern physics, but instead our interpretation of them may need to change to reflect physical reality. In section VI, we propose a way to consider how we must perceive time by arguing for its separation from space. In section VII, we show how to interpret the relativity of simultaneity to preserve the Presentist view. In section VIII, we define and distinguish what we meant by preferred and privileged frame (PRF) and argue here for their constructing in our physical theory of spacetime. In section IX finally, we close the discussion by arguing that the theory of relativity itself allows us to resolve the 3D/4D dilemma by presenting an analysis of Lorentz Transformation (LT) as it relates to the theory of the relativity of simultaneity.

II. Understanding Time In Context Of Causal Reality

The question of time and space naturally arises as we consider, what happened in the big bang and account forthe point of singularity to formulate a space time cosmos, where we can account for its causation or its inexplicable [5]. How does an inexplicable cosmos that has always existed escape the notion of time before the big bang? In an anthological way, is the cosmos as we observe become out of the big bang, or is it something else of which the big bang is just a part? Steinhardt and Turok[7]proposed the idea of endless universe. This idea suggests that the singularity of the big bang is due to the collision of two 3D brain sheets. The 'branes' model is derived from the M-theory, suggests a universe with a 4D space bounded by two 3D domain walls. The membranes (branes) have a negative and positive tension and are free to move along the extra spatial dimension result in instances of collisions [7].Thus, they seem to suggest that time was not created in the big bang but existed before. Since this is a cyclic phenomenon, then they must come to a halt and be drawn to each other for another big bang only to start the universe over again. If we adopt this view of the universe, then we must classify two kinds of time: one before the brain sheets collided, and one after. Consequently, time wouldhave an absolute notion that is different from what we will call *Einsteinianspacetime* to which the big bang gave birth.
The representation of relationships in both space and time seems a mandatory requirement of many studies related to the study of real-world phenomena. Further many applications require a combined representation of topological and temporal relationships in order to analyze trajectories in space and time. Therefore, in an effort to understand what we mean by time we must explore its behavior according to the perception of norms in our reality. Whatever behavior time exhibits, it must be defined according to the Cause-Effect principle (CEP) of known reality.

Definition
The causality principle defines time as flowing in one direction such that cause precedes effect.

Time could be defined as a real dimension,in the sense of our experience with spatial dimension in which two events occur, or the passing of events from the present to the past at the same point, in the same, frame but are distinguishable by measuring the interval between them. Time in another sense is the measure of the movement between two points in space. In the mind of Aristotle it is the link to change, a measurement of motion. Kant on the other hand argues that time is the *a priori* notion that, together with other *a priori* notions such as space, allows us to comprehend the sense of experience. For Kant space and time are illusions or constructs used to quantify the spatial and temporal notions of our experience. What if our notion of time and the way we think about it are erroneous? McTaggart[8] presents the idea that the way we perceive time is an illusion. He proposes time in context of events A-, B-, and C-series:

1. The A-series consisted of events in the future, present and past moving along the timeline toward the past in a constantly changing position (flow of time).
2. TheB-series as a fixed relationship between earlier and later (the arrow or direction of time).For instance the death of a person always occurs after their birth or a person is single before they are married.
3. The "C-series", a series that has an order but with no notion of time, like a series of letters.

He argued that the changing A-series is more essential to time than a fixed relationship of an earlier and later time, therefore, our perception of time is an illusion. Since the B-series depended on the A-series, then only the C-series could remain as a meaningful ordering? [8]. His most interesting observation however may be that historical events has the same time characteristic as fictional stories. He considered the way that things could be ordered in time and reasoned that the procedure that creates the temporal ordering from future to present to past was outside time.
On the other hand, Dorato [3] argued that for a fundamental understanding of time we must ask the following two questions:

- If time (together with space) were a non-entity (unreal), how could it yield the most important criterion of the reality of things and events? Shouldn't this criterion imply, by itselfthat time is, in some sense, real?
- How can we explain the fact that objects and events are objectively "separated" by space and time without

also assuming that the latter, in some sense exist, either as "carrier" of the spatiotemporal relations in empty space, or as real, mind-independent relations exemplified by physical entities?

Kant proposed an answer to the first question when he suggested that time is a construct of human reality. Dorato [3] pointed out that Ernst Cassirer[9] and Kurt Gödel[10]claimed that the theory of relativity is a striking confirmation of Kant's claim that time is ideal. For Kant time is ideal as it relates to *noumena* but real in how things appear to an observer. Thus, we build constructs to better appreciate this nominal world to describe things Kant refers to as 'phenomenon world'. These constructs we form to describe how objects persist in time in Kant's phenomenonal world are mathematical. Mathematical constructs are not physical objects but they allow us to describe physical things. It is not a necessity or a requirement that the constructs themselves be physical things. For instance,i is used in mathematics to describe imaginary numbers, which are used to model physical systems but i itself is not a physical thing.Einstein's equation shows that, in any universe described by the theory of relativity, time cannot exist[11]. This means that time is not a physical dimension of space through which one could travel into the past or future; a statement that Einstein did not find to be strange.

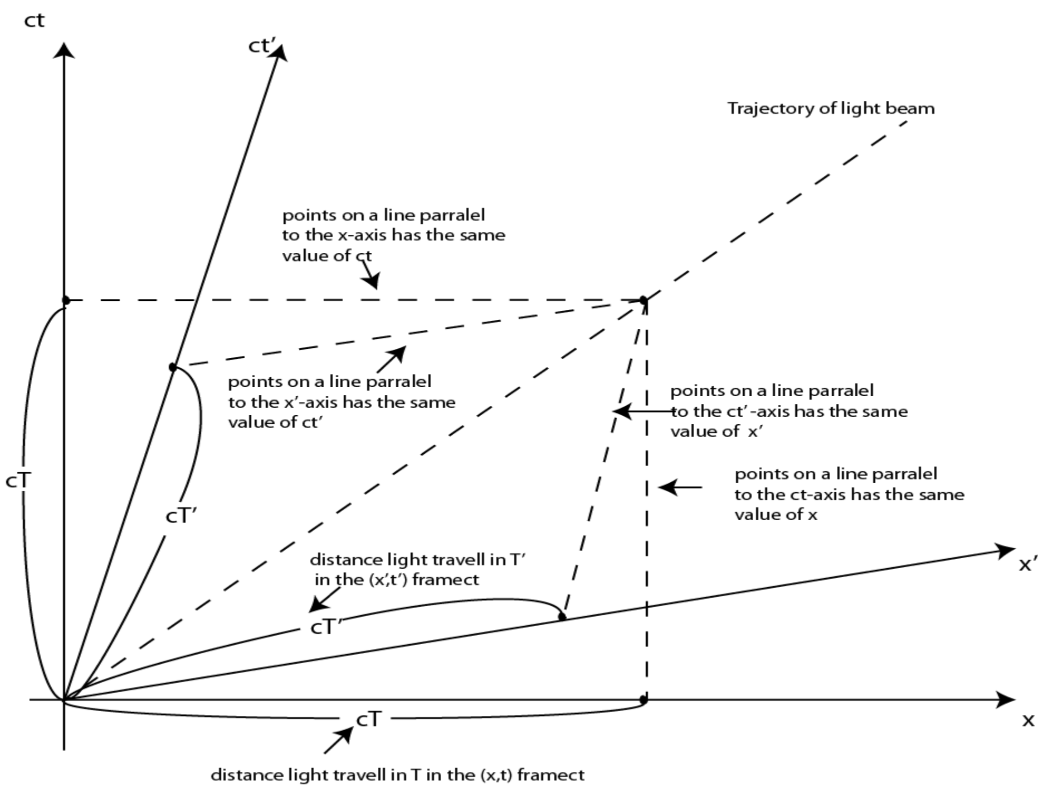

Fig. 1 Space-time graph of a fixed coordinate in comparison to a moving frame axis. The dotted line is the trajectory of a light beam

Dorato's second question moves us to consider how an object persists in space time. Figure 1 shows a space-time axis that allows us to compare a moving inertial frame (x-t frame) with a fixed inertial frame (x-t frame). The dashed lines running parallel to the axes describe events that occur simultaneously in the particular inertial frame. Everyday experience tells us that every event is based on cause before effect. Figure 2 illustrates an event in various spacetimes in a coordinate frame:

- In the x-t frame the observer concludes that the apple is hit after an arrow is shot, which is our every day experience of causality: cause precedes effect.
- In the x'-t'frame the observer concludes that the arrow being hit and the shooting of the arrow occur simultaneously. This is like moving from **A** to **B** in same time.
- In the x''-t'' frame, the observer concludes that the apple is hit before the arrow is shot. This is even more bizarre. How could this possibly happen? This implies that an object can arrive at **B** before leaving **A**.

Such scenarios as seen in the (x'-t') and (x'-t'')-frames are not only bizarre but ridiculous according to an everyday notion of reality. These oddities occur by allowing the arrow to travel along the line connecting **A** and **B** at a speed exceeding the speed of light.

