# The Physical Reality of Time

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**Abstract –** A model of time is described which is based on presentist ideas. The main issue facing presentism is the apparent contradiction it brings when one is faced with considering the future and the past as being existent exclusively in the present. The model presented herein relates time to the constant change of energy in the universe. In particular, parallels are drawn between future, present and past, representing time, and potential energy, kinetic energy and entropy representing change. This model includes the future and the past as integral parts of the present.

# 1. Introduction

In different perspectives, everybody around the world talks about time. However, deep questions remain regarding the existence of time and its understanding at a fundamental level. Does time exist? If so, when does it exist? Why do we remember the past and not the future? This paper focuses on presenting a model of time which provides answers to these fundamental questions.

What is the present? I provisionally define the present as "when things happen", that is, when change, motion occurs. I propose that it is mistaken to think of time as flowing, but the universe, and all that it contains, is in a constant state of change, in the present. What we think of as 'time' is a measurement of this change.

St. Augustine (2008) addressed the issue in the following terms; "*What now is clear and plain is that neither future things nor past things exist. Nor is it properly said, "there are three times: past, present, and future". Yet it might possibly be properly said, "there are three times: a present of things past, a present of things present, and a present of things future." For these three do exist in some way in the mind, but I do not find them elsewhere. The present of things past is memory. The present of things present, sight. The present of things future, expectation.."*(p45).

McTaggart (1908) stated the following, "*Past, present and future are incompatible determinations. Every event must be one or the other, but no event can be more than one. If I say that any event is past, that implies that it is neither present nor future, and so with the others. And this exclusiveness is essential to change, and therefore to time. For the only change we can get is from future to present, and from present to past*. (McTaggart, p. 32)

Based on this McTaggart concluded that time cannot be considered real. The model of time outlined hereafter includes the future and the past as integral parts of the present, thus resolving McTaggart's paradox.

## 2. Hypothesis

Only the present exists and the present includes the future and the past.

The **future** is represented in the present by potential energy (PE)

The **past** is represented in the present by entropy

The kinetic activity in the present continuously transforms energy from higher potential energy to lower potential and from lower entropy to higher entropy.

Time is the measurement of the rate at which this transformation takes place.

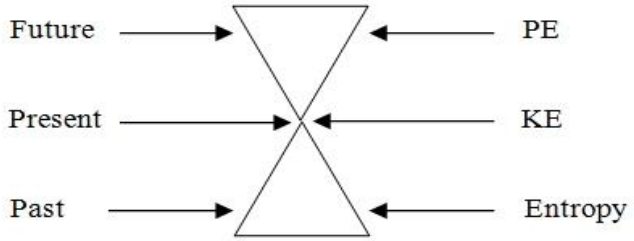


**Fig. 1** The future, present and past shown relative to energy transition

Every **action** proceeds: potential energy - > kinetic energy -> entropy. Every **system** consists of potential energy, kinetic energy and has entropy. Thus are the temporal actions in the universe related to the three dimensional physical objects it contains.

**Future** - Potential energy is the energy still available for use in the future

**Present** - Kinetic energy is energy currently being used

**Past** - Entropy represents the degree to which energy has been irrevocably used up

The past is thereby fixed by the 2nd law of thermodynamics and the future is a future of potential, explaining why we can remember the past but not the future.

### 2.1. Assumptions

a. The past hypothesis

b. A heat death for the universe

# 3. Supporting Arguments

## 3.1. Relationship between time and energy

Considering time as a measure of energy change it is possible to view the past, present and future as being co-existent in the present. I argue that time has a relative aspect (Einstein, 2009) in the same manner as energy within the Universe **is** relative. In particular, I propose that the A series of events, enunciated by McTaggart, that is, labelling events as being in one of three states, Future -> Present -> Past, is related to the physical action of energy which follows the same order; Potential Energy -> Kinetic Energy -> Entropy.

