Dium TOE Solutions To 12 Intractable Challenges in Physics And Cosmology : Space Object, Dark Matter, Dark Energy, Nothing, Time, Vacuum Catastrophe, Neutrino Oscillations, Particle-Wave Duality, Velocity Against Space, Three Generations of Matter, Double Slit Experiment, and "Nobody Really Understands Quantum Mechanics"

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Abstract: In this paper the Dium TOE, a model of continuous space, is applied to solve the following challenges or at least gain some traction. There are a dozen intractable challenges in Physics and Cosmology that current physics models fail to solve or solve weakly: 1) Space as a real object, 2) Dark Matter, 3) Dark Energy, 4) Nothing versus Space, 5) Time, 6) The Vacuum Catastrophe, 7) Oscillations of Neutrinos, 8) The Particle-Wave Duality of light and particles, 9) Absolute Rest Frame, 10) The Three Generations of Matter, 11) The Double Slit Experiment, and 12) Richard Feynman said nobody really understands Quantum Mechanics. The failure to solve these is evidence current models are deficient. A continuous model of space may be more appropriate to solve these. These may all be part of the same problem with 1 solution.

I. INTRODUCTION

A Theory Of Everything (TOE) should be required to explain all the unknowns in Physics and Cosmology. That will be attempted here with the Dium TOE (Figures 1 and 2). This TOE is the product of 24 years of unsupported and independent side effort with no oversight from 1990-2013 at Cafes. The original intent of creating this model of the universe was to start fresh, even diverge if necessary, and that is what happened. This explains why it is so different than other models. It was not originally called the Dium TOE nor did it even have a name in the beginning. Instead of starting with current models like the Standard Model of Particle Physics and/or General Relativity, the Dium TOE starts with natural dimension and builds up from there. This paper will not focus on describing everything in the Dium TOE, only as much as is necessary to apply it toward solving these 12 intractable challenges.

Dium is a foundational model, the base of reality. Due to its continuous property no other model can be lower. Additionally the modeling rules are included before the actual model, establishing axioms, hypothesis, theorems, conjectures, etc. It is theoretical and properly labeled so. The Dium TOE is rigorous, yet has no equations which is extraordinary. It is primarily a Geometric Dimensional model, specifying volume, shape, transformations and other properties. The properties are expressed qualitatively instead of quantitatively, except for infinity. The Dium TOE is content to rely on higher level models to provide their equations. Other higher level models like Newtons, Maxwell's, Einstein's Relativity and Quantum Mechanics are add-on layers on top of the Dium TOE base. Dium is reality with no equations, other models are equations without reality, a good fit.

Note that this paper does not prove the Dium TOE. It is allowed in Science to make assumptions to define a model. Then within that model's assumptions and derivations resulting from those, check to see if that model can explain the Universe and solve the unknowns better than other models. That is the approach here in this paper using the Dium TOE. Where higher level models use equations to describe how much of something, the Dium TOE will describe what is actually going on in each challenge without equations.

There can be infinite models of the universe, each with pros and cons. It is possible to model a thing in many different ways, providing different insight and solutions. Models do not have to always attempt to be reality. Sometimes the purpose of different models is to get different answers. That is not the goal of the Dium TOE. This is the Grand Challenge, a claim to have the model of the single universe that is reality: the Dium TOE. I think it is necessary to understand our way out of these 12 intractably hard challenges. That is how this paper proceeds, by understanding how all these challenges are related and connected to the dium.

II. 12 INTRACTABLE CHALLENGES AND SOLUTIONS

1) **Continuous 3-Space Object**: Initially it is necessary to describe the Dium TOE with enough detail to be able to solve the other challenges. It is appropriate here as this challenge is itself directly solved by the Dium TOE specifically. Thus this #1 solution is much longer than the rest.

In the Dium TOE space is a continuous natural dimension object. This is in nature, not abstract space like Mathematics. This object is of type Natural "Dimension". It is 3-Dimensional which establishes locations in the volume with time progression. Space is generically named dium for the linguistic contraction of dimension-ium. Specifically, tridium is 3-space. Tridium is distinguished from particle based objects which also have extents in that particles require tridium to be the volume in which they exist, but tridium is the volume. Once the order of 3 for volume or 2 for plane or 1 for line is established, the generic term dium may be used to refer to it for brevity. But when using more than one order it is preferred to be specific. See Figures 1, 2 and 3 for the Dium TOE which is prerequisite for continuing this paper.

Tridium is the first discovered and identified continuous object in nature, a significant finding!

When the word "natural" is used as an adjective for dimension that distinguishes it from the well known abstract dimensions of algebra and the Cartesian Plane. Natural dimension means the core volume of the universe with time progression. These are the XYZ and T variables. Abstract on the other hand is allowed to have unlimited dimensions to satisfy whatever variables are being compared in equations. For example, variables for the count of deer versus wolves become the abstract D and W axii of a graph. But deer and wolves are not the basic natural dimensions of the universe, they are merely life forms on a planet in the universe. Deer and wolves do not permeate the entire universe. But both creatures have XYZ and T values in the dium. The base of tridium natural dimension provides the volume for these creatures, and in general for all matter and forces to exist. Within the tridium, there cannot exist anything which lacks XYZ and T values. Even the emptiness of space if devoid of particles and fields has location and time.

The word "continuous" means that while the dimension is extended, that extension is not a collection of discrete objects when zoomed into it infinitely. It means there is no lower limit of continuity. Contrast with the dis-continuous lower limit of the Planck scale in Quantum Mechanics which by definition is discrete. Imagine a discrete fabric like cloth with a cross weave. From far it may seem continuous, but when zoomed in the threads become visible. But continuous natural dimension has no lower limit of continuity. Infinite zoom shows no threads nor structure. The continuity is infinite "in the small". This continuous property is outside the bounds of the atomic principle which is discrete by definition.

Comparing continuous to discrete is somewhat analogous to the comparison of the abstract Mathematical real numbers and whole numbers. The real numbers are continuous. Between any two real numbers there are infinite real numbers. Although the IEEE 754 floating point number standard for computing does have limits to the number of real numbers between 0 and 1, that is just a computing limit. Between 0 and 1 there are infinite real numbers. Alternately, the whole numbers are discrete and each is size 1. There are no whole numbers between 0 and 1, only fractions. Fractions belong to the real numbers. If a discrete model is used in a continuous reality, there will be fractions and rounding errors when motion occurs, but in the discrete model fractions do not exist, so these are lost into a kind of mysterious quantum "foam" from which they can add up to a whole. Real numbers contain the whole numbers entirely, and so analogously is the continuous Dium TOE more precise than discrete models like Quantum Mechanics.

In the Dium TOE, the mass of a particle is described as a kind of "pinch" or "dimple" but ultimately is a compression of natural dimension 3-space. If the inner compressed region holds the compression then it is a static dimple. If the inner compressed region oscillates from higher density than surrounding region to lower density and repeating, then it is a dynamic dimple. The non-neutrino Fermions (quarks and leptons) of the Standard Model are static dimples with constant mass. Neutrinos oscillate in their dimple warp and thus have dynamic mass. They oscillate across all three generations of matter. Whether static or dynamic, as long as the compression does not involve a twist of space, then there is no charge.

In the Dium TOE, the charge of a particle is described as a “twist” of tridium. The exact shape of the twist is not provided here. The twist cannot cause a compression of tridium, else charge would cause mass. A static twist of dium is where the twist is non-changing. If the twist oscillates from twisting one way and then rebounding back across neutral to the other way and repeating, that is an oscillation such as the electromagnetic wave. The EM wave twist does not compress tridium anywhere and thus has no mass warp of space. The shape of the twist is such that it can have an opposite shape to account for positive and negative charge. Fractional charges may be the amount of twist and/or other properties of the shape of twist.

The mechanism that determines static versus dynamic oscillating dimple warps and twist charges of dium is not fully determined yet. A brute force approach can sometimes help to tease a solution from the unknown. The difference between the two is one is static and unchanging and the other is dynamic and oscillating. One can speculate that static is somewhat like being frozen in time, the other is not. It is possible to interpret that literally as the static form of the warp and charge as being anchored just beyond the trailing edge of the time into the frozen history. History, aka Chronodium in the Dium TOE, is static so it is a well known source of the property called “unchanging”.

Alas, there is one change that static warps and charges can experience a transition to and that is annihilation of matter and antimatter particles of same mass and opposite charge. The twists undo to neutral untwisted space and the warps unwarp to neutral smooth space. However, annihilation is exceptional and existential to the particles; it is during the existence of the particle that is in question and whether during that time it is static or oscillating so annihilation should not necessarily except this line of speculation.

The stretched rubber-sheet-ball model of gravity is useful but has serious flaws. First, 3-space is dimensionally reduced to 2-space rubber sheet but the ball resting on the sheet is 3-D and it is pulled downward into the rubber with gravity in 3-space. Mixing of 2 and 3 dimensions is flawed. Instead, the Dium TOE models gravity and mass as a compression of 3-space. It has higher compression at center and surrounding space stretched to lesser density. This can be modeled in the dimensionally reduced 2-space rubber sheet as a pinch compression of the space sheet but keep the sheet flat. Then conceptually freeze that compression to static state with liquid nitrogen. In this example liquid nitrogen is the means to freeze the rubber sheet, but in tridium it is not temperature that freezes the higher inner compressed space.

