Another Understanding of Time and Dimension

----by Ruijie Mao

Preface:

The first time I get involved in this issue was when I was reading a pair of contrasting article about time-traveling. One of them discuss the probability of the time travelling, pointing out the fatal error lying in the time-traveling "Grandfather Paradox"----"a traveler jumps back in time and kills his grandfather, which prevents his own existence, which then prevents the murder in the first place, and so on." **(1)*** Therefore, the son will never appear during the time when time travelling is possible. The similar augment is presented in the book <To Explore the Direction of Time with Hopkin> by Mai Li.

I have a full passion in the time-traveling. Therefore, these articles are firmly carved in my mind and I believe that there will be a refutation against what presented in the article.

Until one day, after viewing the movie <Interstellar>, I was deeply engaged by what happened in that movie----the father is talking to his daughter through space-time. Because I have heard that the director of this movie has consulted a lot of physics professors in order to make this movie real, I think that what happened in the movie must have scientific foundation. Therefore, in order to make sense of what happened in the movie, this movie has given me the impulse to dig further into physics. It has come up with the idea of higher dimensions, so I wonder whether I am able explore the issue of time-traveling from the higher dimensional perspective.

Thanks to the participation of Ross 2016, though a math summer camp, I did learn the basic way of thinking in this camp. It taught me to think from the fundamental level. That is, every theorem or formula has its foundations. In different foundation, the situation will be different in terms of whether the theorem holds and every theorem is proven after a series of reasoning from the basic definition. This essay is also organized in this way, from the basic definition and assumption to the theorem, for the purpose of making this essay logical.

Unfortunately, because of my limited resource, I cannot get access to a single University Course or a professor (most of them will apply the excuse of "I am too busy" to delay) to consult. Therefore, for the general relativity part, I may not be able to apply a lot of calculation or advanced math to quantify my conclusion. However, I'll do my own part, trying my best to work out what I know, just as I write in my Personal Statement----play my best cards.

I hope this essay will come up with a new understanding about the issue of dimension. I was really hoping some of you reading this essay may come up with the suggestion for this essay. If any of the you can refute part or all of the essay, I will be even glad to hear your refutation and in which part this essay is incompatible with the existing theories.

Introduction:

This essay is aimed to reveal a new understanding in the issue of dimensions, which, according to what I have known, pose no incompatibility to the existing theories. Through such understanding, some theorem and relation are deduced and proven based on such assumption and ***the Grandfather Paradox*** will be refuted. Also, the existing knowledge and laws in physics are extended to different dimensions too.

Basic Assumption and Characteristic about how the dimensions are defined:

Basic definition: the n-dimensional world is defined as the world in which there must be at least n real numbers in order to distinctly note all points in that world.

Suppose there is a dot A. This is the zero-dimensional world without size and dimension, which can just symbolize a specific position, as shown in the diagram 1, although the dot A may has diameter of 1 mm, but the perfect dot has no diameter. This is the beginning of all the issues about dimensions. Because it is just a single dot, there is no need to use number to describe such point, for there is just one position in the world of 0-dimension.

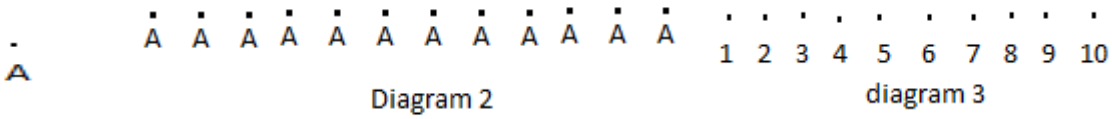


Diagram 1

The zero dimensional-world

Diagram 2

Several points so that it is needed to have number to note them in order to note them distinctly

diagram 3

One dimensional number so that they do make sense

However, if there are a lot of such points (as shown in diagram 2, though there are only twelve dots), the call of dot A will not make any sense. So, in order to distinctly describe every point, every dot should be labeled with a specific number, shown in diagram 3. In this case, dot 3, for example, will distinctly symbolize the third point right there.

When infinite dots (uncountable) gathered, and each dot included in the line can be described in a specific real number (and particularly, if how long every unit is, the number axis will form (shown in diagram 4)).

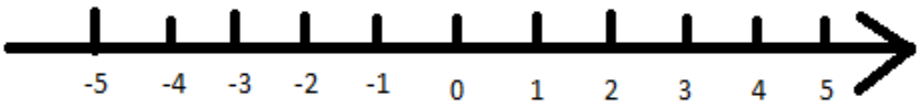


Diagram 4

This is the first dimension, in which every point can be indicated by ONE particularly number. There are only two directions in the first dimension----positive and negative, just as other definition n-dimensional world will have n different independent direction to change its length. **(2)*** The axis is like a track, and the one-dimension creatures can never digress from the track, nor can they escape from the one dimension without assistance from others.

The first dimension is not limited to the straight line but also curves, on which all the point can be defined and noted with ONE real number.

