The zero-dimensional physical theory (VI): charting the Clay Mathematics Institute Millennium Prize problems and Beal conjecture

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Abstract: Explored here are the Clay Mathematics Institute Millennium Prize problems, namely the Poincaré conjecture, the Hodge conjecture, the Riemann hypothesis, the Birch and Swinnerton-Dyer conjecture, the Yang-Mills existence and mass gap problem, the Navier-Stokes existence and smoothness problem, and the P versus NP problem. Here is identified how the possible solutions to each of these problems can be of use to physical theories. To be charted here therefore for each of these problems is their relevance to dimensional number theory in their application to physical theories, and if indeed a common dimensional number theory basis can solve these problems, and if so how, and if not why. In this charting process, it is found that curved 4d spacetime is an unlikely solution basis given the failure of the currently accepted solution to the Poincaré conjecture to solving the remaining problems. A new dimensional number theory basis is therefore proposed as a solution for the problems, and their solutions identified. By such, new solutions are also formed for Fermat's conjecture, Goldbach's conjecture, the twin prime problem, and the Beal conjecture.

Keywords: Clay Mathematics Institute; Millennium Prize problems; Poincaré conjecture; Hodge conjecture; Riemann hypothesis; Birch and Swinnerton-Dyer conjecture; Yang-Mills existence and mass gap; Navier-Stokes existence and smoothness; P versus NP; Beale conjecture; Fermat's conjecture

1. Introduction

Any well-based physical theory needs to conform with key fundamental basics and known limitations. Fundamental basics include consistencies essential to what is being measured and described, fundamentally the dimensions of time and space. There, other fundamentals include what a point in space and moment in time are as both mathematic and geometric concepts for a physical theory to entrust its execution upon. There also, a certain level of rigidity in defining those basics is required.

Although numbers and geometry are abstractions that seek to describe physical reality, the aim of any mathematical application to physical phenomena is to propose a quintessentially precise model of mathematics and geometry, to have that mathematical tool as sharp and descriptive of its sharpness as a number theory as possible. There, any such geometric/dimensional number theory must aim to describe physical reality in upholding a universally consistent framework in line with a principle of relativity, namely in being consistent for all accepted observed notions of space and time. By such, a physical theory of space and time in using mathematics is asked to solve all the great number theory problems with its availability as dimensional descriptions to number theory, as much as mathematics needs to in all its number theory vastness make itself available to dimensional analysis.

The work of Temporal Mechanics[1], this its 55th paper, proposes exactly such in setting a mathematical description for a point in space (zero-dimensional space) and a moment in time (zero-dimensional time), and by that mathematical description to develop a geometric dimensional number theory to then be scaled with physical reality to represent a physical theory.

The context of this paper, specifically here as paper 6 in the 8th volume[2] of Temporal Mechanics, is central to addressing the currently proposed great unsolved problems in mathematics and how such problems relate to physical theories. Specifically, in following on from paper 54 [54] describing a mathematical basis of physical theory information and intelligence, that basis is now being used to highlight the features of Einstein's curved 4d spacetime and how such has influenced/reified the arena of mathematical endeavour, determining the status quo of mathematical endeavour by the presumption of the correctness of Einstein's curved 4d spacetime theory and associated dynamic play and mathematical description[3] of the dimensions.

Here therefore shall be examined the core mathematical problems and their relationship to physics theory. Those core mathematical problems are proposed to be circumscribed by the Clay Mathematics Institute (CMI) Millennium Prize (MP) problems[4] and Beal conjecture[5]. This paper is sectioned as follows in addressing such:

1. Introduction

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[1][1][2][3][4][5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52][53][54].

[2] [50][51][52][53][54].

[3] Or rather absence thereof, as shall be demonstrated ahead.

[4] *"To celebrate mathematics in the new millennium, the Clay Mathematics Institute of Cambridge, Massachusetts (CMI) established seven Prize Problems. The Prizes were conceived to record some of the most difficult problems with which mathematicians were grappling at the turn of the second millennium; to elevate in the consciousness of the general public the fact that in mathematics, the frontier is still open and abounds in important unsolved problems; to emphasize the importance of working towards a solution of the deepest, most difficult problems; and to recognize achievement in mathematics of historical magnitude"* [55].

[5] The Beal conjecture is considered as a generalization of Fermat's Last Theorem [56].

2. Discussion points

Shown here are how all the great challenges in mathematics have become distracted in supporting the idea of a specific model of reality, namely as a support of Einstein's general relativity curved 4d spacetime physical theory. Shown here is that number theory in being distracted by such has limited its ability to execute real solutions to physical theory problems, noting that general relativity has yet to lead to any technological applications or advancements in its 100 years of telling other than being the theoretic description for some[6] and not all astrophysical phenomena.

Outlined here therefore is the relevance of number theory to physical theory analysis and how the CMI MP problems may have unwittingly undermined that effort in being shown to pre-suppose a topological model for time and space in the form of Einstein's curved 4d spacetime work. Indeed, it might be that physics pre-supposes what number theory must do, and if such is the case, presented here is how physics has unwittingly pre-supposed all the great challenges in number theory in its focus on curved 4d spacetime topology.

As shall be highlighted, Einstein's curved 4d spacetime theory as a topology demonstrates how malleable and not necessarily rigid the number theory must be to describe physical reality. In fact, as shall be shown here, the CMI MP problems highlight the implausibility of curved 4d spacetime theory, also highlighting that curved 4d spacetime theory has presumed to have solved all such problems from the get-go, which is certainly not the case given the CMI quest for the solutions to the nominated MP problems. There, an analysis of curved 4d spacetime theory is thence required to highlight just exactly what the mathematics there has detailed and what more importantly it has not.

As this discussion shall highlight, curved 4d spacetime topology, the need to describe it as a physical process, is bending mathematical rules to such an extent it demonstrates itself as being a reification, namely presuming itself to be a truth. Fundamentally, this discussion shall highlight that a proof of the Riemann hypothesis is not complete without highlighting how that number theory proof would apply to solving the remaining CMI MP problems, and thus using the other CMI MP solutions to act as supporting proof for the solution to Riemann hypothesis if indeed:

[6] Notably, what is perceived as black holes and associated proposed behaviour of light with mass.

- The CMI MP problems are relatable to a description of physical reality.
- Physical reality can be described by the one number theory.
- Thus, the one number theory related to describing physical reality must also be constitutional to the CMI MP solutions.

The paper here shall discuss the CMI MP problems and then present the case for a singular number theory resolving those problems, highlighting the relevance of those problems to a unified physical theory based on the one number theory. By such a process, in charting the CMI MP problems, their wording and design are discussed for any breaches of dimensional number theory logic and application to physical theories thence highlighting the quixotic mathematical nature of general relativity's curved 4d spacetime. Despite the precision and excellence of the current pursuits of mathematics and physics, the question asked here is if there is a feature to mathematics and thence physics that has been overlooked in both design and strategy, and fundamentally so.

3. Describing physical reality

Much of the description of physical reality today takes root from the geometric mathematical utility of straight lines, and thus the equation of a straight line to measure and thence presumably account for physical reality in its most basic sense; the presupposition of measuring physical reality is that the mathematics used to measure physical reality can then represent a physical theory description of physical reality by a massive interlinked network of mathematical geometry as a geometric and thence dimensional number theory.

With geometric mathematics in its simplest sense, points are assumed to represent a virtual beginning and end of a straight or curved line, and any nominated point on that line regarding for instance the x, y, and z axes, as nominated by the equation descriptor. Physical reality as spaces and associated physical objects is/are described by such.

Clearly with 3d space and a presumption of 1d time simple linear and curved equations become more complex, as much as describing physical reality has become a complex thing itself. Yet in describing physical reality in all its complexity, can the concept of complexity itself of physical reality be described *mathematically* upon the basis of linear/curved algebra becoming, for instance, topological/deformable 3-sphere[7] space via accepted mathematical steps and formulations? This is the question regarding Einstein's curved 4d spacetime theory in aiming to link with quantum mechanics, and then presumably both with the standard model of particles. There it is found that measuring physical reality is a precise and finely tuned thing, and often those measurement processes require specific processes and descriptions for those unique features of physical reality. Those fine-tuned processes and measurements are also assessed for their consistency in continually aiming to check

[7] A higher-dimensional analogue of a sphere.

and test for the known constants of physical reality, such as the fine structure constant, the gravitational constant, and Coulomb's constant.