Pinching the dimensionally reduced rubber sheet may be difficult. A simple way to do this without pinching is to scribe a grid of XY lines on the unstretched rubber sheet. Then apply liquid nitrogen to a spot to freeze it at this density of (relatively) unstretched state. Once that spot is frozen, then stretch the rubber sheet from all four sides of the square. The frozen spot now represents higher density than the surrounding stretched area. This is warped space in the Dium TOE, but is dimensionally reduced from volume to plane. The stretched grid lines will show this. This is easily imagined in a thought experiment. If liquid nitrogen was allowed to slowly drip on the spot that spot would remain at constant density. Otherwise the spot will warm up and release its stretch and rubber sheet space will slowly rebound back to prior shape.

One of the properties of tridium is that it can stretch. However, the stretch is not constrained by the properties of discrete atomized objects which connect to each other and have breaking points. A balloon is such a discrete atomized surface where stretching beyond a certain limit by filling it with air will cause a compound to break causing a tear and the balloon pops. Continuous natural dimension has no breaking point limit to stretch because it is continuous. Tridium has a resistance to but no limit to stretch. It can stretch to infinity due to its continuous property.

If two objects of mass M and N aggregate, their combined mass is M+N under additive rules. But if the aggregation is going to release mass by having less than M+N, such as in fusion or annihilation or if black holes and neutron stars will lose mass in their union, then the release of mass is a 3-D outward flow of tridium as the tightness of space is allowed to become less tight. This is like the 2-D rubber sheet with a frozen spot of higher compressed sheet melting, releasing the compressed sheet of rubber. The frozen spot could melt instantly, violently releasing space with longitudinal waves. This unstretching travels outward from the center as longitudinal waves of space re-normalizing to less stretch. This is not a transverse wave. After the wave has passed, space has normalized

to less stretch than before. This difference before and after should be detectable and is a way to test the Dium TOE as space after the wave passes is less stretched than before. This is the dium interpretation of the gravitational waves detected by LIGO.

Section 6 of the Dium TOE establishes how the warps of dium are what attracts one mass to another. It is not directly the object with mass that is attracted at a distance to another object with mass. Instead, their warps extend far beyond the aggregate objects. Thus two planetary objects like the Sun and Earth attract each other at a distance of 93 million miles because their warps of space overlap and intersect. In the Dium TOE, when warps interact and attract, their bodies at the center of their warp are brought along with no inertial effects. Inertial effects are felt by the bodies only when the objects themselves collide. Thus, the warp of space is elevated to a significant actor in the force of gravity and how it is related to the lack of inertial effects. This is a new and original explanation of gravitational attraction, solving action at a distance elegantly.

Additionally the Dium TOE subsumes all the fields as being properties of the dium itself. It is important to be clear what this means. The fields like gravity, electric, magnetic, etc, exist but as properties of some kind of geometric shape of the dium. The fields do not exist in the Dium TOE as some kind of region independent of the dium. All these fields now become properties of the dium: inflaton, gravity, electric, magnetic, charge and Higgs. Inflaton may not actually be a field, just a cause of the initial rapid expansion of the universe that might be explained differently. The Higgs field energy component is merely Axiom 3 in the Dium TOE. The Strong and the Weak forces are left to be determined if they are fundamental properties of the dium or can be derived from the properties already provided.

The Dium TOE is a Reality-Class (Figure 4) model because it addresses directly and initially what natural dimension is. The alternative Predictor-Class models do not address this but instead are extremely useful at predicting how much will happen, but not what is. Often in Predictor-Class models it is meaningless to ask what-is something, but instead calculate the values to predict the measure of something. Only a Reality-Class model such as the Dium TOE can answer “What is natural dimension made of?”. [*Do not conflate this question with useless ones like “what is the meaning of life”*]

2) **Dark Matter**: The Dium TOE has a solution in Definition 19 and 7.1, 7.2. Tridium expresses mass and its warp of space (gravity) as a kind of “pinch” or compression of space, like a pinch of a rubber sheet in 2-D but this is 3-D volume. If the pinch is static it is unchanging. If the pinch was straight inward then it has no twist, else the pinch and twist represent mass and charge respectively. Most particles except neutrinos have a charge which the Dium TOE models as a static twist of tridium. If the charge (twist) is decoupled or stripped from the warp, the warp is exactly the Dark Matter: gravity without charge and thus non-interacting with ordinary matter. Neutrinos prove particles with mass need not have charge, but DM is not necessarily neutrinos. Dark-Matter is these combined warps of space lacking charge yet having gravity by their warps. They travel right through normal matter affected only by gravity. Thus, for Dark Matter, no new particles need to be added to the Standard Model as it is just existing particles that got their charge removed to leave a warp in space.

How the charge and warp can be decoupled is to be determined. How matter and antimatter particles are created in the first place is also unknown, and how they annihilate is also unknown. So it is not as if there is just one new mystery here. There are two opportunities here to create DM, the first by modifying the creation process and keep twist away from the compression, and the second to modify annihilation to perform half its task and just decouple these without releasing the compression of space.

The Dium TOE dark matter candidate, being a pure warp of space without charge, should be affected only by other gravity warps of space. They will be highly undetectable individually since they are as tiny as original particles. Their presence very likely can only be detected by their combined mass warp of space. If this explanation of charge being decoupled from the mass warp is how Dark Matter is being created, then five times as much matter has already been converted to DM. That is assuming matter is 5% and DM is 25% of the universe. This dimple warp can travel through planets effortlessly. They probably can traverse through black holes.

If the decoupling of mass and charge results in a static charge, then that charge and warp go separate ways slowly. If the decoupling causes the charge to oscillate dynamically, then it is an electromagnetic (Rotor) wave. Whether static or dynamic, the charge without mass should be detectable and should provide supporting evidence for the decoupling. However, two equal and opposite static charges lacking mass will attract to each other without inertia and should neutralize each other.

3) **Dark Energy**: The accelerating expansion of the universe implies space itself does not dilute its energy as it expands. Such volume expansion while retaining the same amount of energy in the same original volume seems to break the Conservation of Energy Law. For example, if an atmosphere with finite energy expands in volume, the original volume now has less energy in that volume because some of the energy is now in the expanded volume. But Dark Energy does not dilute its energy density as space expands. Otherwise the universe would have less energy density in the increased volume with which to use to expand further and thus could not continue accelerating the expansion of the universe. Therefore cosmologists conclude the Dark Energy does not thin out as it it expands. It remains constant as the universe expands. In human experience this seems impossible.

There is one entity that has this property and it comes from abstract Mathematics. The continuous real number line, or a continuous plane if 2-D, or a continuous volume if 3-D has the property of infinite stretch or scale. An analogy will demonstrate how this abstract continuous thing models Dark Energy perfectly. A snippet of the real number line such as from 0 to 1 can be scaled to 10 times that length to be 0 to 10, repeatedly and infinitely. After each expansion take the snippet from only 0 to 1 before the next expansion. Because of the continuous property of the Real Numbers, no matter how many expansions or contractions in reverse, any snippet of the line can itself expand or contract and yet retain the same infinite scale within it to repeat that infinitely. One tenth of infinity is still infinity, repeatedly. The Dium TOE continuity property from Axiom 1 and Axiom 3 that space IS energy, not merely has energy, results in the dium not losing any energy as it expands. Thus the XYZ Real Number volume in abstract Mathematics models the Reality Class Dium TOE continuous natural dimension in the specific case of expansion and contraction.

There may be another consequence of the expanding universe and the Dium TOE. In a gravitational field time slows as per Einstein's Relativity. In the Dium TOE, gravity is a stretched region of space or dium. If stretched dium (space warp) equates with slower time, this can be applied this to the expansion (stretch) of the universe. As the universe expands there is a general and universal slowing of time. Such a slowing of time everywhere may not be detectable as it is universal. As time slows, there can be a perception that things are speeding up, which in fact curiously matches exactly the accelerating expansion of the universe. As dium is continuous (infinitely stretchable) so is time continuous with no lower bound to slowness. But does time slow as the universe expands since time is special from the dium? Space density thins but it still has infinite energy in any volume.

There is another variable in the expansion of the universe. Tridium may have a geometry of a simple cube or sphere with an outermost edge. Or it may wrap around and connect to itself like a 1-D line segment wraps around to make a circle, and a 2-D plane wraps around to make a ball. In the line/circle and plane/ball example, a higher container dimension is necessary to allow for that wrap around curvature. To allow for that in tridium a higher container dium (quadium) would be necessary. Time could be that dimension, or a fourth spatial dimension. If the expansion of the universe is like the dimensionally reduced ball with interior volume being history and exterior volume the future, then the expanding ball may not require any energy at all. It may not be caused within the tridium. The force controlling expansion could be external to tridium like temporal pressure from the inside. If it is temporal pressure driving the expansion of the universe, then the 75% estimate for Dark Energy is unnecessary and factored out, elevating matter and dark matter from 5% and 25% to 16.6% and 83.4% respectively. These are options left to explore. The Dium TOE has not solved everything yet. But beware lower diums pushing unknowns into higher diums.

