Building a model of the universe

Introduction

In this document, an outline is given to build a working model of the universe. In much of what follows has a high degree of logical speculation and conjecture of hypothesis to create such a model. The aim is not to displace or contest current modern theories of physics, but to explore an alternative method of thinking and test its validity so as to inspire a different path of investigation of the physical universe in an attempt to gain a better understanding and knowledge of its processes ans workings, or to dismiss such a hypothesis so as to demonstrate that a line of thought of explanation is ill conceived.

First steps

The first step to building a model of the universe is to define some axioms of rules that are required to form a basis upon which the model is to use to work. These axioms are defined based upon the current knowledge and understanding of the physical universe in conjunction with the tools of mathematics that is deployed as an argument of validation.

Some concepts of human perception of the physical world that cannot be explained by a theory of a lower level or by any simple physical experimental measurement. These are the crucial axioms of the model which are needed to be defined as a basis of construction. These axioms are such things as time, energy, space, and the most fundamental basic mathematical process that the universe can be modelled on.

From these axioms, a model is built from the ground up with the same current knowledge and understanding of the physical universe in mind. Advanced mathematical models can be utilised, but they must not loose the context or meaning of what physical behaviour or phenomena that it refers to.

Model Axioms

Space
Time
Energy
Mathematics

Physical Model

Electromagnetic field
Electric Charge
Mass
Matter
Interaction

Model Axioms

Space

The very concept of the physical space that the human experience lives in, and that defines the universe may not be as straight forward as it is perceived to exist. The concept of space can be defined by a mathematical model which can then abstract the actual physical space into a mathematical form. This abstraction is largely based upon the human experience of the world that is lived in.

But what is physical space actually, is a different question, and can the real physical space of the universe be represented by a mathematical model?

Is space a physical entity and does space have a structure? Is the space the human mind experiences an illusion of a higher order of existence of matter? etc

Without delving into the historical and philosophical questions and arguments of what is physical space, the basic premise that will be used as a first step in building up a model of the universe is that it must follow a given set of definitions and axioms for its properties regardless of whether or what any physical structure it may posses, or the origins of physical space.

One common classical definition of what physical space is

Definition DS1

Space is the stage upon, or in which interactions of physical entities take place.

This definition implies that space is separable and apart from the entities and phenomenon that exits and are observed. This implies that space is a physical entity in itself and thus has properties without the existence or need to exist of physical entities such as particles of matter or electromagnetic radiation, that is light. This definition implies space is like a sheet of paper where entities are placed on it and interact with each other, and perhaps the space itself.

From modern observations of the universe in a cosmological perspective, no observation or measurement has been currently made to determine the size, shape or geometry of the physical space that the universe exists within. However certain properties of physical space can be deduced from astronomy and cosmology observation and theory which can be defined as an axiom to model the fundamental physical space properties need to have

Axiom AS1

Space is a domain where all entities and phenomenon reside and exist in and such that the following properties hold in all situations.

> **i** : Be infinite in extent, but be finite such that there is no starting or end location.
> **ii** : Have no central origin or coordinate reference.

For Axiom AS1 to be valid, this would suggest utilising the geometry of a closed spherical surface as an analogy that physical 3D space that the human mind exists within is a closed geometrical equivalent to that of a 2D being existing on the surface of a 3D sphere. Utilising this analogy, an axiom for the structure and property of the physical space of the universe is that the 3D space of the universe is a surface on a higher dimension 4D space. Thus have axiom AS2 stated for the geometry of the universe is

Axiom AS2

The geometry of the 3D physical space that the observable universe exists as is that of a 3D physical space existing on the surface of a 4D geometry space of a closed spherical topological shape , analogous to that of a 2D surface existing on a 3D closed spherical topological shape.

Axiom AS2 states that the physical space of the universe is on a closed 4D surface, and by virtue of being of a topological spherical shape, does not restrict that closed surface to be a perfect sphere. By astronomical observation of the universe, and by the theory of general relativity, gravity can distort space. This distortion can be interpreted as by use of Axiom AS2 to be distortion of a 4D spherical surface The closed spherical shape of the 4D surface being distorted means that if can be stretched, compressed or warped into a different geometrical 4D shape so long as it is still topologically equivalent to a 4D sphere. This leads to **Axiom AS3**

Axiom AS3

The geometry of the 3D physical space that the observable universe exists within that is observed to be distorted such as in the form of compressed or expanded space is the result of a distortion or change in the geometry of the 4D topological spherical surface space upon which the 3D universe exists on.

Utilising **Axiom AS2** and **AS3**, another axiom AS4 can be stated.

Axiom AS3

> **i** : Physical space can be scalable to a minimum or maximum extent that can not be exceeded.
> **iI** : Physical space can have any "shape" that satisfies Axiom AS1 and **AS3:i**
> **iii** : Physical space has no fixed rigid structure that cannot be altered.

What **AS3:i** states is that a physical space has a limit to how compressible or expandable it can be distorted. That is, physical space cannot be confined to a volume smaller that a given compressible limit, or larger than a given expansion limit. Axioms AS1 to AS3 thus give the postulate that physical space is a substrate that has some kind of physical form and structure. What this physical form and structure is can be postulated from observation, experiment and theory of the current physics.

Experiment observation and measurement in physics give a sense of what may constitute a physical substrate of space. What are defined as electric, magnetic and gravitational fields give an indication and initial tuition of a kind of action at a distance effect of one entity of matter on another. These are actions of attraction and repulsion. These fields are defined to exist in 3D space and through theory are largely defined as being transmitted through space by some medium. With the discovery and theoretical basis that light is a photon or packet of electromagnetic waves, and that a vacuum is not empty, but is a kind of foam of electromagnetic excitations there is a basis that can be formed that space itself could be structured as being constructed of, is from, and is of an electromagnetic nature. Thus an axiom can be stated for the existence and structure of physical space.

Axiom AS4

Physical space of the universe has a substrate in a form such that an electromagnetic density of charge permeates from every location of its existence, and has as a minimum natural base state, a neutral charge of zero.

However, from observation and experiment, electromagnetism can be defined as consisting of existing in two opposite forms, being of designated as of a positive and negative charge. Thus physical space needs to be able to be defined as having these two states of charge existing within it. Given **Axiom AS3**, where space can be distorted, then so is the electromagnetic field that constitutes space. Or more accurately, it may be that the distortion of electromagnetic fields that in turn, is the source of the distortion of space. This then would lead to the assertion that mass, which is attributed to gravity, is an emergence of some electromagnetic interaction where the distortion of space that is electromagnetic in origin creates or has as an emergent property that is measured as mass.

The reasoning for this hypothesis and speculation is from the energy – mass equivalence relationship discovered by Albert Einstein of the equation $E = mc^2$. This distortion of space is what is measured as mass and can be stated by Axiom AS5.

Axiom AS5

Physical space of the universe that undergoes a distortion has as a basis that distortion influencing the density of the electromagnetic composition of space from which space is constructed of and from. This distortion of space creates an emergent property that is referenced to as gravity.

If Axiom AS4 and AS5 are accepted as being valid for the construction of a model of physical space, then Definition DS1 needs to be modified. If it is considered that all matter in the universe has its origin derived from an electromagnetic origin as all matter has an electric charge and mass, and that photons of light are a disturbance of the electromagnetic field, and hence space then Definition can be restated as

Axiom AS6

Physical space is the stage in which physical entities are constricted and part of, and that interactions of physical entities is the influence of the space that one physical entity is constructed from on the space that each and every other entity is constructed from.

What AS5 infers is that the physical interactions that are observed in the universe is an interaction of the physical space from which they are constructed from. Each entity can be said to modify the space that surrounds them (ie electromagnetic and gravitation) which interacts with all the other modifications of space that define matter, and is observed as motion of matter This motion of matter then changes the physical state of space that then defines a new set of interactions, which in turn define a new set of motion of matter.