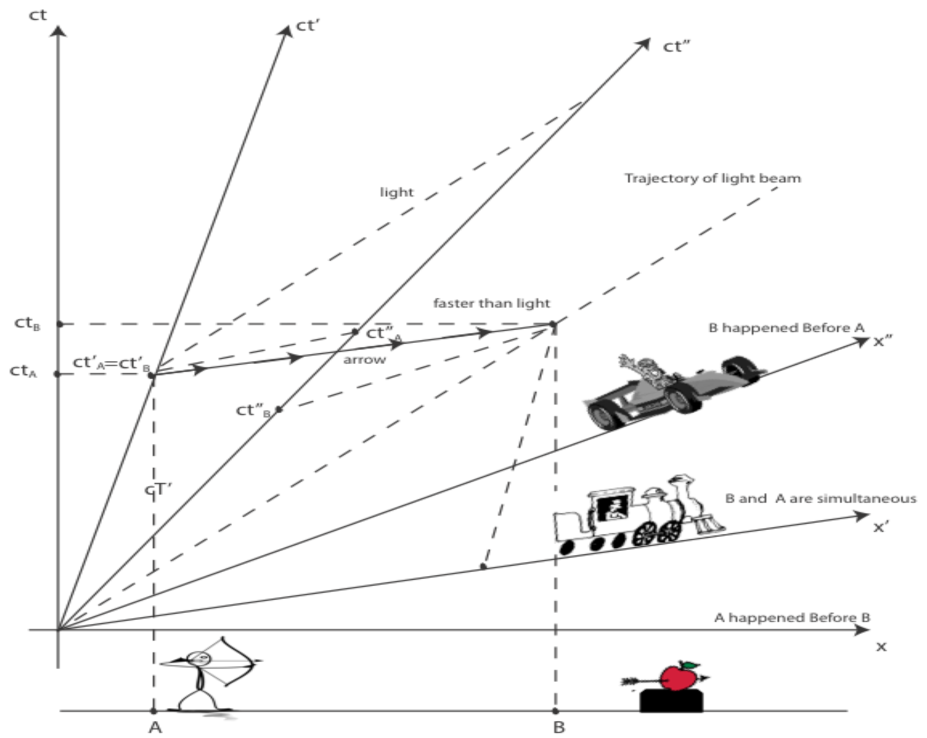

Fig. 2. Space-time graph showing how different observers see the same events.

Einstein tells us that an event that is simultaneous in one frame will not be in another. How does this help us to understand how **A**and**B** could happen at same time, or **B** (hits an apple) happening before **A** (releasing an arrow)? Would not light from the archer releasing the arrow still reach an observer first since the light would travel faster than the speed at which the arrow is shot? If an observer were moving faster than light she would never observe the event; thus there cannot exist any frame where an observer would conclude that **B** happens before **A**, unless the archer shoots the arrow faster than light speed. Thus we submit our first proposition of this essay as follows:

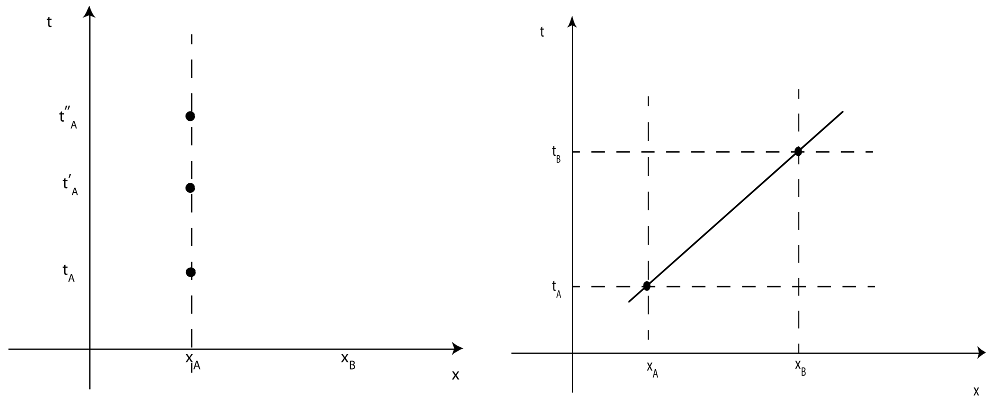

Fig. 3 Space-time showing (left) how an object persists in time and (right) how an object moves in space and time.

Proposition 1
If an object moves from **A** to **B** there can be no frame where an observer's conclusion violates normal causal relation unless speeds faster than light are allowed.

Consider an event where someone moved from **A** to go **B** in time t_1, this would mean that time is not changing. That is, **A** and **B** happen along the same time line. If an object could move along a constant in time (Figure 3a), then the object would not perceive any time passing and would be in a state where it would experience motion without a change in time. It is this concept that is referred to when talking about objects not experiencing aging. It is like attending a party and being quite "wasted", there would be no perceiving of time as the events go by.
It seems that motion is a necessary result of space-time and as a result, motion is a cause of the passing of time

and space. An object's motion in space-time is such that it moves in a piecewise connected with speeds slower or equal to light speed seen in the contrast of the blue and red lines illustrated in Figure 4.

Proposition 2
Any points embedded in flat space geometry, and separated by some distance d cannot instantaneously be traversed without changing the dimensionality of the geometry.

Proposition 2 suggests that any attempt to move from **A** to **B** must alter the spatial geometry such that **A** and **B** are spatial equivalent. Proposition 1 forbids an object's movement parallel to the space axis, that is, motion experience in constant time. That would be like being in two places at once. Time then is not a stationary quantity but is constantly moving forward whether objects are in motion or not. Time does not seem to go leaving us but takes us with it (Figure 3). Thus,we are always in moving time frames, which can only be perceived in the present. This tells us that events are objectively "separated" by space and time must exist, either as "carrier" of the spatiotemporal relations in empty space, or as real, mind-independent relations exemplified by physical entities. We must classified events by the nature dependent and independent events.

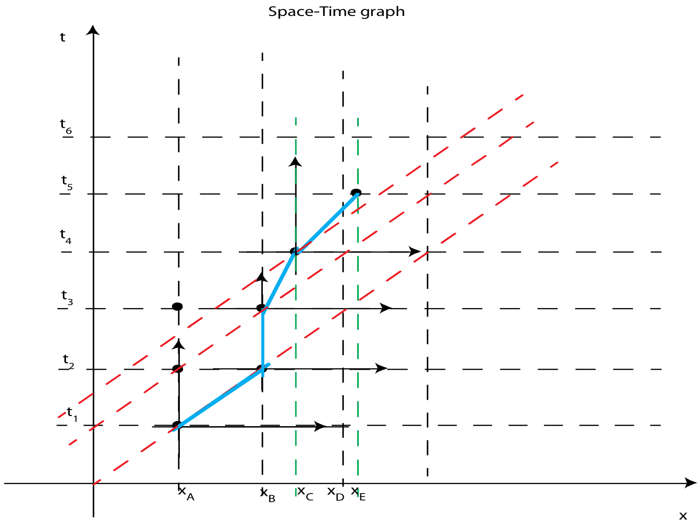

Fig. 4. The blue trajectory demonstrates how we experience space-time. Time carries us along with it, which is unlike space where objects can stop, go, and turn around. That is time only moves forward.

Every event is carrier of the spatiotemporal relations in empty space. Thus, in the case of dependent events like that of an archer shooting an arrow, which pierces an apple. This has a definite flow of time where our causal structure is preserved. However, independent events in the sense of their occurrence are independent of the causal structure since one did not cause the other; they cannot be mind-independent causality, but will be dependent on the perspective of the observer.Thus, flow of time is observer-dependent and not necessarily related to something physical.

As we conclude this section, we propose that in order to define time it must be imposed that any such definition must preserve our causal structure of our everyday experience. Moreover, in defining what time is we must ask the question: How does time really flow? Can we move back and forth through time? Well, it depends on who we ask the question. It is such conclusions as time from SR and GR theories that many philosophers argue rules out the Presentist's view. Therefore, if the Presentist's view of time is to be true then we must define a context where the results of relativity are congruent with our everyday understanding of causality.

III. Traveling Through Time

Einstein's proposal of time running slow in a moving frame would be mind blowing to Aristotle. Aristotle proposed a picture of space-time in which the motion of an object would run slow or faster in space but not time. This is something Aristotle in his everyday notion of experience would not comprehend. That is, if he moved faster he may conclude that time sped up since he got from **A** to **B** in the quicker time frame, but the idea that time slowed down when we are in motion would be described as a miracle. It is clear that Einstein's idea was revolutionary and transforming to human thought.

Some scientists believe that the fact that time slows down in the presence of a gravitational field, then by connecting two points in curve space-time through a wormhole one might be able to travel back to an earlier time. Although science struggles to understand gravity in its entirety, it seems that exploring the relationship of time to gravity is actually necessary. We live in a four-dimensional space-time universe: three spatial dimensions and a time dimension. As we accept this as our reality, one cannot help to ask what is relation between space and time? Does time have a beginning as was suggested by Augustine many centuries ago or as Stephen Hawkins tells us? As we try to make sense of these basic questions we are faced with oddities as illustrated in figure 2. Any explanation of time seems to be quite a complex one. A conclusion drawn from this is that it suggests that there is possibility for the existence of a frame where an observer could see the apple being hit before the archer shoots the arrow. How could an event be happening before its cause occurs? Cause before effect? Einstein's Relativity has turned our paradigm of reality upside down. Is it possible to achieve such phenomenon in reality? What is the nature of reality, does it allows for us to move back and forth through time? Could I go back and save my mother or can I move forward and see my end? There are a plethora of questions about time, and little assurance in the answers we find. If such travels were possible how would this affect Kant's answer to the Hume Problem?

Time provides a baseline to human progresses or failures but these are only memories of real events to us. It seems as it stands that there is no way to change these memories, or at best no one has yet figured out a way to do so. Visser[12] argues that the notions of chronology, causality, special relativity or flat-space quantum field theory are so fundamental to Newtonian physics that they are simply builtinto the theory ab initio. In these theories we reject any violation of normal chronology as unphysical. Time travel may be only a theoretical construct that lives in human imagination.