If there is a number on the axis which will indicate two point (as shown in the Diagram 5): point A and point B are both mapped with integer 6. In that case, it will be confusing if only one number is applied to note every point, since there are two points which have got the name “6”.

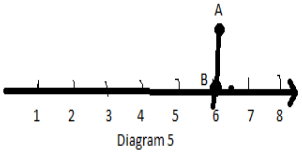


Diagram 5

Point 6 refers to two points (point A &B), so that only one number to donate all points does not make sense.

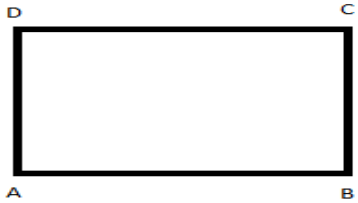


Diagram 6

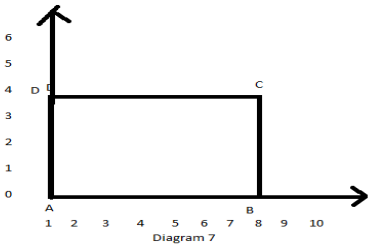


Diagram 7

In order to distinctly note every point on the surface, the number pair is needed. Therefore, there are two number axes to

So, for the purpose of making sense, “A” in the diagram 5 can be noted as (6,2), while “B” can be noted as (6,1). Since two numbers are needed in order to get every point marked, this is the two-dimension diagram. As there are infinite points on the one-dimensional axis, the two-dimensional world is formed.

The two-dimensional world is a surface, just as the upper surface of a cube, with no height, only length and width (shown in diagram 6), with dots A, B, C, D. Let dots A and B are indicated by number 1 and 2, which is one axis with the positive direction to the right. If we call for dot 1, for example, it cannot be distinguished between “A” or “D” (they have the same horizontal coordinate), which contradicts the definition of dimensional world. Therefore, in order to distinguish the such dots, there should be another vertical axis, which is shown in the diagram 7. So, it makes sense: the “D” is referred to as (1,4), without any puzzlement. Not only these four point, but also other points on this surface. There illicit what dimension 2 is----all the point on the second dimension are distinctly noted by two numbers (also the number pair). Also, any pair of numbers can be mapped and be only mapped to one specific point on the 2-dimensional world.

On a straight line, a one-dimensional creature moving on its track: suppose it is moving toward the positive direction. When the creature is on point 9, suddenly, it digressed from its track and transfers into another world (as shown in diagram 8). This just formed dimension 2 (the two lines have to be distinguished by another number and thus every dot has on this line should be labeled by a pair of numbers).

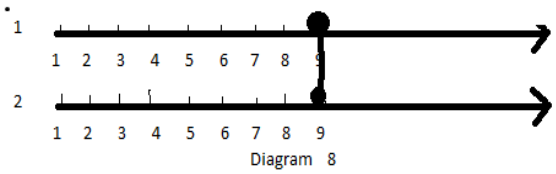


Diagram 8

another world for one-dimensional creature is still a line


Diagram 9

The happy face is stepping into the black hole

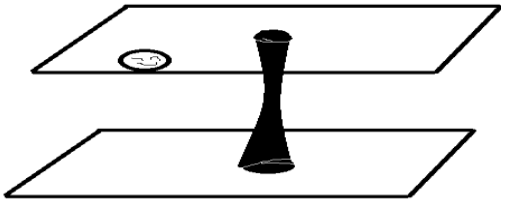


Diagram 10

The hole connected two two-dimensional worlds. the happy face is falling into hole, which leads to another two-dimensional world. Therefore, the way of two number label will not make sense.

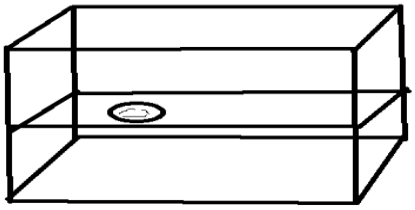


Diagram 11

The happy face now is in the three-dimensional world, although, for the happy face, it is just another two-dimensional creature.

It is the same way how the dimension 2 changes into the dimension 3, on which every point should be specified by three numbers. Once, one two-dimension creature (the happy face), going around alone the surface, sees a black hole (not the one referred to in astronomy). It is curious about it, not knowing what is in it. It stepped into the hole (shown in the diagram 9). Everything seemed fine and normal (in terms of him), but something is never normal and usual: the creature has stepped into another two-dimensional world. The dimension 3 is just the extension of the dimension 2, whose transition is just like the one-dimensional world changed into two-dimensional world. The dimension three, however, is just formed because of the insufficient indication of the dimension two (shown in the diagram 10, on which it will be confusing to use just two number to show the points on the diagram). ***In this case, we can conclude that the higher dimension is formed by digressing from the original world into the seemed the same world. (Theorem 0.1)***

Have a short witness of diagram 8, because the creature itself is one-dimensional, he can only see the SINGLE straight line (if not, it will be able to see himself at two time points, which would not be possible), and from his perspective, he still feels he is moving along the positive direction as usual. That is to say, during this process, the creature experienced nothing special, but he has already gone through to another world, simply because he can never see or feels the transporting process.