That is, physical space is in a permanent state of self interaction if it is considered that the entire universe is one entity.

From this perspective, another axiom can be stated.

Axiom AS7

All of physical space that constructs the entire universe can be treated as a single entity that is in a state of constant self interaction, and that this self interaction can be broken down into smaller sub entities of pockets of self interacting sub spaces referred to as matter.

From these axioms, physical space is modelled to be a 3D surface on a volume of 4D topological spherical space. Physical space can be considered as a single self interaction entity of electromagnetic energy that also has subdivisions of interacting electromagnetic nature which define the matter of the universe, and deform or a result of the deformation of this 4D topological spherical space.

Axioms AS1 to AS7 give a basis foundation to defining a physical space from which a mathematical model that reflects physical space in a relevant and contextual manner can be constructed.

Time

Much of what follows in stating the axioms for time in a physical model of the universe have been discussed in the section About Time.

The concept of time can be said to be ingrained in the human consciousness and mind as a physical reality that permeates the universe as the human consciousness and mind has a sense of memory and an imagination. A memory to remember past events that have occurred, and an imagination to use the human consciousness to predict future events. Thus a concept of events that occur in the universe have a past present and future constructs a physical dimension that is time. For a series of events that occur in the universe, time can be said to be the order in which these events occur, and the duration or interval between events is determined by some clock that some observer has a means of measuring when one event event occurs, and another.

Physical experiments performed record the transformation of an entity from one physical state A, to another physical state B, and the interval between this physical transformation has a duration measured against the experimenters clock. This clock is in itself a series of physical transformations that is considered to be of a constant standard duration, and hence time. Thus a definition of time can be established which can also explain what time is.

Definition DT1:

Time is the change of physical state of an entity or system of entities from a physical state A to a physical state B.

Consider that any transformation of any physical entity or system of entities from one physical state A to another physical state B can occur, and that such a transformation has no subdivision of transformation   that can act as an intermediate step. Tjat is there is no physical state between A and B. Then this transformation can be stated and defined as being of a fundamental quantum transformation. This quantum transformation then also can be defined of as by using definition DT1 as having a quantum value of time associated with it.

Definition DT2:

If there is no intermediate physical state of an entity that exists between the change of physical state of an entity or system of entities from a physical state A to a physical state B, then that change of physical state, and hence time for that transformation of physical state is said to be quantised

Consider that by the definition of a quantised state of transformation, there exists in the universe, a physical transformation of an entity, known or unknown, that can change from one physical state A to a physical state B within a common frame of reference relative to all other   quantised state of transformations, and is considered to be of the lowest duration (ie the transformation occurs before all others) then this duration can be considered as the minimum permissible duration of time by definition DT1 and DT2 that can occur in the universe. From this deduction two axioms are proposed.

Axiom AT1:

There exists within the universe a minimum interval in which all entities can transform from a physical state A related to that entity to a new physical state B related to that entity.

Axiom AT2:

There exists within the universe a minimum interval of duration relative to all entities of transform from a physical state A related to that entity to a new physical state B related to that entity that can be considered as a fundamental time step of a clock by which all transformations of physical state cannot be less than.

These Axioms state that the universe has an iterative step by which entities transform from one physical state to another, and that there is in existence a min duration of the relative iterative step of one transformation for one entity against all others which can be used as a time clock for the universe. That is the universe has an inbuilt mechanism analogous to a tick of a clock that it cannot be less than. Or to put another way, time in the universe is quantised and cannot be lower than some value, and that the universe progresses form one state to the next iteratively according to this minimum time step.

The consequence of this iterative time step of transformation of entity or systems of entities physical states is that mathematical models involving time would need to take into account axiom AT1 and axiom AT2. If any model uses a mathematical expression involving integral calculus or differential equations, then the differential and integral will need their limits of differentiation and integration trending towards the minimum time step of axiom AT2, and not zero.

For example, the calculus differential in respect to time interval δt for velocity of an entity is defined as

$$\text{eg} \quad \text{velocity } \mathbf{v} = \lim_{\partial t \to 0} \frac{\partial \boldsymbol{p}}{\partial t}$$

would need to be modified to

$$\text{eg} \quad \text{velocity } \mathbf{v} = \lim_{\partial t \to \epsilon} \frac{\partial \boldsymbol{p}}{\partial t}$$

where ϵ is the minimum time interval that the process of changing the physical state of the entity velocity.

This would also mean that models of the physics of the quantum realm on the micro, molecular and atom scale may not be able to utilise traditional differential and integral calculus, but need to utilise a similar limit of time.

Adopting $\epsilon \neq 0$ may lead to more complicated mathematical equations, but would also be more accurate in describing the physical system. Using a time scale smaller than ϵ would result in errors if ∂t is of the same order of magnitude as ϵ. This is because the entity cannot have a transition of state occurring smaller than the time ϵ .This would be most notable on the quantum scale where measurements of ∂t is of the order of 10-12 seconds or less.

Local Time

In the universe that exists, the universe consists of what can be considered an infinite system of individual elementary entities, that has an infinite change in its state from one section of the universe to the other. The interactions between entities cause a change of physical states of those interacting entities in the universe, and hence the universe itself, including the processes in the human brain. The human brain has an ability to store memories of a past physical event and compare it to what is seen as current physical event or change of physical state of the surrounding universe. From this memory, a sense of continuity is perceived of the passage of time. This can lead to a perception is that time exists even when a change of state of the universe does not.

If a human brain and body has all the particles and sub-particles, energy exchanges etc remain in a single state down to the quantum level, then time does not pass for that human. The same can be said for any physical system including the universe. To perceive that time does pass when there is no change in physical state is incorrect for that entity or system of entities that undergoes no change in physical state. For an isolated entity or system of entities that undergoes no change of physical state, but exists within a larger system of entities surrounding that do have a change of physical state, then a perception of lost time can be argued to have occurred for that isolated entity or system of entities in human terms. Similar is the analogy of lost time when one sleeps. There is no perception of time is in the human brain while it is inactive. But when awaken, a passage of time has been perceived to have occurred.

In the physical world there is no such thing as lost time. For an isolated entity or system of entities, time progresses at a different rate when compared to entities or system of entities external to it.

That is, time or physical state progression of an entity or system of entities is a local, and not universal when considering an individual entity or system of entities within a lager universe. Taking the universe as a whole, the progression of time within it is lumpy and inconsistent from one region to another, right down to the quantum level.

That is, time is a local physical phenomenon for any entity or system of entities that has a change in the physical state from physical state **A1** to physical state **A2**.

Thus a new definition of time can be defined as given in definition T3.

Definition DT3:

Time only exits between the change of state of a physical entity or system of entities from one physical state to the next. Time is only measurable in a relative sense between two or more mutually exclusive entities or systems of entities such that the change in the physical state of one physical entity or system is compared to another.

What this definition T3 means is that by comparing the changes in physical states between two or more entities or systems, each entity or system can act as a "clock" to every other entity or system.

Thus Time can be suspended, or slowed, or sped up for one physical system of entities when compared to another. This can be a system of entities that is part of a larger system. (eg an atom within a molecule) or two separate entities as part of the same larger system. Any change of physical state is independent of any other entity and the larger system they exist in, but one has a change of physical state while the other does not. As a result the one that changes its physical state experiences a time progression, while the other that undergoes no change in physical state does not.

To reiterate in a different form. If one entity E1 takes a greater number of standard metric time intervals (**Definition T2**) to change its physical state when compared to another, second identical entity E2 undergoing the exact same change of physical state, then entity E1 can be considered to have time slowed down, and time is sped up for E2. An "observer" independent of the entities E1 and E2 and is able to "see" and has its own "clock" to measure a progression of time, the changes in physical states of E1 and E2 would measure that E2 has changed its physical state before E1, and thus, time passes more slowly for E1.