Yet the question becomes to this process as to why physical reality is both a complex and yet finely tuned structure. Why for instance is there a constant that determines the electric binding strength of the atom as the fine structure constant? Why are the known field force constants the values they are in proportion to each other? Fundamentally, what determines the status of the lightest particle, namely why is the minimum mass value of a neutrino its value, and why is it sub-quantum? Similarly, although the various measurable features of physical reality can be described simply, their interaction with each other invariably leads to the idea of turbulence, namely the continual emergence of nonlinearity and randomness, despite there being underlying fundamental field effects that are local and unchangeable. Is there a fundamental reason behind such turbulence, and if so how can it be described? Two of these key problems of describing physical reality have been accounted for by the CMI MP list in the form of the Navier-Stokes existence and smoothness problem and the Yang-Mills existence and mass gap problem, namely describing the basic physical processes of turbulence and minimum mass respectively, as shall be explained ahead.

Solving the reason for the field forces, the etiology of their existence, and their relationship to each other, requires a tapestry for the dimensions to be described upon if not described mathematically as being such. Currently, that dimensional basis is conjectured as curved 4d spacetime as per the work of Einstein's general relativity describing the nature of mass and gravity. Owing to the topological nature of curved 4d spacetime, there are certain mathematical conditions for the description of curved 4d spacetime as 3d topological/deformable space (3-sphere). How that deformable space mathematically relates with the known elliptical orbits of the planets, and how space can metrically expand and yet still have local strict/rigid qualities are still uncertain, and that's important to note as most assume that Einstein's equations have solved such. Proposed here is that the CMI MP list has acknowledged this poverty of mathematics in Einstein's 4d curved spacetime theory in the form of the Poincaré conjecture, the Hodge conjecture, and the Birch and Swinnerton-Dyer conjecture conjecture, all seeking to resolve general relativity's lack of mathematical execution, as shall be explained ahead.

Most fundamentally in describing physical reality is what the entire point of describing reality is all about, or rather, what is a problem to be solved and are the solutions to the problems of reality self-evident, and if so how, and are those solutions to reality, can they be, more efficiently explained than by using one solution method? Proposed here is that the CMI has acknowledged such in the form of the *P v NP* problems, namely whether is it as easy to *check* the solution for a problem (P) as it is also easy to *find* the solution to that problem (NP), as shall be explained ahead.

One could be forgiven in thinking that by the apparent difficulty of solving such problems that such ideally is all there is to successfully describe physical reality as a number theory, for indeed how could describing physical reality as a number theory get any more difficult? The question there is whether this is how reality has emerged, namely as complex systems yet with basic number theory related conditions in association with what is thought to be a curved 4d spacetime tapestry of mass. Or is a more regular process at play? In either event, a common issue to describing physical reality becomes apparent, namely that to best describe physical reality a dimensionally relevant geometric number theory is required to be then scaled to physical reality, from the scales of zero to infinity ($0 \rightarrow \infty$). Proposed here is that the CMI has acknowledged such in the form of the Riemann hypothesis problem, namely mapping the number system from zero to infinity ($0 \rightarrow \infty$) as per the primes and how such can represent a dimensional number theory per se, as shall be explained ahead.

4. The problem with scaling infinity

Physics, in developing models of physical phenomena, requires, develops, and enacts standardised measurements and associated definitions; for phenomenon A and phenomenon B to be related, they need the same standards of measurements to define them, the same "realm" of measurement basis. Mathematics is the obvious process of measurement used.

The measurements usually rely on a point-reference (zero-dimensional) circumscribing physical phenomena, either as a point reference in space or a point reference in time, usually both. A point reference of space to another point reference of space leads to the idea of a line, as one dimension, and thence two and three dimensions by the use of further points and thence lines. A point reference in time is generally scaled to an arrow of time moving through the datum reference of time-now as a flow from time-before to time-after via time-now. This one-dimensional idea of time has been associated to 3d space as 4d spacetime according to Einstein's works of special and general relativity. There, the idea of time is used in an action principle Lagrangian time-domain ([40]: p9-18) deriving a sequence of events for time pointing to a 0 value in 3d space, such in describing a momentary event in time and thus presumably an instantaneous location.

Contemporary ideas of zero-dimensional space are purely mathematical, as physics relies entirely on considering a point as an infinitesimal marker, as much as considering time as being what a clock measures. With the discipline of mathematics, the mathematics of zero-dimensional space is considered as that of zero-dimensional topological space having *dimension zero* with respect to other non-zero dimensions of topological space, simply put graphically as a point. There, the "*metric*" of zero-dimensionality *is given as zero* in being associated to *what is not zero*, namely in being associated to accompanying topologies. There are various mathematical descriptions thence for how to define such zero-dimensional spaces (as points) with other associated non-zero topologies. The closest idea mathematics provides for a stand-alone zero-dimensional space is the idea of a zero-dimensional *ball* as a *point*.

Mathematics also provides zero-dimensional space with the idea of the set of rational numbers as the idea of "*subspace*" topology. Yet such is zero-dimensional "sub-space", not zero-dimensional space. Indeed, it is logical to think any of the rational numbers could be used to label a point, as is common practice, namely, to label a point with a number despite that point still being zero-dimensional space. Such though is abstract labelling of for instance a point on a line, and not a true mathematical definition for zero-dimensional space. By all of such though has developed a standard metric system of measurements for physical phenomena, thence arriving at the current ΛCDM model, the big bang model, where there was a point in time where space and time came into existence, a beginning, where time started ticking (so to speak) and space as a metric began expanding from nothing, and everything therein came into existence, as is proposed by the ΛCDM model.

In short, the modelling process from any "point" in Einstein's curved 4d spacetime, in *assuming* this point as an infinitesimal and thence zero-dimensional spacetime construct as a point, has had everything almost quixotically lead to the beginning of all such *as a point*, namely the moment before the big bang event as a singular infinitesimal zero-dimensional reference. The interesting if not problematic feature there is that ahead of the proposed shock front of space as it is proposed to metrically expand, of the proposed big bang, is still a zero-dimensionality of space and time, and thus also a "point", yet here the idea of an infinite super-massive point, creating a type of point-paradox between the pre big bang *infinitesimally-sized* point and the post big bang *infinitely-sized* point. Consider this infinitesimal-infinite zero-dimension paradox as the ΛCDM zero-dimension paradox.

The other problems found with the ΛCDM system are the energy needed for the big bang and how the perceived phenomena of galaxies can be explained in that metric expansion of space context without those stars of those galaxies flying apart. These problems have led to the requirements of dark energy and dark matter respectively, signifying the name ΛCDM as the required notions of dark energy (Λ) and cold dark matter (CDM), concepts that are nonetheless "dark" because there is no direct phenomenal evidence for them. In other words, although the entire curved 4d spacetime ΛCDM system seems understandable, there are issues with zero-dimensionality (ΛCDM zero-dimension paradox), energy (required for the redshift phenomena and thus presumably expansion of space), and mass-gravity (required to keep the phenomena of galaxies together).

To resolve these issues, one could ask if the idea of time and space were incorrectly joined as Einstein's curved 4d *spacetime*, technically the basis for the ΛCDM model (more so than classical and quantum mechanics). Yet Einstein's curved 4d *spacetime* theory has predicted the phenomenon of black holes, time-dilation, time-contraction, to name a few. Perhaps Einstein's curved 4d spacetime theory is incomplete, or that it only as a full theory describes a *portion* of reality? How can this be assessed?

Traditionally, to describe points in space and thence curved 4d spacetime requires a type of geometric grid, or rather a topology that accommodates for the known phenomenal features considered to be at play, particularly with the cosmological scales. The process there acknowledges that directly describing physical phenomena by way of direct measurement is not sufficient, and that conversely an underlying dimensional number theory for time and space is required, specifically that a dimensional number theory needs to be *applied to* physical reality to best describe a just as complex physical reality, especially so in trying to resolve known infinity-scale issues. Thus, it could be suggested that the role of mathematics with physics is to describe this order, complexity, precision, and turbulence of physical phenomena with mathematics. What therefore does a break-down of the CMI MP problems suggest in that regard, especially regarding the idea of infinity?