## 3.2. Each object has its own unique time rate

In the theory of special relativity, all motion is relative (Einstein, 2009). In that respect, physical time cannot be an exclusive property of the universe. Since the motion of the objects moving at a constant speed are relative, they define their own unique time. This time rate is subject to constant change or dilation, e.g. positioning oneself at the top floor of a building will result in a faster time rate than is experienced on the ground floor. Even the everyday action of walking reduces a person's time rate. Therefore, time is a property of each object, and, as all objects are fundamentally energy, it follows that time is a property of energy.

## 3.3. The changing state of the universe

The universe is constantly changing state, meaning that each fundamental particle must individually refresh its state. All systems consist internally of potential energy and kinetic energy with a dispersal described by entropy. Every action in the universe, including the life of the universe itself, follows this sequence, potential energy, kinetic energy and resulting in increased entropy. Therefore I define an action as energy changing from potential to kinetic and resulting in increased entropy. Each action is itself a super-action, in that it constitutes a number of sub-actions, providing of course, that it is not fundamental. Each action is also linked back, through its preceding actions, to the big bang. An action will continue until equilibrium is achieved or all available potential energy is exhausted. This is the duration of the action.

The result of an action, including all of its sub-actions, I refer to as an event. In this sense the fall of the Berlin Wall or a hurricane is an event. There are many actions required to result in each of these events, with the outcome of each sub-action being itself an event. Each event reflects a new state of the universe. Every object

in the universe is, in this view, an event; the earth in its current state is an event resulting from actions over a period of approximately 4.6 billion years of conventional time.

The overarching super-action is that of the universe itself, bounded by two events, the big bang, which heralded the start of time, and the end of time. At the time of the big bang, energy was entirely potential, entropy was 0 and time was all future. The big bang initiated kinetic activity, which releases potential energy. This results in increased entropy and will continue to do so until equilibrium for this super-action is reached. This means all matter will have dispersed to the empty space resulting in a heat death for the universe.

## 3.4. The arrow of time

The state of the universe can be uniquely defined at any point in time as a combination of its potential energy, its kinetic energy and its entropy. The present can be seen as the transition from the future to the past. It is a uni-directional transition, giving a clear physical arrow of time from future to past, i.e. potential energy to entropy.

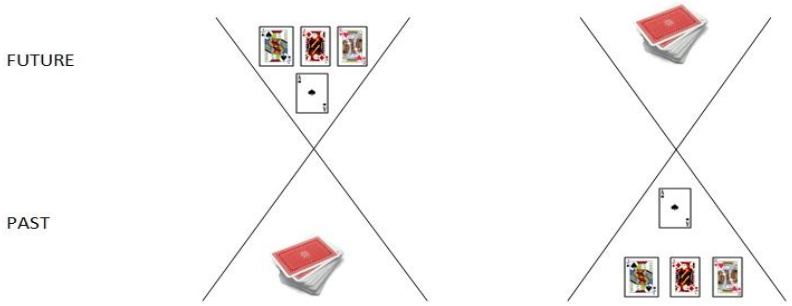


Fig. 2a – Past to Future

Fig. 2b – Future to Past

Fig 2 above demonstrates the arrow of time using a deck of playing cards. The deck of cards turned face down (unknown) represents PE, the future. The turning of a card is kinetic action and the resulting outlay of upturned cards (revealed) represents entropy, the past. It is easy to see from Fig. 2a that an arrow from past to future is not logical as the face up (known) cards are laid out in the future which, of course is unknown.. Fig. 2b shows that, with the potential energy in the future the revealed cards are spread out in the past. Thus, I assert that the arrow of time runs from future to past as McTaggart stated. It runs from PE to entropy. Furthermore I believe that this arrow is rooted in the fact that energy always moves outwards from its potential source. This can also be applied to other arrows such as radiation and the cosmological arrow of expansion.

