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An Introductory Framework for Statistical Unified Field Theory

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Abstract:- The modern theory of quantum mechanics is incomplete. It is capable of describing the quantum energy field on the microscopic scale via the Schrödinger equation and its derivatives but is not capable of describing the energy field on the macroscopic scale such as the domain of thermal diffusion and sound intensity in audio rooms. . etc.

On the other hand, in previous articles we have shown that the so-called theory of Cairo techniques and its chains of B matrices are more complete.

They can numerically resolve both the macroscopic energy field on the thermodynamic scale, such as the energy field in thermal diffusion PDEs, and the sound energy field of PDEs in audio rooms. . etc.

In a precise and revolutionary way. Additionally, they are also capable of describing and resolving the quantum energy distribution at the microscopic scale initially described via the Schrödinger equation and its derivatives.

Considering that they can describe and solve pure mathematical problems such as numerical integration and infinite integer series in more detail, we better conclude that the numerical statistical methods of Cairo techniques and its B matrix chains are capable of describing almost all fields with the exception of the gravitational field (of general relativity) which will be the subject of the next article.

Therefore, we propose that the Cairo techniques and their B-matrix chains constitute the required foundations of a unified field theory.

It's logical and it makes sense. In this paper, we present detailed theoretical and numerical studies of six diverse physical and mathematical studies where the numerical results are surprisingly accurate.

In conclusion, B-matrix strings and numerical statistical theory of Cairo techniques provide a framework for a unified energy density field theory. Schrödinger's equation can be considered as a diffusion equation with a diffusion coefficient $\beta^2 = \hbar / 2m$.

D=(6.65E-34/2 Pi/2.9.31E-31=E-34/18.6 E-31=E-3/18.6=5.6E-4. . !! SQRT Mue 0/Eps 0)=377 Ohm = Z01/Z0 =2.65 E-3 mho

I. INTRODUCTION

As a first step, we need to agree on a generally accepted definition of the term unified field theory. We propose this definition as follows:

The theory capable of describing and resolving all types of energy fields.

It's logical and it makes sense.

This term was first coined by Albert Einstein who attempted to unify his theory of general relativity with electromagnetism.

He said: "I don't stand on Newton's shoulders but I stand on Maxwell's shoulders."

Later, in 1927, when the Schrödinger equation with the Bohr/Copenhagen interpretation became a resounding scientific success, many scientists claimed that it was the unified field theory.

Einstein described the Schrödinger equation with the Bohr/Copenhagen interpretation as incomplete.

Note that Einstein used 4D x-t unit space to derive his theory of special and general relativity.

We also assume that the Schrödinger equation is incomplete for the following three reasons:

- *The Schrödinger equation lives and functions in 3D geometry + t as an external parameter or controller.*

✓ Nature itself lives and functions in a unitary 4D x-t space.
✓ Any equation or formula formulated in 3D + t geometry is fundamentally incomplete.

- *The Schrödinger equation is capable of describing the quantum energy field at the microscopic scale like that of the Schrödinger equation but is not capable of describing the energy field at the macroscopic scale like the PDE of thermal diffusion, the sound energy field in audio pieces. . etc.*
- *The Schrödinger equation is not capable of handling purely mathematical formulas such as single, double and triple finite integration or the sum of infinite integer series.*

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Therefore, we propose the numerical statistical method called Cairo techniques and its B-matrix chains as a unified field theory for the following reasons:

- The chains of matrix B [1,2,3,4] live and operate in a 4D x-t unit space. It is complete.
- The chains of the B matrix are capable of describing the quantum energy field on the microscopic scale such as that of the Schrödinger equation and are also capable of describing the energy field on the macroscopic scale such as the heat diffusion PDE, the sound energy field in audio rooms. . etc.
- Matrix B strings are capable of manipulating and solving purely mathematical formulas such as single, double and triple finite integration or the sum of infinite integer series.

We recall that many of these remarkable results were published everywhere as clear as the sun but the iron guards of the Schrodinger equation are denying them.

But who are the old iron guards and why do they defend the Schrödinger equation to their last breath?

The old iron guards are defined as those scientists who are brainwashed and defend their master until their last breath because they wrongly believe that SE and its derivatives are the only unified field theory?