5. Charting the CMI MP problems

One would rightly suppose that in mathematics being instrumental to physical theory, then the key unsolved mathematics problems could be relevant to physical theory in some way. The proposal here is such, namely that the CMI MP problems are directly relatable to "state of the art" physical theories, specifically Einstein's curved 4d spacetime physical theory. There though, the list of unsolved problems promoted by the CMI in the form of the MP problems does seem to shed light on what physics itself cannot know or understand with any degree of merit without having such problems solved, especially with how to sufficiently describe the scaling issue of ΛCDM space.

To be highlighted here is how the CMI MP problems appear to function and be purposed in describing dimensional (space and time) complexity with a mathematical (number theory) model in mind, a dimensional number theory model of reality that is presumed to handle that complexity while avoiding if not accounting for any measurement and scaling problems (particularly so with infinity). To do this several features known to all the measurements and thence associated mathematics of physical reality need to be considered. Thus, the idea here is to highlight how the listed CMI MP problems are worded to validate general relativity's curved 4d spacetime as a geometric number theory formwork for describing physical reality.

To note is that thus far only one solution has been granted to the listed CMI MP problems (Poincaré conjecture), which itself as a solution has failed to impart itself as a number theory as a solution to the other problems, a solution as a number theory presumably relevant to an entire/overall mathematical number theory description of physical reality.

Suggested here in this discussion therefore is the idea that it would be practical if not mandatory that the intention of the CMI has been for the solutions of its MP problems to be a part of a general number theory that is able to be scaled with physical reality to prescribe a physical theory in line with general relativity's curved 4d spacetime. If not, any confounding issue with the unique quests of the problems seeking solutions in play if not the idea of curved 4d spacetime itself will need to be identified.

The 7 problems to be discussed in order are as follows:

5.1 The Poincaré conjecture
5.2 The Hodge conjecture
5.3 The Riemann hypothesis
5.4 The Birch and Swinnerton-Dyer conjecture
5.5 The Yang-Mills existence and mass gap
5.6 Navier-Stokes existence and smoothness
5.7 P versus NP

5.1 The Poincaré conjecture[8]

[8] As stated by the Clay Mathematics Institute [57].

The Poincaré Conjecture states that the sphere is the only 3d object that can be shrunk to a single point, given certain conditions. The CMI poses the problem as follows:

> *If we stretch a rubber band around the surface of an apple, then we can shrink it down to a point by moving it slowly, without tearing it and without allowing it to leave the surface. On the other hand, if we imagine that the same rubber band has somehow been stretched in the appropriate direction around a doughnut, then there is no way of shrinking it to a point without breaking either the rubber band or the doughnut. We say the surface of the apple is "simply connected," but that the surface of the doughnut is not. Poincaré, almost a hundred years ago, knew that a two dimensional sphere is essentially characterized by this property of simple connectivity, and asked the corresponding question for the three dimensional sphere.*
>
> *This question turned out to be extraordinarily difficult. Nearly a century passed between its formulation in 1904 by Henri Poincaré and its solution by Grigoriy Perelman, announced in preprints posted on ArXiv.org in 2002 and 2003. Perelman's solution was based on Richard Hamilton's theory of Ricci flow, and made use of results on spaces of metrics due to Cheeger, Gromov, and Perelman himself. In these papers Perelman also proved William Thurston's Geometrization Conjecture, a special case of which is the Poincaré conjecture.*

The Poincaré conjecture is about making 3d space (2-sphere) into a 3-sphere, as for instance annexing an extra dimensional component as time for a 2-sphere to make it a 3-sphere, and thus analogous to curved/deformable 4d spacetime, as a process of deformation or rather change in shape and size of a 2-sphere. The issue there is in describing how time can represent a type of harmonic deformation of closed 3d space (2-sphere) as a 3d curve, and thus being able to take a sphere, in theory, to a point.

Mathematician Grigori Perelman found the conjecture true in certain 4d characterizations of the 3-sphere, and was awarded the prize [58]. The problem with the solution there is that it has not lent to any insights into the other CMI MP problems as a solution, which ideally it otherwise should. The proposal here is that the mere fact that the Poincaré conjecture solution did not lead to the other CMI MP solutions would suggest that those certain 4d characterizations of the 3-sphere, presumably for 4d spacetime, are invalid for those other potential CMI MP problem solutions, unless the solution itself to the Poincaré conjecture is not valid, as shall be now highlighted.

5.2 The Hodge conjecture[9]:

The Hodge conjecture identifies a proposed loose topology of a 3-sphere (such as 4d spacetime), while also acknowledging an overall macroscopic/universal rigid scale and associated microscopic/local rigid scale the 4d spacetime looseness is proposed to be defined and behave in between. The CMI poses the problem as follows:

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[9] As stated by the Clay Mathematics Institute [59].

> *In the twentieth century mathematicians discovered powerful ways to investigate the shapes of complicated objects. The basic idea is to ask to what extent we can approximate the shape of a given object by gluing together simple geometric building blocks of increasing dimension. This technique turned out to be so useful that it got generalized in many different ways, eventually leading to powerful tools that enabled mathematicians to make great progress in cataloging the variety of objects they encountered in their investigations. Unfortunately, the geometric origins of the procedure became obscured in this generalization. In some sense it was necessary to add pieces that did not have any geometric interpretation. The Hodge conjecture asserts that for particularly nice types of spaces called projective algebraic varieties, the pieces called Hodge cycles are actually (rational linear) combinations of geometric pieces called algebraic cycles.*

Here, the quest is for 3-sphere topology to be rigid in microscopic (local) and macroscopic (universal) scale contexts, yet the cycles/deformations Hodge proposes allows for *loose* deformations of topological 3-space which then need to be resolved, to be associated to local and universal context rigidity. The presumption of the solution here is that the idea of a curvature of 4d spacetime can be executed, analogous to the idea of expansion of space or *curving* of spacetime, without losing the idea of topological 4d spacetime rigidity, and thus by such presumably upholding a principle of relativity for local events in *curved* 4d spacetime.

The Hodge conjecture essentially seeks to have *fluid topological space* become algebraically rigid in both microscopic and macroscopic rigid algebraic contexts. Essentially, here is the idea of a deformable topological 3-sphere that is asked to execute rigidity on microscopic/local and macroscopic/universal scales.

The issue here is how the solution to the Poincaré conjecture has not lead to any insights to a solution here given both conjectures are central to a 3-sphere. It is also interesting to note how specific this 3-sphere space is to the known proposed features of Einstein's curved 4d spacetime, namely that solutions to the Poincaré and Hodge conjectures should greatly assist in executing needed mathematical detail for curved 4d spacetime, specifically there in the context of both the behaviour of gravity on local/microscopic scales and how space can metrically expand as it is proposed to in using the ΛCDM model ad associated spatial characteristics.

5.3 The Riemann hypothesis[10]:

Here the quest is to find the pattern of a certain function, the Riemann zeta function, written ζ(s), when it equals zero. Although there are many known values of s where ζ(s) is zero composing the negative even integers, the Riemann Hypothesis proposes that apart from these known values the ζ(s)

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[10] As stated by the Clay Mathematics Institute [60].

values equal zero only when s is a complex number with real part ½ or a negative whole number. The CMI poses the problem as follows:

> *Some numbers have the special property that they cannot be expressed as the product of two smaller numbers, e.g., 2, 3, 5, 7, etc. Such numbers are called prime numbers, and they play an important role, both in pure mathematics and its applications. The distribution of such prime numbers among all natural numbers does not follow any regular pattern. However, the German mathematician* G.F.B. Riemann *(1826 - 1866) observed that the frequency of prime numbers is very closely related to the behaviour of an elaborate function* $\zeta(s) = \sum_{n-1}^{\infty} \frac{1}{n^s} = \frac{1}{1^s} + \frac{1}{2^s} + \frac{1}{3^s} + \cdots$ *called the Riemann Zeta function. The Riemann hypothesis asserts that all interesting solutions of the equation* $\zeta(s) = 0$ *lie on a certain vertical straight line. This has been checked for the first 10,000,000,000,000 solutions. A proof that it is true for every interesting solution would shed light on many of the mysteries surrounding the distribution of prime numbers.*

The aim here is to use a number theory to confirm the scope of numbers, here as the primes from $0 \to \infty$. The solution here would set the basis for forming a number grid from $0 \to \infty$ for a dimensional number theory which should then highlight how a scale for metric and thence geometric space can be fashioned as a network of prime number positions. This hypothesis is considered as the most difficult problem of the CMI MP list to solve, as it must tackle the idea of ∞.