E2 will "see" that it has time running faster than E1 as it has completed the physical transition whereas E1 has not,. E1 will not "know" that it has a slower time than E2 as when it has completed its transition from state A to state B, it will see that E2 is in state B but has no information to say when E2 reached state B. Simultaneously or prior to itself reaching state B. Neither would E2 be able to tell how long it took to reach state B from state A.

Only an "observer" that has an internal "clock" that runs "faster" than the transitions of state A to state B of entity E2 would be able to gauge which physical transition of E1 or E2 had occurred first. This "clock" would itself be a series of transitions of physical states that can be compared to that of E1 and E2. The "observer" is at sate O1 when the beginning of the transition of E1 and E2 from physical state A to B begins. At the "observers" physical state O2, E2 has completed its transition, and at the "observer" physical state O3, E1 has completed its transition. Only by been given information from this observer would each of E1 and E2 "know" when according to the observers clock measuring the changes in physical states they completed their transitions. The observer physical states O2 and O3 may have had many more transitions (eg ticks of the clock) of physical states between these, and "knowing" how many of these transitions had occurred, a standard "clock" can be defined for that "observer".

If there are more of these "observers" also able to "see" and use their own clock to measure the changes in physical states of E1 and E2 from state A to sate B, then they may have a series of transitions of physical states that are different to observer O and observe these transitions of state that are inconsistent to observer O. Thus any standard "clock" to "measure" time must be the same exact physical transitions for all "observers", which ideally would occur with the smallest transition of state compared to all other transition of state of any physical entity.

Note that in the above discussion, "observer" actually refers to a hypothetical situation where an entity or system of entities detects the physical states of entities E1 and E2, or has a means of detecting a change in the physical states of entities E1 and E2 at each step or change in its own physical state. This detection has a zero clock time delay between when E1 and E2 completing the transition from state A to state B and the "observer", or that there is no difference in receiving a signal from E1 when it completes its transition to that of E2.

the word "see" refers to a signal being received from entity E1 and E2 that causes a detection or awareness of the state of E1 and E2 in every step or transition of its own physical states.

In Summary, local time is the change of physical state of an entity, or group of entities that is considered independent and a subset of a larger system, and that the duration of this change of physical state is also independent of any larger system.

Universal Time

If the universe were to be considered as a whole entity, and that the change in its physical state was just one atom transitioning from physical state A to another physical state B, then how can a measurement of time be made for this transition?

The simple answer based upon the argument for Local Time is that this is not possible. Time occurs, but can only be measured relative to some secondary physical entity that acts as a "clock".

Now consider the universe as a whole where no entity within it changes its physical state. As determined by definitions T1, T2 and T3, time does not occur. Imagine that there is some hypothetical "observer" that can travel throughout the universe using as an origin some location in this universe. This "observer" can detect and know every physical state, and in turn, location of every entity within this frozen universe and records all this information. This "observer" traces its path back to the origin where it began its trek.

A definition needs to be given for the next phase of this hypothetical thought experiment, and that is a universal time step.

Definition DT4: Universal Time Step

Within the universe as a whole, there is a minimum time interval that one, many or all physical entities can complete for a specific physical transition of state when compared to all other entities undergoing physical transitions. This minimum time interval for this physical transition compared to all others is called the universal time step or metric of universal time.

What this means is that the "observer" described in the paragraph above exists within this universal time step and can measure the progression of the universe in time against it. Also this "observer" does not interact with the universe in any way, which means the location that was chosen as a point of origin also does not change at any stage with respect to the universe as a whole at any point in time according to the "observers" time clock. To continue.

The universe advances one universal time step and the "observer" then repeats the procedure as stipulated above. ie The hypothetical "observer" travels throughout the universe from the specified origin previously defined. This "observer" detects every physical state and location of every entity within this frozen universe and records all this information. This "observer" traces its path back to the origin where it began its trek.

Now consider that this is repeated over and over again, giving a "history" of the universe in time and space. What is being described here is that the universe can be considered as a whole, a clock, of which the metric of the passage of time is definition T4. The universal time step.

That is, time can be considered as a quantum phenomenon if this concept of a universal time step exists.

Evidence that such a universal time step may exist is if the velocity of light is truly the maximum limit of the propagation of EM, gravitational and the strong and weak nuclear radiation or forces. Only by interacting with these forces does the physical state of an entity or system of entities change.

To find this universal time step, one clue may be the shortest EM wavelength (highest frequency) or the limit thereof. Propagating EM radiation can be considered as a change in physical state of the EM properties of space. The shortest wavelength may represent the shortest possible space in which a change in physical space can occur in, and in turn give the minimum, or indicate the order of magnitude of this universal time step.

If this universal time step does exist, would the universe actually run according to it as described above? If so, could it be determined if it does? This will not be answered here.

The description given above could be interpreted as the absolute time and space that Newton and others used to simplify the mathematical description of physical phenomenon rather than using a relative relationship of describing the universe. The merits or not of this will not be discussed, but the use of the description of the "observer" view above to illustrate a point, which is.

The universe must be considered that if frozen in time, a point of origin in time for the whole universe can be given and described. Consider this frozen universe as a snapshot or time slice of the "current" state of the universe. By observing the universe by progressing it forward one universal time step at a time, a new way of viewing, and perhaps a greater understanding of the universe and the laws that govern it may be known.

However in reality, any observer in the universe such as ourselves cannot know this current state of the universe at any such given instant in time. This is because every entity or group of entities (including the whole universe) within this universe will only experience time if it changes its physical state. A change in physical state only occurs by interaction of an entity with one of the forces governing the universe. These forces can be considered to propagate from entities that have some kind of charge, eg electric, mass. This propagation itself can be considered as a change of the state of space. This propagation of the change of space reaches and interacts with another charged entity, changing its physical state and causing time to progress for that entity, and the universe as a whole. Thus the rate of this propagation is finite and infinitesimal compared to the universe as a whole.

What all this means is that a present change in the state of any entity in the universe, including the universe itself is a sum of previous field propagation from entities that themselves may not even exist in the frozen snapshot of the universe described above.

Thus time can only be progressed by the propagation of a force or field originating from a charged entity. This propagation, by current theory has a maximum velocity given by the speed of light. This implies the speed of light governs the rate of change of physical states of entities and their measurement. Einstein and others have shown in their theories how the measurement of time, and how observers in one reference frame is effected by their physical states in that reference frame, and having an interacting force influence its physical state from a source in another reference frame. The guiding principle is that the measurement of the speed of light is constant in all reference frames. This implies by the above argument that the change in physical state of any entity is also constant in all reference frames. If not, the laws of physics would be observed to change as the interactions between entities would become stronger or weaker in one reference frame when compared to existing in another.

This does not mean that an observer in one reference frame observes the same phenomenon in a different reference frame as being the same. eg the frequency of light in reference frame A can be observed to be different in another reference frame B if transmitted from reference frame A to B.(the Doppler effect). The

theories of relativity give account of this. This is digressing and not in the scope of what is being discussed, so will go no further.

Consider that If only one entity, say an electron, of the entire universe were to change its physical state, and hence undergo a progression in time, would the entire universe advance as well. By the definition DT3 the universe as a whole would because this single electron is part of the universe, and being one part of the universe, which is a system of entities, only one entity needs to change its physical state for the progression of time for the whole to advance. But treated as a separate system of entities from this electron, this separated or sub universe would not progress in time relative to the electron that did.

What this means is that time is universal and local. Universal in that the whole progresses in time by needing only one entity to change its physical state for the whole to progress. Local in that any sub part of the whole progresses in time in a different step relative to any or all other sub parts of the whole.

Returning to the question. If this universal time step does exist, would the universe actually run according to it as described above?

If the reference frames in which physical phenomenon occur in can only be incremented by amounts such that they must obey some law involving this universal time step value, then perhaps.

The definition of what time is, is summarised by Definition T3

Time only exits between the change of state of a physical entity or system from one physical state to the next. Time is only measurable in a relative sense between two or more mutually exclusive entities or systems of entities such that the change in the physical state of one physical entity or system is compared to another.