They expect Bohr, Schrödinger, Heisenberg, Dirac, etc. come back from eternity to solve all the mysteries and paradoxes.

The preceding analysis shows that the numerical statistical methods of the Cairo techniques and its chains of B matrices are capable of describing almost all fields except the gravitational field of general relativity which will be the subject of the next article.

Knowing that classical 3D+t physics and mathematics are only a subset of modern 4D statistical matrix mechanics, it is expected that

Many topics, solutions, or derivations that do not exist in classical physics and mathematics are well defined and explained via modern statistical mechanics theory.

Note that there are two completely different languages for approaching the subject of time-dependent physical phenomena (both in classical macroscopic physics and in modern microscopic quantum mechanics) by studying the temporal evolution of the energy density field in the geometric space (x, y, z), which gives rise to two different approaches **A** and **B**:

A: Classical theory [5,6] where the energy density field U(x,y,z,t) is represented via a partial differential equation relating the time derivative of U to its space derivatives.

This theory is considered valid both for classical physics situations describing physical phenomena at the macroscopic scale such as the heat diffusion equation and for quantum mechanical situations described by the Schrödinger equation.

Here the energy density field U(x,y,z,t) lives and operates in a 3D geometric space plus t in real time.

The real time t is considered as an external controller.

Furthermore, the typical normal classical method to numerically solve this PDE is to follow the following procedure in three consecutive steps [5,6]:

Here the problem of the initial value arises where U(x,y,z, t=0) must be known explicitly everywhere at time t=0.

And the temporal evolution of U is assumed,

U(x,y,z,t+dt) = constant. U(x,y,z,t)dt……………………(1)

With Dirichlet boundary conditions or any other appropriate conditions.

Degree of stability and speed of convergence of the solution of the equation. 1 are not guaranteed in advance to exist or to converge towards a unique solution.

- *Note that the stability and convergence of the solution are quite assured in B-matrix chain techniques for any physical situation.*

At present, we only know two transition matrices, namely the well-known Markov statistical matrix [5,7]and the proposed statistical transition matrix B.

We start by comparing the two matrices.

An original Markovian process is described by a square matrix M (nxn) whose entries M i, j satisfy the following two conditions [5,6,7]:

- All inputs M i,j are real and element of the closed interval [0,1]
- The sum of entries in all columns (or all rows) is equal to 1.

Since Markov's time, numerous attempts to improve his M-matrix in any way have been made, but with little or no success.

The breakthrough in 2020 was achieved through the Cairo Techniques Transition Matrix B by adding two additional conditions iii and iv, namely [7]:

- B i, i = RO, for all i = 1,2, ... n, which means that the main diagonal consists of constant inputs RO element of [0,1].

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In the thermal diffusion equation, RO approaches unity for superconducting materials and zero for thermal insulators.

In quantum mechanical situations, RO is the acronym for quantum energy storage.

$$M\ i, j = M\ j,i$$

Which means that the statistical transition matrix M(i, j) is symmetric.

We replaced the Markov matrix M with the matrix B of the Cairo techniques for the distinction.

In previous articles, the proposed transition matrix B is defined by the above 4 conditions and further complements condition i with an important innovation:

Condition I is improved to,

Bi, j = 1/2-RO/2 for 1D,

Bi,j= 1/4-RO/4 for 2D and

Bi,j=1/6-RO/6

Only for adjacent i, j in 1D, 2D and 3D configuration respectively and B i, j = 0 otherwise.

As a result, the sum of entries of all lines adjacent to the boundaries is less than 1 and away from the boundaries this sum is equal to unity.

This condition allows a space to take into account the value of the boundary conditions BC as well as the source/sink term S. Far from the boundaries, and when the symmetry condition exists, the transition matrix B transforms into a transition matrix doubly stochastic. It is clear that the original Markov matrix is just a single stochastic transition matrix.

The question arises as to why the stability, uniqueness and convergence of the solution in the PDE technique are not assured while the stability, uniqueness and convergence of the solution are quite assured in the matrix chain B for any physical situation?

The explanation is that classical 3D+t physics and mathematics are a subset of modern 4D statistical matrix mechanics, it is expected that:

Many topics, solutions, or derivations that do not exist in classical physics and mathematics are well defined and explained via modern statistical mechanics theory.