However, in the case of general relativity one cannot simply assert that chronology is preserved, and causality respected, without doing considerable additional work. In order to have a universe that allows for time travel there must exist closed timelike curves (CTCs). Godel found a solution to Einstein's equation by assuming that the entire universe was rotating and showed in such a universe the simplest CTCs is loop[13]. Aperson can travel between any two points in space and time in Godel universe. Gott[14] showed that if two infinite parallel cosmic strings passes each other with sufficient speed that resulting spacetime would contain CTCs. Carol et.al.[15] prove that a Gott time machine could not exist in an open dimensional universe for which the total momentum is timelike. Further, Mallet[16] proposes that time travel can only be possible from the time we build a time machine. That is, there is no going back before the machine, or worst, hope the power never goes out since the machine can never be shut off. He has devised an experiment to observe a time traveling neutron in a circulating light beam, which he believes can show the possibility of time traveling. Phenomenon such as Black holes, wormholes, and even cosmic strings have been proposed as means for time travel, since it has been theoretically demonstrated that they could distort space-time. How feasible is it to use such methods that need an unthinkably gigantic amount of energy?

Stephen Hawking[17]proposes that any CTCs cannot be created in a finite region of space unless there is exotic matter present, which violates certain energy conditions. He further states that, since time travel is not observed and present us with absurdity challenges it seems quite reasonable to assume that there exist a Chronology Protection Agency (CPA) as coined by Hawking. Hawking believe such an agency prevents the appearance of (CTCs) which makes the universe safe for historians. By arguing that the vacuum polarization Stress-Energy Tensor always diverges on a compactly generated Cauchy horizon, due to which the space-time geometry at the Cauchy horizon gets thoroughly disturbed, Hawking[17] showed that the laws of physics do not allow the existence of CTCs. This leads to the destruction of the Cauchy horizon and the region containing CTCs. However, Hawking conclusion is not without opposition, Li[18]on the other hand argues that it is not necessary that the existence of CTCs be prevented by the laws of physics, on the basis of CPA conjecture (under the necessary quantum effects), because:

1. The Einstein equation is local and the divergence of the stress-energy tensor on Cauchy horizon does not imply its divergence in the region containing CTCs. Thus CTCs would not be destroyed.
2. With quantum mechanical effects accounted for, the treatment can no more be classical and in such case the CTCs converges to the Cauchy under certain condition.

Further, Li contends that there is no law of physics preventing the appearance of CTCs and propose ananti-chronology protection conjecture that rejects the CPA. Even if Hawking is correct, to date there are no convincing arguments that such an Agency is housed in either classical general relativity theory or in semi-classical quantum gravity[19]. Thus, it would be appropriate to use a quantum mechanical theory of gravitation, rather than using Quantum Field Theory or Classical General Relativity.

Mallet's time machine idea is not that much different from Gott's time machine[15], for which it has been shown by scientists that any attempt to create a time machine in a closed universe would cause the space to collapse entirely, Dresser[20, 21]. Within the context of ST Dyson[22]found the existence of a Chronology Protection Agency that prevents causal violation as Hawking suggested. She noted that, "When trying to construct the geometry, however, we saw that massless degrees of freedom arise before reaching the causally sick region. These new degrees of freedom appear at precisely the location where the energy due to transverse momentum cancels the energy due to rotation of the gravitational waves which make up our geometry. We propose that the special radius where this occurs is a chronology protection horizon, beyond which the gravitational waves cannot travel. Instead they expand to form a shell outside of the chronology violating region. Since the presence of the gravitational waves beyond this point was crucial to create the causally sick region, our geometry is rendered safe and chronology is protected."

Therefore,any theory suggesting time travel as a viable possibility is premature and must first demonstrate how it would avoid causal violation. Our reality so far agrees with the conclusions of Hawking[17] and Dyson[22] and provides a framework from which we can discard any proposed model of time travel as wishful idealism within the physical theory. Thus we are now in a better position to shape the discussion on time from a philosophical perspective.

IV. Arrow Of Time And The Direction Of Causality

Thenotion of time depends on whether we are referring to the quantum world of subatomic particles or the macroscopic state of our reality (i.e. the classical world). It is said that in the subatomic world one can only say that an event occurred, that is, we cannot perceive past or future, nor can they be determined. Thus the microscopic version of reality seems to be timelessness. From a causality perspective, time is one-directional. For a simple event that occurred, the past to the future is intrinsic to that event. A broken glass on the floor lying in a puddle of water will never reassemble itself such that the spilled water will gather together and place itself back in the glass [23]. If we are however, faced with a system containing a large amount of particles,thermodynamics could be employed to obtainthe associated mathematical expressions which would indicate a direction of time from past to future.From the second law of thermodynamics, the state of entropy of a closed system always increases.

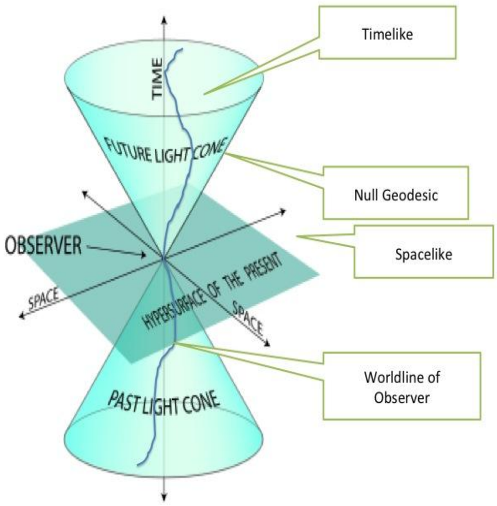

Fig 5. The space-time light cone

Our universe could be in a state of temperature homogeneity if all sources of energy were to give up their thermic process; it would have suffered "heat death". Any closed system left to its own vise would move from order to disorder, which implies a single direction; as in one seeing an arrow of time that moves only in one direction.

SR implies that we can move through time in any direction as in Figure 5. However, our causal reality reveals an asymmetry in our experience, that is, what we do now influences only our future. If a backward arrow of time was a viable possibility then our future would influence our present and past; thus, creating anotherpossible future, but this is absurd because the future that influences our experience never existed. The laws of physics do not allow for such absurdities, hence the arrow of time can only be going in one direction. Therefore, figure 6 provides an interest way that we must think about the light cone.

The dashed lines in Figure 6 suggest that the past does not exist and as such we cannot travel back. However, if time travel is possible, we might only be able to travel forward. This would mean though that once you travel forward you cannot return. This only works if you assume that the future already exists, which again presents us with another absurdity. We propose that if time travel is possible, it cannot be in the same universe. Any rip in space-time would always take us to a new or alternate universe. Thus time measurement might be a bit fuzzier where one would interact with a parallel universe by disturbing its future. This in itself suggests that the future is changeable. Therefore, proposed phenomena such as blackholes, wormholes or cosmics strings don't allow us time travel but instead space travel within the same universe. Since matter causes the fabric of space-time to curve,a very strong gravitational field would so distorted or warped space-time such that one point in space would touch another leading to space travel over vast distances almost instantaneously.

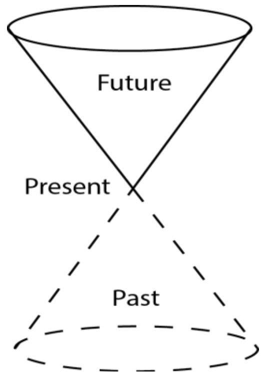

Fig.6. The space-time light cone illustrated by the dotted lines indicates that the past is not real. However, it does influence all future events.

We turn our attention to time as its was birthed in the big bang thus looking back as far may help us to unravel its very nature. Smolyaninov and Hung[24]simulated such a phenomena of the early universe in very a simplistic experiment with metamaterials. Such materials have already been used to create artificial blackholes and multiverse simulators. Their findings show plasmons particle generated from the interaction of green laser light with gold-atom created paths that became sloppier the farther out they moved. Thus, for these plasmons to time travel they would need to complete the loop that runs along an exact path it previously travelled, but these plasmons strayed from the path. Thus, this experiment suggests that the arrow of time cannot curve back on itself, so, one cannot return to earlier times where an event already occurred. Thus, their finding agrees with our everyday experience. Further, their result is consistent with the second law of thermodynamics that suggests that a system will tend to become more disorderly with the passage of time. Some researchers have suggested that this model was too simplistic to illuminate the more vexing question on what is possible in the real universe, where arbitrary equations of state might be possible. Moreover, Du[25]showed that a single photon of light couldn't travel faster than light, rendering time travel impossibility and in essence showing that our causal structure is preserved. This, Du believes has the potential to give a better picture on the transmission of quantum information to scientists.

These questions of the nature of time will be answered when there will be an accepted theory of quantum gravity (QG). Then the very nature of time will be unraveled. Is it continuous as relativity suggests, or it is discrete according to the quantum perception of the cosmos? At present there is no complete description of QG[26]. Lieu and Hillman [27], in a recent experiment of galaxy observations distances of more than 4 billion light years from the earth reported results that challenged the prediction of quantum physics. The implication is far reaching because if time is continuous then there can be no quantum description of gravity.

Quantum theory says that time flows in incredibly small measurable units. The fact that Lieu and Hillman [27]found patterns that should not be present according to quantum prediction suggests that time after all may not run in discrete intervals.Time cannot be considered to be a quantum function with a lack of distortion. More so that time might flow fluidly and precisely at intervals infinitely smaller than Planck time. Time that is not 'fuzzy' beneath a plank interval will present contradictions to several astrophysical and cosmological models, including the big bang model of the universe [27]. The conventional views that the fuzziness of time smears out the singularity, keeping density finite, are impossible [21].