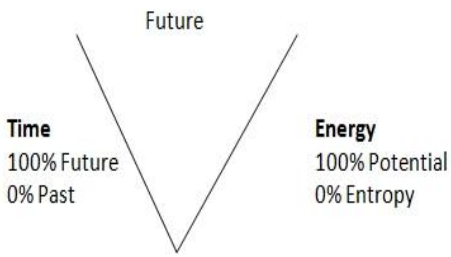


**Fig. 3a** Light cone at Big Bang

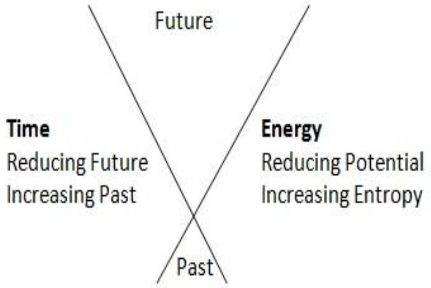


**Fig. 3b** Light cone shortly after Big Bang

Fig. 3a shows the moment of the big bang having zero past and zero entropy. Energy was 100% potential and time was 100% future. Fig. 3b shows the light cone shortly after the moment of the big bang, now including a growing past. This coincides with increasing entropy, a correspondingly reducing PE and a reducing future.

## 3.5. Time dilation

Each object within the universe can be described in the same manner as for the Universe itself, with one exception. When considering the universe as a whole we can view it as a closed system with all its energy being internal. In the case of objects contained within the universe, energy is divided between internal and external energy. External energy is concerned with forces on, or motion of, the body as a whole while internal energy reflects the motion of the atoms and molecules within the object. All objects will have a refresh rate. The refresh rate is determined by the ratio of potential energy, kinetic energy and entropy. This ratio fluctuates, affected by external forces acting on the object such as gravity and acceleration.

## 3.6. Measuring time rates

Time rate depends on the ratio of potential energy to kinetic energy in a system. If all energy in a system were potential there would be no kinetic activity and therefore no temperature (0 Kelvin) and no time. Reducing internal kinetic energy reduces the time rate. Kinetic energy is measured by temperature suggesting that temperature, and its relation to potential energy, is worthy of investigation as a measure of time rate.

Considering that each object is its own clock, imagine an object being represented as a computer controlled chess game where the pieces represent potential energy, the moves made by the computer, kinetic energy and the layout of the board, entropy. Different moves take different lengths of time depending on complexity,

representing time dilation. A clock can measure the total time taken to play the game and this divided by the number of moves will give the rate of play or time rate of kinetic activity for this game. However, if we were to know that the computer took 1 unit of time per option available, i.e 20 options for the opening move and increasing as the game progress, we could use this to calculate the time rate of the game and dispense with the clock. In this example time is measured relative to the planck unit.

However, temperature must be considered. Accepting that time is dilated by acceleration and gravity and that time stops for an object when it reaches the speed of light or is gravitationally compressed to the point where no movement takes place, we must also consider that when temperature is reduced to 0 Kelvin, internal motion also ceases, as does time. A fundamental particle, having no internal motion, will also experience no rate of time. Taking that acceleration affects time rate, it follows that increasing temperature, which results in accelerated internal motion, will likewise affect its time rate.

## 4. Conclusion and Discussion

The hypothesis presented herein is radical and raises many questions of its own. However, there is evidence before us everday to support it. The following are some examples;

- Putting food in a fridge, makes it last longer by cooling it.
- Heating a piece of wood to burning point and seeing its energy disperse rapidly, reducing its duration
- When one animal eats another, steals the potential energy and the future of his victim. Conversely, by consuming the potential energy of his victim he has extends his own future.
- Evidence that time is slowing[5] and the universe is getting colder [6]
- Medical evidence that keeping a wounded person cold increases survival chances[7]. It dilates time in the victims favour as his internal is slowed down by the cold. Cryonics is the freezing of a human body for the pupose of preservation with the intention of defeating time. Being colder must bring us closer to this state, agradual slowing of internal activity corresponding to a reducing time rate.

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