But how can we explain that these disadvantages of the PDE approach do not occur in modern statistical matrix chains of Cairo techniques?

- *Stability*

Nature is stable.

- *Principle of Least Action*

Any time-dependent physical process must satisfy the principle of least action.

Many PDEs do not explicitly satisfy the principle of least action, but modern statistical matrix chains of Cairo techniques do.

The real interpretation here is that nature is fast.

- *Symmetry*

It is worth mentioning that all known universal laws of physics are symmetrical and a unified field theory should be as well.

For example, the spontaneous solution of quantum mechanics problems via the Schrödinger equation is assumed to be symmetrical about a central point.

Schrödinger PDEs do not EXPLICITLY satisfy symmetry.

Fortunately, the three principles mentioned above are satisfied by a single hypothesis, namely [1,2,3,4]:

dt = dx^2/2.α^2…………………………………………...(2)

The interpretation of equation 1 is that the time step or time jump dt is imperative and cannot be chosen arbitrarily at will as in the case of the classical solution of the initial value problem in the diffusion equation of the heat.

Equation 1, one of the main features of Cairo techniques, shows that the correct time path is the fastest. This corresponds in some way to the principle of least action of classical physics.

Equation 1 also suggests that time is not continuous but rather discrete with a well-defined time step or time jump dt.

Note that in the PDE approach, equation 1 is replaced by another equation (Eq 2) which characterizes another temporal route different from that of equation 1. In equation 2 below, dt is chosen continuous and arbitrarily such that:

dt <= dx^2/2.α^2………………………………………….(3)

Let us emphasize again that equation 3 characterizes another temporal path different from that of equation 1 and is obviously not the shortest path of the principle of least action.

Note that condition 3 is called the stability condition for solving the initial value problem in classical physics [4,5].

The alternative approach of digital statistical chains with a transition matrix actually constitutes a breakthrough.

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The transition matrix approach completely ignores all partial differential equations as if they never existed.

When a physical statistical transition matrix chain B exists for the energy density U(x,y,z,t) of the system concerned then it can be defined by their recurrence relation,

U (x, y, z, t+ dt) = B. U(x,y,z,t)……………………………(4)

Note again that the transition matrix B is well defined via four statistical conditions (i-iv) mentioned previously and that it has a place for the boundary conditions BC and the source term S which are also essential in the solution of the thermal diffusion equation as well as the Schrödinger equation [1,2,3,4].

Following equation 4, a chain transition matrix B emerges and must be able to describe the solution trajectory for the energy density U through its own solution space for any given time evolution in unit x-t space 4-D.

This is the so-called Cairo techniques approach.

The time-dependent solution of the energy density U(x,y,z,t) is given by [1,2,3,4],

U(x,y,z,t)=(B^0+B+B^2 + . . . +B^N) . (b + S) + IC. B^N. . . . . (5)

Where b is the vector of boundary conditions, S is the vector of the source/sink term and IC is the vector of initial conditions.

Equation 4 is called time-dependent statistical equivalence matrix which can be used in the solution of classical physics problems such as heat conduction PDE and is also proposed to find a solution to the 1D Schrödinger equation, 2D and 3D [8,9,10].

It should be noted that equation 5 contains a term due to the initial state conditions described by IC. B^N which is expected to decrease exponentially with time because the modulus of matrix B is less than 1.

This term tends to zero with time in classical physics systems such as the heat diffusion equation, but not in isolated quantum mechanical systems such as those described by the time-dependent Schrödinger equation.

Also note that the string transition matrix B describes the energy density which is a scalar quantity in classical physics problems and we assume that the energy density is equal to the square of the wave function ψ2(r) in quantum mechanics problems.

We emphasize again that in the B-matrix chain solution for the time-dependent energy density U(x,y,z,t), the real time t is completely lost and replaced by N.dt where N is an integer describing the number of iterations. and dt is an inherent time step or time jump.

In other words the real time is replaced by the number of repetitions of the physical process N. It is also worth mentioning that discretizing time t into forbidden and allowed where t = N dt and N is an integer is itself a quantification of time.

Note that:

- *B Matrix Chains are the Only Transition Matrix Chains Other than the well-known Markov Chains.*

However, it is worth also mentioning that the Markov matrix leaves no room for boundary conditions or the source/sink term.