This finding is not without challenge. Ng and his colleagues [28]contended that, at Planck scale, space-time is "foamy" because of the quantum fluctuations predicted by QG. They further argue that there is fundamental disagreement with the Lieu and Hillman's interpretation of their result. In their opinion Lieu and Hillman assume that the microscale fluctuations induced by QG into the phase of electromagnetic waves are coherently magnified by a certain factor, which is not correct.

The issue has been left unsettled as to whether time is continuous or not, and the understanding have implications on how we perceive time properties in space-time. Our treatment of gravity will come as a result of which side of the conflict we decide to stand on. Would our choice affect our conclusion of the direction of time? Can time flow both forward and backward? What are the implications if we allow time to be bidirectional vs. flowing in only one direction? As shown in the Figure 7 the arrow of time is always moving in one direction even in scenarios where there would be multiple big bangs. Sean Carroll[30] in an interview with the *Wire* holds the view that

"There's different moments in the history of the universe and time tells you which moment you're talking about. And then there's the arrow of time, which give us the feeling of progress, the feeling of flowing or moving through time. So that static universe in the middle has time as a coordinate but there's no arrow of time. There's no future versus past, everything is equal to each other. … The weird thing about the arrow of time is that it's not to be found in the underlying laws of physics. It's not there. So it's a feature of the universe we see, but not a feature of the laws of the individual particles. So the arrow of time is built on top of whatever local laws of physics apply."

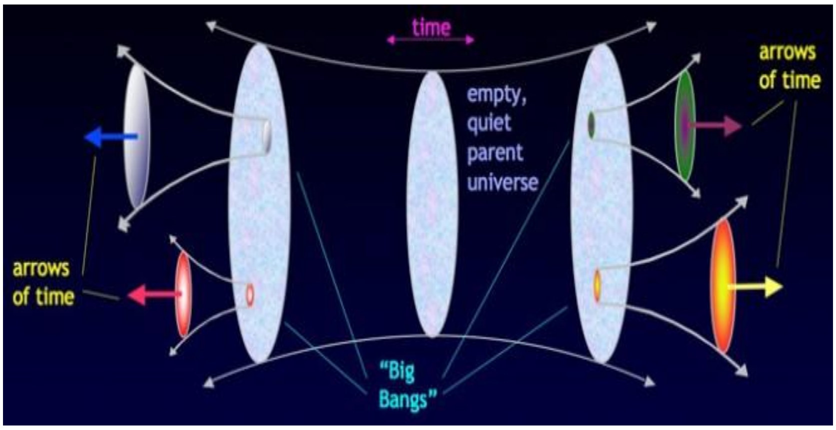

Fig. 7 This is an image from Carroll's "The Particle at the End of the Universe[29]. It illustrates that the arrows of time are going in one direction for a universe that has not reached its equilibrium state.

As consequent, we construct the following proposition based on our experience in present reality:

Proposition 3
If time flows in one direction going from past to future, then only a causal asymmetry reality exists.

If physics is telling us that causation has an objective asymmetry then our interpretation of time in SR must be incorrect. For one thing, the work of Hawking[17]and Dyson[22] has shown that the laws of physics do not allow for such causal violation and as such to argue that past or future exist becomes ludicrous. In any event, if it could be shown to be true, a daunting challenge in science is that we are always working with a little piece of the puzzle at any moment in time; this renders a very difficult task to arise to global conclusions. SR is only an approximate theory to GR in that it describes a flat space-time where GR is a general description for a curved geometry. This means that we cannot find a transformation that will map the whole SR geometry to the global geometry of GR. However, in some small neighbor of the curved geometry of GR we can map a whole SR geometry to it. Moreover, we are supporting the idea that to settle this question on both causality and the direction of time a more complete theory of quantum gravity is necessary.

V. Presentism And Relativity

Let's return to an earlier discussion of two basic thoughts about time. *Presentism* is a view that suggests the very thing that we have just concluded with our space-time graph. Further, the Presentists conclude that only time in the present is real or represents our perception of reality. As such, they must conclude that past and future do not exist and that the passage of time is just an illusion. Next, another measure of time is represented as *Eternalism*, or the *block universe*, which views all points in time equally as "real". This philosophy is supported by the Einstein's theory of SR. Physicist Roger Penrose proposed another interpretation called the *Andromeda paradox*. These paradoxes and anomalies arise from lack of simultaneity due to Einstein's postulate of constancy of the speed of light in SR. The block universe suggests that all times in past, present, and future exist which seems to be limiting to the notion of free will. We propose that although Presentism is not supported by the current interpretation of SR, the Presentism's framework best explains reality in how we experience time. To say "what time is?" or "what causes it?" we must take it in context of our experience.

Depending on the model we subscribe to about time, we must embrace its radical notions in our perception of reality. The Block Universe theory suggests that all our future is already determined. What does a deterministic future mean, and what does time flowing in only one direction imply? Relativity agrees with the employed approach that time is another dimension waiting for our consciousness and the predicament that the future is predetermined. A future that is deterministic is concerning, because it suggests that no matter what we do now, our future is determined and is just waiting for us to step into it. As such we must wrestle with the notion that we cannot do anything to change destiny or that there is no allowance for free will. For such a state of "a preexisting future" to exist, there can be no allowance for time travel back to the past which contradicts the Block Universe premise. This is an indication of the type of absurdities we encounter when adopting such models. To accept the theory of relativity is to accept that the future may already exist[24]. Further, Saint Augustine proposed that, "the present is a knife edge between the past and the future and could not contain any extended period of time." If we accept that the present as extended, then it must have separate parts, which must be simultaneous if they are truly part of the present. This poses a problem for the Presentists since time cannot be both past and simultaneously present, and consequently, cannot be extended.

Definition
Extended present is like an extended object occupying space-time, which covers some area that expand backwards and forward in space and time.

However, Tselentis[31]points out that extended is an infinite causal loop and such infinite causal loops are logically valid but are inconsistent or incomplete with regards to common experience. These infinite loops are like two-fold objects in which one half consist of "forward causation and the other is formed by "backwards causation". Tselentis[31]made two important points, first, our ability to find cause in thinking forward allows us to form a sense of reality while our thinking in the opposite direction by making probabilities may nurture a sense of illusion. Secondly, this flexibility could be influencing our perception of the present as extended in the past and the future, or as separated from them in which case time travel does not exist.On the Other hand, Stcherbatsky, the Buddhist philosopher, argues also that, "everything past is unreal, everything future is unreal, everything imagined, absent, or mental is unreal. Ultimately real is only the present moment of physical efficiency", an echo to the Presentists' construction that only "now" exists and is real.

Tselentis [31]approach time-travel from a very unique perspective, which seems to form coherency with a Presentist's conception. Time travel for him comes about not in the physical sense but in a state of consciousness. That is the ability to recount events that have happened in the past and accept them as facts despite us living within the present is an example of how our own consciousness displays the properties of a closed time-like curve. This time-like closed loop incorporates the past and future alike such that within the extended present of this loop we can travel in "time" without restrictions. While this happens in the realm of our imaginations, we can consider our close time loop as a way to understand how the past and future events always take place simultaneously within the present.

Furthermore, the argument raised against the Presentist viewpoint comes from the SR's conception of simultaneity. SR suggests that there is no such thing as absolute simultaneity; events that are simultaneous in one reference frame are not simultaneous in another. As a result, what counts as the present, is different from one reference frame to another.It removes all objectivity to the concept of the present. What we perceive as the present corresponds only to what is occurring simultaneously to us in our reference frame.

Although SR and GR theories seem to present, on the surface, contradictions with the presentists' view of time, they allow for consequences that leads to violation of causal reality. This is the strongest indicator that our interpretation of these theories needs much refinement. McTaggart [8] suggests that we must think of time as fictional events written by various authors. Past historical events have in them also, the 'earlier' and the 'later' as well as the past, the present, and the future. This suggests that past really is more like memory of events and does not exist anymore than the imagination of a writer.

"Of these three divisions of time (past, present, and future), then how can two, the past and the future, be, when the past no longer is and the future is not yet? As for the present, if it were always present and never moved on to become the past, it would not be time but eternity. If, therefore, the present time is time only by reason of the fact that it moves on to become the past, how can we say that even the present is, when the reason why it is that it is not to be? In other words, we cannot rightly say that time is, except by reason of its impending state of not being. – St. Augustine; The Confessions, Book XI".

On Kant's side, his idea of time being an illusion actually depends on our perception of it, and seems to come to a head on collision with our interpretation of modern physics results. For Kant, there is nothing comparable to associating time and space, and in his view, we cannot grasp nor understand that transcendence. It pervades what is and what is not, and thus, we cannot define that either. Kant posits that we can only suppose that objects exist, and we can do that when we become aware by our sense of time and space, which creates experience. An objective world according to Kant is a series of spaces and times in which things exist by tense.