Then, let us look the world from the “happy face” ‘s perspective, which is put in the three-dimensional world, the cube shown in the diagram 11. Still, as a two-dimensional creature, the happy face can only move on the specific surface shown in the cube, but his two-dimensional nature has determined that he can never see the three-dimensional world, but just a surface. Also, as the diagram 8 has shown, the one-dimensional creature, the dark point, can only see the one number axis, though it has created the second dimension by extending the line. So, we can reach the conclusion----***when the lower dimensional creature goes into the higher dimension by extension. It can only see the lower dimensional world, which is the subspace of the higher-dimensional world. For it, the world is just the same and the process of going through is nothing special happening to it. (Theorem 0.2)***

diagram 12

The two-dimensional surface is composed of infinite (uncountable infinite) one-dimensional lines.

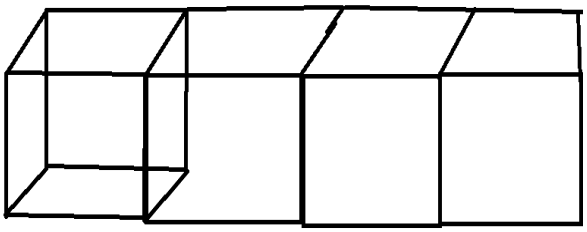


Diagram 13

Infinite three-dimensional worlds formed into four-dimensional world. every cube is an independent three-dimensional world.

Note: the cubes shown are not simply the cubes, but the symbol of the several three-dimensional spaces.

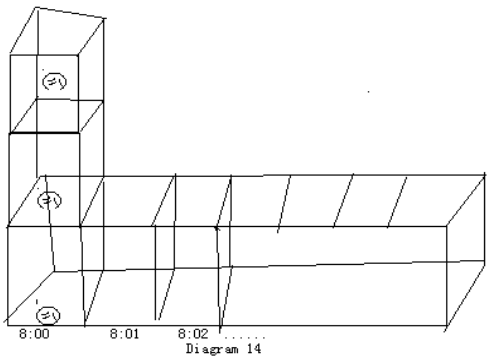


Diagram 14

Infinite four-dimensional worlds formed five-dimensional world

Additionally, having a short witness of the two-dimensional surface, it has contained several (uncountable infinite) one-dimensional lines (shown in the diagram 12). Every line has a specific number (a real number). And just like the points shown in the one-dimensional world, every real number can symbolize a line. It is the same with the three-dimensional world, which contained infinite two-dimensional surfaces. ***Therefore, we can make a conclusion that the higher dimension is the infinite (uncountable) combination of the lower dimension worlds. (Theorem 0.3).***

Given such knowledge, it is reasonable to deduce how the three-dimensional world changes into the four-dimensional world and also how the four-dimensional creature views the world. As Theorem 0.3 goes, several lower dimensions' make up the higher-dimensional world. So, the four-dimensional world is the combination of infinite three-dimension worlds (shown in the diagram 13). The volume of every cube is infinite just like the length of the one-dimensional line and also the area of the two-dimensional surface----infinite. Just the same as the points in the diagram 8, we can name these "cubes" also the three-dimensional world with numbers and every real number can be mapped to a three-dimensional space which is a subspace of four-dimensional world. Because we humans are three dimensional creatures, if no one has built the tunnel shown in the diagram 8 and diagram 10, we can only stay in one cube but never get into another one.

According to Einstein, and a lot of other scientists, the fourth axis for us is just the time. In that case, the numbers which is used to indicate the fourth axis are just some time points. Such is what four-dimensional creature saw about their world----they can see the spaces at different time point simultaneously. If we are four-dimensional creature, what we can see is three-dimensional creatures today and also them yesterday at the same time! What is more important is that you can travel to the space "yesterday" (this is the three-dimensional timeline), which will be further discussed later.

Also, when we discuss how the four-dimensional changes into the five-dimensional one, it is the same. By copying the four-dimensional worlds and adding one another axis which can indicate there are several different four-dimensional spaces, the five-dimensional world is formed. As shown in the diagram 14, during the same time, the object can be everywhere in the three-dimensional space (as there are infinite four-dimensional worlds (space-time))! Suppose an object, which is referred to as the happy face in this diagram, is staying the bottom of the space cube, although there is no bottom at all, for the space is infinite. However, the five-dimensional creature will see he is at the middle of the cube "simultaneously", from the perspective of our time, the four-dimensional axis (the time of the three space cubes are all 8:00). Still, we are the three-dimensional creatures, which mean that we can only see one of the three-dimension cube in the five dimensional worlds and that we can only see one happy face in the space at the specific point of time.

Since the five-dimensional creature measures the same object (maybe an atom, maybe a molecule or something like that) can have some different positions at the same time, this dimension is called possibilities.

Theorems Developed through Dimensions

As Hermann Minkowski said "time should be treated as equal footing as space." [3]* *Therefore, in regards to the time, there are two ways to define what time is like:*

Definition 1: the n-dimensional creatures regard (n+1)th dimensional axis as its own timeline, as diagram 15 shown. In this way, the elapse of time will be regarded as that the n-dimensional world is moving along the (n+1)-dimensional axis and the (n+2)th axis is n-dimensional possibility.

