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Is it Time to Demolish Current Mathematics?

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Abstract:- Current mathematics in 3D geometric space plus real time t as an external control is incomplete and misleading.

The dream of theoretical physicists and mathematicians to demolish all current mathematics and replace it with a single universal numerical statistical law in 4D is now within reach.

In this paper, we first focus on the introduction and definition of the proposed unitary 4D space.

Next, we introduce and explain what we call the modern Laplacian theorem in 4D unit space.

Finally, we explain some unexpected and striking numerical results such as measuring the speed of sound in air at 330 m/s and that of light at 3 E8 m/s.

There is an inherent relationship between the speed of sound in air and the diffusivity of sound waves in the sound room, similar to the relationship between the speed of light in a vacuum and the thermal diffusivity of metals when they all live two in a 4D unit. space.

I. INTRODUCTION

We assume that 4D unit space is the most important space of all time and at the same time the least understood.

The proposed unit space constitutes a real breakthrough in the search for a new 4D numerical statistical theory which has always been lacking in mathematics and modern theoretical physics of the 20-21 centuries.

It is worth mentioning that this first theoretical model of discrete time in 4D discrete temporal unit space was introduced and defined in 2020-2021 [1,2,3] and later via more than 30 notable papers in all fields of physics and mathematics.

- *The Proposed 4D unit Space has Brought many notable Achievements such as:*

- Solve the time-dependent PDE in its most general form.
- Derive and solve Schrödinger PDE quite simply.
- Find numerical integration formulas like Sympson's rules without the need for Lagrange multipliers.

The strings of the B matrix constitute a new scalar space never before known.

First of all, we need to introduce and define the new modern 4D unit space in a rigorous way, which is not an easy task since there are several approaches.

The simplest and clearest definition of **discrete** 4D unit space is that it must satisfy four conditions i-iv[1,2].

- *The Basis of the Proposed Numerical Statistical Theory is the Following Recurrence Relation:*

$$U(x,y,z,t+dt) = B \,.\, U(x,y,z,t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(1)$$

Where U(x,y,z,t) is the energy density vector and B is the proposed statistical transition matrix.

Note that the recurrence relation in equation 1 is the cornerstone of the matrix chain model B introduced to show how nature works in the 4D x-t unit space [2,4].

Nature itself is known to be linear, binary and symmetrical. Therefore, an appropriate statistical transition matrix that satisfies linearity, binarity and symmetry such as Matrix B or any other adequate statistical transition matrix would be able to model this natural behavior across its time chains.

According to the requirements and practical convenience, the transition matrix B itself is well defined through the following four numerical statistical conditions [1,2].

For Cartesian coordinates in 1D, 2D and 3D space, the entries of the transition matrix B (B i , j) corresponding to the binary transition probability respected or are subject to the following conditions:

- B i, j = 1/2-RO/2,1/4-RO/4 and 1/6-RO/6 in 1D, 2D and 3D for i adjacent to j and B i, j = 0 otherwise.

Condition (i) reflects an equal a priori probability of all directions in space, i.e. no preferred direction.

- B i, i = RO, i.e. the main diagonal consists of equal or constant RO entries.

RO can take any value in the interval [0,1].

Condition (ii) corresponds to the assumption of equal residual storage after each jump or step time dt for all free elementary nodes.

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For example EMW in free space RO=0 and for a perfect insulator in the thermal diffusion equation RO=1 and for thermal conduction-diffusion PDE RO is equal to a specified value between 0 and 1 depending on the thermal diffusivity and of the size of the system concerned.

- B i, j = B j, i, for all i, j.

The matrix B is symmetrical to conform to the symmetry of nature and the physical principles of reciprocity and detailed balance.

- The sum of B i, j = 1 for all rows (or columns) away from the borders and the sum B i, j < 1 for all lines connected to the borders. Condition iv means that the probability of all space = 1.

The physical statistical nature of B is essential and clearly explained above through its four conditions i-iv which support the hypothesis of being an accurate model of nature itself.

Note that n which represents the number of rows or columns in the nxn square matrix B should not be confused with N which is the number of iterations or the number of time steps dt.

- Note also that the well-known Heisenberg matrix space is neither statistical nor complete.

II. THEORY

We assume that 4D unit space is the most important space of all time and at the same time the least understood.

The proposed unit space constitutes a real breakthrough in the search for a new 4D numerical statistical theory which has always been lacking in mathematics and modern theoretical physics of the 20-21 centuries.

The first time the 4D discrete temporal unit space was introduced and defined was in 2020 [1,2,3] and later via more than 30 notable papers in all areas of physics and mathematics.

In short, the simplest and clearest definition of discrete 4D unit space is that the 4 conditions given by reference 1,2 from the numerical statistical theory of matrix chains B of Cairo techniques.