One consideration that can be drawn from this discussion is that the progression of the universe, or any subset of it, can be considered as an iterative process, and that the universe is governed by the iteration of progressive steps from one state of the universe to the next in a feedback loop where a current physical state of the universe determines the processes that occur to progress to the physical state.

Energy

Much of what follows in stating the axioms for time in a physical model of the universe have been discussed in the section About Energy.

The concept of energy is based upon a definition given by physicists as the ability of an entity to do work.

What is work?

To answer this question, and subsequently, what is energy, one needs only to look at what happens in the physical world regarding all entities that requires these entities to do something other than do nothing. Entities require something to make them move, change their shape or form, or from one state of matter to another. Eg from a solid to a liquid to a gas.

This is what a physicist means by doing work.

A better definition of energy that can be better understood is to say that energy is

Definition DE1

Energy is the "substrate" that causes the change of the physical state of an entity from one physical state A to another physical state B.

In many of the observed physical processes that occur in the universe, it is the interaction of a property or characteristic that the entity has that is the root cause of the change of physical state of an entity. But for this interaction to occur, in all observed cases, both interacting entities need to both have this property or characteristic. Eg electromagnetic properties of one entity will only interact with another entity that possesses the same electromagnetic property. Thus the substrate of change of physical state are the electromagnetic properties, or field that each entity has, and thus the energy is in the net electromagnetic interaction of the respective entities.

Therefore the "substrate" of definition DE1 is not a physical property that makes up energy, but it is the interaction of one physical property of an entity A with that of another entity B that can be defined as the source of the energy.

Definition DE2

Energy is the interaction of physical properties of one entity, or a system of entities with another entity or system of entities that causes the change in the physical state of all entities involved from one physical state A to another physical state B.

Given that the interaction of entity properties, such as that for the case of electromagnetism, is the common given observed reason for the transition of an entity physical state from a state A to a state B, then a more general and simple definition of energy can be stated as

Definition DE3

Energy is what causes a change in an entity or system of entities to change form an initial physical state A to another physical state B.

If it is considered that there exists at a fundamental level for all physical processes of transformation from one physical state A to another physical sate B, no intermediary physical state exists, then the translation from A to B can be said to be quantised. Experimental evidence (such as the photo electric effect) and the theory of quantum physics gives a high degree of confidence for an argument that this is the case at the fundamental level of the physical processes of the universe. Thus have Axiom AE1

Axiom AE1

In all physical processes at the most fundamental and basic level, the energy that is required to perform the transformation of an entity from an initial physical state A to a physical state B is of a finite, discrete quantum value, and that there is no intermediate or fractional value or step of this process that can be defined or undertaken to perform this process of transformation.

Through interaction, energy is not only gained by one entity, but is lost by another, and thus the interaction of entities by Axiom AE1 is of a discrete quantum nature.

Energy and forces

When considering energy as defined by Definition DE3, it is defined commonly in physics that to change the physical state of an entity, such as the direction of motion or velocity, a force is exerted on the entity. Gravity, or an electric force for example. Thus energy can be considered as another expression or definition of a

force, and from Definition DE2, a force can be defined as the simple interaction of energy fields, where those energy fields on the most basic level are gravitational, electromagnetic or nuclear.

Mathematics

Much of what follows in stating the axioms for time in a physical model of the universe have been discussed in the section Reality of mathematics.

In all of human history regarding the development of mathematics, certain mathematical doctrines have been applied that may not be applicable in the real physical world. One of these is that there is an infinite divisibility of certain aspects of the natural universe such that a limit of trending a numbers towards zero forms the basis of much of calculus that much of modern mathematics is based upon.

With the advent of modern physics and physical theory of even the ancients that the universe is made of small constituents of matter such as atoms and nuclei that has formed theories of quantum and nuclear physics, this should have brought forth a view that like with the quantum realm, there exist in the mathematics of the universe, a limit to how small a number one can use to model it.

Thus axiom MA1 is defined in creating a model of the universe.

Axiom AM1;

There exists a non zero limit on how small a number that can be used in any mathematical model of any physical process, or for any physical state.

This smallest number representing a physical quantity, such as the distance between two nucleons, may be different for each physical quantity, and it may be possible that the universe has a set of relationships between them such that one influences the other.

Axiom AM1 gives the property that at the most basic level, the universe is quantised and has a form of digitisation, where not being able to be any smaller in extent or quantity, all values of that physical quantity is possibly an integer addition or multiple of this smallest quantity. What this means is that certain mathematical irrational or infinite decimal numbers that mathematics has defined like π, or $\sqrt{2}$ may not exist, or have a limit applied to their accuracy of resolution. Eg, π can have a higher degree of decimal accuracy as one zooms out from the microscopic to the macro world.

That is, the mathematics of the real world modelled at the smallest scales are discrete and discontinuous. This means that any mathematics that require a continuous and non discrete infinite divisible number system become less applicable as the scale of the physical universe that is modelled becomes smaller, and at some level generates errors large enough that it cannot be used.
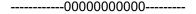
Thus it may be that the mathematics that has at its core, that the number system it uses is infinitely divisible and is essential to be continuous, such as the Euclidian, and hence some integral calculus mathematics, becomes less relevant and applicable on the microscopic scale and cannot be used at that scale. Therefore a set of mathematical tools and rules need to be defined and set to model the universe of the micro. These mathematical tools could be such as discrete calculus and discrete geometry.

Thus axiom AM2 defines the mathematical approach and tools that are to be used in creating a mathematical model of the universe, reflecting that all physical processes by **Axiom AE1** that is applicable for all physical processes that require an interaction of an entity property which in turn is defined as a transfer of energy from on entity to another.

Axiom AM2;

On the most fundamental level of the universe the physical processes that occur are discrete and quantum where no further subdivision of the physical process can be present or performed. Thus any mathematical model or description of the process that is being derived must be of a discrete mathematical nature to reflect and be accurate and relevant to what is being studied.

To repeat, traditional mathematical tools that require a continuous number system beyond a certain level of the micro scale cannot be used.

------------00000000000---------

Consider the simple abstract mathematical relationship or equation represented using the alphabetic symbols in **M01** below that is taught in basic mathematics gives a value represented by C as being the mathematical addition of two values represented by A and B.

$$C = A + B \qquad\qquad \textbf{M01}$$

This abstraction of numbers forms the most basic foundation of all mathematics, but it is meaningless unless a context of what A, B and C are is given. C could represent the total population of a country, while A and B the number of Males and Females.

So mathematics in its pure form without a representation in the real world can loose its meaning or relevance. This is the danger of using mathematics as a tool to reflect the real world. If no check is put into place as to what the symbols represents, then what a mathematical result or relationship may be interpreted to represent may be totally incorrect and even lost.

M01.0 : Mathematical Context

In order for mathematics to have meaning in the real physical world, it must have a context associated with the mathematics being used to make sense and be plausible in its use. Take the most basic mathematical statement of

1+1 = 2. What does this mean in the real world? Replace the numbers with an object, say an apple, and the meaning can become obvious. One apple and one apple becomes two apples. But what about if one has one apple and one orange? One could now say that 1+1 $\neq$ 2 because apples and oranges are not of the same type, thus the mathematical equation **M01** becomes invalid as A and B are not of the same type or same contextual content. However, if an apple and an orange are classified in context as fruit, then one apple and one orange are two types of fruit, and **M01** becomes valid if A, B and C represents fruit as a category, and the mathematical operation of addition is not dependent upon the individual types of fruit that A,B and C represents.

Thus mathematical statements need a context so as to have meaning, relevance and be truthful in interpreting the results that a mathematical statement or equation gives. A more accurate meaning of a mathematical statement such as 1+1=2 could be $^a1+^a1 = {}^a2$ or $^a2=\sum_{i=0}^{i=2} {}^a1$ where the superscript a before the number gives an abstract symbol for a physical or real world context of the type of object that the number represents. Thus the mathematical statement $^a1+^b1 \neq {}^a2$, $^a2 \neq \sum_{i=0}^{i=1} {}^a1 + \sum_{i=0}^{i=1} {}^b1$, $^a1+^b1 \neq {}^b2$, $^b2 \neq \sum_{i=0}^{i=1} {}^a1 + \sum_{i=0}^{i=1} {}^b1$ can be written and stated in context.