Note: the t_n denote the timeline in n-dimensional world, while C^n denotes the speed of light in n-dimensional world.

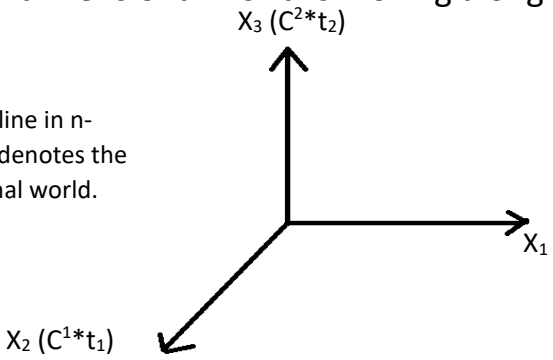


Diagram 15

Theorem 1.1*: The wormhole of instant traveling in n-dimensional world can only be built by (n+2)-dimensional creature.*

Proof:

Suppose there is object in the n-dimensional world (the yellow point in diagram 16, and every cube here is not three-dimensional space but n-dimensional ones). At 8:00, it is traveling east and heads down at 8:03.

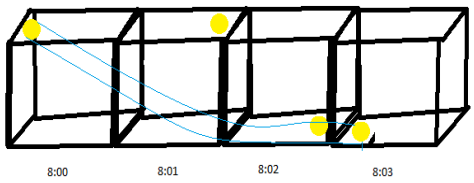


Diagram 16

If it is in the (n+1)-dimensional creature, shown in the diagram 16. That is, if the (n+1)-dimensional creature opens a wormhole between the 8:00 and 8:03. Since the timeline does not change, the yellow point will only go directly from 8:00 to the 8:03. To himself, it may seem like instant travel. However, while time does elapse in this case, it is just that he does not experience 8:01 and 8:02.

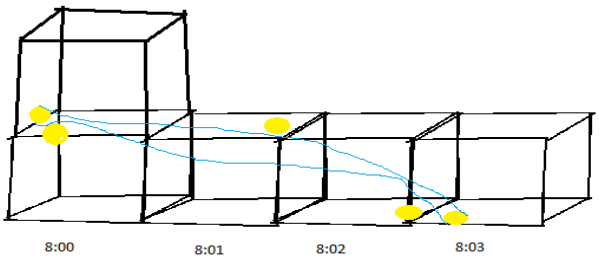


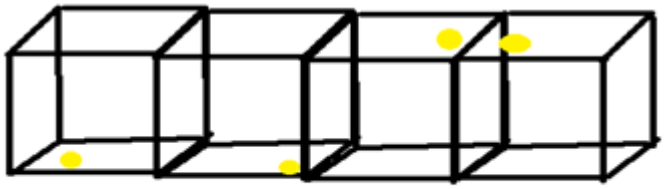
Diagram 17

Nevertheless, in case of the (n+2)th dimension, as shown in Diagram 17. If 8:03 and 8:00 is connected, the instant transportation is realized. The yellow himself will not experience any time change and the actual time does not change either.

Theorem 1.2: *(n+1)-dimensional creature is able to build the wormhole that allow n-dimensional creature to travel to the past without* ***grandfather paradox****.*

Proof*:*

According to the nature of the (n+1)-dimensional creature, he is able to see the n-dimensional creature simultaneously at a lot of time points, from its past to its future, as shown in the diagram 18.



Note: every cube symbolize a specific n-dimensional world on a timeline, which is the (n+1) axis. Although shown on the diagram, what the (n+1)-dimenisonal creature see is that the four point are on the same line

Diagram 18

Therefore, it was easy to for the (n+1)-dimensional creature to brought the yellow point shown in the graph to its (n-dimensional creature's) own past.

However, still it does mean that the yellow point is able to "kill his father before he is horn". Actually he can do that, but the possibility ((n+2)th axis) has already changed. Without the consideration of Non-Locality, nothing can travel faster than the speed of light. Therefore, no matter how fast the (n+1)-dimensional creature brought the yellow points, it will take him some time (elapse of possibility of n-dimensional creature, the time in (n+1)-dimensional world) for him to do that. Thus, the possibility for the yellow point (time for (n+1)-dimensional creature) must have changed if it is doing such "time travel". In that case, it is reasonable for the yellow point to do such time-traveling in its own world----even kill his father, since the possibility (how the things will develop at different time) has already changed, the cause and effect has also changed!

Theorem 1.3*: the n-dimensional creature is formed by the time elapse of (n-1)-dimensional creature.*

Proof:

As the hypothesis assumed, the n-dimensional world will apply the n+1th dimensional axis as its own timeline.

Therefore, it is trivial to infer that (n+1)-dimensional world is constructed by the time elapse of the n-dimensional world. (the n-dimensional world plus a timeline thus it is the (n+1)-dimensional world).