As a result, in Markov matrix chains we do not care about the energy density field, boundary conditions, source term, average properties of the medium, etc., whereas in the case of B matrix chains, we are doing it.

It is also worth mentioning that B-matrix chains and Cairo techniques statistical methods are not entirely new and have been successfully applied to solving problems in classical physics and quantum mechanics since 2020 [1,2,3,4].

The numerical results of the proposed numerical statistical method show stability, accuracy and superiority over conventional PDE methods.

- *The Physical Image is now Clear:*

If we compare the old image of partial differential equation techniques with the modern statistical mechanics of Cairo techniques, the superiority of the latter is confirmed and appears as the challenge of the future.

In fact, this article is a sort of collection and integration of all our previous articles devoted to the same subjects just to see things more clearly.

A related question arises: how can the strings of matrix B describe the two seemingly opposite natures, namely the microscopic scale of quantum mechanics and the macroscopic scale of classical physics via the same matrix?

- *The Answer is:*

- ✓ Mother Nature has only one face to show in classical physics and quantum mechanics.
- ✓ The theory of Cairo techniques is the same but the difference lies in the definition of the boundary conditions **b** and the source term **S** in equation 4.

We assume that if the boundary conditions in B-matrix chains are Dirichlet or similar, then they describe a microscopic or macroscopic particle. On the other hand, assuming that the boundary condition extends to plus and minus infinity, the chains of the B matrix describe the mechanics of wave particles.

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Note that in all cases B-matrix chains operate in a 4D unit space x-t where time t is woven into geometric space.

Here again the real time t is completely lost and is replaced by N dt where dt is the time step and N the number of iterations.

We emphasize once again that the Cairo technical approach does not require iteration of the out-of-the-box MATLAB or PYTHON algorithm or any other conventional mathematical iteration method.

Finally, we should answer the important question of why the B-matrix chains approach is widely successful while the PDE approach fails?

We generally assume that the answer is that B-matrix chains are in some way a branch of so-called stabilization methods since B-matrix chains are intrinsically autonomous or self-contained in the sense that they have maximum possible symmetry and maximum possible stability.

In order not to delve into the deep and vast area of how to define and explain the complex concepts of the two theories in the introductory explanations, let us move directly to the theory.

II. THEORY

Cairo Theory of Techniques expands to cover the theory and practice of almost all areas of classical physics and quantum mechanics.

We prefer to present the theory via a somewhat exceptional way of explaining this vast area.

This presentation consists of asking relevant questions **Q** and proposing their appropriate answers **A.**

Our goal from these questions and answers is to demonstrate the difference between PDE approaches and those of B-matrix chain techniques and to further demonstrate the superiority of one over the other, where applicable.

- *Q1: How to invert a 2D and 3D Laplacian matrix without using MATLAB iteration or any other conventional mathematical method?*

- *A1:*

The classical conventional numerical procedure for solving the Laplace partial differential equation is based on the discretization of the 1D, 2D, 3D geometric space into n equidistant free nodes and on the use of the finite difference method FDM supplemented by the Dirichlet boundary conditions (vector b) to obtain a system of n first order algebraic equations.

In the matrix form A,

A . U(x,y,z,t) = b

Where **b** is the boundary conditions vector.

The solution to the above matrix equation is,

$U(x,y,z,t) = A^{-1}.b$

Which is often quite complicated since the matrix A is singular.

It is worth mentioning that common numerical iteration methods such as Gaussian elimination and Gauss-Seidel methods are complicated and require the use of ready-made algorithms such as those in Matlab or Python..etc .

The B-matrix chains predicts that there exists another SIMPLE statistical numerical solution expressed by:

A^{-1}=A^0+A+A+A^2+....+A^N…………………………...(6)

Together with,

$(I-A)^{-1}$= A^0+A+A+A^2+....+A^N……………………….(7)

For sufficiently large N.

Where,

$\mathbf{A^0=I}$, the unit matrix and N is the number of iterations or time steps dt.

Note that Formula 6 is an important innovation and constitutes a revolutionary and unprecedented leap forward.

It is also worth mentioning that matrix A is singular therefore matrix **I-A** is not singular and can be inverted.