Of course, if the mathematics represents objects all of the same type or context, this can be negated and the method of writing mathematical equations not be altered. Thus a more abstract statement of this concept could be that the addition of two or more numbers has the relationship

$$^aC = \sum_{i=0}^{i=n} {}^ac_i \qquad\qquad \textbf{EM01.0.1}$$

Where C is the total sum of n numbers, c_i is any number of the same object or number type a. If c_i is not of all of the same object or number type, then **EM01.0.1** becomes invalid. If there is no limit to what value n can take, then C in **EM01.0.1** can take on any value.

M01.1: Context of Mathematical Operations.

The most basic, and probably first use of mathematics by the human mind is to add and subtract objects that eventually became abstract symbols to represent numbers, and then from this, a number system itself was developed. Other concepts such as multiplication developed as a shorthand method of addition was developed and applied, which then invoked the concept of division to group large groups of objects into smaller number objects. More than likely, all this developed as a part of a society that needed some basic maths for the purposes of trade commerce, and the administration and organisation of societies. Maths had real world context and application.

Addition, subtraction, multiplication and division are mathematical operations on numbers. Multiplication can be thought of as an addition of groups of numbers, and division can be thought as the opposite of multiplication and is a form of subtraction of groups of numbers from a larger number to obtain a number of groups of numbers.

With the argument in section **M01.0**, such mathematical operations must also be performed with a context of what the numbers represent to have meaning and relevance.

M01.1.1: Subtraction

The basic mathematical statement of subtraction of two numbers is represented by

$$C = A - B \qquad\qquad \textbf{EM01.1.1.0}$$

cannot be performed if A and B are not of the same type of contextual object. One cannot subtract two apples from any number of oranges for example as apples and oranges are different types of incompatible objects. However, if apples and oranges are classified as fruit and are thus equivalent, then **EM01.1.1.0** can

be performed only if A,B and C are abstract representations of fruit, not caring what kind of fruit A,B or C represent.

For a subtraction to occur in the real physical world, physical objects need to exit and be present. Thus the value of A in **EM01.1.1.0** must be a number that in the mathematical domain is positive, and so must also be the case with B. By taking B away from A, C is derived. If A is greater than B, then C has some objects remaining over. However, if B is of a greater number than A, then zero objects remain. Therefore, in a real world physical sense of objects, subtraction has a lowest limit values of zero. In other words, in the physical real world of objects, negative objects do not exist. One cannot have negative apples on a tree if one wants to pick more apples than exist on a tree. In this context of real world objects, negative numbers do not exist and have no relevance.

In the same rational as used in section **M01.0** to create **EM01.0.1** obtain a concept for subtraction

$$^aC = {}^aA - {}^aB \qquad\qquad \textbf{EM01.1.1.1}$$

where A, B, C ≥ 0 and are all of the same objects of type a.

M01.1.2: Multiplication

The basic mathematical statement of multiplication of two numbers is commonly represented by

$$C = A \times B \qquad\qquad \textbf{EM01.1.2.0}$$

Multiplication in essence is a summation of the number A, performed B times. That is if A = 3 and B = 2, then **EM01.1.2.0** is equivalent to C = A+A = 3+3 = 6. Conversely, can have C = B + B + B = 2 + 2 + 2 = 6. Thus multiplication can be regarded as equivalent to the expression for a summation of n numbers given by **EM01.0.1**. Using the same arguments that the numbers represented by A and B must be of the same contextual type as for the addition of two numbers in section **M01.0** to create **EM01.0.1**, an expression of the multiplication of two numbers can be expressed as

$$^aC = {}^aA \times {}^aB = \sum_0^B {}^aA \qquad\qquad \textbf{EM01.1.2.1}$$

Where C is the total sum of objects of type a, A is the number of objects of type a, and B, also a number of object type a is the number of times A has the addition operator applied to form a total. Conversely as demonstrated above and proven in many mathematical derivations.

$$^aC = {}^aB \times {}^aA = \sum_0^A {}^aB \qquad\qquad \textbf{EM01.1.2.2}$$

=> $\qquad\qquad\qquad ^aC = {}^aA \times {}^aB = {}^aB \times {}^aA \qquad\qquad \textbf{EM01.1.2.3}$

=> the order in which two numbers representing the same object type gives the same resultant total and is said to be commutative. A basis of definition of multiplication in mathematics.

M01.1.3: Division

The basic mathematical statement of division of two numbers is commonly represented by

$$B = C / A \qquad\qquad \textbf{EM01.1.3.0}$$

Division in essence is the opposite of multiplication, and the number represented by B is how many groups of objects of number A are present within the number C. For example, if have C = 12 and A = 4, then the result B would be 3. Thus representing the division being the opposite of multiplication can be represented by

EM01.1.3.1

Using the same arguments that the numbers represented by A and B must be of the same contextual type as for the addition of two numbers in section **M01.0** to create **EM01.0.1**, an expression of the division of two numbers can be expressed as

$$^aB = \frac{{}^aC}{{}^aA} = \left({}^aB \times {}^aA\right)^{inv} \qquad\qquad \textbf{EM01.1.3.2}$$

Where C is the total sum of objects of type a, A is the number of objects of type a to find that is in C that gives the result represented by B. Thus if swapping both A for B in the division side of the expression to give the number of times B can occur in C, the same swap needs to be done in the multiplication side. In other words in the case of division, to conform to the definition of multiplication as given in **EM01.1.2.1** and **EM01.1.2.2**. Thus division of two numbers that can be multiplied together can b said to be strictly not commutative.

M01.1.4 : Mathematical Context of Generating a Number Representing of a New Contextual Nature.

In many cases in mathematics, numbers of different object contextual types have operations performed on them that generate a number that has a different or no contextual meaning to that of the individual numbers on their own. An example can be that of graphical Cartesian coordinates, where two designated coordinate types x and y on a flat two dimensional plane that represent a length or distance in different directions are multiplied together. The resultant number of this multiplication is interpreted and designated in the context of an area. This is different from the multiplication of a coordinate, say x with a number representing the same coordinate type as a length that gives a resultant number representing an increase in x or the length of the coordinate. An area can be interpreted as having a totally different meaning and context to a length or distance, even if it is defined using the same units as the length, eg meters squared.

Continuing with the example of area, mathematical operations of numbers representing different units or of contextual objects are often performed to give a result that is then interpreted as a new quantity of a new type of object, concept, or simply to create an equation of relationship between two or more properties of an object or objects to gain an understanding of how certain properties interact or are related to each other. This may be logical or even desired, but the danger is that in doing so, a fundamental understanding of the physical process or processes of the interaction and relationship between objects, their properties, and other factors may get lost or be misinterpreted.

In some instances, it makes no sense, or has not ability (ie is invalid) to perform a mathematical operation on two numbers of different object types. Eq if one number A, represents a number of apples, and B represents a number of oranges, the equation C = A x B makes no sense and is invalid as apples and oranges are not alike in any manner, do not share any of the same properties, and cannot be merged together. Thus the concept of multiplying apples with oranges being invalid can be translated into mathematical tools used to model the real physical world that only operations on numbers that represent objects or properties that have the same or compatible physical context of form can be valid to use.

With this in mind, a way of thinking of understanding the universe by using mathematical models needs to have a consideration that the model needs to include a context that the mathematical operations performed within the model needs to have a consistency of like with like objects or properties to produce a new physical concept of contextual meaning. The example of area is that of an enclosed space in which physics can happen and be measured, and even equations of relationships derived to that area, even if area in reality has no fundamental physical process attached to it, only the physical processes at locations within that area.