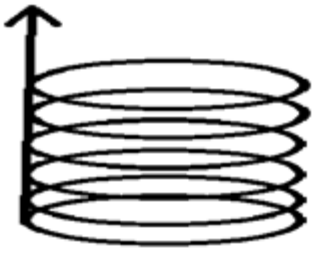


Diagram 19

Diagram 20

Suppose there is a person (a three-dimensional object)

A cylinder can be viewed as the time elapse of a circle

Diagram 21

He is formed by the growth of two-dimensional objects, during whose first period

Diagram 22

As the two-dimensional creature grow older, it becomes this shape, (his bottom).

For instance, suppose there is a cylinder in the three-dimensional world, which is constructed by infinite circles. Therefore, such cylinder can be seen as the time (2-dimensional time, which is the third dimension) elapse of a circle put together (a circle in the two-dimensional world does not change as the time elapse) and later (on the top of the cylinder), the circle suddenly disappeared in its own world.

Take a human as another example (shown in the diagram 20). Suppose we consider the arrow listed as the timeline for the 2-dimension creature. Therefore, when he was born, he has the shape of two feet listed above (diagram 21). However, as he is growing, he changes into the shape of two circles (the leg). Then during his middle age, he has the shape of diagram 22 (the bottom). At last, he grows into a huge circle (the head) and finally died.

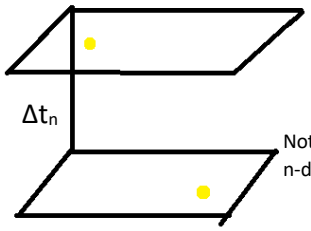
However, this is not the only way that the cylinder is constructed. This cylinder can also be seen as the life of the object that when it was born, it is only a line (through its lateral and the abscissa axis is its own timeline) then it grows into a rectangle, which is always growing wider till its prime. Finally, it become to decline, smaller and smaller, and finally returns to a line and disappears.

Actually, by symmetry of the nature **(4)***, any line (even curve on condition that nothing happened different at the same time) can be seen as the timeline of the two-dimensional space. Therefore, every n-dimensional space, there are infinite (uncountable) (n-1)-dimensional space that can construct it.

Theorem 1.4: *the (n+1)-dimensional creature will view the elapse of time of points in n-dimensional world a continuing line.*

Proof:

Suppose there exists the elapse of a point in n-dimensional world such that they discontinued, as shown in the diagram 23 and Δt_n is infinitely small.



Note: the surfaces symbolize n-dimensional world

If such situation happens, which means the yellow dot transfers from left to the right without elapse of the time. In that case, without consideration of the Non-Locality, such case is impossible. So, the supposition fails. The theorem holds.

Diagram 23

Definition 2: all dimensional creature share the same timeline, as diagram 24 shows. They share the same timeline.

Note: axis x, y, z are perpendicular to each other.

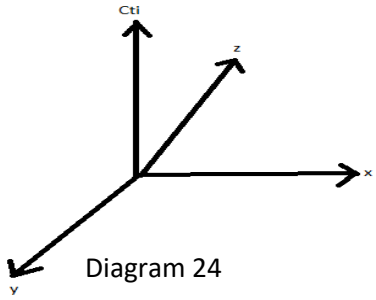


Diagram 24

Theorem 2.1: *the instant transportation is impossible without the consideration of quantum entanglement.*

Proof:

Suppose it is possible that n-dimensional creature, still a happy face, was traveling from point A to the point B without elapse of the time, as shown in diagram 25. Suppose the happy face borrow the help from a m-dimensional creature (m > n).

In m-dimensional world, since A and B are not the same point. Therefore, without the consideration of quantum entanglement, time will elapse in m-dimensional world.

As the assumptions goes, all dimensional worlds share the same timeline. Thus, the time absolutely elapse in dimension n, which contradicted with the supposition of instant transportation.

So, the statement holds.

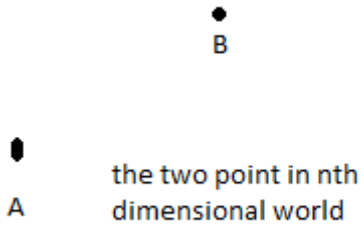


Diagram 25

Theorem 2.2: *creatures in all dimensions share the same light-cone.*

Proof:

Suppose that it is not the case, that there exists n so that n-dimensional world and (n+1)-dimensional world does not share the light-cone.

As diagram 26 shows:

Note: axes Xi, Xm (1<=i, m<= n) are perpendicular to each other.

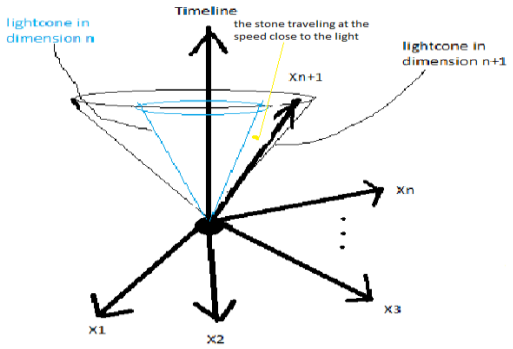


Diagram 26

Suppose, there is a stone (the yellow point in diagram 27) is traveling very close to the speed of light and is about to bump to the object in dimension n, which will be regarded as a surface in (n+1)-dimensional world. The creature in (n+1)-dimensional world will think the object is collided by the stone. However, those in n will view the stone has no effect toward the objects.