This simple and accurate solution of the Poisson PDE and Laplace PDE via B matrix chains shows that nature operates in a 4D x-t unit space and that the modern statistical chains of the Cairo techniques is able to solve efficiently the general form of Poisson PDE.

- *Q2: How to solve a 1D, 2D and 3D Poisson and Laplace PDE without using MATLAB iteration or any other conventional mathematical method?*

- *A2:*

The solution is carried out in two consecutive steps [1].

- *Step 1-*

Transfer the PDE Fish from its timeless classic 3D form,

Nabla^2 V + S =0

In a form similar to 4D thermal diffusion PDE, i.e.

dV/dt)partial = Const . Nabla^2 V+S

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- *Step 2 –*

Consider that the energy density U(x,y,z,t) represents the potential energy V(x,y,z,t) and use equation 5 of the B-matrix chain techniques to find the solution depending on time [1,3],

U(x,y,z,t)=(B^0+B+B^2 + .+B^N) . (b + S) + IC. B^N….(5*)

To solve the Poisson equation with boundary conditions [1].

Follow the same procedure as steps 1,2 to solve the Laplace PDE which is a special case of the Poisson PDE.

(The Laplace PDE is a special case of Poisson PDE. It is similar to the Poisson PDE except that the source term S is equal to zero)

Note that in the 1D, 2D and 3D Poisson and Laplace PDE solution, the main diagonal entry of the 1D, 2D and 3D transition matrix RO is assumed to be zero.

The reason is that there is no energy storage in the n free nodes of the vacuum EM field.

- ➢ *Q3: How to solve the heat diffusion partial differential equation with Dirichlet boundary conditions?*

- *A3:*

Heat diffusion partial differential equation is written in 4D unitary x-t space as [2],

dT/dt)partial = Const . Nabla ^ 2 .T + S…………………...(8)

We follow exactly the same procedure as that of the Q/A 2 equation except that the main diagonal entry of the 1D, 2D and 3D transition matrix RO is not zero.

RO is function of the thermal properties and the size of the tested object.

For example, the calculated thermal diffusivity D for aluminium = 0.98 E-4m^2/s.

- ➢ *Q4: How to find the Ψ distribution of the quantum wave function of a quantum particle in a one-dimensional infinite potential well?*

- *A4:*

We assume that the similarity between classical physics and quantum physics has already been demonstrated in previous papers[8,9,10].This means that nature only has one face to show in classical and quantum physics. So:

- ✓ The starting point is to replace the complex wave function Ψ (probability amplitude) in the Schrödinger PDE by its square Ψ Ψ*= Ψ*2 (probability density which is also equal to the density of quantum energy U) [8,9,10].

Note that Ψ^ 2 = U (x,y,z,t) is real.

In fact, we ignore the Schrödinger PDE as if it never existed and proceed in the same way as the B-matrix chain techniques.

The PDE for Ψ^2 which is the probability density of finding the quantum particle in the volume element x-t dx dy dz dt is assumed exactly equal to the energy density of the quantum particles.

- ✓ Therefore, the chain solution of matrix B follows the same procedure of solving the heat diffusion equation explained above in the last question.

- ✓ The third and final step is to take the square root of the solution for Ψ^2 as the solution for Ψ itself.

Let Ψ(x,y,z,t) =SQRT Ψ^2 (x,y,z,t) =SQRT U(x,y,z,t)

Note that if the square root of Ψ^2 does not exist, then the quantum mechanical solution for the system concerned does not exist.

- ➢ *Q5: How to find 1D, 2D and 3D statistical numerical integration formulas?*

- *A5:*

Many people think that in mathematics there is already everything, but in fact it is true that something important like statistical differentiation and statistical integration is a missing part of mathematics [3,13].

The steady state transfer matrix E arises from the relation,

E=B^0+B +B^2 +B^N

For N tends to infinity.

Or equivalent,

$E=(I-B)^{-1}$

For a sufficiently large number N.

The transfer matrix D is given by,

D=E-I

The transfer matrix D constitutes the basis of the statistical weights used in numerical integration.