4) **Nothing**: There have to be additional words to define "nothing" to distinguish it from natural dimension. The word nothing is used almost universally to refer to no corporeal object. Thus a cardboard box in a room can be empty, having nothing in it. Yet it has air, and electromagnetic waves are

traversing it. This kind of loose usage of nothing can be called Weak-Nothing. Moving up the scale there can be Medium-Nothing which can be in its most base form the dium itself, specifically tridium in its continuous phase. If there could exist a box which could let particles and waves out through its sides but not allow those in, and also calm the space to prevent matter-antimatter particles popping into existence, then after a while this volume in the box would be tridium minus particles and fields. That is Medium-Nothing. The final scale is Strong-Nothing which is the lack of dium itself. Strong-Nothing is lack of natural dimension. The fifth-dimension at right angles to tridium and time has not been proven to exist, so it is Strong-Nothing. Ditto all the other natural dimension from 5 to infinity, all Strong Nothing. Just because one can imagine higher dimensions and use equations with their higher variables does not make them real or natural, they remain abstract.

Since Natural Dimension has orders as numbers to indicate linearity, planar, volume, etc to higher dimensions, a constraint is placed on Strong-Nothing to limit it to natural dimensions higher than 3 if time is a part of tridium, or 4 if time is its own unique Natural Dimension. Tridium with time progression is a natural dimension object and thus is a thing, specifically Medium-Nothing and containing many Weak-Nothing cardboard boxes. Outside of 3-space with time is Strong-Nothing, which is the absence of natural dimension. It is not appropriate to refer to the absence of natural dimension as a thing, it is the absence of thing, thus Strong-Nothing does not "exist". One cannot move or translate into an empty space of Strong-Nothing to occupy it because it does not exist. An empty slot of space is Medium Nothing, easily moved into. Strong-Nothing is not even that.

5) **Time**: From Section 5 of the Dium TOE there are two competing models of time. Type 1 is where time is the 4th dimension with storage allocated for a future and past and a dynamic Now, and Type 2 where time is only a dynamic Now property of tridium and lacking the storage for the past and future. Since Type 2 time has no storage for future nor past, arbitrary travel to the future or past can be ruled out, only travel forward with the dynamic Now. But Type 1 time has future and past allocated so it exists, thus arbitrary time travel cannot be ruled out, but neither is it guaranteed. Time is distinct from space in that time progresses to the future.

Nobody has demonstrated time travel to the past. But time progression can be slowed by traveling at high velocity relative to the speed of light or be in a strong gravitational field or acceleration. To be compatible with Einstein's SpaceTime of Relativity, time can be modeled to have the Now vector. The Now is like a conceptual unit vector in normalized coordinates 0 to 1. When motion is at rest against space itself, this vector points entirely straight to the future at right angles to XYZ. Fastest time is no motion against space. When this vector points at any angle up to 90 degrees away from straight to the future, such as towards any XYZ direction, that motion in XYZ detracts from the forward motion vector in time, a velocity against space and slower time. However the unit vector is not linear when time is reduced and spatial velocity is increased. At 90 degrees away from straight forward in time is the velocity of light c, and time stops as per Relativity.

There is further work on Time in 10).

6) **Vacuum Catastrophe**: This is the difference of 120 orders of magnitude between the observed values of vacuum energy density (the small value of the cosmological constant) and the theoretical large value of zero-point energy suggested by quantum field theory. The above discussion on Dark Energy showed how continuous space can expand infinitely. The Dium TOE Axiom 3 is that continuous natural dimension IS energy, not just has energy. The word "has" provides an ambiguity which would allow interpretation of "has" being the energy coming from particles and fields within a volume. But "is" is more restricted, meaning that the space itself is energy, not because of the sum of particles and fields in the volume. Having infinite expansion ability and being energy, it is easy to deduce any volume of space has infinite energy. Thus the Dium TOE would make the 120 orders of magnitude difference in the Vacuum Catastrophe trivial since the high number in the Dium TOE is infinity. The Dium TOE theoretical value for energy density of dium in any volume of space is infinite.

7) **Neutrino Oscillations of Mass**: Neutrinos change their mass as they transform into each of the 3 Generations of Matter in the Standard Model of Particle Physics. Each of the 3 neutrino generations, the electron neutrino, muon neutrino and tau neutrino have different masses, and increasing respectively. If one neutrino is observed to later become a different

neutrino, it has different mass. Thus the neutrinos oscillate and change mass. In the Dium TOE Definition 18, a dynamic dimple wave is one which oscillates in its compression, like a pinch of space rebounding back and forth in compression. This is different from a static dimple wave of Definition 19 which is like a static pinch of space, no rebounding of density. Only neutrinos exhibit these mass oscillations and only the neutrinos of the Fermions have no charge.

It is possible to hypothesize or deduce that charge is the or at least a mechanism to stop oscillations in mass since every other fermion with charge has static mass. But that is not conclusive, only hypothetical. That is all that neutrinos are, dimple waves of space where the compression is rebounding from max to min endlessly and there is no twist of space, thus no charge. It is even possible for several overlapping compression oscillations to be present simultaneously in the same particle. With such a multi-compression oscillation, the order of the oscillation between generations need not be linear.

8) **Particle-Wave Duality**: In Quantum Mechanics this is the particle-wave duality where any quantum entity can be a particle to satisfy certain experiments and that same entity can also be a wave to satisfy other experiments. In the Dium TOE an electromagnetic wave is a rotational twist oscillation of dium. Analogously, using dimensional reduction to a 2-space rubber sheet, apply contact from above and below the planar rubber sheet with the thumb and finger and perform a twist where the axis of rotation is in the Z direction outside plane. Release the contact and the sheet will rebound to neutral because a rubber sheet is made of discrete atomized molecules. But a continuous sheet has the property of rebounding to neutral and then past to the other negative maximum, stopping and then rebounding back to original twist, and repeats infinitely. Now undo dimension reduction and this twist of tridium is that extruded in 3-D except with the rotational axis being Z instead of higher 4-space. Thus as per the Dium TOE Definition 15 a Rotor Wave is defined as a torsion wave in space itself. Definition 16 then defines EM waves as being Rotor waves. In this sense an EM wave with oscillatory wave behavior is also like a particle having this compact torsion volume.

In the reverse, a particle is a higher compression of dium at the center surrounded by lesser density dium borrowed for the central compression. Except for neutrinos the compression is static. If charge is present, then dium is also twisted in some shape. It is easy to see that the density change for mass and twist for charge if present means the particle does not have a simple classical “sphere” where the particle is and outside is not particle. The density change for mass and twist for charge is gradual, extended and drops off to neutral space. In this sense the particle has some extension beyond its central part, the distance where gravity is affected and ditto charge if present. This extension into the dium surely is the means by which particles are also able to be modeled as waves. See the Double Slit Experiment 11) for more on this.

9) **Rest Velocity Against Space**: The Dium TOE differs from Einstein’s Relativity in that with Dium there is a rest velocity against space itself. The Michelson-Morley Interferometer experiment failed to find this rest velocity, but there are two other ways to do this. The easiest way is already done with the Cosmic Microwave Background (CMB) radiation anisotropy where the raw data measures a Doppler shift of shorter wavelength in one direction and a longer wavelength in the opposite direction. This CMB Doppler shift is the motion against dium as the Earth rotates, as the Earth revolves around the Sun, as the Sun moves through the galaxy, as the Milky Way galaxy moves in the Local Group, etc. Entry-level physics books provide this answer as the motion against the background radiation, but they do not say it is motion against space. It can be deduced that since CMB radiation moves at a standard velocity c it needs a standard to move against, else the CMB could catch up and surpass other waves. The standard at which all electromagnetic waves in free space moves against is space itself, the natural dimension tridium.

A different way to measure velocity against space is An Experiment in Relativity Figure 5 which is simply the Twins Paradox experiment carried out in each XYZ axis twice. Each pair of twins is departing in opposite directions in an arbitrarily chosen XYZ axii. There is no universal XYZ axis. Consider in the X axis, two twins depart Origin Base in opposite directions. Against the master clock at Origin, General Relativity results in the clocks that return with each traveler to be slower than Origin. But only in the case of Origin being at rest velocity to space itself will both X travelers clocks be identically slow. The bias of Origin moving through space will cause one axis travelers

clock to be slower or faster than the opposite axis traveler. Ditto Y and Z.