Take the simple physical equation of

$$PV = nRT \hspace{4cm} \textbf{EM01.1.4.1}$$

giving the relationship of properties for an ideal gas, where P is the measured pressure of a gas within a volume V, and T the measured temperature. R is a constant of proportionality and n the number of molecules of gas. Pressure is a defined quantity of force per unit area on a surface. This force is dependent upon the kinetic energy of the gas molecules impacting upon a surface area and how many molecules are impacting upon a surface at the instant of measurement. This kinetic energy is determined by how fast the molecules of gas are travelling, and since the energy of any gas is defined by a measurement of its temperature one should expect a relationship between pressure and temperature. The number of gas molecules impacting upon a surface at any instance can be increased without increasing the total number of gas molecules by increasing the frequency of gas molecules hitting a closed surface within volume and rebounding in a continuous motion from one portion of the closed surface to the other. This frequency of impacting can be determined to be a function of volume as decreasing the volume increases the frequency of impact and hence pressure.

But **EM01.1.4.1** does not take into account that the gas molecules are interacting with each other that can and do give results such that this equation fails when certain temperatures, volumes or pressures arise as the interactions between gas molecules create conditions that do not honour the basis upon which this equation is observed or derived.

EM01.1.4.1 is an equation derived from observation that holds in certain physical conditions for certain types of gas, but if a mathematical equation is derived from a pure mathematical derivation and based upon certain axioms and or assumptions, then such equations can end up being incorrect or even meaningless without limits and conditions applied. One may say that even if limits and conditions are applied, mathematical equations may be so abstract that the origin and relevance of an equation is lost, and that what is the result has no function in the real world of a physical universe. This can be the case even if mathematical predictions give accurate results. These results may only be accurate for a limited set of physical circumstances, and the mathematics in deriving those results may be so abstract that the real physical processes that are being modelled are lost and misinterpreted, and thus so is a real understanding of the physics involved.

This may be the case in attempts to unify the standard model of the quantum world with general relativity for gravitation. The mathematics of each satisfy the observation each theory with prediction, but there is within the mathematical equations, a loss of meaning of one or more real world physical processes that will give a greater understanding of the processes of the universe.

M01.1.5 : Mathematical Context of Non Natural numbers.

In the evolution of mathematics, and used widely in modern times, the mathematical concept and construct of negative and imaginary numbers and number systems has arisen.

M01.1.5.1 : negative numbers and number system

Negative numbers has three meanings of context in mathematics as related to a physical object and physical systems.

i. To represent a coordinate on a coordinate axis that is below some coordinate of origin which has a value of zero for that coordinate.

ii. To represent a mirror or opposite property of an object or object type. Eg electric charge of an electron and proton, or anti particle to a particle.

iii. To represent a quantity of direction of a coordinate or property within a coordinate system that is opposite to a defined positive direction.

In accounting and other applications of negative numbers, negative numbers represent a deficit or debit of a resource or money that is owed and needs to be payed back. In the real world of physical objects, negative numbers, it can be argued not to exist as one cannot have negative quantities of an object or properties as negative numbers represent a real physical object or property of an object, not an accounting deficit of a non existent object or property that needs to be payed back.

Thus when used in mathematical models of a physical system, negative numbers need to be treated differently to that of a pure mathematical operation with different and even new mathematical rules and operations that may be valid from a pure mathematical perspective, but are invalid from the perspective of a real world physical system. One such rule has already been explained and demonstrated in section **M01.1.1** for subtraction. No negative number of apples can be extracted from an apple tree.

In respect of context of negative numbers being used in models of a coordinate system, those negative numbers can become zero or positive by simply moving or translating the location of the origin of that coordinate system. Some coordinate systems such as polar or spherical do not have negative values for a measurement of radial distance, but can have a negative value of orientation angle that indicate a direction of rotation of an angel in those coordinate systems. However, a negative angular coordinate in this system is equal to a positive angular coordinate which then creates a dilemma of which is the correct number to use. Eg $+\pi$ radians = $-\pi$ radians in a polar or spherical coordinate system. Same applies to $+3\pi/4$ radians = $-\pi/4$ radians. Which one should one use? Perhaps it does not matter if one has knowledge and understanding of the concept and context of what a negative coordinate number represents and means. A positive radial coordinate is equivalent to a negative coordinate $+2\pi$ radians.

And thus when dealing with negative numbers representing physical objects, properties and coordinate systems, a contextual argument needs to be applied that is separate and even counter to the pure mathematical treatment of negative numbers. For example, when modelling an electric charge, if one has a number of A negative electric charge in a system, one cannot just simply multiply that charge by another negative number B since this has no physical meaning if one follows the conventional mathematical statement that a negative number multiplied by a negative number gives a positive number. A physical system will not become positive if the operation of two negative numbers representing electric charge are multiplied together where multiplication is a shorthand method of addition as stipulated in section **M01.1.2** above. The same can be said of two negative numbers representing the direction of vector component in two vectors. Does a mathematical operation applied to two vectors of a particular coordinate component really result in a physical property of that component becoming positive in its direction?

A common place where two negative numbers multiplied together or squared to give a positive value works in the accepted mathematical convention is when calculating areas or lengths. But these are values that are intrinsically always positive as they are pure scalar quantities of magnitude that have no meaning if negative by virtue of the context of what they represent. In calculating a volume in a coordinate system that has negative components to numbers representing length, negative numbers involved can give a negative result for a volume, something that is physically difficult to be contemplated as possible. It could be argued that in evaluating any quantity of scalar magnitude for the real physical world, all negative numbers need to be made positive when performing certain operations to attain results for a defined property. This can be performed by a simple translation in terms of coordinates or change of coordinate system such as what length and area are defined to be part of. In other words, if a negative number that is part of a coordinate

system that can be made positive by a translation of coordinates, then performing that translation perhaps should be performed, or a set of rules applied to transform negative numbers into positive numbers before any mathematical operations are applied.

Perhaps a new thinking needs to be incorporated into modelling the physical world through use of the mathematical tool that is so central in trying to create an understanding of how physical systems are constructed and work. The mathematics of the physical world is not fully reflected by the purity of the mathematical world that has developed in with some rules, axioms and postulates that do not exist, or should not be applied in the natural physical world.

M01.1.5.2 : imaginary and complex numbers and number system

An imaginary number, **i**, in mathematics is defined as the square root of negative one. ie **i** = $\sqrt{-1}$. In conventional mathematical theory, the square root of negative numbers is undefined and considered not to exist. But mathematics can create number types and the rules that govern those number types as one wants or wishes hard enough for certain problem solving situations. Such as it is for imaginary numbers that when combined with real numbers creates a new category of number called complex numbers.

However, despite the mathematical convention that the square root of negative numbers is undefined and cannot exist, perhaps in the real physical world the square root of negative numbers is defined and do exist as $\sqrt{-1}$ = -1. But the use of complex or negative numbers yields that the square of a negative number -A is

$$\sqrt{-A} \ = \ \sqrt{A}\sqrt{-1} \ = \ \sqrt{A} \ \textbf{i} \qquad\qquad \textbf{EM01.1.5.2.0}$$

which can lead to the conclusion that

$$\left(\sqrt{-A}\right)^2 \ = \ \left(\sqrt{A}\sqrt{-1}\right)^2 \ = \ \sqrt{A}^2 \ \textbf{i}^2 = A(-1) = \text{-A}$$

EM01.1.5.2.1

Such a mathematical rule for imaginary numbers can lead to a new rule that negative numbers multiplied by negative numbers is a negative number, and that the square root of a negative number is a negative number. But this is as mentioned in the previous sections, and especially that for negative numbers in section **M01.1.5.1**, is only valid in the context of which such a mathematical operation is being performed.