➢ *Existence and Uniqueness of the 4D x-t Unit Space:*

- *Theorem: For a sample space V(x,y,z) element of R^3 and delimited by a closed surface A where V is discretized into n equidistant arbitrary free nodes and A is subject to Dirichlet boundary conditions then:*

The 4D space xt for the energy density field U(x,y,z,t) only exists if the transition relation, exists.

$$U(x,y,z,t+dt) = B.\ U(x,y,z,t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2^*)$$

Bnxn is the Numerical Statistical Transition Matrix.

- Note that equation 2* is a result of the 4 numerical statistical conditions i-iv and is equivalent to equation 3 below [5].

$$U(x,y,z,t) = D(N)\{[\text{Vector BC} + S(U)] + [(B)^N].IC\} \ldots . (3)$$

Where BC is the vector of Dirichlet boundary conditions and S is the vector of the source term. The boundary conditions vector BC and the source term vector S are no longer problematic but rather a source of simplified solutions.

Again IC is the initial conditions vector corresponding to U(x,y,z,t=0).

The transfer matrix D(N) is defined as the series of matrix powers,

$$D(N)= B + B^2 +B^3+B^N. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

- Note that for N sufficiently large close to infinity then D(N) tends towards:

$$D(N)=1/(I-B) –I$$

Where I is the unit matrix.

To bring more clarity on the subject, we compare the structure and properties of the proposed 4D unitary space with those currently existing in 4D spaces, namely,

- Stochastic Markov space.
- Einstein relativity space.

➢ *Markov Chain Space [6],*

In both chains, the Markov and matrix B chains, the dimensionless time t is expressed by t = Ndt.

- *However,*

✓ The solution of Markov chains may converge to the required solution or not, an additional condition is required.

While the convergence of all B chains to the solution of the IC-BC problem is ensured for all values of the RO element of [0,1].

✓ It is not easy to find the eigenvalues and eigenvectors of the matrix M. On the other hand, it is simple to find the eigenvalues and eigenvectors of the matrix B and its transfer matrices expressed as a summation of the power series.
✓ Markov chains are not able to deal with the source/sink term S or boundary conditions BC, but B chains can.

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Contrary to the Markov statistical chains, The B-transition matrix has a place for boundary conditions vector b and source term vector S in addition to initial conditions IC.

- *The conclusion is that B matrix chains are superior to Markov ones.*

➢ *Einstein Space for the Theories of Special and General Relativity,*

- Einstein space and matrix string space B are included in a 4-dimensional unitary space where space and time are not separate entities but rather intertwined in a four-D
- The framework of Einstein's physics is the continuum [7,8] but since the universe is discrete, we assume that it is more likely that the 4D Einstein unit space (for special and general relativity) is classified as a subset of the B-matrix unit string space 4D than the reverse.

The conclusion is that the proposed B-matrix string space is superior to Einstein's.

➢ *In a Google Search [9] we Find:*

There have of course been proposals to discretize space-time. But these are speculative theories and not dominant features of physics validated by experiment.

But this claim is now invalidated.

III. APPLICATIONS AND NUMERICAL RESULTS

In this section, we focus on 3 different applications and study their numerical results.

➢ *These Applications are,*

- Laplacian theorem.
- Sound speed at NTP in audio rooms.
- The speed of the radiation signal **c** in metals.

In fact, the calculation of the speed of sound at NTP in audio rooms and the speed of the radiation signal c in metals follows directly from the Laplacian theorem as shown below.

➢ *Laplacian's Theorem*

The modern Laplacian theorem expressed in 4D unit space forms a kind of magic.

Consider the case of a free fall in energy density where BC=0 and S=0.

In this case, equation 3 for the spatio-temporal evolution of the energy density U reduces to [11],

$$U(x,y,z,Ndt) = D \cdot B^{\wedge}N \cdot U(x,y,z,0) \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Equation 5 is equivalent to,

$$U(x,y,z,Ndt) = D \cdot r^{\wedge}N \cdot U(x,y,z,0) \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where r is a real fraction ∈ [0,1].

We define the wave in a medium as a macroscopic transfer of energy in the medium without transfer of the medium itself.

➢ *The Laplacian Theorem then States that:*

For the case of free fall the energy density time dependence is expressed as,

$$U_{M^*}(t) = \text{Const} \cdot \text{Exp} - \alpha\, c\, A\, Sav / 4V^* \; t \ldots\ldots\ldots\ldots (7)$$

M* is the median node or center of mass node.

Equation 7 indicates that in the case of free fall of the energy density where BC = 0 and S = 0,

The decay of the energy density is exponential and its exponent is proportional to the diffusivity α and the speed of the energy wave c.

It is worth noting that there are theoretical proofs of Equation 7, namely Equation 6, and experimental evidence of Laplace's theorem, Equation 7, from metal cooling curves published in 2022 [10].

Equation 7 is magical because it allows us to calculate the wave speed Vson or $\mathbf{c}_{light}$ for sound and light respectively simply by measuring the diffusivity of the medium.

Equation 7, never known before, is intrinsically related to the Laplacian operator, so we call it the Laplacian theorem.