5.4 The Birch and Swinnerton-Dyer conjecture[11]

The Birch and Swinnerton-Dyer conjecture describes the set of rational solutions to equations defining an elliptic curve. The CMI poses the problem as follows:

> *Mathematicians have always been fascinated by the problem of describing all solutions in whole numbers x,y,z to algebraic equations like* $x^2 + y^2 = z^2$*. Euclid gave the complete solution for that equation, but for more complicated equations this becomes extremely difficult. Indeed, in 1970 Yu. V. Matiyasevich showed that Hilbert's tenth problem is unsolvable, i.e., there is no general method for determining when such equations have a solution in whole numbers. But in special cases one can hope to say something. When the solutions are the points of an abelian variety, the Birch and Swinnerton-Dyer conjecture asserts that the size of the group of rational points is related to the behaviour of an associated zeta function ζ(s) near the point s=1. In particular this amazing conjecture asserts that if ζ(1) is equal to 0, then there are an infinite number of rational points (solutions), and conversely, if ζ(1) is not equal to 0, then there is only a finite number of such points.*

[11] As stated by the Clay Mathematics Institute [61].

Here, given the zeta function ingredient, the solution to the Birch and Swinnerton-Dyer conjecture would ideally annex the Riemann hypothesis number theory solution by applying the prime derivations to elliptical curves in the context of 3-sphere spacetime. Also involved here would ideally therefore be the number theory solutions to the Poincaré and Hodge conjectures for 3-sphere spacetime. The thinking here with this conjecture is that the solution in its applied form to physical theories would form a basis of describing the elliptical nature of the gravitational field effect of curved 4d spacetime as when associated with the Poincaré and Hodge conjectures as 4d spacetime solutions. In many ways, the Birch and Swinnerton-Dyer conjecture is the definition for the elliptic integral which Einstein's 4d spacetime as a topology has not yet mathematically executed.

5.5 The Yang-Mills existence and mass gap[12]

The Yang-Mills existence and mass gap problem addresses the work of Yang and Mills who introduced a framework to describe elementary particles using structures that are proposed to occur with a proposed geometry in mind relevant to quantum mechanics. The interesting feature here is that elementary particles are sub-quantum, and thus can only be described in using the idea of a "mass-gap" as a description that needs to be integral to a quantum mechanical description, thence the requirement for an abridging geometric framework to account for the sub-quantum nature of the elementary particles. This framework though has not been understood from a purely mathematical and thence theoretic point of view. The CMI poses the problem as follows:

> *The laws of quantum physics stand to the world of elementary particles in the way that Newton's laws of classical mechanics stand to the macroscopic world. Almost half a century ago, Yang and Mills introduced a remarkable new framework to describe elementary particles using structures that also occur in geometry. Quantum Yang-Mills theory is now the foundation of most of elementary particle theory, and its predictions have been tested at many experimental laboratories, but its mathematical foundation is still unclear. The successful use of Yang-Mills theory to describe the strong interactions of elementary particles depends on a subtle quantum mechanical property called the "mass gap": the quantum particles have positive masses, even though the classical waves travel at the speed of light. This property has been discovered by physicists from experiment and confirmed by computer simulations, but it still has not been understood from a theoretical point of view. Progress in establishing the existence of the Yang-Mills theory and a mass gap will require the introduction of fundamental new ideas both in physics and in mathematics.*

Here the idea is to establish the mathematical theory for the lightest particle as the mass gap, ideally in a way synonymous with a quantum mechanical understanding, and thence presumably link the idea of mass and thence gravity to light (quantum mechanics) itself. Here, the solution would be a

[12] As stated by the Clay Mathematics Institute [62].

result of the solution to the proposed topology of gravity as curved 4d spacetime and thus require a solution to the Poincaré and Hodge conjectures, noting that a solution to the Poincaré and Hodge conjectures would involve the solution to the Riemann hypothesis and thence the Birch and Swinnerton-Dyer conjecture.

5.6 Navier-Stokes existence and smoothness[13]

The Navier-Stokes equations are essential to the understanding of fluid mechanics in aiming to better approach the known phenomenal issues of turbulence in gaseous and fluid dynamics. The CMI poses the problem as follows:

> *Waves follow our boat as we meander across the lake, and turbulent air currents follow our flight in a modern jet. Mathematicians and physicists believe that an explanation for and the prediction of both the breeze and the turbulence can be found through an understanding of solutions to the Navier-Stokes equations. Although these equations were written down in the 19th Century, our understanding of them remains minimal. The challenge is to make substantial progress toward a mathematical theory which will unlock the secrets hidden in the Navier-Stokes equations.*

Here the quest is to describe the known turbulent features of physical phenomena in the context of gaseous and fluid mechanics and how such a solution could be related to curved 4d spacetime, and thence the as-mentioned CMI MP problems. Here the question is whether the solution would be an emergent feature of curved 4d spacetime and thus a feature of the mathematics describing such by the previous solutions (5.1-5.6) or an interlinking feature of those solutions not described by those individual solutions per se.

5.7 P versus NP[14]

The *P v NP* problem asks if a problem is as easy to check the solution for (P) as it also easy to find the solution to (NP). The issue is one of solving a problem in a certain amount of time and being able to check that solution concurrently in that same amount of time against all other potential solutions. The CMI poses the problem as follows:

> *Suppose that you are organizing housing accommodations for a group of four hundred university students. Space is limited and only one hundred of the students will receive places in the dormitory. To complicate matters, the Dean has provided you with a list of pairs of incompatible students, and requested that no pair from this list appear in your final choice. This*

[13] As stated by the Clay Mathematics Institute [63].

[14] As stated by the Clay Mathematics Institute [64].

is an example of what computer scientists call an NP-problem, since it is easy to check if a given choice of one hundred students proposed by a co-worker is satisfactory (i.e., no pair taken from your co-worker's list also appears on the list from the Dean's office), however the task of generating such a list from scratch seems to be so hard as to be completely impractical. Indeed, the total number of ways of choosing one hundred students from the four hundred applicants is greater than the number of atoms in the known universe! Thus no future civilization could ever hope to build a supercomputer capable of solving the problem by brute force; that is, by checking every possible combination of 100 students. However, this apparent difficulty may only reflect the lack of ingenuity of your programmer. In fact, one of the outstanding problems in computer science is determining whether questions exist whose answer can be quickly checked, but which require an impossibly long time to solve by any direct procedure. Problems like the one listed above certainly seem to be of this kind, but so far no one has managed to prove that any of them really are so hard as they appear, i.e., that there really is no feasible way to generate an answer with the help of a computer. Stephen Cook and Leonid Levin formulated the P (i.e., easy to find) versus NP (i.e., easy to check) problem independently in 1971.

In many ways, the issue here is asking an ideological case of there being only one solution and that the solving process would automatically eliminate in its solving process all other potential solutions.

From a physical theory perspective, the issue is to ask if physical reality is the only outcome available for time and space, as though physical reality presents itself as the only solution available having eliminated all other possible solutions in its presentation as the only solution available. To answer this problem properly for the dimensions of time and space, all the previous problems need to be solved and applied here, namely as the only solutions available with a common number theory basis link for all the solutions to all the problems.

6. Key issues with the CMI MP problems

The genius and brilliance of each of the questions asked as number theory problems cannot be disputed, yet how well do they measure up together as one in aiming to serve the goal of describing physical reality?