This experiment is easily shown to be fool-proof when each of the 6 travelers themselves can also, while traveling away from Origin, launch their own sub-Experiment in Relativity with their ship as the sub-Origin Base, and they need only test their single axis. The clock on the ship they send from sub-Origin towards Origin Base is conflicted in that it must be on the faster time rate with OB compared to SOB, yet it must also be on the slower time rate than SOB in order for the time paradox to work. Both cannot be true if the Twin Paradox is true for any pair of departing twins from an Origin Base. The factor of the Origin Base moving through space (dium) impact results. Only the case of OB being at rest velocity against space will all 6 clocks returning be equal to each other. This is a test of the Dium TOE which could refute it.

Alternatively, it is easy to see that two photons traveling in exactly opposite directions from the same origin each travel at velocity c against space. Their separation velocity is 2c. There is a central point which is always half the distance between both photons. This central point is not necessarily the device which emits the photons because that device may be moving against space and not have the rest velocity. Subsequent photons released again chase the original photons but never catch up, nor do they fall behind further. The subsequent photons maintain an exact distance behind the earlier photons. The photons travel at a velocity of c against natural dimension.

10) **The 3 Generations of Matter in the Standard Model of Particle Physics**: The Dium TOE may provide some insight into this in a few ways. The Dynamic Now in Section 5 of page 2 modeled in Type 1 does not say it has 0-thickness along the 4th dimension of time. There is not anything that explicitly requires the Now to be 0-thick. The Now could have thickness >0 in time. This means it is possible for there to be a little “play” or variability (not tight) in the range of the dynamic Now instead of it being instantaneous with zero thickness temporally. If the Now had a range of perhaps 1 millisecond, then at one end is the edge of history where time becomes solid chronodium. At the other end of the range is where time is fluid chronolium. In between both edges of the thickness of Now is the middle. The edge of Now at history is one, the middle is two, and the edge at the future is three, making three generations of matter. This chunk of time could be thought of as the time it takes for QM probability functions to “collapse” into place. Alternatively, if frozen time is analogous to a crystal and the future is fluid, this chunk is the crystallizing of reality as all falls into place.

The temporal dynamic Now could be more intuitively modeled as a 3-wave train into the future where our 1st generation is at the tail edge where time solidifies into history and the 2nd and 3rd generations of the Standard Model particles are two leading edge longitudinal time compression waves slightly in the future. Some property of being too far ahead causes particles there to break apart and have short lives. It may be that the closest proximity to solid time (history) allows its property of “unchanging” or “static” to give 1st generation particles their long unchanging static existence. Perhaps touching the edge of history or anchoring into chronodium freezes the 1st generation particles into being long lived and stable.

Another potential solution comes from neutrino oscillations. These were modeled earlier to be oscillations in the tridium of rebounding compression of space inward and outward. As each of 3 neutrinos are in different generations, the above model of the 3-wave train would imply the neutrino can travel slightly ahead into the future and rebound back to our time without moving in XYZ. This model would also imply that all the particles in 2nd and 3rd generations are from the two temporal waves slightly ahead in the future of our 1st generation. If the 3-wave train in time model is real, it may also allow for additional waves in the train, perhaps a 4th and higher Generations of Matter may have existed in the past, and/or may develop in the future. All options are open. This neutrino model would require it to not be anchored into the chronodium of history like normal constant-mass particles.

11) **Double Slit Experiment**: In physics, Richard Feynman said this experiment defies any Classical explanation. It is an experiment that shows classical particles behaving as both particles and waves, and results change when the observer measures it closely. The Dium TOE may provide the solution. The Double Slit experiment contains 5 variables, 1) an emitter of objects (particles or photons), 2) the objects emitted, 3) a barrier with two slits for the objects to pass through, a 4) detector at each slit to detect which slit it passed thru when enabled, and 5) a receiver wall to record the

arrival of the objects. Thus, the experiment consists of these five things.

However, the Dium TOE would add a 6th thing that is not previously considered to be a part of this model: tridium, the space the objects travel through as a continuous object. Where the object is a particle like an electron or a wave like a Rotor-Wave, it travels through space which is continuous natural dimension. As an extended object in dium it may be able to have part of its extended self travel through both slits simultaneously to interfere with itself. Without the tridium in the model it is exceedingly difficult for the particle to split into two parts and travel through both slits. The simple addition of the 6th component tridium to this model is an elegant and natural solution.

12) Richard Feynman and others say **"nobody really understands Quantum Mechanics"**: The Dium TOE may provide the reason why. Predictor-Class models are supposed to predict things, usually with mathematical equations. Such a class of models are not supposed to explain the qualitative What-is something. The mantra of the Predictor-Class scientist is "Shut up and calculate". Quantum Mechanics is a model which assumes small things are discrete quantums. The opposite of Quantum Mechanics would be the opposite of the discrete quantum: the continuous natural dimension object of the Dium TOE. Maybe nobody really understands QM because it is not a Reality Class model.

III. DISCUSSION

It is allowed and encouraged to pick and choose the axioms, sub-axioms, definitions and other parts of the Dium TOE model to solve challenges and mysteries, as in On Applying The Dium TOE, Figure 6.

The obvious astonishing thing about the Dium TOE is that in the two-page Communication which defines it there are no equations. Yet it is a Physics and Cosmological model claiming to be a Theory Of Everything. It is impossible for a Theory Of Everything to lack equations, unless this model provides a mechanism to use equations from other models. That is exactly what the Dium TOE does in the Dium Order in page 1, right side. The Dium TOE is the foundation model, and other models layer on top of it. As the base layer, there is no layer more fundamental than the Dium TOE.

It is the conceptual equivalent of Object Oriented (OO) programming sub-classing from Software Engineering, but this is not software. It is modeling Reality. The Dium TOE is the base "class", other models can extend it and add their own additions like equations as layers. A conceptual model from before OO is the software APIs where there is a base library, then others build on that, and others on top of those. Having mentioned software I do not want to diverge to Simulation universe but will just point out the Dium TOE Definition 13 eliminates all Simulation universes.

In answering (1) Space Object, the Dium TOE addresses directly what this volume is, the property of continuous, conservation, energy, and moves on to properties of this object that will form the basis of dynamism, particles and constant. This establishes the dium as the fundamental object of the universe from which all else is derived, a non-trivial effort. It did take 24 years to achieve, no small effort.

In answering (2) Dark Matter, the solution merely accepts the last several decades of failure to find Dark Matter and instead applies the decoupling of mass and charge predicted in 7.1. Such a decoupling obviously leaves the miniscule gravity warps of space to be exactly Dark Matter.

In answering (3) Dark Energy, the Axiom 3 that dium is itself energy and Axiom 1 that dium is continuous natural dimension together result in infinite energy of any volume of space itself. Thus, there is no lack of Energy needed to fuel the expansion of the universe, even accelerate it. Although the presence of energy is solved, the mechanism of applying that energy is not provided. That mechanism is likely tied to the early inflationary period at the Big Bang. Still, solving half the problem of where does the energy come from is significant.

In answering (4) Nothing versus Space, a very detailed breakdown of nothing into Weak Nothing, Medium Nothing and Strong Nothing was described to leave it clear how Nothing is related to Space and how common usage of that term blurs the meanings.

In answering (5) Time, the Dium TOE has two Types (1 & 2) that provide different possibilities of the extension of time into allocated future and history, or just the Now. Neither Type is yet proven to be reality so both Types remain options. A simple model with normalized unit vectors in XYZT was provided to show how motion in space affects time, a highly simplified representation of time slowing down at higher velocities.

In answering (6) Vacuum Catastrophe, it is explained that 120 orders of magnitude difference is actually trivial compared to the difference with infinity. Thus the catastrophe is actually comparing or measuring the wrong things and came up only 120 orders of magnitude difference.

In answering (7) Neutrino Oscillations, Definition 18 of the Dium TOE was actually present in the Dium TOE before the author realized neutrinos oscillate, so that is effectively an original prediction of them. That is a sign the Dium TOE is right on track. The neutrino oscillations are merely a dynamic in/out compression of dium.

In answering (8) Particle Wave Duality, Electromagnetic waves are shown to be dium Rotor waves, a special case of a torsion wave in dium itself. Particles are also extended into the dium, not some ball that cuts off at its surface. In this way waves and particles are part of the dium and this is how both seem to be interchangeable by Quantum Mechanics.

In answering (9) Rest Velocity Against Space, the Cosmic Microwave Background radiation is the first method using its anisotropy which has a biased direction in space. An alternative way to measure this is using the Twin Paradox itself, scaled up 6 times, two for each XYZ axis. Send out the twins, when they return with clocks behind, the difference in the clocks per axis will point the way to the Rest Frame in space. This test should be foolproof as everyone says the space faring twin returns at less age. This test depends on that.

In answering (10) Three Generations of Matter, this was the hardest to find a solution for. Two possibilities were explored, one that the dynamic temporal Now may have a small thickness range instead of having no thickness. This would provide for 3 places, at the edge of history, middle of thickness and the edge of the future. A variation of this concept as a 3 wave train in time is probably easier to grasp. The closer to frozen history would provide the mechanism to freeze particles to long life, the other two waves for generations 2 and 3 result in particles falling apart with no anchor into frozen history. Then the oscillating neutrino is applied into this hypothesis to claim it oscillates slight into the future for 2nd and 3rd generations. A consequence of this model is that all 2nd and 3rd generations particles are also slightly ahead in time.