Diagram 27

This is what the creature in n-dimensional creature sees. A surface with two circle. May be, the two circle are a part of a sphere

Suppose, this is a huge crush that the object breaks into parts, shown in diagram 28. Those in the n+1th dimension will view such sphere be broken into pieces, so does its circle (its subsurface), which will contradict with what those in nth dimension see----the stone has no effect on the object.

Diagram 28

The same holds when the light cone in (n+1)-dimensional world is smaller than that in n-dimension.

The assumption fails, the theorem holds.

Another aspect of Relativity

Basic Assumption:

1. **That the speed of light is constant in any reference frame still holds in other dimensional worlds.**
2. **Definition 1 (under Definition 2, things would be trivial, because just by transforming the theorems in the three-dimensional world directly to n-dimensional world is ok.)**

(X1, X2, X3, X4, …Xn refer to the n axes in (n-1)-dimensional world and $Xn = C^{n-1}t_{n-1}i$, the time in (n-1)-dimensional world (Definition 1), C^n refers to the speed of light in n-dimension world (this index has no contravariant or covariant meanings). If Xn (unit: meter) is a well-defined length axis in n-dimensional world and also the C^{n-1} is a constant in (n-1)-dimensional world, the second in (n-1)-dimensional world (time unit) can be defined as meter/C^{n-1}. It is easy to define that $t_{n-1} = Xn/C^{n-1}i$).

1. Special Relativity Extensions:

1.1 The Lorentz rotation in n-dimensional world

1.1.1: Short Introduction to the Lorentz Rotation:

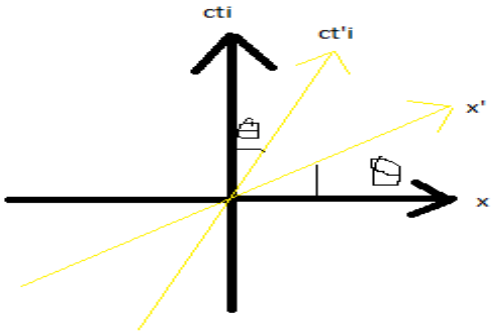


Diagram 29

If there is a point (x, cti) on this surface in the black coordinate, in the yellow coordinate (the reference frame moving at the speed of v), this point is (x', ct'i), where X' = (XCosΘ – CtiSinΘ)/Cos2Θ, Ct'i = (CtiCosΘ – XSinΘ)/ Cos2Θ if tanΘ = v/ci: such is the just Lorentz rotation.

1.1.2: Extension to the world of dimension:

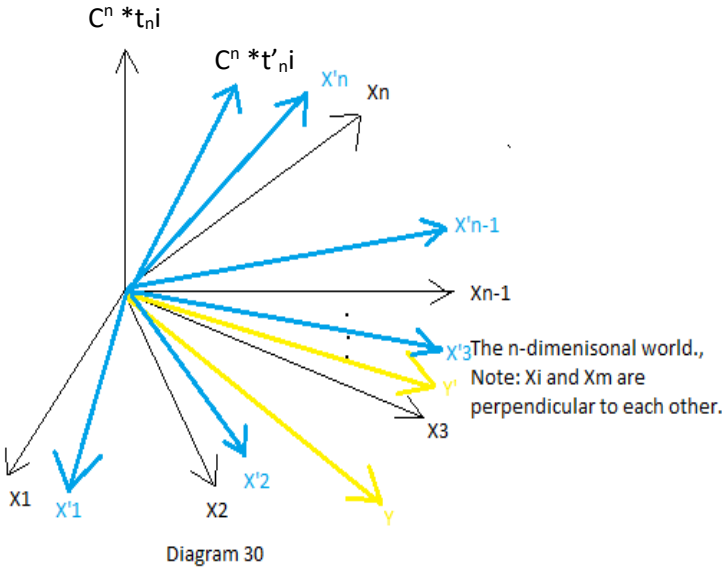


Diagram 30

The Lorentz rotation can be regarded as what happened in dimension 1 (the reference frame has one-dimensional world to move). When it happened to higher dimension (as shown in diagram 30), it is trivial to compare t_n to time axis shown above (suppose another S' reference frame is moving in the direction of Y), and x axis to Y axis. In this case, the S' reference frame is formed by tilt Y' and the time axis of S' off those of the S reference frame in the degree of Θ, with $\tan\Theta = V/C^n i$, and other axes will remain the same angle, for example, in the S reference frame, Xi (n >= i >= 1) and Y is α. Then, in the S' reference frame, the angel between Xi (n >= i,m >= 1) and Y' is α too (the proof is too complicated to present). Also, Xi and Xm remain perpendicular to each other. (n > i,m >= 1)

1.2 The proper length &time in different dimensions

The proper length in three-dimensional world is $s^2 = -c^2 t^2 + x^2 + y^2 + z^2 = \delta_{nm} X^n X^m$(in the flat space-time), with the proper time $\zeta^2 = t^2 - (x^2 + y^2 + z^2)/c^2$ **(5)***. Therefore, it is trivial to find out that the proper length in n-dimensional world is $s^2 = -(c^n)^2 t^2 + \sum Xi^2$, with the proper time $\zeta^2 = t^2 - \sum Xi^2 / (c^n)^2 = \delta_{nm} X^n X^m/(c^n)^2$.