In the context of awarding the Poincaré conjecture to specific conditions of curved 4d spacetime (3-sphere), it does seem that CMI MP problems are all connected in testing the validity of curved 4d spacetime, namely a 2-sphere (3d space) with a temporal deformable component (4^{th} dimension) in describing what are proposed to be its topological features relating to all aspects of physical phenomena, especially in the case of the mass gap relating to quantum mechanics, and thence curved 4d spacetime holding quantum mechanics as its own. Are there issues with the underwriting of the problems themselves therefore in that regard? Furthermore, is the trust given to a theory (curved 4d spacetime) that is currently absent of sufficient mathematical execution properly warranted?

The key problem identified here with the CMI MP problems is the allowed malleability of topological space especially regarding the idea of the allowed linear convergence of two parallel lines as the ends of those lines approach infinity in the case of the Hodge conjecture, and thence how the idea of infinity can be defined geometrically and thence dimensionally by a gradual deformation of parallel lines as they approach infinity. Here, one can only presume the way infinity is being used in the Hodge conjecture with the deformation of topological space can describe the deformation of a line, or rather assume its existence. Implicit to the Hodge conjecture therefore should be the solution to the Poincaré conjecture, namely how a 3-sphere can deform. In solving those two conjectures, ideally first the Poincaré conjecture and thence Hodge conjecture, mapping the primes to infinity should be proven for the Riemann hypothesis in deforming a 3-sphere to infinity by use of Euler's zeta function, and there also by such the Birch and Swinnerton-Dyer conjecture should be proven in accommodating for infinity and primes and in thence executing proof for elliptical curves, something though which Einstein's curved 4d mathematics has *presumed* to have achieved already in describing the perihelion of Mercury and associated precession value. By such, one should then be able to present a proof for the Poincaré conjecture in describing how 4d spacetime deforms and thence curves, and there also perhaps describe a "minimum mass" precedent for a relationship between mass and space in the form of the Yang-Mills existence and mass gap theorem.

The problem here therefore as it stands is that the Poincaré conjecture has been listed as solved yet has thus far shed no light on solutions to the other problems, specifically the Hodge conjecture and thence the Riemann hypothesis and Birch and Swinnerton-Dyer conjecture.

The thinking here is that the way the Hodge conjecture has been constructed and the basis (topological 3-sphere) that key conjecture is related to (as the Poincaré conjecture) is the confounding issue at hand, namely almost asking the solutions be applicable to curved 4d spacetime theory; the constitutional design of the Poincaré and Hodge conjectures there asks how topological space can confer to the proposed features of curved 4d spacetime, its extension presumably off to infinity, and its local features with mass as local rigidity, together with a required universal rigidity, yet with deformable and thence flexibility in between the local and universal frames. Despite such favouritism, one would think that the Poincaré conjecture and Hodge conjecture should be resolved together, first by the Poincaré conjecture and thence in describing infinity via the Hodge conjecture, to then map primes along the lines approaching infinity and thence resolve the Riemann hypothesis. This though has not been the result in considering the Poincaré conjecture as solved in the absence of solving the Hodge conjecture and Riemann hypothesis.

In some regards, the only mathematics allowed here[15] as a solution base is curved 4d spacetime (3-sphere topology), which thence requires mathematics steeped in topology and set theory according to such a condition. Should such be the case though as the only requirement for a solution to each of the problems?

The suggestion here is that the oversight with the design of the CMI MP problems is in not having sufficiently described mathematically the idea of a point in space and a moment in time, and how

[15] According to the conditions of the CMI MP problems

each relate to the idea of infinity, namely how a linear and rigid scale can exist for space as points between zero and infinity, how time as a moment can be related to such, and how then a number theory can be developed in that zero-infinity scale for points in space and moments in time.

The issue it seems is that the CMI MP problems have quixotically jumped to curved 4d spacetime without first constructing the zero-dimensional features of space and time.

In short, the theme of the CMI MP problems appears to be a stretching of space out to infinity via a worded description of a deformity of parallel lines, thence as it would seem reducing the validity of the principle of relativity by that mathematical application to physical theories, creating a type of looseness there to the principle of relativity, thence requiring a re-tightening for local infinitesimal and broader infinite universal effects as sought for in the Hodge conjecture. The other feature to note is that the implications of each of the problems ideally require a solution to each other, clearly though needing to use the same dimensional mathematical basis. The problem there is that the currently accepted solution, the Poincaré solution, has failed to shed any light on the potential solutions for the other problems, which thence suggests that the basis for the CMI MP problems, the conditions of description that exist there, are inconsistent with the actual mathematics of the dimensions themselves.

In all, the standout theme with the problems is the issue of infinity, infinity used rather loosely in the constitution of the Hodge conjecture, yet the idea of infinity though particularly important in proving the Riemann hypothesis, and thence the Birch and Swinnerton-Dyer conjecture with the requirement of primes there. One would also think that not properly describing infinity would also be an issue for the Navier-Stokes existence and smoothness and *P v NP* problems.

Simply, two key stumbling blocks for the CMI MP solutions are the Poincaré and Hodge conjectures seeking to spruce the idea of topological 4d deformable spacetime. There, the problem with the Poincaré conjecture is its wording and how it was proposed to be solved as a deformable if not dynamically (Ricci flow[16]) deformable space. The fact that the Poincaré conjecture has not led to any advancements in solving the Hodge conjecture suggests an issue with the Poincaré conjecture solution and its applicability or lack thereof to other mathematical concepts pointing to a fuller number theory description of physical reality.

It is therefore proposed that the focus for a total solution for problems 1-7 of the CMI MP problem list is to understand the "*infinity*" scaling problem for dimensional analysis, together with at least defining zero-dimensional space as a point and zero-dimensional time as a moment in the context of defining what infinity could be, yet by doing this in forming an analogous mathematical description for all the known features of physical reality Einstein's curved 4d spacetime theory has been credited with resolving[17] despite Einstein's work having no real mathematics or number theory to show for it, otherwise why would these mathematical problems exist?

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[16] As a certain partial differential equation for a Riemannian metric.

[17] Such as elliptical orbit (perihelion) precession, black holes, light effects with gravity.

7. Zero-dimensional number and physical theory solution basis

The idea here is to take a step back from the assumption of linear algebraic geometry and its more complex developments of curved 4d spacetime and to re-construct dimensional analysis with a number theory, *as a proposed new paradigm of numbers describing the dimensions of time and space*. The suggestion here is to achieve such by focussing on the zero-dimensional features of space (points) and time (moments) to thence construct a number theory for zero-dimensional time and zero-dimensional space from 0 to infinity.

Here it is shown that for the zero-dimensional level for time (a moment) and zero-dimensional level for space (a point) numbers can be applied, specifically 1 for zero-dimensional time and 0 for zero-dimensional space to then construct the most logical way zero-dimensional time (as 1) can relate with zero-dimensional space (as 0). By such, positive integers as the real (not zero-dimensional) dimensions for time and space are derived, and thence so too a dimensional grid, leading to a geometric dimensional number theory. The next proposed step there is to with that geometric dimensional number theory to resolve the Poincaré and Hodge conjectures and thence the Riemann hypothesis if not other crucial conjectures not contained in the MP problem list (here Goldbach's conjecture, Fermat's conjecture, and the Beal conjecture).

Not to be underestimated is that no geometric mathematical theory should be complete without a solid description for what a point is and how such can be *scaled* to infinity, and a solid derivation of all primes to infinity, and how such can be related geometrically for space. So, the task here is to be deliberate in resolving these issues. Because of such, the idea is not to make *mass* (and thence momentum) the primary axiom as is otherwise a common theme in physics theory, yet to make the idea of zero-dimensional time and zero-dimensional space themselves as the primary axioms, and to then develop a number theory for such, as a number theory relevant to a spatial scale of zero→infinity. This was presented throughout paper 49 [49] of the Temporal Mechanics paper series:

- *Zero-dimensional number theory* [49].

Described there was the scaling issue of $0 \rightarrow \infty$ for zero-dimensional space, noted as a fundamental zero-dimensional paradox ([43]: p1-3). The paradox there was that a scale does not exist for a point as the idea of *size* for a point is subjective. This is considered as analogous to the Poincaré conjecture in asking how a 3-sphere can be reduced to a point. To address that conjecture the idea of a point needs to be defined. With the zero-dimensional paradox, the solution is to consider that something infinitely large as a 2-sphere could in fact be infinitesimally small as a point. By such a proposal, the constitution of the Hodge conjecture where two parallel lines can meet at infinity is brought into question.