Let's consider the events of your life as connected set of "yous" in space such that each "yous" is along a world line. If time travel is allowed, then it produces a disconnected set of "yous" on your worldline with no way to get the next "yous". Another problem that Eternalism or SR and GR face is that multiples copies of "yous" it allows to exist or you appear where you never existed in space-time. Thus, it introduces a multiple worldlines problem or worldlines of objects appearing in space-time where it should not exist. This would have consequence on our present reality in space-time of astronomical scale. Therefore, the universe would be one big absurdity, that couldn't possibly exist. However, the fact the universe is here, then there must exist some mechanism like the one proposed by Hawking to prevent such absurdities in space-time. Early signs in ST as emergent theory of quantum gravity already suggest that no such causal violations are allowed. The discussion for the Presentist is not yet settled, because he still must clarify the issue of simultaneity as described by SR and GR. In the next sections we present the framework to do just that.

VI. Spatial Dimension Debate

Using SR as a premise, philosopher Putnam[32] claimed that he proved the universe to be deterministic. Putnam contended that the best tool to investigate reality and determinateness is physics. His belief is that the philosophical ideas regarding the concept of time are fully addressed. Through physics, he argues we discovered that we live in a four dimensional world as oppose to three-dimensional. Hitherto, we need to fully understand the specifics of the geometry. Putnam was essentially claiming that he proved the Block Universe view of reality. Callender [33]refutes Putnam's claim by arguing that Putnam's reasoning is violated by the core of physics in that his argument run on quantum mechanics rather than tenses, would prohibit good interpretations of quantum mechanics from reproducing and enforcing violations of Bell's inequality. Further, Lucas[34] in his book "The Future" says, "The block universe gives a deeply inadequate view of time. It fails to account for the passage of time, the pre-eminence of the present, the directedness of time and the difference between the future and the past." Moreover, Zimmerman[11] points out that a Newtonian four-dimensional manifold is a series of distinct, infinite, Euclidean, three-dimensional spaces; each is instantaneous in temporal length and spread out continuously in a fourth temporal dimension. However, SR manifold is different in the sense that it is a less intuitive geometrical structure, called "Minkowski space-time". Seemingly, GR is considered as a more complete theory than SR to describe the structure of space-time. The different type of four-dimensional events that was applied to estimate the Minkowski space-time structure in a arbitrarily small regions is in agreement with GR. However, it should be noted that varying curvature is possible on large regions.

Einstein pointed out that it is a widespread error that SR theory is supposed to have first discovered, or at any rate, newly introduced the four dimensionality of the physical continuum. This, of course is not the case. Classical mechanics too is based on the four dimensional continuum, of space and time. In a review of Emile Meyerson's book *La deduction relativiste*, Einstein[35] writes that she, "rightly insisting on the error of many expositions of relativity which refer to the 'spatialization of time'. Time and space are fused in one and the same continuum, but the continuum is not isotropic."

In Euclidean space-time we see the metric of flat space-time as $ds^2 = c^2dt^2 + dx^2$. We think of this in the following way, suppose we define a vector in this space as $ds\hat{s} = cdte_1 + dxe_2$ then $ds\hat{s} \cdot ds\hat{s} = ds^2$. Similarly, we might think of Minkosky's space-time metric coming from the complex space such that we define a vector in this space as $ds\hat{s} = icdte_1 + dxe_2$. Therefore the Minkosky's metric is given as $ds\hat{s} \cdot ds\hat{s} = ds^2 = -c^2dt^2 + dx^2$. The implication here is that time dimension is not really physical, but is a mathematical construction designed to characterize motion in our spatial experience.

Time occurs in all directions of our spatial experience, it takes the spatial axis with it. Sorli and Fiscaletti[36]have proposed that time is a mathematical construct. In this framework, the three spatial dimensions are intuitively visualized, while the time dimension is mathematically represented by an imaginary coordinate and cannot be visualized in a concrete way. The presence of time dilatation in SR is not as a result of time being the fourth dimension of space, but a plausible explanation is that a slowing of velocity comes from a faster moving inertial system. For instance, if we consider the GPS, it is clearly different from the rates between clocks on an orbit station and a clock based on the surface of the earth [36]. Thus, Sorli and Fiscaletti concluded that there is not a determined correlation between time dilation and length. Therefore, time is only a mathematical quantity of change that we measure with clocks.

Gradually, the difficulties in squaring GR with quantum theory have become clear to more and more people working on foundational physics; it is no longer obvious what space time will look like in tomorrow's theory of quantum gravity. Almost all theories of quantum gravity propose a reality with hidden dimensions of space. ST proposes that there are extra spatial dimensions that were separated in the early big bang. The issue on dimensionality of space time is not yet settled one, but one thing is certain, we experience three spatial dimensions.

VII. Simultaneity

Einstein's theory of relativity suggests that it is possible for an observer in some frame to conclude that someone could be going simultaneously from **A** to **B**. It was shown in Figure 2 that a frame exists where an observer in his frame saw an archer firing an arrow while at the same time saw the arrow hitting an apple at some distance away. In context of dependent events can there exist such a frame? Lets take our space-time diagram of Figure 2 with the archer shooting at the apple. In the (x'-t')-graph this event is simultaneous, but in the (x-t)-frame the arrow is shot and hits the apple sometime later. SR tells us that there is no preferred-reference-frame. Moreover, if two events take place simultaneously for some observer, all other observers will conclude that they are not causally related or that if two are not causally related, there exists an observer who would say that they are simultaneous. We agree to the truth of these statements, but not necessary with the interpretation that it is evidence for the block universe viewpoint. We propose that a reference frame must be defined by natural causality to clarify what is meant by a PRF. This must be done in the context of certain kinds of events such as what is described in Figure 2 vs. events that are happening in distant frames, or independent of each other.The following propositions summarize our main point:

Proposition 4
*Two events are said to be causally related, if one influences the other. If **A** causes **B**, then **A** must occur before **B**. We can say that **A** and **B** are causally related. If **A** and**B** occur simultaneously, then **A** cannot cause **B** and such events are independent.*

Proposition 5
*A premise of SR is that all observers agree on the speed of light. Therefore, if **A** is an event that must be followed by **B**, that is **A** causes **B**, then A and B must be distinguishable in all frames. That is, there can be no frame where **A** and **B** occur simultaneously.*

As a proof of proposition 5: let's suppose that **A** causes **B** and assume that there is a frame where **A** and **B** happen simultaneously. For an object to be at **A** and **B** simultaneously, it requires that the object move in space while time stays unchanged. In the frame moving at constant speed such that these events occur simultaneously, the object would be required to move at least at light speed such that light from **A** would reach an observer in his reference-frame at the same time as the light from **B**. Our assumption would require that the object must at least be moving at the speed of light from **A** to **B** for an observer to view these events as simultaneous. In SR theory, an infinite amount of energy is required to accelerate an object to the speed of light. A photon moves at the speed of light, because it has no rest mass. This implies that it is impossible for a material object to move at light speed. Thus, light from **A** would always reach **B** before the observer. As a result, **A** and **B** cannot be simultaneous, which contradicts our assumption. Therefore, **A** cannot cause**B**and occur simultaneously at the same time in any frame, norcan there can be any frame where an observer sees **B** happen before **A**without violation of the speed premise of SR. SR does not allow for such causality violation. Q.E.D

Proposition 6
Suppose there exists an absolute frame, then all events are said to be simultaneously present in that frame at an instant in time that they are occurring in.

How do we now make sense of what is real since a Presentist's view posits that only the present is real? Considering dependent events, it is clear that simultaneity is not possible in any frame, then all observers will conclude that **A** happens before **B;** but they may not agree on when. That is, each observer will disagree on present versus past according to their frame of reference. The issue of simultaneity is not concluded yet. We know that light bends in a strong gravitation field.Our previous argument only works if we consider light as moving along a straight line.Such a field would produce the effect of a mirror, but the observer would still conclude that the event is not simultaneous because he would observe a series of events simultaneously along the path from **A** to **B**. When his own notion of causality is used,he would conclude that the events couldn'tbe simultaneous.

Events that aresimultaneous must be independent. Consider a train in motion to the right with a light bulb in the roof of a cart at its center.Suppose that this light bulb flashes every two seconds or so. An observer in this cart would conclude that the light from the flashing bulb arrives at the front and back of the train at the same time. A person standing in a fixed frame relative to the train would conclude that the light hits the back of the train before the front. What would an observer moving past the train at high speed when the light bulb flashes conclude? For her, the light that hits the front of the train would catch up to her first since it has less distance to travel, and as such, she would conclude that the light reaches the front of the train before the back.Consequently, the flash of lightning would be observed simultaneously in one frame and not in another. Thus, the prediction of SR is only for independent events. Suppose we are able to cheat a little by saying that there was another light of a different color in the frame where simultaneity was observed, but this light only would come on if the first light would hit **A** and **B** simultaneously. Since we are proposing that the light was simultaneous in say, the rest frame, then every observer would observe the second flash in which they would conclude that the first event must have occurred simultaneously and their reading that **A** happened before **B** is an illusion due to their time and position.

We consider two independent events **A** and **B**. Let X_A be the distance between event **A** and an observer at **O**. $X_B$be the distance between event **B** and an observer at **O**. If $X_A > X_B$ [/] $X_A < X_B$and events **A** and **B** are observed as simultaneous then **A** should have happened before **B** [/] **B** should have happened before **A**, which implies that **A** and **B** are not simultaneous events. If $X_A = X_B$ and events **A** and **B** are observed as simultaneous then **A** and **B** are simultaneous events. As a result, when it comes to the question of simultaneity, the question to be asked and answered is whether or not the events **A** and **B** occur simultaneously. Asking whether they were observed as occurring simultaneously by some observer does not tell us if the events are naturally simultaneous. The answer in this case can only be frame dependent. Since simultaneous observation depends on the relative position and time of an observer, then their conclusion must be deemed illusory. Hence there can be no absolute definition of what we mean by time.