1.3 The proper Speed &Momentum in the n-dimension world.

The proper velocity in space-time is vector $U^n = \gamma(Ci, V^x, V^y, V^z)$ **(6)*** and, where Ci is the fourth speed, specifically the move on the imaginary time axis. Therefore, the same way, it can be extended to the n-dimension world, with the proper velocity $V^n = \gamma (C^n i, Vx_1, Vx_2, Vx_3 \dots Vx_n)$ and the momentum is $P^u = m^n \gamma (C^n i, Vx_1, Vx_2, Vx_3 \dots Vx_n)$, where m^n is the mass in n-dimension space (see in the section 2.2).

Note: there is no relation between $C^n i$ and Vx_{n+1}. Since we invented the 4th velocity just to make it convenient to note the proper length in n dimensional world that proper length $s^2 = (U^n/\gamma)^2$, but not to establish the relation between the fourth dimension and the other three dimensions.

Also, since the definition of the velocity is dx / dt, in n-dimension world, which, under Hypothesis 1, is dX^{n+1} / dX^{n+2}, while the $C^n i$ can be seen as $K\, dX^{n+1} / dX^{n+1}$. Therefore, there is no direct relation between these two velocities.

2. General Relativity Extensions:

Under the assumption that the speed of light constant law still holds in any dimensional space and that "we are allowed to make all sorts of coordinate change as long as metric change accordingly" (7)*, it is reasonable to extend the general relativity to other spaces:

2.1 Basic subjects of GR extended to n-dimensional space.

2.1.1 The proper length in nth dimensional space (curved):

While the formula in 3-dimensional space-time is $ds = \sum\sum dx^r\, dx^m g_{rm}$, where both r, m is from 0 to 3(x0 is the timeline), thus, it is practical to define proper length n-dimensional as $ds = \sum\sum dx^r\, dx^m\, g_{rm}$, where both r, m is from 0 to n (x_0 is the timeline), with the g_{rm} the metric tensor in the n-dimensional space.

2.1.2 The geodesics in n-dimensional space:

According to the definition of the geodesics: the shortest possible line in spaces no matter it is curved or not. (8)*

in 3-dimensional space, it is given that the geodesic is the solution of s: $d^2x^r / ds^2 + \Gamma_{pm}^{\ r} (dx^m / ds) * (dx^p / ds) = 0$.

Therefore, just change the dummy index from 3 to n, which will become the formula in n-dimensional space.

2.1.3 The curvature in n-dimensional space

According to the definition of the curvature, such term is well-defined in the dimension higher than 3. It is noted by Riemann tensor $R^u_{\ rmp}$, a matrix that describes the change of a unit vector when it parallel transport around a tiny loop.

As the formula $V^r\, R^u_{\ rmp}\, dX_p\, dX_r = \Delta V^u$ (9)*, where ΔVu describes the component of change of the vector V, this formula will applicable to n-dimensional world.

2.2 Mass &Matter in n-dimension world.

As the theorem 1.3 goes, the matter in (n+1)-dimensional world is formed by time elapse of the world in n-dimensional world. Therefore, it is plausible to deduce that by cutting the matter in (n+1)-dimensional world into surface pieces along the timeline, the matter in n-dimensional world will formed. For example, as the cylinder listed above, suppose we choose the height of the cylinder as the timeline, so that we get the time elapse of the two-dimensional objects----infinite circles. Since they are objects in 2-dimensional world, it is reasonable to deduce that they have mass in two-dimensional world. Because the unit of mass in three-dimensional world is kg, the mass in two-dimensional space is $m/ (C^2 t_2 i)$, with the unit kg/meter ($C^2 t_2$, which equal to the three-dimensional meter, t_2 is the two-dimensional time and C^2 is the speed of light in two-dimensional world). In this way, we can deduce the

mass in n-dimensional worlds is $m/(-C^2t_2\ C^1t_1)\prod(C^mt_mi)$, with the unit $kg*m^{n-3}$. If n > 3, the matter is formed by (the time elapse)$^{n-3}$, while if n < 3, we obtain the object by dividing the object along the timeline (3 – n) times.

In this case, the ***Stress-Energy*** Tensor, under the assumption that the energy-mass relation still holds in n-dimension world, T^{uv} would be a (n+1)*(n+1) matrix, with $T^{uv} = P^uC / \Delta S^v$, where $P^u = m * U^u$, the proper velocity in n-dimension world and $S^v = (\prod X^i)/X^v$. X^0 is the C^nt_ni in n-dimensional world, while Xi (i does not equal to 0) is other coordinates in n-dimension world.