In short, with the zero-dimensional paradox proposal clarified in paper 49 as the $0\text{-}\infty$ paradox ([49]: p9) geometric space retains its rigidity, and that with such rigidity two equations can be derived relevant to that geometric dimensional rigidity, namely the golden ratio equation and Euler's equation ([49]: p11-16, eq1-10). From there was formulated a solution to the Riemann hypothesis ([49]: p16-24) and then by that process a known condition for other fundamental theorems, there as solutions to the Goldbach conjecture ([49]: p16-18), the twin prime problem ([49]: p17-18), and Fermat's conjecture [49]: p23-24, eq 24-25). To note there is that such also constitutes a geometric and thence dimensional proof and not number theory proof alone, a geometric/dimensional proof that disallows any line curvature/deformation of the x-y-z axes other than accounting for the complex-number axis driven Euler's identity $e^{i\pi} = -1$.

To then make this dimensional number theory relevant to physical phenomena, the idea was to identify how that dimensional number theory is analogous to known features of physical phenomena by scaling the number theory to two known scales of physical phenomena, nominated there as the speed of light c as a proxy for space-distance and the charge of the electron e_c as a proxy for time-charge.

There, paper 50 [50] presented that process of scaling the dimensional number theory to physical phenomena:

- *The zero-dimensional physical theory (I): solving reality's puzzle* [50].

Paper 51 [51] then presented how the dimensional number theory and thence physical theory is limited by fundamental scaling constraints of measurement, underwriting a solution to the idea of turbulence and the elliptical (perihelion) precession orbits of planets:

- *The zero-dimensional physical theory (II): causality, locality, and indeterminacy* [51].

Paper 52 [52] then proposed how that physical theory can be graphed as an observable reality with all the correct observed scales and known physical constants in play:

- *The zero-dimensional physical theory (III): graphing time and space* [52].

Following such, paper 53 [53] presented a scheme of proving this new theory in a way the axioms and thence construction of Einstein's 4d spacetime cannot:

- *The zero-dimensional physical theory (IV): zero-point field dynamics* [53].

Paper 54 [54] then approached the idea of information, energy, and intelligence in approaching a basis for resolving the *P v NP* problem.

- *The zero-dimensional physical theory (V): information, energy, efficiency, and intelligence* [54].

These papers [49-54] approached the known issues in physics not just relevant to the CMI MP problems, yet other ideas such as the measurement problem[18] and locality, ideas that Einstein's 4d spacetime has by its design found itself in distress with.

In short, paper 48 [48] of Temporal Mechanics described the philosophy of numbers, highlighting their abstract nature, including how they are used with geometry and thence points, all proposed as abstractions, as abstract concepts *about* physical reality and *not being* physical reality per se. With that philosophy of numbers and geometry (using points) a number theory was developed in paper 49 [49]. The next hurdle was making that number theory *relevant to* physical reality. The proposal in paper 50 [50] was to scale the number theory to physical reality, specifically to two known values of physical data, namely the values for the speed of light c and the charge of the electron e_c.

That number theory of paper 49 [49] was thence proposed to represent a physical theory [50] if all its equations when scaled in such a way (c and e_c) could account for known features of physical phenomena together with new features physics is only now learning about[19]. Paper 51 [51] thence addressed the key issues in contemporary physics theory, namely causality, locality, and indeterminacy, identifying their zero-dimensional aetiology in the process of measuring physical reality. Paper 52 [52] thence graphically mapped the nature of the medium of dimensional *timespace* intrinsic to causality, locality, and indeterminacy in preparation for the proposed new proofs (experiments) outlined in paper 53 [53]. Paper 54 then provided an overview of how such a physical theory would appear to represent a basis for information, energy, efficiency, and intelligence.

8. Proposed solutions for the Clay Institute MP problems

Core to the proposed solutions to the CMI MP problems is a new solution to the Poincaré conjecture by way of the zero-dimensional number theory [49]. There, the basis of an infinitesimal point is discussed regarding a scaling paradox, namely "how big is a point?". This was identified as the zero-infinity paradox for a point in space. This paradox was described and then resolved accordingly ([49]: p8-9). Upon the zero-infinity scaling paradox basis therefore are the proposed solutions to the CMI MP problems listed as follows:

8.1 The Poincaré conjecture solution
8.2 The Hodge conjecture solution
8.3 The Riemann hypothesis solution
8.4 The Birch and Swinnerton-Dyer conjecture solution
8.5 The Yang-Mills existence and mass gap solution
8.6 Navier-Stokes existence and smoothness solution
8.7 P versus NP solution

[18] As presented in paper 51 ([51]: p9-10).

[19] Such as the X17 particle: ([30]: p19-20).

The space and time (dimensional) number theory description and solution for the zero-infinity paradox is the key solution basis here for the Poincaré conjecture, and thence subsequently the key proof basis for the remaining CMI MP problems. There, from the zero-infinity paradox and associated dimensional mathematical solution is generated a solution for the Riemann hypothesis *without changing the Riemann equations* yet using/deriving a fractal equation to confirm the primes in the context of resolving the zero-infinity paradox. That was achieved in paper 49 ([49]: p16-24) with the zero-infinity paradox description and associated golden ratio equation derivation by which Goldbach's conjecture ([49]: p16-18), the twin prime problem ([49]: p17-18), and Fermat's conjecture ([49]: p24, eq24-25) were all also proposed to be solved. The next step there was to use the zero- infinity paradox description and solution as the zero-dimensional number theory to chart and thence resolve the remaining CMI problems.

To note with the following solutions is that they are all interlinked by the one number theory, a number theory that obeys strict requirements, namely of defining known equations (the golden ratio equation and Euler's equation) and remaining true to the idea of rigid and thus non-deformable geometry, and thus not constructing space that is deformable to suit words describing physical phenomena alone, yet understanding that numbers as with shapes are framework abstractions and should ideally be kept rigid and not deformable and thus obey a principle of relativity. Here therefore curved 4d spacetime is not considered given its deformable nature and suspicious qualification for upholding a physical theory principle of relativity.

Here, conversely, all the sought-for mathematical features of curved 4d spacetime are resolved and replaced with a new understanding of mass and gravity as connected fundamentally to the idea of a quantum wave function as both a wave and particle. Here also fundamentally it is also shown how the derived *timespace* equation as Euler's equation and its utility in the Riemann hypothesis proof disallows any curvature of otherwise flat space with time.

To note therefore is that the CMI MP problems in all manner of regard do appear posed to resolve what the mathematics of Einstein's general relativity (curved 4d spacetime) and associated features (metric expansion) did not resolve or describe, otherwise these CMI MP problems would have been solved by such. The proposed solutions therefore to the CMI MP problems in taking a different basic mathematical dimensional standpoint must first explain that new standpoint in resolving what appears to be the basic conjecture analogous to such, namely the Poincaré conjecture.

8.1 The Poincaré conjecture solution

The solution here requires the new zero-dimensional (0-∞) paradox context description. This is explained in paper 49 [49]:

- *Zero-dimensional number theory*, chapter 3, pages 7-10, points (xxxi)-(xliii).

Of importance to note here is how the dimensions of time and space as zero-dimensions are being labelled with numbers to thence execute a number theory. The development of that number theory is proposed to resolve the Hodge conjecture and thence Riemann hypothesis in deriving the nature and limit of the non-zero dimensions of time and space.

8.2 The Hodge conjecture solution

The solution here is an extension of the proposed solution to the Poincaré conjecture (8.1). This is presented in paper 49 [49]:

- *Zero-dimensional number theory*, chapter 4-5, pages 10-18, points (xliv)-(lxxix).

Of importance to note here are the concomitant solutions to the twin prime problem ([49]: p17-18) and Goldbach's conjecture ([49]: p16-18).

8.3 The Riemann hypothesis solution

The solution here is an extension of the proposed solutions to the Poincaré and Hodge conjectures (8.1-8.2). This is presented in paper 49 [49]:

- *Zero-dimensional number theory*, chapter 6, pages 18-24, equations 13-25, points (lxxx)-(c).