We turn our attention to Putnam's objection to the Presentist's view about time.Putnam[32] proposed an idea to which he concludes that the question of time is solved by physics' 4D space-time. His intent was to show that SR and Presentism (the man–on-the-street's view of reality) are incompatible. He argues that,"only statements about events in the lower half of my light-cone have a truth value; only events that are in 'my past' according to all observers are determined." "Truth-value" we take to mean - can be determined or occurred. Not only events that are in my light-cone have a truth-value but in everyone else's as well. Further, Putnam was the first to point out that events in someone's future light-cone can be in someone else's *relative present* or even relative past. Stein [37](1968) argues that Putnam's argument is flawed in that he failed to take note of the changed situation in that context, and that "definiteness" to the present has to be replaced by "definiteness" at given space-time points. By introducing a binary relation between spacetime points ("being determinate as of"), Stein [38] reasons that for any point *p* in Murkowski space time, only those points in the causal past of *p* are definite (Possibilism). Stein is suggesting that the history of the world exists only in events that happened (i.e.'ontologically fixed and definite'[39]), and a part that is not yet settled[38] (i.e. events that will happen in sort of a predetermined frame).

We are against the notion that suggests that because if we have not experienced an event, then it has no truth value. It is however true in some sense that if we have not experienced an event, we will conclude that the event has not occurred. In Figure 8, although **a** and**c** are occurring simultaneously, they are unable to influence each other;**a** has already become for **b**, and can influence it. **b** experiences events simultaneously (prop.6) with **a** and **c,** but **a** does not experience events simultaneously with **c**.Thus, SR says that **c** is becoming for **a,** but the argument for the Presentist is that **c** is unreal for **a** according to Putnam. However, this only true if Presentists perceive it in the local sense as SR, but Presentism must be in the global sense and would say that **c** is real for **a,** whether **a** is aware of it or not because the space in which they occur is *aware* of them.

As a matter of fact, **c** has become for **a** by transitivity of reality relation. In Figure.8, Daroto's argument [40] brings the Presentist to a contradiction by transitivity relation since his starting assumption is that everything that is future is unreal. Figure 8 poses a serious problem about what we mean by future and must be clarified. This is the heart of the causality principle. Note that an event in **c** may occur in the "now of **a**", yet with **a** being unaware. Putnam is starting from **a** as "now"; heconjectures that since for some observers **a** and **c** are simultaneous, whereas for others**c** and **b** are simultaneous, then the event at **b** must be real "now", that is (**a** and **b** being arbitrary), that everything (the entire history of the world) is always real. This causes to come to the conclusion that future events are determined. The problem is obvious, we are defining the future by events that are already experienced in someone else's frame. Thus Putnam was led to conclude that this Presentism premise must be impossible (the coexistence of past-present-future), and contends that future events are existing already.

Both Putnam and Stein conclude that "presently-existing" is incompatible with SR. SR treats the time coordinate as a physical thing, which forces an observer to conclude that a foreign object is in the future since its light has not yet reached the observer. However, all observers in the object's neighbourhood would conclude it to be real. Putnam argues that the observer by the property of transitivity of simultaneity will conclude that the object is real. Daroto [40] points out that denying *transitivity* would imply that what exists at a distance depends on a state of motion or an observer.SR then can only tell us whether an object is becoming now or if it has become. It cannot tell us anything about a future event that has not occurred for any observer. By transitivity SR is a theory of determinism as concluded by Putnam. The reason is quite simple, the event has occurred; if an event has not occurred anywhere in space, such an event is, we will term, as the future and must be true for all observers in space time, but SR can tell us nothing about the kind of event there is. Stein [37] was led to conclude that the Rietdijk-Putnam thesis of determinism was not attained, but this is due to a confusion caused by the difference in their ontological structure about time. We believe that if we allow the transitivity property of simultaneity to be true, then SR is definitely a theory of determinism; but we agree with Stein that Putnam's conclusion that the issue of time is now solved is falsity. SR cannot determine anything about an event that has not happened in space-time in the global sense. Thus we present proposition 7 as self-evident

Proposition 7
There is no frame in which an event occurs in one frame such that one could travel from a second frame after the event in the first frame has occurred to arrive there before the event happens. Once an event occurs in spacetime, it occurs for all observers in spacetime.

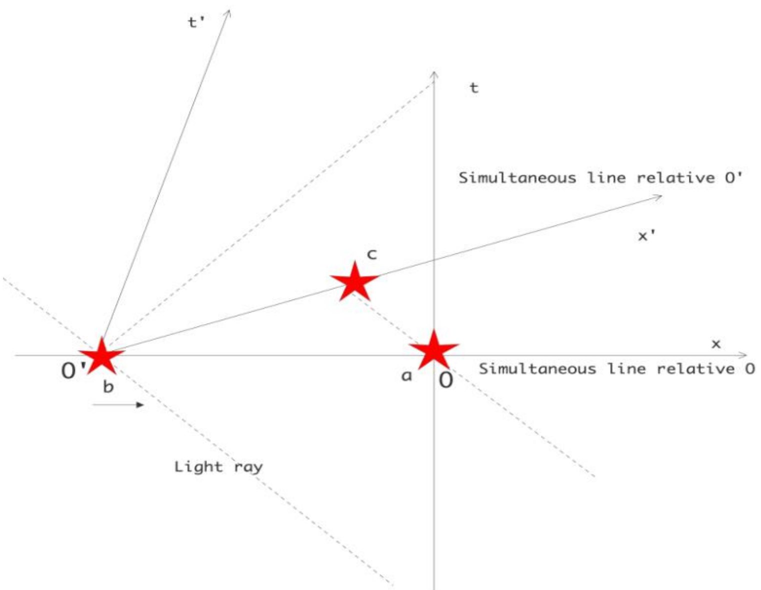

Fig.8 Schematic use to illustrate Putnam argument[40].

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The question is,is an event real or unreal because it is not observed? This is what proposition 7 has attempted to clarify(i.e. all events that are simultaneously present are real and need no unique observers). Proposition 6 suggests that once an event occurs, then it is real for all observers whether it occurs in their neighborhood or foreign to them. Stein [37]makes the point that "in Einstein- Minkowski space-time an event's present is constituted by itself alone", and suggests that in SR, the present tense can never be applied correctly to "foreign" objects. Only can an event that has not occurred be in my future, that is, although **c** has not become for **a** it still exists. However, when it is experienced in **a**'s frame because it is foreign at the time **a** experiences it, then it no more exists.Nonetheless, all observers in Minkowski'sspacetime are relativity dependent. Thus to clarify the issue, we must remove time as a physical object. SR has rejected the transitivity of simultaneity across different reference frames[40], which we argue is due to applying SR globally when its conclusions are depending on the observers' experience and not on the existence of the events themselves.Transitivity provides an epistemological logic that allows the Presentist to clarify what is real and what he means by the 'future' in relation to the causality structure. Saunders proposed that in order for Presentism and SR to work together, SR must be supplemented by some type of verificationism, in that, Presentism demands a unique resting frame which cannot be identified by any measurement.A more radical notion is to consider space itself as the privileged frame. Take the crude analogy of three ants walking on your body simultaneously but unaware of each other. Your brain however knows of their presence almost instantaneously. SR works in the sense that information between points depends on their distance and motion relative to each other. This means that we must dissociate time from space because it is not a physical quantity. In light of considering the unphysical nature of time then there is no contradiction between SR and Presentism; SR is only limited in its scope of reality and gives us a picture that is local to each observers.

VIII. Preferred Frame

We must develop our causal structure in relation to position and time of the events occurring. So we should assert within our causal structure aPRF. Therefore, all observers must be required to account for all relevant information. For example, if two lightning flashes in their frame 10 seconds apart and are also separated by

some distant $d$as shown in figure9, then an observer must take in account his position relative to these events. Based on the aforementioned information, the observer would realize that his simultaneous reality of the events not in his neighborhood is not really simultaneous; only the frame in which they occurhas the true perspective. He always sees these events in the past of their occurrence by virtue of him traveling in a frame not in the neighborhood of the events and as such should not be allowed to conclude that his perspective is real.
Presentism as a philosophy is submitting to that only the present is real. However, some have extended this to suggest the view that only present objects exist. Consider a ball being thrown to you in a game of catch. Let's further assume that there is a fence between you and the thrower, so you never see the ball being thrown. The thrower is required to throw the ball and move quickly to a peephole in the fence. When the ball leaves his hands, the event of the thrower throwing the ball is in the past and the event of you catching the ball is still in the future. Assume that you are running at some speed and that there is a third frame where a third person cruises along with the ball but at vantage point where he sees the ball leaving the hand of the thrower and heading toward you. He concludes that the throwing of the ball is past and you catching the ball is future. Neither events exist since the ball has been thrown but has not been caught yet. The ball is present in the vantage viewer's frame, along with the thrower moving to the hole in the fence to see the ball being caught, while you run waiting to catch the ball. This frame where the events are being observed is what we can refer to as a *privileged-frame*. The objection of SR can be met by a sufficient condition that is related to some reason for privileging one reference frame over any other. This would allows them to safely claim that what exists is what is simultaneous with your reading of this in keeping with the privileged reference frame[41].
The question that presents itself for resolution is simply as follows: when the ball is thrown, is there a frame existing in which the ball is not thrown? Suggesting that the event does not exist because it is not yet observed cannot be correct. *Thus in some sense, the privileged-frame must be the one in which the events are simultaneously present, and the preferred frame is one in which and to which all events refer.* Any other frame that is not in the neighborhood in which the event occurs, will not know that the event has occurred until it is observed. By computing the time at which the event occurred, the observer would conclude that this event happened as they were preoccupied by some other event. The conclusion would always be in the past tense.In much same the way, by knowing how far a star is from us we are able to say how long in the past its light has shown. It seems that the confusion being faced is that the Presentists perceive the present to be when an event occurs. We would like to suggest that the privileged-frame or present frame must depend on the answer to the question we are asking at the very moment.