2.3 Einstein's Equation in n-dimension world.

With the extension of stress-energy tensor and the symbol of geometry of space-time to n-dimensional world, the Einstein's Equation can also reveal the relationship between the geometry of the space and the Mass &Energy in n-dimensional space that: $R^{uv} – ½\ g^{uv}R = KT^{uv}$, where the constant K can vary with the speed of light and also the gravitational constant in that dimensional world.

Theorem 3.1: *the gravitational wave may be a medium of information that can transmit through space-time.*

Proof:

Suppose at time t, the mass in the n-dimensional world has changed from m to m+Δm. Therefore, the matter in m-dimension (m>n), which is formed by the time elapse of the n-dimensional matter, will change from $m*\prod(C^k*t_ki)$ to $(m+\Delta m)*\prod(C^k*t_ki)$, for k from n to (m-1). So, according to the Einstein's Equation, the geometry in the m-dimensional world will change too! In that case, another n-dimensional world (the sub-world of m-dimensional world in another possibility) geometry will also change. In that case, by changing n-dimensional matter, it will cause the change in the space-time in other n-dimensional worlds (those in other possibilities).

2.4 Conjecture about energy and momentum:

According to Einstein's Equation, it is interpreted that both mass and momentum are able to curve the space-time, both three axes and the timeline. In that case, I make a conjecture that actually only three-dimensional mass may just be able to curve the three-dimensional space. ***The reason why the timeline (the fourth dimensional axis) is curved is because with the elapse of the time, the three-dimensional matter may form the four-dimensional mass*** and as proven in theorem 3.1, the mass in lower dimension will pose influence on those in higher dimension.

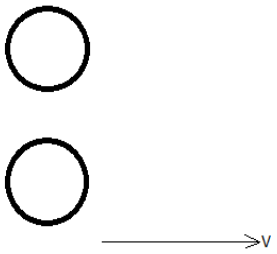


Diagram 31

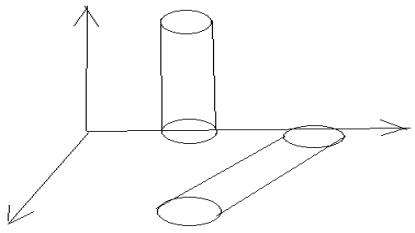


Diagram 32

I also make a conjecture about the issue momentum: as the theorem 1.3 goes, the four-dimensional matter is formed by time elapse of the three-dimensional matter. In this way, if the matter is with velocity, for example, two

circle (two-dimensional creatures) as shown in the diagram 31, with one of them is moving with the velocity v and the other still.

For the matter that it formed in three-dimensional world (the third axis to be its timeline), as shown in the diagram 32, one of them will form a right cylinder and the other will tilted because of the velocity in two-dimensional world. The curvature generated by these two objects will be much different. ***In that case, I was guessing the reason why the momentum can also affect geometry is because it affects the matter formed in (n+1)-dimensional world.***

However, because of my limited knowledge in advanced math, I'm not able to prove or disprove these two conjectures through the use of Einstein's Equation.

Topics Exploring Currently:

1. The relationship between time direction (possibility) and those in the Quantum Mechanics.

2. How does N-dimensional matter curve the space of M-dimensional matter quantitively (N does not equal to M).

3. How to use the Array lists to draw the different dimensional world, since human cannot easily evaluate the higher dimensions but computers can. It is very easy to construct a 5-dimensional array list instead a 5-dimensional world.

4. Proof of the conjecture in 2.4.

Reference:

(1)* This saying is from https://www.wired.com/2010/07/time-travel-2/. Note: this is just my citation source to explain the grandfather paradox, but not source of the contrasting article I mentioned in the first paragraph.

(2)* This definition about dimension is adopted from *Travels in Four Dimensions: The Enigmas of Space and Time* by Robin Le Poidevin, originally published in English in 2003, then translated and published by Hunan Science & Technology Press.

(3)* This saying from Hermann Minkowski is adopted from *Einstein's Physics* P_{167} by Ta-pei Cheng, published by Oxford University Press 2013.

(4)* The issue of symmetry is adopted from *A Different Universe* by Robert Loughlin P121.

(5)* the formula of proper time &proper length is adopted from *Modern Physics* by Frank J. Blatt P39 published by Oxford University Press 1992.

(6)* This formula is from *Einstein's Physics* P_{172} by Ta-pei Cheng, published by Oxford University Press 2013.

(7)* This basic assumption about tensor is from *Einstein's Physics* P_{209} by Ta-pei Cheng, published by Oxford University Press 2013. Also, it is the basic assumption of all issue about general relativity.

(8)* The definition of Geodesics is from *https://en.oxforddictionaries.com/definition/geodesic*

(9)* This equation of Curvature is adopted from Stanford Continuing Studies by Leonard Susskind.