M01.1.5.3 : Summary

In pure mathematics, various mathematical axioms, postulates, theorems and systems of numbers have been developed with governing rules that have had much success in being applied in accounting, finance, engineering, science and technology. However, as may be hinted and demonstrated with the need for imaginary and complex number systems to compensate for certain situations of solving certain mathematical conundrums involving negative numbers , the current thinking of mathematics may need a modification. That modification is that in the real physical world, conventional mathematical rules do not apply, or in fact are contrary to conventional mathematical thinking as the context in which those rules are applied are not valid for the real world physical system that is at hand.

What is argued here is that in the same context that numbers representing apples and oranges are not able to be merged or mixed together, the same can be said for real world physical systems. When creating mathematical models of real world physical systems, what needs to be taken into account is the context of what the mathematics represent, and thus what mathematical rules and processes can be applied.

And thus is demonstrated by use of imaginary and complex numbers. They are used to compensate the mathematical dogma that square root of negative one is invalid. However, it may be that in the real world, the square root of negative one is valid and is equal to negative one, and all negative numbers have a valid square root value. The only question is, what does that negative number represent. And that negative number represents something that is, again, in the context of physical system that the mathematical model is being used to represent.

Physical Model

Electromagnetic Gravitational Field and Physical Space

In all of physics, the vast majority of interactions of matter, and the construction of physical objects Is due to two forms of interaction, electromagnetic and gravitation. These both have a long range, and both have a charge property of matter that defines the magnitude of interaction between entities of matter. The physical properties of charge are defined as electric charge for electromagnetic interaction, and mass for gravitation interaction.

Though these forms of interactions seem to be different in that all charges of mass have an interaction of an attractive nature, but electric interaction can be both of an attraction and repulsion, they both share a common physical property. By theory and observation, they both exists in, and are influenced and interact with what is defined as the space of the universe.

Einstein's theory of general relativity that gives a geometrical model of gravity in a nutshell states that the mass of an entity generates a gravitational field around it that bends or warps space, and that the interaction of two or more entities creates a net warping of space such that the masses then have a motion determined by this net warping of space. As famously stated, mass tells how space is to bend, and space tells how mass is to move. A feedback system of interaction.

But not only is mass influenced by this bending of space, but so are electromagnetic fields, and in particular the electromagnetic field of a massless photon of light. As predicted and observed, the warping of space can generate gravitational lenses that focus photons of light of objects behind stars and galaxies.

This would suggest a relationship between gravity and electromagnetism in such a manner that they both interact with each other in the form of the space that is conceived and observed by the human mind.

Given that by theory, and observed by telescope and experiment, gravity can be considered as an expression of interaction that makes up the observed space of the universe.

Likewise, given that electromagnetism interacts with space in that through photons of light, it follows a path of motion according to the bending or warping of space, it can also be considered as an expression of interaction that makes up the observed space of the universe.

With this speculation, then it can be proposed that gravitation and electromagnetism have a form of interaction with each other, and have a common form of source of this interaction that then defines and constructs what is observed and defined as the space of the universe in which all entities and physical processes exist.

That is, the space that defines the physical universe and all the entities and physical processes that exist within it emerges from the source of the electromagnetic and gravitational fields that are observed to exist within it and interact with this space. If the electromagnetic and/or gravitational fields are themselves the source of, and constitute the make up what is considered as the space that the universe exists within, then space is of some form of electromagnetic and/or gravitational field.

Consider that space is of an electromagnetic nature and is a form of an electromagnetic field. Consider that a disturbance or deformation of that electromagnetic field occurs analogous to a wave in a pond of water, and that disturbance is transmitted through that space as a photon of light. Photons of light are generated by accelerating or decelerating electric charges, which in itself creates a change of electric field in space, which can be interpreted as a disturbance of an otherwise neutral default zero state of a universal electromagnetic field that exists throughout space. It can be speculated that this suggests that space itself is an electric field.

Consider that space is of a gravitational nature, and is a form of a gravitational field. Consider that a disturbance or deformation of that gravitational field occurs analogous to a sound pressure wave in a medium of some kind, and that disturbance is transmitted through that space as a change in the density or pressure of that medium. Gravitational waves are generated by the motion of a mass changing its location relative to where the gravitational effect is being observed, which can be interpreted as a disturbance of an otherwise neutral default zero state of a universal gravitational field that exists throughout space. It can be speculated that this suggests that space itself is a gravitational field.

With these speculations, space itself is proposed to be both electromagnetic and gravitational in its construction and nature of interaction. This than would suggest that electromagnetism and gravitation are are a manifestation of each other, either by being originated from a single source, or one being an emergent property by means of some interaction or process of the other.

By observation and experiment, it is recorded that a photon of light of sufficient observed and interpreted wavelength, (ie energy) incident and interacting with the nucleus of an atom can produce an electron -

positron pair. Ie electromagnetic energy is transformed into mass and hence a gravitational field. This suggests that the interaction of the electromagnetic field of a photon interacts with the electromagnetic field of a nucleus of an atom in such a process so as to create separate electric fields of opposite and mirrored properties of a quantity defined as charge, and have equal properties of gravitation having a quantity defined as mass.

This gravitational property of mass is agreed by physicists not be a property of the photon, and hence has no gravitational field associated with it. If it is that a photon of light is considered as a disturbance of an electromagnetic field, and acts analogous, but perhaps very different to a wave propagating in a medium, then the electromagnetic field of a photon interacting with the electromagnetic field of a nucleus of an atom by some process of electromagnetic interaction can produce two proposed, self interacting electromagnetic fields of opposite mirror properties defined as charge. These two proposed, self interacting electromagnetic fields are the electron-positron pair. Each self interacting electromagnetic field has a common emergent property that is defined as gravitation, and of the same quantity defined as a charge that is called mass.

Thus it is speculated and proposed for a model of the universe that the structure or medium of physical space that defines the universe and all of its constituents of matter and interactions of entities that are observed to exist. Physical space is in essence, an electromagnetic field where disturbances of that field define the observable physics of electromagnetism, and through processes of stable self sustaining interaction of pockets of that field yield stable entities of that electromagnetic field with an emergent property related to, and interacting with the electromagnetic field that is space known as gravity.

In short, space, gravity, and electromagnetism are all related, and in effect, manifestations of the same common property that defines and constitutes the observable, physical universe.

Thus stating an axiom to the same effect for a model of the physical universe.

Axiom APMS1:

Space, gravity, and electromagnetism are all related, and in effect, manifestations of the same common property that defines and constitutes the observable, physical universe.

Axiom APMS2:

Physical space is defined as a manifestation of a universal electromagnetic field by which constitutes the structure and properties of space.

Electric Charge

In the section, **Electromagnetic Gravitational Field and Physical Space**, it was speculated and proposed that physical space is in effect a construct that is an electromagnetic field. This space of an electromagnetic field could be said to have a zero energy state if it is of the same value throughout. That is, if space and an electromagnetic field is considered to have an electromagnetic charge density, and that density is the same in all of space, then that space and electromagnetic field can be said to be in a flat zero energy state. If however, if one zone of that electromagnetic field was to gain a higher density, to compensate and equalise such that the overall density of the electromagnetic field value is constant, another zone would have to lose its density of an equal quantity.

Consider that such electromagnetic field densities are defined as the electromagnetic charge of the zone in which they exists within.

Consider that within a particular zone of space that there are many smaller zones all of different densities interacting with their respective neighbourhood zones in such a manner that a resultant interaction emerges as a form of motion of that electromagnetic charge. Consider that such a result of interaction can be interpreted as a photon of light.

Consider that an interaction of two electromagnetic charges results in a self sustaining zone of self interaction of higher density charge, and another of self interaction of a lower density charge of equal quantities.

If these self sustaining zones of electromagnetic densities are unstable, then they exist for as long as the self interaction process is in progress and its physical state is stable, but once it reaches a physical state that where the physical process of self sustainability is not longer viable, it transforms into a different physical state or states by a process of decay as the process of self interaction collapses.