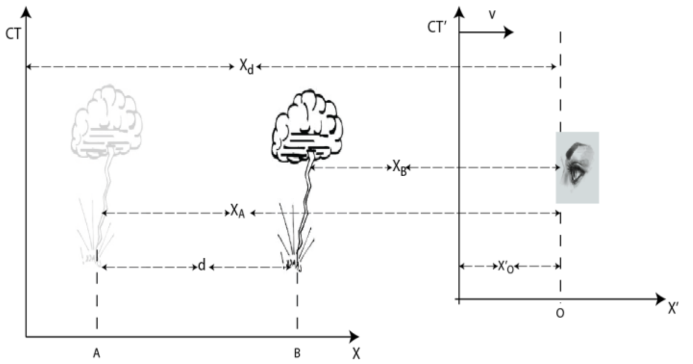

Fig. 9 Reference frame with events lightening flashes observed.

Let's assume that it takes light 10 seconds to reach you from some planet we will call X. Two seconds before light arrives from X, you decided to travel much faster than light to reach X in that two seconds; just when you reach X, the light would have reached your planet. No matter how fast you travel, once the event occurs there is nothing that can be done to prevent the event from happening. Take for instance that North Korea decides to fire a missile at the United States, and that you were in South Korea and observe such an event. Suppose the missile travels at Mach 2 and left 3 seconds before you are able to jump in your super flight ship that travels at Mach 100 to warn the United States of this event that has occurred. Observe you would not be able to change the event of the missile leaving North Korea, but you could change a future in which the United States would be bombed by North Korea. Similarly, in the ball throwing exercise, the ball being thrown would be the privileged-frame, hence the present. The frame then where the question is asked, "has the ball been caught?" is the present frame. As soon as the ball is thrown that event exists, although in the frame where the ball is caught the event of it being thrown does not exist anymore, because the event has passed. This is the essence of proposition 6 and 7.
The construction of preferred or privileged-frame has a contextual development in physics and is fundamental to the understanding of QM. However, QM turns out to be a theory of indeterminism about reality and poses problem for a number of great scientists such as Einstein who believed that the nature of reality is quite

deterministic. Attempts were made to come up with a theory that could explain the inner workings of QM. De Broglie's[42] was the first to propose a hidden-variable theory (HVT), which was not accepted because of John von Neumann's [43]proof suggests that "hidden-variable" were impossible. The story does not end here, David Bohm[44] independently rediscovered De Broglie's HVT and showed that Neumann's [43]proof was flawed. Thus, this theory is known as De Broglie - Bohm theorem (BBT) and provides the framework to understand the existence of preferred-frame in the universe. This theorem suggests that a wave, which evolves in time, influences the direction where the particle moves. This is a clear violation of the relativity of simultaneity since it proposes that there is a single observer's frame of reference for which the wave influences the particle. BBT tells us that there is a preferred-frame where an observer's clock measures the preferred motion of physical time. As example, it is well known that our position in the universe is unique in that it seems that the universe has arranged itself to pick out a preferred state of rest. The majority of galaxies are receding away from us in all directions. A similar state of rest comes to us from the CMB. Our vantage point sees the CMB at the same temperature from every direction. Thus Newton's notion of absolute space seems to make sense in the context of BBT, which we can say that the cosmos is organized in a way that selects a preferred state of rest.

Callender[45] speaking about foliation in the context of Bohmian mechanics and Ghirardi–Rimini–Weber [46] (GRW), infer that "assuming neither can be made modified and made fundamentally Lorentz invariant, then quantum phenomena plus a solution to the measurement problem demand a preferred-frame." Therefore, we propose two ideas for preferred-frame. The first comes from the Newtonian paradigm, which suggests that a preferred-frame is one that is at rest with everything else; this we can define as an absolute reference-frame. The other idea is one in which a preferred-frame is such that an observer's clock measurement of an event occurs in the same reference-frame. The first idea leads to the construction of simultaneously present and the second clarifies how we must treat events as they occur relative to one another. The next section will expound more on these points.

The quest to find a plausible explanation to the concept of time in terms frames of reference is ambiguous. Consequently, since the frame of reference with respect to an event can go either way (past or future). "There is no principled reason for privileging metaphysically any one frame of reference over another; there is no reason for claiming one gives a definitive answer as to when now is[47]." Bearing this in mind, there is not a definite basis for Presentism. Consequently, it is justified to argue that there is no such frame as an absolute frame when we do not have the whole story. Moreover, there are various theories of quantum gravity out there (such as ST, loop quantum gravity (LQG), dynamical triangulation (DT), quantum graphity approach (QGA)…) that suggest that in the emergence of space at its deep level the relativity of simultaneity cannot exist due to the high connectivity of space. Additionally, it is well-known that quantum theory violates locality (by locality we mean object that are in the neighborhood of each other that are directly influenced by their surroundings), which is essential to both SR and GR. Smolin[48] defended the idea of time being real by insisting that the relativity of simultaneity in special relativity is a consequence of locality. Einstein's GR theory did to Newtonian gravitation what Maxwell's equations of electrodynamics did to Coulomb's law, it reformulated it to obey locality. However, quantum mechanics largely rejects locality in favor of non-locality. SR and GR seem to argue against absolute simultaneity, but Newton had a different approach although he understood relativity of motion. Was his conclusion flawed simply because he had no notion of the constancy of light? We believe that he understood something that needed much better clarity. All motions and positions are in w.r.t to the space they are embedded in. Thus, this is Newton's privileged-frame from which one could argue for absolute spacetime.

GR triumphed in the 20th century, because it proposed an explanation between matter and geometry. Geometry tells matter how to move along geodesic, while matter shapes and evolves geometry. At quantum scale matter and geometry depend on the preferred-frame, but the question is, how does reality emerge to show this locality described by GR that brings about the theory of relativity of simultaneity? The quest to determine the simultaneity of two distant objects is impeded by taking into consideration the speed of light since we have to factor in the upper limit transmission signals. Simultaneous events can however be determined if the two events are in the same space using relativity. Moreover, in a quantum universe all events are considered to be simultaneous which allows for clock synchronization [48].

The question of preferred-frame still remains debated and a recent buzz about Hořava's[49]theory of gravity (HTG), which splits time from space,as it was unified by Einstein's GR theory. Einstein's theory of gravity is strongly associated with time and this is a major issue that we face. Einstein disagrees that time is absolute as outlined by Newton. The alternative presented by Einstein is that time is another dimension strongly tied to space. Hořava makes a case for both ideas. Hořava[49] suggested that at high energies similar to those represented in the earlier universe that time and space are not related. On the contrary, he suggested that at low energies Einstein's idea is supported [50]The fundamental description of HGT is deeply nonrelativistic where Lorentz invariance is emergent only at long distance, and at short distances the spacetime manifold is equipped with an extra structure, of a fixed codimension-one foliation by slices of constant time. This preferred foliation of spacetime defines a global causal structure [50]. As a result such structure puts some of the fundamental

puzzles of general relativity and quantum gravity into a new perspective. The various aspect of the “problem of time”, which we usually say is used in quantizing GR, are removed. Indeed the very characteristic of the preferred spacetime foliation warrants considering a non-changing concept of time that is only sensitive to time-dependent reparametrizations.
Therefore, HTG requires a preferred-frame within space-time foliation that is like that of Bohemian Mechanics; which reproduces exact quantum probabilities in its framework. HTG is also constructed in a preferred slicing of spacetime. Some have pointed out that a major challenge in the foundations of quantum mechanics is to devise a relativistic quantum theory without observers and to reconcile nonlocality with relativity[50,51]. Tumulka proposed GRW theory of spontaneous wave function collapse as the model that compatible with relativity, does not rely on a preferred slicing (foliation) of space-time that describes a possible many-particle world in which outcomes of experiments have the probabilities prescribed by quantum theory to some degree of accuracy. The reality here is that, sacrificing the preferred slicing leads to a less accurate probability theory, as such Tumulka[50] concludes that “with the presently available models we have the alternative: *Either the conventional understanding of relativity is not right, or quantum mechanics is not exact.*” For now we can say that QM gives rise to a Newtonian notion of absolute space-time; however for Smolin space is an illusion while time is real. This idea is a conjugation of what Sorli and Fiscaletti posit about time being an illusion while space is real. For Kant however, space-time is mind-dependent.