Of importance to note here is the dependence of this proof and associated use of the golden ratio equation ($t_B + 1 = t_A$, where $t_B^2 = t_A$) and Euler's equation ($e_{t_B}^{i\pi} + 1_{t_N} = 0_{t_A}$) for a non-deformable *timespace.* The graphing of this non-deformable *timespace* was then presented in paper 52 [52]:

- *The Zero-dimensional Physical Theory (III): Graphing Time and Space.*

Of importance is that to resolve the Riemann hypothesis in any number theory manner certainly would require non-deformity for that number theory geometry, and thus one asks how such a solution would be useful to a presupposition of deformable 3-sphere topology. Here the solution to the Riemann hypothesis acknowledges the requirement for rigid geometry.

8.4 The Birch and Swinnerton-Dyer conjecture solution

The proposed solution here is an extension of the proposed solutions to the Poincaré and Hodge conjectures (8.1-8.2), and the Riemann hypothesis (8.3). Here, the solution requires the Riemann hypothesis number theory solution basis and by what condition elliptical curves as *timespace* patterns emerge in the zero-dimensional number theory. This is presented in paper 51 [51]:

- *The zero-dimensional physical theory (II): causality, locality, and indeterminacy*, chapter 4, pages 11-14.

8.5 The Yang-Mills existence and mass gap solution

The solution here is an extension of the proposed solutions to the Poincaré and Hodge conjectures (8.1-8.2), and the Riemann hypothesis (8.3). Here specifically, the solution requires the Riemann hypothesis number theory solution and by what condition prime numbers in a most basic utility and format are represented as a minimum mass gap regarding a derived basic dimensional scale of light, specifically the Planck scale. This is presented in paper 49 ([49]: p25-35):

- *Zero-dimensional number theory,* chapter 7, page 25-35.

This is pre-empted in paper 35 ([35]: p27-28):

- *Temporal Mechanics (E): Time-Space Logistics*, chapter 10, pages 27-28, equations 1-2.

Deriving the lightest mass has several key features central to not just the utility of prime numbers yet a minimum quantum wave function scale (Planck length), as presented in paper 39 [39]:

- *Temporal Mechanics, and the derivation of an electron degeneracy neutrino, Gravity constant (G), fine structure constant (α), Planck constant (h), and the phenomenal values of Sol (temperature, radius, luminosity, and corona)*, chapter 9, pages 52-59.

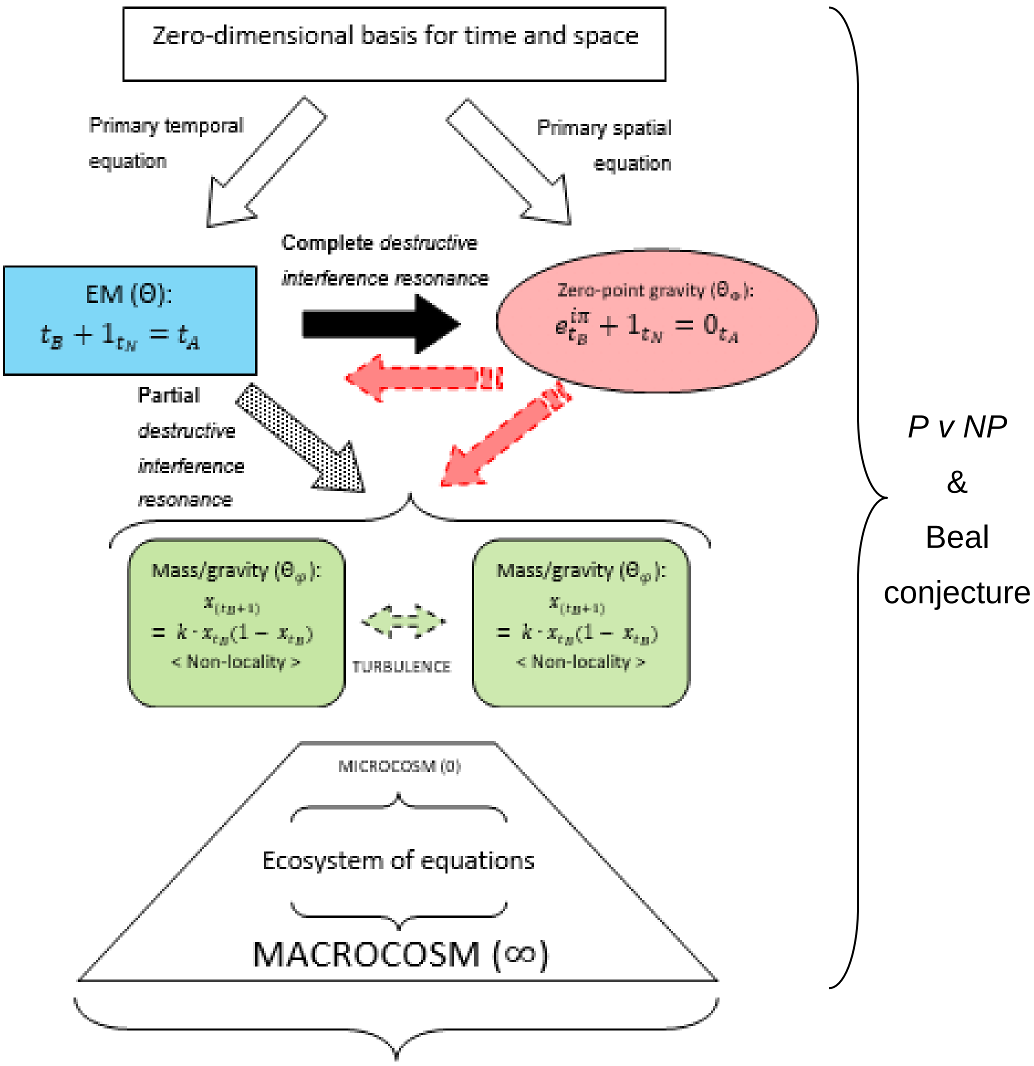
8.6 Navier-Stokes existence and smoothness solution

To solve this problem is to understand in the proposed case of the scaled zero-dimensional number theory what the phenomenon of turbulence is and if in fact it can be represented by a single equation. This question asks if turbulence is a mystery or is it describable. The zero-dimensional number and associated physical theory finds that there is unequivocally no one general equation that says “this is turbulence”, yet that there are two fundamental equations in non-deformable *timespace* as $t_B + 1 = t_A$ and $e_{t_B}^{i\pi} + 1_{t_N} = 0_{t_A}$ that bring the effect of turbulence into play and thence explain such by proxy as the emergence of physical phenomena in space ($e_{t_B}^{i\pi} + 1_{t_N} = 0_{t_A}$) and time ($t_B + 1 = t_A$). This is presented throughout paper 51 [51]:

- *The zero-dimensional physical theory (II): causality, locality, and indeterminacy.*

In short, the solution here proposes that the temporal component for mass in space as $e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A}$ is out of sync with the temporal component of gravitational waves as $t_B + 1 = t_A$, and thence defines a process of turbulence as such. Fundamentally, it is the *P v NP* problem that really encapsulates the idea of turbulence, namely a continual process of two equations seeking to resolve with each other. The question there is how efficiently is that process proposed to be executed in nature, and thence if there is a component of infinite complexity in that process. The nature of this infinite complexity can be highlighted with another conjecture not listed in the CMI MP problem list, namely the Beal conjecture[20]. Consider figure 1 as an adaptation of figure 5 from paper 51 ([51]: p16, fig5) :

Figure 1



Number theory and associated equations scaled with e_c and c to result in a physical theory that matches known physical phenomena and associated descriptors, despite highlighting the inherit issues of locality and indeterminacy and thus the flaw of labelling numbers directly to non-zero physical reality.

[20] See section 9.

8.7 P versus NP solution

The *P v NP* problem would appear to be the most difficult of all to solve, yet here the zero-dimensional number theory and how it is applied to physical reality suggests that reality is based on an entire number theory itself and represents an “only solution available” to a physical reality scenario with non-zero dimensions for time and space. This is presented throughout paper 54 [54]:

- *The zero-dimensional physical theory (V): information, energy, efficiency, and intelligence.*

The utility of this proposed solution is unique to a description of physical reality.

