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Fundamentals of Quantum Mechanics Theory and Practice

Ismail Abbas[1]

[1]Military Technical College, Cairo University, Egypt

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Abstract: Quantum mechanics is the newest science and should therefore be the most precise, but unfortunately, it's quite the opposite.

If you don't understand quantum mechanics, ask yourself if I'm right, because others don't either.

The field of experimental quantum mechanics is so vast and confusing that its theoretical practitioners will always have to adopt new explanations from their own context to conform to the facts of quantum mechanics.

Quantum mechanics was created in the early 20th century to establish mathematical and physical laws or rules for subatomic objects subject to an external potential field in order to explain so-called quantum systems.

Studying the spatiotemporal evolution of a quantum system, defined as a microscopic subatomic system of low energy density subjected to a potential field, external or internal, is a rather complex subject.

However, in 1927, the well-known Schrödinger PDE, valid for infinite free space subject to Dirichlet boundary conditions, was introduced.

Schrödinger's PDE must be complemented by the Bohr/Copenhagen interpretation of the wave function Ψ involving the rules of quantum systems of instantaneous entanglement and superposition.

We all know that the Schrödinger equation is incomplete because it lives and operates in the incomplete space R^4 and therefore the wave function Ψ is incomplete in itself and cannot be defined as scalar, a vector, nor a tensor.

The complex wave function Ψ has never been properly defined.

Moreover, the Schrödinger PDE is not Lorentz invariant and is not compatible with the special theory of relativity, and is obviously even less so with the general theory of relativity.

However, quantum mechanics has come a long way, both in theory and practice, since 1927, nearly a century ago. This long journey has added even more illogical and confusing properties to the Ψ wave function, such as causality and wave function collapse.

Many attempts have been made over the last century to reform the Schrödinger equation, the most notable being to combine it with the general theory of relativity, but all these attempts have been in vain.

The breakthrough came in 2020-2024 [2,3,4], when the author of this article claimed to replace the classical Schrödinger equation Ψ with the PDE for its square Ψ^2, which is logical and physical. Ψ^2 is needed to express the quantum energy density flux (U(x,y,z,t) = Ψ^2 (x,y,z,t)) and we therefore propose a new Schrödinger equation for Ψ^2 which should have the form of the energy density diffusion PDE such as that of thermal conduction.

Equation 3 should be supplemented by the advanced artificial intelligence proposed by the author [5,6].

Comparing Schrödinger's classical PDE of 1927 with the PDE proposed for Ψ^2 in 2020 shows that we currently have two different or distinct theories of quantum mechanics!

Which one is more theoretically true and more practically useful?

This is the purpose of this article.

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I. INTRODUCTION

Quantum mechanics is the newest science and should be the most perfect and clearest, but unfortunately, it is the opposite.

As a general rule, if you don't understand quantum mechanics, ask yourself if I'm right, because other people don't understand it either.

There is a great divergence between the theory of quantum mechanics of yesterday and today.

Quantum mechanics was initially established and interpreted a hundred years ago to understand the spectrum of the hydrogen atom, and then its scope was extended to study the spatiotemporal evolution of an arbitrary quantum system, defined as a microscopic subatomic system of low energy density subjected to a potential field, external or internal.

In microscopic quantum mechanical theory, the spatio-temporal evolution of a closed quantum system is described by the Schrödinger partial differential equation, valid for infinite free space subject to Dirichlet boundary conditions and the applied potential energy V.

i h dΨ/dt)partial=-h²/2m . Nabla^2 Ψ+ V(x,y,z,t) Ψ . . . . (1)

OR,

H^Ψ = EΨ. . ……………………….…………………. . . (2)

Reduced form

In normal convention.

Equation 1 was presented in 1927, when the wavefunction Ψ itself was defined by the Bohr/Copenhagen interpretation involving the entanglement and superposition of physical quantum systems.

We all know that PDE 1 is incomplete since it evolves and operates in the incomplete space R^4 (3D and real time as external controller). Therefore, the wavefunction Ψ is incomplete in itself and is neither a scalar, a vector, nor a tensor.

Ψ has never been properly defined.