In answering (11) Double Slit Experiment, this is highly related to (8) Particle Wave Duality and the reasoning is similar. This missing piece of the experiment is that dium was never factored into it. When particles and waves are factored in as being extended in the dium, that is the extension they have that allows them to pass through both slits and interfere with themselves. No need for a separate pilot wave to be present as per Bohm, the dium subsumes that concept of extension.

In answering (12) where Richard Feynman and others say, “Nobody really understands Quantum Mechanics”, that is explained as because QM is a Predictor Class model where “what is _____” is considered meaningless. Instead, just calculate how much. In QM, the Particle Wave duality is not a problem, it is a feature, so “shut up and calculate” is the mantra. With the Dium TOE, these “what is “ questions are welcome and addressed directly.

The dium may seem like the Aether, but that was supposed to be some kind of very fine fluid filling the void. But in the Dium TOE, the void is the dium, and there is no need for an aether fluid to fill dium. Dium subsumes the aether fluid and all fields as properties of the continuous natural dimension.

As a lower baseline of reality, the Dium TOE allows higher level models like discrete Quantum Mechanics to layer on top of the baseline. The Dium TOE can coexist with Quantum Mechanics even if QM is a discrete Predictor Class model. They model different levels. The Dium TOE is the base of reality. QM is a predictor class model of discrete quantums where “what is space” is meaningless. It is entirely allowed and expected that there can be the Dium TOE with a higher level model that replaces the discrete Quantum Mechanics probability model with one that

uses no probabilities and which integrates well with General Relativity.

The Dium TOE also differs from Quantum Mechanics in that the dium has no need for a Higgs Field. Dium mass and inertial effects are the result of the warp compression of dium and how these warps interact and bring along their particle as described in Section 6, page 2 of 2 of the Dium TOE.

The Dium TOE also differs from General Relativity (GR) in that GR says planets orbit around the Sun in a straight line in curved space where such a "straight line" is an ellipse. If space was curved such that a straight line became an ellipse as the orbit, then a photon should be required to follow that "straight line" orbit. This claim of a straight line in curved space fails in explaining this.

When engaging in hypothetical modeling using the Dium TOE, it must be understood that humans bring with them an experience based in discrete objects like the sub-atomic particles, atoms, compounds, and aggregates of these. But the Dium TOE is continuous. The proper heuristic to use when applying an experience based in discrete objects to the continuous dium is to not let our discrete experience be the limiting factor in the continuous model. Because discrete models are less precise than continuous models, do not allow properties from discrete models to constrain continuous models. Instead allow the continuous model be unconstrained by discrete principles. That approach has worked well for me so far in the Dium TOE.

CONCLUSION

The ability of a Theory Of Everything in Physics and Cosmology to provide solutions for the 12 most intractably hard challenges in Physics and Cosmology is an indicator that TOE is right or is on the right track. The Dium TOE achieves that. A single fresh idea that Space itself is a continuous thing that exists in nature is the basis for all these twelve solutions. Even if the solution is highly theoretical, that at a minimum provides traction to generate more ideas with variations where none existed before. In this way, ideas are put forth, even if unproven, but get the ball rolling. When solving intractable challenges, any traction is useful. The Dium TOE has elegant solutions for most of these challenges in Physics and provides a lot of traction for the remaining. That it does this without equations is exceptional.

There are countless directions for further applications and research in the Dium TOE. Finding the exact shape(s) of twist charge to show geometrically how the positive and negative charges are shaped in the dium is one good research project. It is possible the twist of dium as charge may be allowed to be inhomogeneous, adding yet more variability to what charge is and how many different kinds of charge are possible. That is another research opportunity. The compression or warp of dium from mass also may have inhomogenous properties, creating yet more variables and opportunities for mass to express itself. The origin of mass and inertia section also deserves more exploration as mass and inertia are decoupled and allowed to express distinctly in the Dium TOE. Almost every sentence in the Dium TOE Communication opens new opportunities for research that deserve exploration. I foresee a new era of study in a new domain of Physics and Cosmology: Dimensional Mechanics.

REFERENCES

None, the Dium TOE began with a blank slate.

APPENDIX FIGURES

This paper draws from five Communications of the Intractable Studies Institute. The first is the Dium TOE. These Communications are self-published at http://IntractableStudiesInstitute.org/Communications/. Urls to each are at the caption of each figure. The Dium TOE was originally self-published as a Communication of the Intractable Studies Institute in 2013, the same year as the founding of that Institute. It was prior self-published in 2011 in my ebook, "Penzar – Journal of Advanced Ideas" ASIN: B005007BSY, chapter 15 as "The hypothesis of natural continuous dimension object". The formatting of the Communications use a different standard than for this paper.

Theoretical

Dium TOE: What Natural Dimension is Made Of

A Communication of the Intractable Studies Institute
Patrick M. Rael, Director, IntractableStudiesInstitute.org

Abstract: The Institutes position on the universe is that dimension itself has to be re-solved before particles and forces. Such a solution is provided here. - Director

1. Modeling Rules

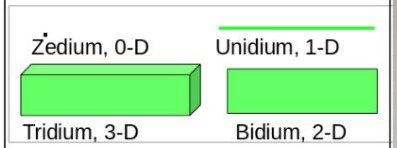
1. Initial state is no thing, no dimension, and zero assumptions.
2. All entities including dimensionality must be declared before used.
3. Assumptions must be declared.
4. Minimize assumptions, but no less than necessary, and no limit.
5. Definitions are word(s) substitutions.
6. Hypothesii can be either proven or dis-proven.
7. Theorems are provable within the model.
8. Conjectures have expectation of proof.
9. Opinions have no rigorous value.

2. The Dium Hypothesis of Natural Dimension

Definition 1: Axiom is an assumption.
Definition 2: Natural dimension is the dimension that is our reality, as opposed to artificial and/or abstract dimensions such as the Cartesian plane for the relation of arbitrary variables in equations.
Definition 3: Continuous – A region which is made entirely of one thing, not a collection of many discrete atomized things. The continuity is infinitely small, therefore not constrained by the principle of atomicity.

Axiom 1: Natural dimension exists as a continuous object.

Definition 4: dium is continuous natural dimension of any cardinality.
Definition 5: zedium is a 0-dimensional continuous point dium.
Definition 6: unidium is a 1-dimensional continuous linear dium.
Definition 7: bidium is a 2-dimensional continuous surface dium.
Definition 8: tridium is a 3-dimensional continuous volumetric dium.
Definition 9: quadium is a 4-dimensional continuous 4-D dium.
Definition 10: chronodium - the solid form of time, aka history.
Definition 11: chronolium - the dynamic form of time, aka future.
Definition 12: dium density - the amount of dium per region.



Definition 13: Universe is the union of all natural dimensions.

Axiom 2: Natural dimension can neither be created nor destroyed: it can only be transformed.

Axiom 3: Natural dimension is fundamental energy by existence, not by relation.

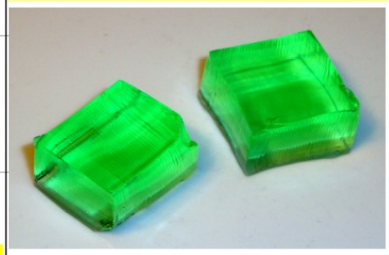
Axiom 4: Natural dimension is capable of phase property, and 3 phases: continuous, particulate and constant.

Definition 14 : Visco-elasticity of dium - A property of any dium where a subset of the dimensions region can deform in an elastic, flowing, and twist without necessarily causing the coordinate system within the dimension to also deform. The resistance to deformation is not caused by particle collisions as in matter fluids, because dium is a continuous object.

Sub Axiom 4.1. Continuous phase dium has three properties:
4.1.1. Elastic property gives rise to gravity.
4.1.2. Flowing loop property gives rise to magnetism.
4.1.3. Twist property gives rise to charge.

Sub Axiom 4.2. Particulate phase is a particle.
Sub Axiom 4.3. Constant phase is static dium, aka history.

Sub Axiom 4.4: Natural dimension in the elastic phase supports rotor and dimple waves.



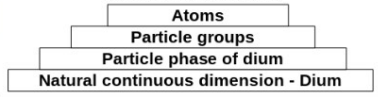
Gelatin cubes are an imperfect analogy to dium.

Definition 15: A rotor wave is a local twisting (torsion) oscillation of dium which then rebounds back in the opposite direction, then back, repeating endlessly without dissipation. A rotor wave can travel in a direction perpendicular to its axis of rotation. It is the dimension itself which is twisting.
Definition 16: An electromagnetic wave is a rotor wave.
Definition 17: A static rotor wave is a rotor wave which stops oscillating at a moment in the oscillation cycle. The region of space is left with a twist. This twist is called charge. The amount of twist is the amount of charge.
Definition 18: A dimple wave is an oscillating rebounding inward/outward compression of dium to higher/lower than surrounding density which then rebounds back, repeating endlessly without dissipation.
Definition 19: A static dimple wave is a dimple wave which stops oscillating at some moment in the oscillation cycle. If the oscillation stops at maximum compression then dium density is higher at the center and at a lesser density surrounding. The delta in density is called a warp in space-time, aka gravity. The higher compressed inner region is called "a particle".