BI=(n-1).D/sum. ∑∑bi,j on all i,j. . . . . . (5) Let us denote the term n-1/∑∑bi,j over all I,j by the statistical integration factor STI.STI=n-1/∑∑bi,**j**

➢ *Q6: Using Matrix Algebra, how can we Show that the Infinite Integer Series [(1+x)/2]^N is equal to (1+x)/(1-x), ∀x∈[0,1[?*

- *A6:*

A validation numerical example, the sum of the entire series,

0.99 + 0.99^2 + 0.99^3 + ... +0.99^N

Tends towards 190 as N goes to infinity.

The proof of A6 is based on the transfer matrix D plus the following rule (principle 1) [14].

[For positive symmetric physical power matrices, the sum of their eigenvalues is equal to the eigenvalue of their sum of power series]

The question arises whether a classical mathematical proof can also be found?

III. NUMERICAL RESULTS

➢ *Q/A -3:*

Find the stationary solution for the two-dimensional heat diffusion equation over 9 equidistant free nodes with Dirichlet boundary conditions as shown in Fig.1.

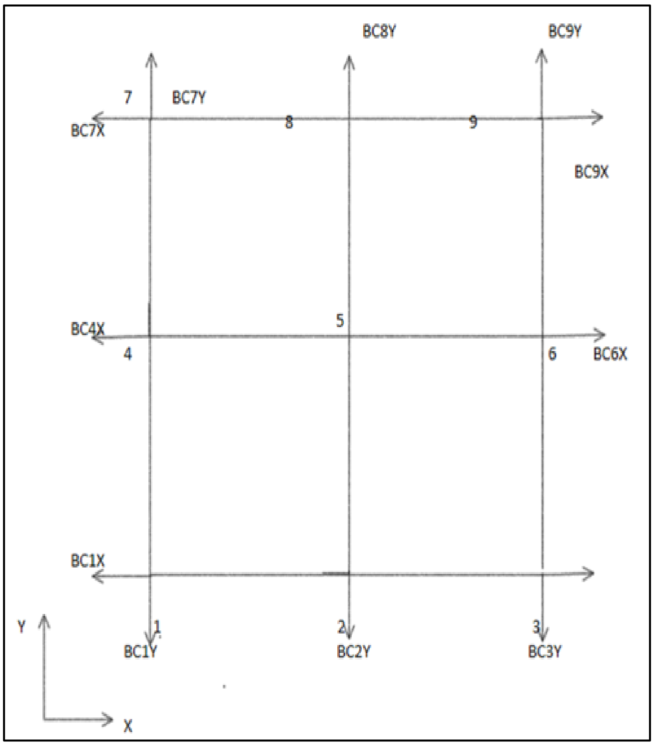

Fig 1 Two-Dimensional Rectangular Shape of Nine Equally Spaced Free Nodes Subject to Dirichlet Boundary Conditions

Reference [5] solved the system of 9 linear algebraic equations using the Gaussian elimination method via a sophisticated penta-diagonal algorithm scheme for the following arbitrarily chosen BC vector [2],

b = [100,20,20,80,0,0,260,180,180] T……………………….(8)

And arrived at the solution vector:

U= [55,714 , 43,214 , 27,143 , 79,643, 70,000, 45,357 ,112,357, 111,786 ,84,286]T.. . . (9)

Now the BC vector for the proposed statistical solution corresponding to equation 8 is simply rewritten,

[100/4, 20/4, 20/4, 20/4, 80/4, 0, 0.260 / 4, 180/4, 180/4] T (10)

The calculated transfer matrix D = E-I can be multiplied by the vector BC (b) from the equation. 10, we obtain,

U=[55,71322 , 43,212685 , 27,1417885 79,6412506 69,9978638 , 45,35554 , 112,856 , 111,7841 , 84,284645]T. (11)

If we compare the numerical results of the proposed statistical solution (vector 11)) with that of Mathews (vector 9), we find a striking precision

➢ *Q/A 4:*

Figure 1 shows the B-matrix chain solution for quantum particle in a one-dimensional infinite potential well. This solution is discussed in detail in references 8,12.