IX. Lorentz Transformation

Returning to the question of how to resolve the issue of what is real; we take a lesson from String Theory (ST). In the Block Universe model of time, it is proposed that events of the past, future, and present are real. The major failure with this concept is to suggest that all these tenses are real and accessible. There is however, “ no real evidence and explanation for the lack of visitors from a futuristic technologically advanced civilization”, said Hawkings. Block Universe also cannot explain what causes us to move through time toward the future and why we cannot willfully move back and forth through this time-space. As McTaggart [8]pointed out that we age as time proceeds forward, what effect should one expect when one move back in time? Perhaps a “Benjamin Button” reality awaits us. Another problem with the Block Universe model is that it allows for moving in time such that you can travel back in time to prevent an event from happening.This is absurd because that the event which is supposed to be the very cause that sends you back in time, would never have happened. Thus rendering time travel anillogical process.Therefore, no access to the future or past. Additionally, the Block Universe is very well correlated with determinism, thus imposing time travel, we arrives at contradiction.
However, let’s consider again a lightning flashes in figure9 that flashes simultaneously in one frame, that is a frame where the light reaches **A** and **B** at the same time, but in a frame that is moving toward **A** from the left. An observer in this frame would conclude that the light reaches **A** before it reaches **B**. Thus, this consequence of SR we have argued to be an illusion of relative frame.
To make this point clearer we turn to the early days of ST when there were five different flavors of strings.At least that is what we thought, but Witten[52] showed that the five different versions of ST to be the same theory, are simply related to one another by dualities. Similarly, a Lorentz transformation (LT) offers a solution that moves us between the various frames. We would say that the way simultaneity is perceived is based on our perspective and hence, is illusive.However, both frames are one and the same, through LT.
What is it that LT does for the discussion? In many ways the transformation allows the frame of the observer to be treated as the absolute preferred-frame. When confronted with different conclusions of reality, that is simply invoking the transformation to understand the perspectives of the other observers. Is there ground to suggest that there is a preferred-frame? We suggest that the privileged-frame is the one in which the event occurs and our LT construction can be used to provide an answer to the question about simultaneity. Moreover, we introduce the idea that there is such a frame that is fixed w.r.t. all events occurring simultaneously. For Newton this would be the space that all frames are embedded in. Manaresi and Selleri [52]propose a general class of transformations of space and time variable between inertial systems S_0 and Sthat gives general proof of absolute simultaneity. SR is obtained for a particular choice of a parameter, which means thatLorentz transformation is only a special case. Thus, such a transformation can export absolute simultaneity to any other inertial system. When this parameter is zero time is divorced from the spatial coordinate showing that time is a numerical order of clock velocity and not the coordinate of an extra dimension. Thus, we state the following proposition.

Proposition 8
If all observers agree that the space in which they are embedded is fixed relative to them, then absolute simultaneity or a privileged-frame exists.

All frames in this space will be observed simultaneously. However, an observer in a space-fixed inertial frame will have a different conclusion about the event than an observer in a moving frame. If the observers have agreed beforehand on what is fixed, an observer in a moving inertial frame can always transform his result to the frame fixed relative to space. As a very crude assumption, let's consider for the sake of argument that the Earth is a fixed inertial frame such that any immobile observer, relative to the earth, is in a fixed reference frame and all other frames simultaneously exist from the Earth's frame. Thus, we are taking the Earth as a close system in which all events are occurring. In one definition of simultaneity the Presentist simply propose that one observer sees **A** before **B**, and another would see **A** and **B** together; but all this is happening simultaneously in the earth's frame.

Proposition 9
Every inertial frame is a closed system in which all physical laws are independently applicable.

Proposition 10
Any inertial frame in which the event is occurring is the preferred-frame. Therefore all transformations must transform back to the frame in which the event occurred.

Moreover,SR'sconclusion that no two observers separated by distance can observe the simultaneity of events we agree to be true. That is if one says it is simultaneous the other will conclude it is not or might just disagree about when the event happened. Can this be resolved? The answer we seek will be derived from propositions8-10. Consider a frame where two light bulbs flash together. In this frame an observer concludes it happens simultaneously, but an observer that is separated by a certain distance will conclude differently. The event is real only when it is occurring in the preferred or privileged-frame and in all other frames this event is in the future as it happened in the first observer's frame. The observers' conclusion is an illusion due to their distance to the event. The event when observed in those frames no longer exists. In a similar way, suppose an event occurs such that the light bulbs flash one after the other in some inertial-frame.Then there exists a distant frame where these events occur simultaneously; the simultaneity in such context is illusory. A resolution comes only through LT back to the preferred-frame.
Newton's idea brings us a much better way to think of such phenomenon in that, if we assume that only time is relational and not distance, at least to the space that all frames are embedded in, then we can invoke a new transformation as was done by Sorli and Fiscaletti[36]. Then clocks in motion will behave differently than clocks that are fixed, which is the conclusion of SR and GR.

X. Conclusion

General relativity gives us the best representation of reality but presents us with a number of absurdities due its allowance of close time curves. Our experience dictates that the future is a projection created by our past experiences stored in our memory. This means that any theory constructed must represent this version of reality, and as such, we must deem any unproven deviation with illogical absurdities unphysical. The fact that the present which gives us the most real feel of time cannot be measured while the inaccessible past and future can be measured as durations strongly suggests that the way we perceive time is an illusion. In the Block Universe, past, present, and future exist together superimposed in different dimensions. This conception of time suggests that Newton, Einstein and every past event still exist in universes in other time dimensions; so there are multiple copies of us, and the whole universe.This view is reinforced by Einstein's General Relativity (GR) in which time extends as the fourth dimension from the past to the future. Such perception of reality suggests that my right to choose or free will is an illusion, in other words, at the conception of the universe all reality already existed. This, we believe, goes against any big bang model of an expanding universe. It just might be that the problem in this debate is that time is invoked as a dimension in our theories instead of a mind-dependent object built in to give a sense of the passing of events in space.
We have proposed in this essay that there is a misunderstanding of Special Relativity and General Relativity. Zimmerman[11] argues that a Presentist who accepted SR would have to suppose that the present slices the Minkowskian manifold in a certain way; and that it's past and future locations would constitute a foliation of the manifold. He further offers Presentists two ways of thinking about the metaphysics of this ostensibly four-dimensional entity, including one that manages to reject "past" (i.e., formerly occupied) and "future" (i.e., soon to be occupied) space-time points. We are arguing that time is only an illusory human notion of measurement for motion. Godel[53] says:

"The agreement described between certain consequences of modern physics and a doctrine that Kant set up 150 years ago in contradiction both to common sense and to the physicists and philosophers of his time, is greatly surprising, and it is hard to understand why so little attention is being paid to it in philosophical discussion of relativity theory" (p. 236)

Einstein on the other hand, remarks that, "people like us who believe in physics know that the distinction between the past, the present and the future is only a stubbornly persistent illusion." He meant that in relativistic models of physics there is no place for "the present" as an absolute element of reality. This simply cannot be a statement of truth because the events are happening in space at this very moment and thus, they are simultaneously present. However, when an observer does make a measurement, he does not embed himself into an absolute frame so his conclusion is relational. Thus different observers will have a different conclusion about events that are simultaneously present. To best understand absolute simultaneity we must consider the frame in which the events occur to be the *preferred frame*and always perform some transformation to bring us into that frame.

The Block Universe theory suggests that our future is predestined and that we do not have the power to change it in any way. How does the universe account for events that occur in one sense and not in the other? These absurdities present problems for SR and GR unless we are willing to invoke the Causality principles in the theories. From philosophy we can invoke the coincidences principle. This is referring to as a string of coincidences that prevent us from violating normal causality. What must be understood about time, and any model that has been exhausted with repetition, is that it is an approximation. Much of how philosopher appreciated the relationship between reality and epistemology as an approximation, the same must be done regarding time. The ontology and the paradox that is drawn with consciousness are innate to these resulting models. Rather than viewing time as an ontological complexity, it should be regarded more as an amalgamation such that we incorporate all parts as they exist in the present phenomena. This was well understood by Bohm'squantum potential term in the Schrodinger equation.

Here is a question we must consider posed by Crisp[54]: Does current physics give us good reasons to prefer the orthodox approach over the unorthodox, presentist-friendly approach? Considering the work of Julian Barbour and collaborators[55, 56, 57, 58]who argues that current physics gives us no reason to prefer orthodox General Relativity (GR) to this unorthodox variant. Zimmerman [11] suggests that SR is only an approximate theory to GR but there exists much difficulty in squaring GR with quantum mechanics. Therefore, the question one might ask is not whether presentism conflicts with SR, but rather whether it conflicts with GR. Barbour[55] proposed a solution by advocating for "the disappearance of time" in the context of GR and that the external inertial frames of reference are redundant. A Machian theory of motion can be constructed with three-dimensional relative configurationsof the universe, by interpreting dynamical histories as geodesics in the space of all possible relative configurations to achieve a timeless and frameless formulation of classical dynamics[58].Consequently, his position of a timeless and frameless formulation of space-time is similar to Kant's mind-dependent conception of space-time. Indeed,Kant proposes a picture of time about which Dorato [3] points out that philosophy suggests that this idea of the time is superseded by General Relativity (GR). Yet, Gödel[10] argued that the theory of relativity is a striking confirmation of Kant's claim that time is ideal. That is if time is not essential to the world and can be done away as a theoretical construct, then theories such as quantum theory of gravity assume that time emerges and is an entity that can be derived.

This essay does not attempt to deny the achievements of modern physics but proposes a framework we must use to interpret its results. Thus we philosophically married Einstein's relativity conception of space and time with Newton's notion of absolute space while rejecting absurdities offered by the theories, which goes against our causal experience. We therefore affirm that the Presentists' view of space-time provides the best description of our reality. Adopting ST as an emerging theory of quantum gravity, then Dyson's Chronology Protection Agency gives us insight that the closed time curves in general relativity is really artifacts of the theory and as such, we propose that they should be transformed out of the theory because they are unphysical. The story is not quite over until we have a complete theory of quantum gravity, and if it turns out that ST is the successful one, then the Presentists' view of reality wins out and maybe after all Kant's view of space-time is the theory that best describes human's perception of time and space.

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