Sub Axiom 4.5: All waves in dium are propagated solely as a property of the continuous dimension, not as particle collisions.

Definition 20: Nothing - no dimension nor time. Empty space is dium, not nothing.
Definition 21: Solidity - A region where particle or solid dium cannot be co-occupied.

The Dium Order



Theorem 1: Natural dimension continues to exist when observers stop measuring it. [Certainty principle]

Proof: (Indirect method) If natural dimension ceased to exist, that would violate the conservation of natural dimension axiom.

Opinion 1: The preceding is intended to describe our known universe, as opposed to being only a theoretical model.

Hypothesis: Our 3-dimensional-spatial and temporal universe is composed of dium conforming to the axioms above.

3. The Mechanisms of 3 Fields

Gravitic attraction, **magnetic** attraction and repulsion, and **charge** attraction and repulsion, all have the common property of symmetry-seeking, thus reducing three unknowns to one unknown of symmetry seeking.

No. 007, 2014-02-16, Revised 2021-06-18

Figure 1: Dium TOE, pp 1 of 2, http://IntractableStudiesInstitute.org/Communications/TheoryOfEverything.pdf

Figure 2: Dium TOE, pp 2 of 2

Hypothesis: A particle with a dimple field is defined earlier has having mass. It is the distortion of the dium in its dimple wave that expresses the gravitational strength. Two+ particles have dimple fields that intersect, it is the fields themselves that attract each other, not the particles. The fields seek to achieve fully symmetric overlay centered on the dimple origin. This solves "action at a distance".

Hypothesis: The mechanism of magnetic attraction and repulsion: Magnetism is defined earlier as a loop flow of dium. When there are two magnetic fields near each other the loop flow vector field cannot flow through another loop flow magnetic field. Repulsion will occur when the vectors are opposing. The two magnetic fields attempt to achieve a fully symmetric overlay centered along the central axis of the flow. Opposite magnetic fields attract because this aligns the central axis of the flow. This solves "action at a distance".

Hypothesis: The mechanism of electric charge attraction and repulsion: The electric field was defined earlier as a static twist of the dium. The twist distortion of the dium can be visualized as a vector field. The twist is an in-equilibrium. Two equal but opposite charged/twist electric fields can create a symmetry only by canceling the twist by superimposing both twisted dium fields. The fields seek this symmetry state by opposites attracting. Same twist/charge fields repel because that decreases the symmetry. The exact shape of the twist is not provided here.

The three dium field properties above combined with dynamic and static temporal produce a rich set of properties of the universe. More properties and/or combinations of these likely account for the rest.

4. The Geometry of dium

Theorem 2: The union of two or more diums of max cardinality N results in the same N ie; two lines are not a plane. Proof trivial.

Theorem 3: The intersection of two or more diums of max cardinality N results in the same max cardinality N. ie; ditto

5. The Nature of Time

Two competing models of time are presented with very different characteristics.

Axiom 5: Temporal change implies a delta in time from T0 to T1. If no time is present, there cannot be change.

Theorem 4: A static universe will always remain static.

Proof: Given a static universe which is the union of ALL dium, ANY introduction of delta time requires time to do that, conflicting with the prior assumption of static universe. You cannot find the time to introduce delta because it's all static as per the definition.

Type 1 Time: Container + Dynamic Now
1. Incorporates an extra chronolium and chronodium as a N+1 container dium for N-dium universe.
2. The NOW is the transition boundary and moves from history to future, partially analogous to a growing crystal.
3. The Arrow-of-time direction is well defined: past to future.
4 Time travel is not ruled out, but not guaranteed either.

Type 2 Time: Dynamic Now
1. Requires no higher-cardinality dium to function in a N-dium universe.
2. Is an intersection dium with the universe providing a morphing ability to effect change.
3. No room for a history store, nor a future store, just a dynamic now.
4. Where a spatial dium provides storage ability but no change, a Time dium provides for change ability for a spatial dium.
5. The Arrow-of-time is not well defined, only a transition.
6. Time travel is ruled out because of lack of time storage.

The Dynamic Now object is self-sufficient for time progression. This object seems to be distinct from the static storage of temporal history which any container dimension can provide. This object seems to be a second kind of object distinct from dium. This may require an addition to the Dium Order.

6. Origin of Mass and Inertia

1. A particle with mass is in an equilibrium state when it's at the center of its warp in space.
2. The gravity well of a particle is more than a side-effect of the mass of a particle: the gravity well is the origin of mass and inertial effects of the particle.
3. When a particle is struck by another particle, it moves non-smoothly out of its centered position into a state of dis-equilibrium. It is the dis-equilibrium of the gravity well that resists this non-smooth jolt, not the particle. Therefore, particles with no mass, and thus no gravity well, have no inertial resistance to acceleration. It is the adjusting of the gravity well around a particle which is the origin of inertia. This decouples mass from inertia.
4. When particles with mass collide among themselves repeatedly they cause particle acceleration. This kind of motion exhibits the inertial resistance to acceleration by the particle because **the particle collision is inducing the motion and causing dis-equilibrium with its warp of space**. Thus a space ship launches from the ground with considerable acceleration forces felt by astronauts.
5. When a particle's warp of space encounters another warp, the warped fields themselves, not the particle, induce the motion of the field. When such a field-induced motion occurs, the particle is brought along with **no inertial resistance to the acceleration**. Thus a space ship already orbiting earth is accelerating and has no inertial effects.

7. Predictions

1. A particle and its warp of space **need not always be together**. If a particle is detached from its warp of space, then the particle has no gravitational field, thus no mass, and therefore is not affected by gravity. Such a particle has spatial extents, boundaries, and maybe charge, but no mass.
2. Correspondingly, the separated warp in space now has no particle associated with it, but can continue to exist. Since it is the warp in space that is the effect of gravity, **the warp continues to exert gravity** and is affected by gravitational fields. Such a warp in space without an associated particle is an ideal candidate for the elusive "**Dark Matter**" phenomenon. This is not a black hole. It is gravity without a particle.
3. Concerning "**Dark Energy**" and the seemingly accelerating expansion of the universe, Axiom 3 defines dium as energy. It's trivial to see there is clearly enough energy to expand the universe, but no mechanism is provided here. Here the solution is split into two parts: mechanism and energy to drive the mechanism. We provide a solution for the latter, thus half ways there.
4. There is no limit to the size of a rotor wave. A standing rotor wave is possible and is highly undetectable until intersected with.
5. If two equal but opposite rotor waves were superimposed, the *effect* of this is to net cancel their effect. However, **the two super-imposed waves continue to exist**. This is a way of hiding and storing waves/energy.

8. Fields and Particles

Opinion: It may be possible that dium are where the important scientific study should be focused, instead of the current particle based research, even for the search for intelligent life. Ie; it's possible the non-particulate universe is where the important action is, the particles being mere flotsam.

9. Extra - Razor and Question

1. Patricks Razor - **Natural dimension XYZ+T cannot be denied existence without also removing the x, y, z and t variables from equations.** The Dium is what provides these variables in the first place.
2. Patricks Question - What is natural dimension made of?

Theoretical.

Space is an Object in Nature

A Communication of the Intractable Studies Institute

Patrick M. Rael, Director, IntractableStudiesInstitute.org

Supporting Evidence for Space as a Natural Object.

Definition: Space = The 3-Dimensional volume with time progression that is a property of, and even the definition of, our natural universe.

Definition: natural object = something that exists in reality, not an abstraction.

1. In the Big-Bang Theory, space initially was very tiny, then expanded. If it is not a thing, how can it expand? Only a "thing" can expand.

2. Albert Einstein said space can warp as the gravitational field of bodies with mass. If space can warp as gravity, then it must be a thing to have that property. If space was no-thing it can't have properties because properties belong only to things or processes.

3. Gravitational Waves are ripples in space. If space can support a ripple as a gravitational wave, then it must be a thing to have that property. If space was not a thing, it can't have properties because properties belong only to things or processes. It is illogical to say both that space is not a thing, but that space has properties.

4. The String Theory, even though it is theoretical and unproven, models strings as vibrating 1-dimensional objects. If it's a vibrating dimension, it must be a thing. Physicists have difficulty accepting a 3-D volume object can exist when the evidence is all around us, but string theorists accept vibrating 1-D strings exists when there is little evidence of them. The stronger case of existence is for 3-D space object.

5. The Cosmic Microwave Background Radiation data shows a red-shift in one direction and a blue-shift in another direction. This is evidence of a standard cosmic rest frame, even if locally moving as per expansion or contraction. Such a rest frame is also naturally the cosmic natural dimension rest frame. See the Communication "An Experiment in Relativity: Time Dilation and Space" to find the cosmic rest frame at your locale.