If these self sustaining zones of electromagnetic densities are stable, then they can exist for as long as they are separated from other electromagnetic charges that interact with them and cause their self interacting states to become unstable and collapse.

Consider that for either of these stable or unstable zones of electromagnetic field density, the electromagnetic field density is constant and has a high or low value compared to the overall flat zero energy state of the electromagnetic field of the universe and space. Consider that this constant high or low value of the electromagnetic field density constitutes what is defined as a particle of matter, and that for such a particle that is not in motion relative to an observer the magnitude of this electromagnetic field density is the electric charge that is given as a property of that particle of matter.

Axiom PMEC1:

Electric charge is the magnitude of the net magnitude of electromagnetic density that exists within a zone of the universal electromagnetic field that defines the observable space of the universe.

Mass

In the section, **Electromagnetic Gravitational Field and Physical Space**, and **Electric Charge**, it was speculated and proposed that the self interaction of a zone of space, which is in effect an electromagnetic field can in a stable or unstable form, give rise to a pocket of high or low density electromagnetic field.

By experiment and observation, only two forms of matter are stable and make up all the matter of the universe, being electron-positron and proton-antiproton pair. Each of these have the same and opposite electric charge that by the reasoning and argument for the postulation of the two mentioned sections are the result of two separate processes of self interacting electromagnetic fields. Protons and electrons have the opposite physical property of charges of equal magnitude, but share a common physical property of different magnitude that is defined as mass.

Speculate that a pocket of self interacting electromagnetic field of a particular electromagnetic field density cannot exceed a resultant electric field charge to remain stable, but that there can exist more than one pocket of self interacting electromagnetic fields of different electromagnetic field density.

That is, an electron-positron pair are a pocket of self interacting electromagnetic fields of electromagnetic field density that is lower that that of a proton-antiproton pair. The result is that the electric charge density of the electron is much lower than that of the proton, but that the overall net magnitude of the charge over the zone of space and electromagnetic field that defines that space is the same as that of the proton.

What this means is that the electron-positron and proton-antiproton pairs of matter exists as different sizes of the zones of space that they exist in. What is speculated and proposed is that the proposed charge densities of the electron-positron and proton-antiproton is what defines their mass, and that mass is an emergent property of the self interaction of the pockets or zones of the electromagnetic field, and hence space that they exist in.

Such a charge density constitutes as being a change in the electromagnetic field that surrounds the electron-positron and proton-antiproton pair, and since it is speculated and proposed that space is essentially made up from and is an electromagnetic field, space has a density and can be considered to be warped by the presence of matter and thus influences and interacts with it.

Axiom PMM1:

Mass is the net magnitude of a charge density of the electromagnetic field that exists for a self interacting pocket of the universal electromagnetic field within itself.

Thus mass is in effect, a deformation of the universal electromagnetic field that defines and constitutes the space that defines the universe.

Physical Matter

In the section, **Electromagnetic Gravitational Field and Physical Space**, **Electric Charge**, and **Mass** a definition of physical matter, what defines it and what it is has by and large been explained.

To summarise a definition of physical matter.

Definition DPH1:

The physical matter that constitutes the observable universe is a manifestation and result of the stable self interactions of the electromagnetic field from which form the basis construct of the universe and space.

The prime properties of matter that has the greatest influence on the processes and behaviours of matter, being electric charge and mass are discussed and defined in the sections **Electric Charge**, and **Mass** respectively.

Physical Interactions
Space

In the section **Electromagnetic Gravitational Field and Physical Space**, where **Axiom PMEC1:** is defined, physical space is modelled as a manifestation of an electromagnetic field where space is in effect, an electromagnetic field. In the section Mass and by the stated **Axiom PMM1:** mass is defined as a result of a stable electromagnetic field interaction from which a stable charge density of an electromagnetic field yields an emergent property mass that is this electromagnetic charge density.

If, as speculated and proposed, that mass is in effect, a deformation of the electromagnetic field that defines space and the universe, that deformation would have similar interactions and consequences as any other deformation of the electromagnetic field, and hence space of the universe.

Place two deformations close to each other, then net addition of those deformations would arise from which those two deformations would react to. In the simplest of terms, this is an interaction of physical space. If one considers that the deformation of space is that of photons, then those photons would react to each others electromagnetic field deformation. But photons are in motion at the relativistic velocity of that of light, and it seems only interact only by adding their electromagnetic deformations which are observed and interpreted as analogous to that of a sinusoidal wave. These resultant interactions are observed as interference patterns of light. In cases where these photons have sufficient deformation of an amplitude of high enough value, and the right conditions are present when they are incident with each other, the electromagnetic field may be of large enough scale to initiate an electromagnetic field interaction that yields as a result, a temporary unstable deformation of the electromagnetic field charge density that can be interpreted as a particle of matter. Ie a virtual particle.

Consider that there exists a stable or unstable deformation of the electromagnetic field charge density that is interpreted as a stable or unstable particle, such as an electron for a stable particle. Consider that this particle has a resultant electric charge as observed and interpreted by observation and experiment, and is accepted as a property of that particle. This resultant electric charge is subject to interaction with the electromagnetic field that defies the space at its zone of existence. Thus the resultant net deformations in the electromagnetic field by itself and other entities such as photons and other particles, stable or unstable, creates an environment in which all entities react to, which is interpreted as a physical interaction of all these particles and photons with each other creating a sense of motion within that electromagnetic field, and hence the space that is built from that electromagnetic field.

The speculation and proposal is that this interaction favours, or is one of following a path of least action. A path of least action is a path that expends the least, or gains the most energy.

However, as observed in quantum physics, no interaction can take place unless only a certain specific condition is met as occurs in the photoelectric effect, or in the absorption and transmission of photons from atoms. Such interactions involve not the motions of entities, but involve the transition of a physical entity or system from a physical state A to a physical state B. With no intermediary physical state, these transitions are quantum or discrete in the conditions that are required for them to occur. Thus there is only one possible path of interaction that can be taken, or no interaction at all.

Consider that space itself is not divisible beyond a certain value, and that space is discrete or quantised. Then motion of any entity within this space, let alone the structure of any electromagnetic field that constituents space is restricted and defined by this quantisation. Beyond a certain level, the motion and electromagnetic field has a form of graininess where the result of interactions are more like that of Brownian motion. Thus ultimately, it may be considered that all interactions of the resultant electromagnetic field that generate motion of particles is of a discrete and quantised form. It is only at the micro quantum level, that this is realised.

Consider that space at this level cannot be divided any further, the concept of singularities of zero spacial volume or area do not exist, and the physics models requiring continuity no longer apply. As the models of the physical universe expands above that of the micro into the macro, the mathematics applied requiring a smooth continuous number system reverts from an approximation that has large errors to one of higher accuracy of prediction. Thus the mathematical model of the physics, ie interactions of the electromagnetic fields, and hence space of physical entities is proposed to be different in that at the micro level, discrete mathematics would need to be applied, where as at the macro level, the approximation and errors of the mathematics is so small, that they can be neglected.

Axiom API1 states in summary a proposal for the physical interactions of entities of the above description.

Axiom API1:

All interactions of entities of matter and energy in the form of photons can be considered as a reaction of these physical entities to a resultant electromagnetic field density or deformation that forms from the individual electromagnetic field density or deformations that are defined as originating from these entities. That is, these entities create the electromagnetic field densities that define the space they exist within and are part of, and then react to that electromagnetic field density as motion or changing their physical state which is interpreted as a field interaction.

Gravity is not mentioned thus for. This is because by **axiom PMM1:** mass is a form of this electromagnetic field density that is of an electric charge density that emerges from a self interacting pocket of the universal electromagnetic field. Gravitational interaction are therefore proposed to be the reaction of entities to the resultant electric charge density of the electromagnetic field that defies space, whereas electromagnetic interaction is a reaction of entities to the resultant magnitude of electromagnetic charge that forms a deformation of the electromagnetic field withing a given zone of space.

Note need to review this to clarify and be more clear.