- *Fig.1-Below.*

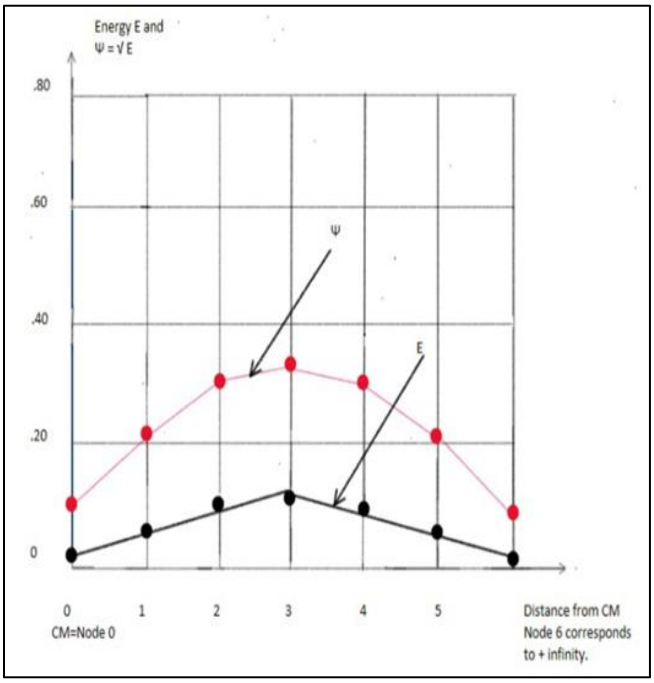

Fig 2 The Solution E=Ψ^2 (Triangle) and Wave Function for a Quantum Particle in a 3D Box.

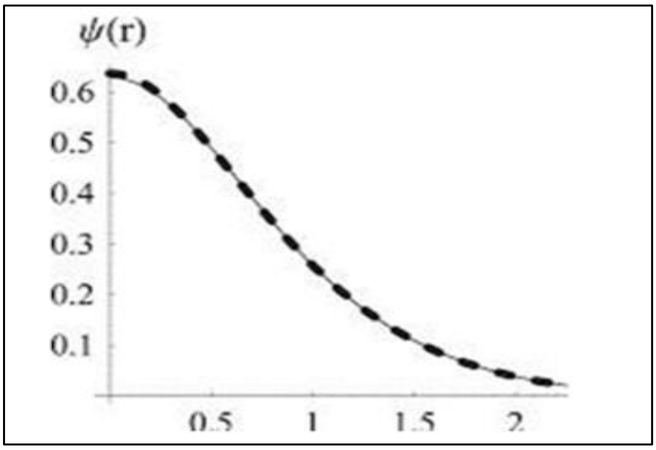

Fig 3 The Solution E=Ψ^2 (Triangle) and Wave Function for a Quantum Particle in a 3D Box.

Fig.1-up-Quantum particle in one-dimensional potential well enclosed in an insulating domain.

Fig.2-down-Quantum particle in one-dimensional potential taken from Google search for comparison.

Note that in Figure 1, V(x) shown is the probability closest to the maximum (i.e. for n = 2) and is symmetric about the midpoint and has a triangular shape.

Note also that in Figure 2, Ψ(x) presented is the maximum probability amplitude (i.e. for n = 1) and is symmetric about the midpoint and its square $\Psi(x)^2$ has a triangular shape.

- *Q/A 6:*

The proof of A6 is based on the transfer matrix D plus the following rule (principle 1) [14].

[For positive symmetric physical power matrices, the sum of their eigenvalues is equal to the eigenvalue of their sum of power series]

The question arises whether a classical mathematical proof can also be found for the sum of this infinite algebraic series?

Since the answer to question/answer 6 is explained in detail in reference 14, there is no need to repeat it.

IV. CONCLUSION

In the present article we compare two different approaches for the description of time-dependent physical phenomena (both in classical macroscopic physics and modern microscopic quantum mechanics), namely classical partial differential equations and ultra-modern statistical theories of the Cairo techniques.

We present a detailed theoretical and numerical study of six diverse situations in the fields of electromagnetism, the heat diffusion equation, the Schrödinger equation, statistical integration formulas and the summation of infinite integer series.

The numerical results show the superiority of modern statistical theories employing chains of B matrices over the classical theory of partial differential equations and in particular Schrödinger's PDE in the fields of classical physics and quantum mechanics.

A ground-breaking conclusion is that the numerical statistical theory of Cairo techniques and its B-matrix chains can form a framework for a unified field theory for energy density.

- NB: Throughout this work, the author used his own double precision algorithm [15,16].
- Python or MATLAB library is not required.

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