Equation 7 or Laplacian theorem is equivalent to,

$$UM(t) = \text{Exp} - \mathbf{c}\, A\, S_{av} / 4V^* \; t$$

- *During the Exponential Decay of Time, there are Two Important Time Markers, Namely:*

T1/2 which is the moment when the energy density decreases to half of its value at t=0.

TR(60 db) which is the moment when the energy density decreases to one millionth of its value at t=0.

This time marker is of particular importance in audio room theory and design and is called TR.

By performing a simple algebraic manipulation of the Laplacian theorem, equation 7, we can show that,

$$TR = 53.13\ V/ASC. \text{ . second} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

- *Note that Eq 8 is in Agreement with the well known Sabine Formula which means:*

✓ The 4-dimensional unitary space and the Laplacian theorem are exact.

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- ✓ L_s (mean length between two successive collisions of sound beams) which is a cornerstone in the derivation of Sabine's theory has never been proven for over a century is now justified [11].

In fact the Laplacian theorem is the alternative or equivalence of Ls.

- ✓ By experimental measurement of TR we can calculate the speed of sound in air at the considered temperature and pressure.

- ➢ *Speed of light C_{emw}=3E8 m/s*

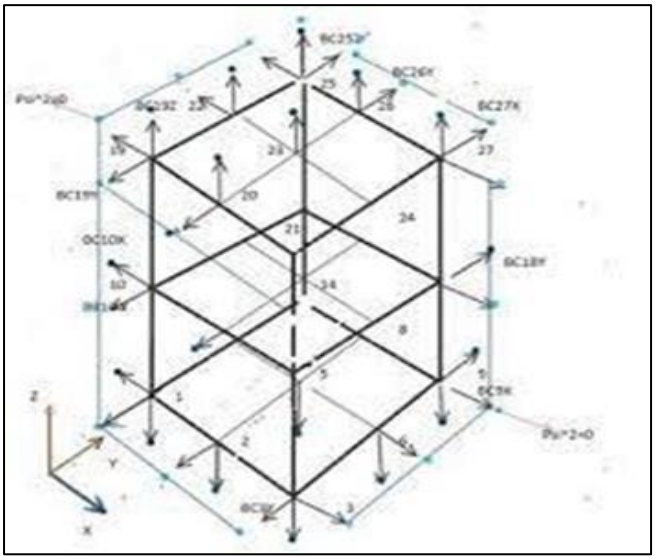

Fig 1 A Metal Cube with Holes to Measure the Temperature T during a Cooling Curve.

- Note that the center of mass M is located at node 14 [10].

Furthermore, the solution of the heat diffusion equation in 4D unit space via the B-matrix chain technique predicts that the signal speed c as,

c=T1/2 *log 2 * L^2/ (thermal diffusivity α) ……...(9)

By replacing the experimental value of T1/2 obtained from the exponential cooling curve [10] and the thermal diffusivity α obtained from the thermal tables, we arrive at the value of the signal transfer or speed of light Cemw=3E8 m/s.

Note that I. Abbas measured the half-time marker of the cooling curve T1/2 at node Cm for an aluminum cube of side length 10 cm at 45 seconds and that of a similar iron cube at 100 seconds [10].

- ➢ *When Substituting the Numerical values of Thermal Diffusivity α found in the Thermal Tables:*

- α (Al) = 1.18 E-5 MKS units
- α (Iron) = 2.5 E-5 MKS units

In equation 9 we arrive at a value of c close to 3E8 m/s.

Applying the above equation gives $\mathbf{C_{emw}}$ = 2.9 E3 in both cases.

We assume that if this is the case, the more important question now is how the solution of the thermal diffusion equation in 4D unit space relates to the speed of light $\mathbf{C_{emw}}$?

The answer may be simple: Mother Nature operates and sends signals in a 4D unit space at a speed **c**.

IV. CONCLUSION

The idea of this work is to replace current mathematics and theoretical physics that live and operate in an R^4 spatial manifold with those operating in a modern 4D x-t space.

This would make it possible to resolve in a simple way almost all classical and quantum physical situations and also to introduce new general rules in science.

We first define the discrete 4D unit space from the numerical statistical theory of B matrix chains of Cairo techniques and compare it with the current 4D unit spaces of Einstein and Markov.

Next, we introduce what we call the modern Laplacian theorem in 4D unit space.

Finally, we explain the unexpected and striking relationship between the speed of light **c**=3E8 and the thermal diffusivity of metals when both live in 4D unit space.

The accuracy and precision of the numerical results show beyond doubt that the proposed 4D unit space is the one in which mother nature operates. This space forms the basis of a unified field theory of all types of energy density, whereas the classical manifold space R^4 is inferior and incomplete.

In conclusion, we recommend the proposed 4D unit space which constitutes a real breakthrough in the search for a new 4D numerical statistical theory to replace the classical incomplete R^4 mathematical space.

- The author uses his own double precision algorithm [13,14].
- Python or MATLAB library is not required.

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