6. Fields – If space itself is the fields of gravity, electromagnetic, and charge, then it's a thing to have these properties. But even if space is space and fields are independent in the space, then space contains the fields and thus space is the container. A container is a thing that exists, not a no-thing.

The kind of thing that space is:

1. Property of volumetric extension.
2. Property of temporal progression.
3. Property of container of particles.
4. Property of container of fields.
5. Property of gravitational wave propagation.
6. Property of warp as gravity around mass.
7. Property of supporting matter-antimatter creation and annihilation.

What space isn't:
1. Space cannot be nothing.
2. Space obviously cannot be a particle.

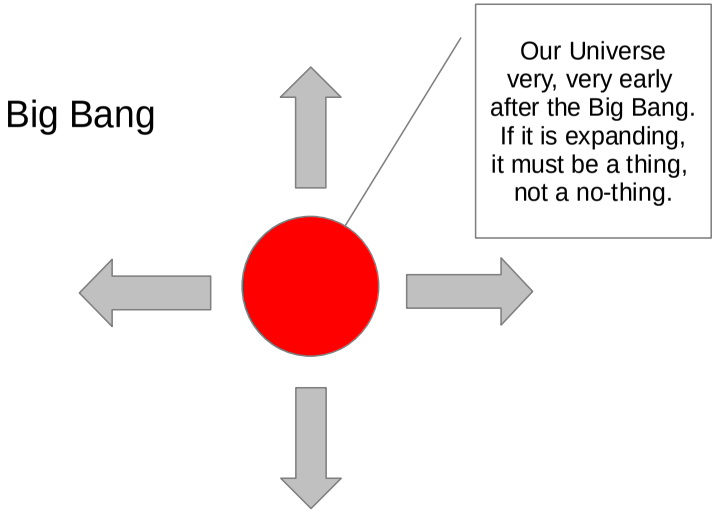


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Figure 3: Space is an Object in Nature, http://IntractableStudiesInstitute.org/Communications/SpaceIsANaturalObject.pdf

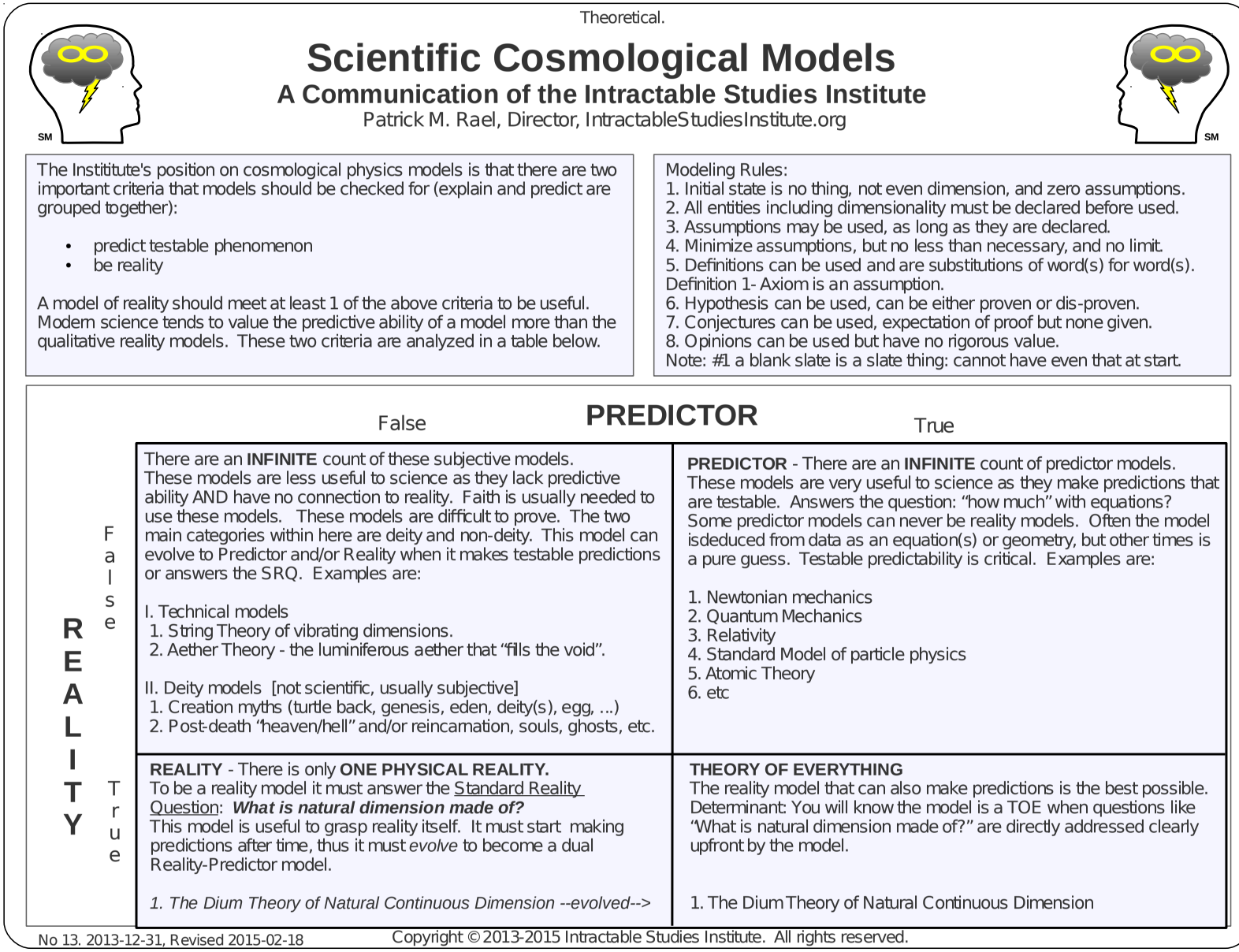


Figure 4: Scientific Cosmological Models, http://IntractableStudiesInstitute.org/Communications/ScientificModels.pdf

Theoretical.

An Experiment in Relativity: Time Dilation and Space

A Communication of the Intractable Studies Institute

Patrick M. Rael, Director, IntractableStudiesInstitute.org

6-Twins Test for Time Rate relative to Space

Abstract: Does velocity in space cause time-lag relative only to observers as per Einstein's Relativity, or does time slow relative to space itself? A test can be done to determine definitively if there is a time rate proportional to space itself, and which merely *seems* as if it is relative to observers. It is known that a space ship at near-c velocity that stops and then resumes near-c velocity in opposite direction will have slow time, faster time, then slow time again. A scaled variation of the twin-paradox test can test this where any observed bias in direction will be evidence of rest velocity relative to space itself.

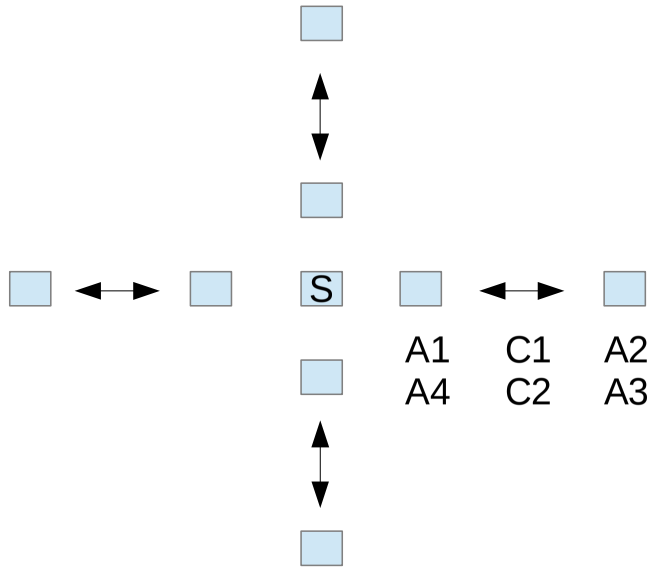
It is understood that if 1 "clock" is sent on a fast spaceship far away and then returned, that clock will have lost time compared to a "stationary" clock. This is the "Twin-Paradox" experiment. But does the direction of travel affect this experiment? An experiment can be done in 3 axii X, Y, and Z, with 2 opposite directions for each, making 6 ships clocks travel out and return. Each ship will be identical in construction, the only difference is the direction they travel. They accelerate initially A1 away from center ship S, coast C1, decelerate A2, accelerate A3, coast C2, decelerate A4 and then are back to the center ship. Minimize gravitational effects by testing far from gravity sources.

If direction doesn't matter, the clocks in all 6 ships that traveled should match each other in time lag since they all accelerated and traveled at the same speed and acceleration. Comparison to the stationary clock S is irrelevant.

If the 6 clocks return with different time lags, then direction matters. One explanation is that the clock-ships can be traveling at a velocity relative to space itself. Note that time dilation relative to space itself can still partially support the concept of pure relativity of time dilation relative to observers, this test will determine where these two diverge. If, at the start, the test must be "calibrated" to find the "rest frame", that proves the point, as the concept of the "rest frame" is relative to space itself.