For instance, the zero-dimensional number theory solution suggests that to make the checking of a solution as efficient as that solution being solved would require a computer system to function specifically for one task in its entire capacity. To design a computer to solve a variety of mathematical problems more efficiently is to ask what the design limitations of that computer are as the ecosystem of its intended problem-solving paradigms.

To note here is that the zero-dimensional number theory proposes physical reality behaves according to two key fundamental equations that seek to resolve each other dimensionally. To note also that reality is proposed to annex time-before and time-after as analogous processes of memory and forewarning. There, in its most basic sense, the zero-dimensional number theory was asked to check itself by solving the most fundamental questions of mathematics, specifically the Riemann hypothesis, Goldbach’s conjecture, and Fermat’s Conjecture. The zero-dimensional number theory achieved those proposed solutions by using the two derived values of the emergent golden ratio equation ([49]: p10-15) which together as a product result in -1 $(\varphi \cdot \frac{-1}{\varphi})$ noting Euler’s equation $e^{i\pi} = -1$. The Riemann hypothesis was then tested for the golden ratio features that should be embedded in $e^{i\pi} = -1$ confirming that they indeed were ([49]: p18-23), noting that the golden ratio was derived in accepting a $0 \rightarrow \infty$ paradox ([48]: p18)([49]: p8-9) when using a 0-dimensional basis for time and space.

There, in confirming Euler's equation and the golden ratio from a zero-dimensional basis for time and space, a 2d and thence 3d *timespace* reality were derived with prime number features. It was thence proposed that such a number theory basis could form the basis of a physical theory if scaled with two known values of physical reality, there the speed of light c and the charge of the electron e_c.

To then prove Euler’s formula further and the associated proposed solution to the Riemann hypothesis, that zero-dimensional number theory when scaled as such has been tasked[21] as a physical theory to correctly derive the known physical equations of physical reality and their associated physical phenomenal descriptors with those equations.

Here, in the absence of historical and/or contemporary works like this approach, Temporal Mechanics [1-54] executes the *state of the art* of *why* numbers and geometry should *not* be applied *directly* to physical phenomena in presuming to be a physical theory yet applied via a dimensional temporal mechanical *number theory route*. The *P v NP* problem therefore should only be considered as

[21] As per Volume 8 of Temporal Mechanics: [50][51][52][53][54].

a solution from a pure number theory basis, and *thence* how that can be applied to physical phenomena.

9. Resolving the Beal conjecture

The description of the Beal conjecture[22] is as follows:

> *If $A^x + B^y = C^z$ where A, B, C, x, y, and z are positive integers with $x, y, z \geq 3$, then A, B, and C have a common prime factor. Equivalently, the equation $A^x + B^y = C^z$ has no solutions in positive integers and pairwise coprime integers A, B, C if $x, y, z \geq 3$.*

The solution here depends on solving the Riemann hypothesis, namely a mapping of all the primes as a concomitant solution to Fermat's conjecture, namely upon the one number theory basis.

Has not Fermat's conjecture already been solved though with its own number theory? Perhaps the question is if it has been properly solved as a number theory solution?

Although one solution has been presented for Fermat's last theorem[23], that solution has failed to address an entire number theory for numbers from $0 \to \infty$. Technically, a solution to Fermat's conjecture requires one to first map all the primes and thence positive integers. Fermat's conjecture (last theorem) states that no three positive integers a, b, and c satisfy the equation $a^n + b^n = c^n$ for any integer value of *n* greater than 2. The cases $n = 1$ and $n = 2$ have been known since antiquity to have infinitely many solutions. Yet the issue is defining those infinitely many solutions, or rather the context of a number theory that can map all primes from $0 \to \infty$ that limits the maximum value of n to the value 2.

Thus, with the proposed solutions to the Riemann hypothesis and Fermat's conjecture upon the one number theory basis, the Beal conjecture asks for the idea of positive integers $0 \to \infty$ to be resolved with Fermat's conjecture, or in other words with a number theory that resolves the Riemann hypothesis with Fermat's conjecture. This was precisely achieved with the solution to the Riemann Hypothesis (8.3) while also solving Fermat's last theorem, there in paper 49 [49]:

- *Zero-dimensional number theory*, chapter 6, pages 18-24, equations 13-25, points (lxxx)-(c).

In therefore identifying the Beal conjecture in that solution, the limit of $a^n + b^n = c^n$ was reached in mapping all the primes. In other words, a solution was forwarded for Fermat's conjecture in resolving the Riemann hypothesis.

By such it is shown that intrinsic to prime numbers is the expression $a^n + b^n = c^n$ where a, b, and c are positive integers only applies for positive integers of $n < 3$ ([49]: p24, eq24-25).

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[22] As presented by the American mathematical Society [56].

[23] As proposed by Andrew Wiles [65].

It would therefore follow that the Beal equation $A^x + B^y = C^z$ for any value of x, y, and z above 2 (> 2) would require a common prime factor for the values of A, B and C. In other words, with the equation $A^x + B^y = C^z$ where A, B, C, x, y and z are positive integers and x, y and z are all greater than 2, then A, B and C must have a common prime factor, or more simply, a common prime factor must be integral to A, B, and C. This though is mandated given the primes were derived in the context of resolving Fermat's conjecture whereby $a^n + b^n = c^n$ where a, b, and c are positive integers only applies for positive integers of $n < 3$ and thus values for x, y, and z *over 2* for $A^x + B^y = C^z$ would need to be *inclusive of a common prime factor*.

The significance of resolving the Beal conjecture in this way is that the zero-dimensional number theory delivers a basis for *infinite complexity* regarding the inter-relationship of $t_B + 1 = t_A$ and $e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A}$ and thence turbulence as there would be there an infinite number of primes featuring in the zero-dimensional *timespace* number theory associated to the dimensional constraints as executed by proving Fermat's conjecture. The thinking here is that infinite complexity *needs to be made available in this way* despite there being a derived order to how the two key equations of the zero-dimensional number theory, $t_B + 1 = t_A$ and $e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A}$, can interact in the dimensional constraint context of solving Fermat's conjecture, an interaction described in the solution for turbulence (8.6).

Therefore, if there is a basis for turbulence as a single equation and not an interaction of two equations it would be in the form of upholding the Beal conjecture using the zero-dimensional number theory description.

10. Conclusion

The process of charting the CMI MP problems is at its core the discovery of their intended purpose, namely their application to physical reality, thence servicing a physical theory. This charting and discovery process has been executed with a proposed zero-dimensional number theory as an amendment[24] to deformable 3-sphere topology. By this one key amendment[25] eleven of the top problems in mathematics[26] including the 7 listed CMI MP problems are proposed to have been resolved, all of which are shown to be relevant to physical theories.

The key amendment executing these proposed solutions is by identifying a $0 \to \infty$ scaling paradox for zero-dimensional space, a paradox that is proposed to be resolved by identifying zero-dimensional "*time*" and "*space*" number-scaling conditions. The proposed solutions are shown to exist for all the prime numbers in resolving the Riemann hypothesis, and thus address the remaining CMI MP problems. There also, the zero-dimensional number theory can explain infinite complexity as the $t_B + 1 = t_A$ and $e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A}$ time and space inter-relationship and associated resolution of the Beal conjecture.

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[24] In the form of addressing the zero-infinity paradox: ([43]: p15), ([49]: p7-10).

[25] In addressing the proposed zero-infinity paradox.

[26] Fermat's conjecture, Goldbach's conjecture, the twin prime problem, Beal conjecture, including the CMI MP problem list.

Indeed, by all accounts, physical reality is difficult to describe, so one would think that it would be easier to break up those core problem pieces as mathematical tasks. That appears to be the function of the CMI MP problems. There, in seeing each problem as a unique identity separate to the list of problems perhaps makes each problem more difficult to understand if indeed the problems are best solved as one in being applicable to the same physical reality that would undoubtedly be better described with the same underlying number theory.

Conflicts of Interest

The author declares no conflicts of interest; this has been an entirely self-funded independent project.

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