Proof: Do the full test and compare the returned clocks. Time diffs can be used to find a vector to rest space. The faster of each pair of clocks points toward rest velocity.

Analytical Proof (thought experiment): If at C1 coasting right at velocity v there was another ship at 2v same direction, with a clock going slower due to higher velocity, then from the ship doing C1, it could repeat this experiment where it itself is the center, launching ships right and left. The one right that matches hypothetical 2v above must have slowest clock, the one left will match original central ship S faster clock, thus the direction will matter. This is trivially obvious. This test does not require visible observations of any other ship in motion as those observations aren't trustworthy.

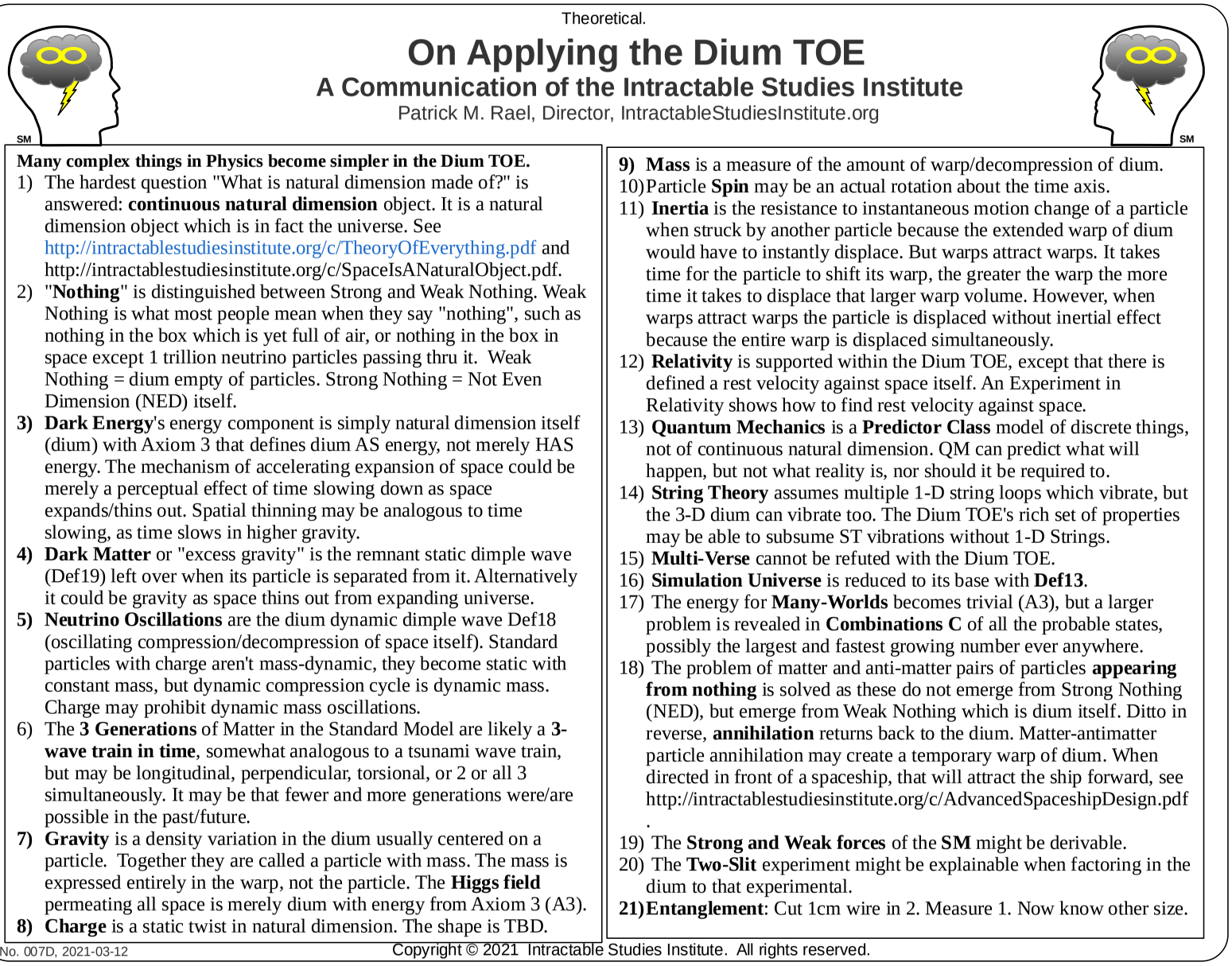


S Original clock-time rate.

C1 —v→ Slower clock-time rate than S.

—2v→ Slowest clock.

Figure 5: An Experiment in Relativity: Time Dilation and Space, http://IntractableStudiesInstitute.org/Communications/RelativityExperiment.pdf



Theoretical.

On Applying the Dium TOE

A Communication of the Intractable Studies Institute

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SM SM

Many complex things in Physics become simpler in the Dium TOE.

1) The hardest question "What is natural dimension made of?" is answered: **continuous natural dimension** object. It is a natural dimension object which is in fact the universe. See http://intractablestudiesinstitute.org/c/TheoryOfEverything.pdf and http://intractablestudiesinstitute.org/c/SpaceIsANaturalObject.pdf.
2) "**Nothing**" is distinguished between Strong and Weak Nothing. Weak Nothing is what most people mean when they say "nothing", such as nothing in the box which is yet full of air, or nothing in the box in space except 1 trillion neutrino particles passing thru it. Weak Nothing = dium empty of particles. Strong Nothing = Not Even Dimension (NED) itself.
3) **Dark Energy**'s energy component is simply natural dimension itself (dium) with Axiom 3 that defines dium AS energy, not merely HAS energy. The mechanism of accelerating expansion of space could be merely a perceptual effect of time slowing down as space expands/thins out. Spatial thinning may be analogous to time slowing, as time slows in higher gravity.
4) **Dark Matter** or "excess gravity" is the remnant static dimple wave (Def19) left over when its particle is separated from it. Alternatively it could be gravity as space thins out from expanding universe.
5) **Neutrino Oscillations** are the dium dynamic dimple wave Def18 (oscillating compression/decompression of space itself). Standard particles with charge aren't mass-dynamic, they become static with constant mass, but dynamic compression cycle is dynamic mass. Charge may prohibit dynamic mass oscillations.
6) The **3 Generations** of Matter in the Standard Model are likely a **3-wave train in time**, somewhat analogous to a tsunami wave train, but may be longitudinal, perpendicular, torsional, or 2 or all 3 simultaneously. It may be that fewer and more generations were/are possible in the past/future.
7) **Gravity** is a density variation in the dium usually centered on a particle. Together they are called a particle with mass. The mass is expressed entirely in the warp, not the particle. The **Higgs field** permeating all space is merely dium with energy from Axiom 3 (A3).
8) **Charge** is a static twist in natural dimension. The shape is TBD.
9) **Mass** is a measure of the amount of warp/decompression of dium.
10) Particle **Spin** may be an actual rotation about the time axis.
11) **Inertia** is the resistance to instantaneous motion change of a particle when struck by another particle because the extended warp of dium would have to instantly displace. But warps attract warps. It takes time for the particle to shift its warp, the greater the warp the more time it takes to displace that larger warp volume. However, when warps attract warps the particle is displaced without inertial effect because the entire warp is displaced simultaneously.
12) **Relativity** is supported within the Dium TOE, except that there is defined a rest velocity against space itself. An Experiment in Relativity shows how to find rest velocity against space.
13) **Quantum Mechanics** is a **Predictor Class** model of discrete things, not of continuous natural dimension. QM can predict what will happen, but not what reality is, nor should it be required to.
14) **String Theory** assumes multiple 1-D string loops which vibrate, but the 3-D dium can vibrate too. The Dium TOE's rich set of properties may be able to subsume ST vibrations without 1-D Strings.
15) **Multi-Verse** cannot be refuted with the Dium TOE.
16) **Simulation Universe** is reduced to its base with **Def13**.
17) The energy for **Many-Worlds** becomes trivial (A3), but a larger problem is revealed in **Combinations C** of all the probable states, possibly the largest and fastest growing number ever anywhere.
18) The problem of matter and anti-matter pairs of particles **appearing from nothing** is solved as these do not emerge from Strong Nothing (NED), but emerge from Weak Nothing which is dium itself. Ditto in reverse, **annihilation** returns back to the dium. Matter-antimatter particle annihilation may create a temporary warp of dium. When directed in front of a spaceship, that will attract the ship forward, see http://intractablestudiesinstitute.org/c/AdvancedSpaceshipDesign.pdf .
19) The **Strong and Weak forces** of the **SM** might be derivable.
20) The **Two-Slit** experiment might be explainable when factoring in the dium to that experimental.
21) **Entanglement**: Cut 1cm wire in 2. Measure 1. Now know other size.

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Figure 6: On Applying the Dium TOE, http://IntractableStudiesInstitute.org/Communications/ApplyingTheDiumTOE.pdf