Moreover, the Schrödinger PDE 1 is not Lorentz invariant and is not compatible with the special theory of relativity, and is obviously even less so with the general theory of relativity.

However, quantum mechanics has come a long way, both in theory and practice, since the 1927, almost a century ago.

Many attempts have been made over the last century to reform the Schrödinger equation 1, the most notable being to combine it with the general theory of relativity, but all have failed.

The breakthrough came in 2020 - 2024 [2,3,4], when the author of this article claimed to replace the classical Schrödinger equation 1 with its square Ψ^2, which is logical and physical.

It is clear that Ψ^2 is needed to express the quantum energy density U(x,y,z,t) and therefore the proposed modern Schrödinger equation must have the form of the energy density diffusion PDE such as thermal conduction:

dU/dt)partial = D. Nabla^2U+S(U) ……………… . . . (3)

S is the vector of source/sink vector term, ordered and expressed in appropriate units (Jm-3s-1).

Note that D. Nabla^2U in Equation 3, where D is the diffusivity of the medium and Nabla^2 a 3D spatial operator, is compressed together or replaced by a Nabla^2U term in a unitary 4D x-t space. Also note that the full PDE 3 will be replaced by advanced intelligence techniques based on the matrix chain B.

In other words, equation 3 can be easily solved numerically using the advanced artificial intelligence proposed by the author [5,6] without needing equation 3 itself.

Comparing equations 1 and 3 shows that we currently have two different or distinct theories of quantum mechanics.

Which one is more theoretically true and more practically useful?

This is the subject of this article.

Note that the definition of time as a positive integer in a 4D unitary x-t space was previously (before 2020) unknown in classical and quantum physics.

The statistical theory of Cairo techniques and the resulting B-matrix chains can only be defined in the control volume space.

Here we introduce the concept of a closed control volume, bounded by a closed surface A subject to Dirichlet boundary conditions, which replaces the classical concept of

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infinite space R^4, which is of limited use. In both cases, the total probability of occurrence of an event such that the transition probability is that of the entire space = 1.

We demonstrate that the squared Schrödinger equation preserves, or even improves, the quantum concepts of the original Schrödinger equation, such as quantum entanglement and superposition. Moreover, the matrix representation of the proposed quantum theory allows a solution with singularities (the energy density U tends to infinity).

In the proposed theory, we assume that:

Classical and quantum entanglement is a universal law of physics.

Entanglement itself exists in both quantum and classical systems, between the elements and the walls of the system, and its flow rate is limited to C which is the transfer rate of the information signal which is the speed of light.

The speed of entanglement is equal to the speed of information transfer C and can never be infinite, and the supposedly spooky action at a distance is just a spooky fantasy.

Schrödinger's PDE fails to explain complex microscopic situations such as vacuum dynamics, nor macroscopic situations such as the formation and explosion of the Big Bang, nor the formation of black holes.

We believe that the main reason for the incompleteness of the classical Schrödinger equation is that it exists and operates in a three-dimensional geometric space plus time t as an external controller (R^4 space), which is an incomplete and inadequate space.

It is noteworthy that this is the first time that the incompleteness of the classical Schrödinger equation is linked to its function space.

Over the past century, several attempts have been made to combine the three-dimensional Schrödinger equation with the theory of general relativity in a four-dimensional unitary x-t space to extend its range and remove its shortcomings, but without any improvement.

The West is losing the battle of quantum mechanics.

Recently, in 2020, a new breakthrough statistical theory in 4D unitary x-t space based on B-Transition matrix chains which is a product of the theory of Cairo techniques emerged [2].

It is a part of advanced concrete theory of artificial intelligence, called Cairo Techniques Theory [5,6].

This theory, which models the behavior of nature, has proven capable of solving temporal situations in classical and quantum physics in the most general cases, as well as pure mathematical problems [7,9,10].

We claim that:

The Cairo intelligence techniques = natural intelligence = artificial intelligence in the strict sense = unified field theory.

The way we've framed time evolution through the B-matrix chains is clean, compact, and captures almost the full range of all physical systems beautifully.

However, one question remains un answered:

Can this framework handle wave function collapse as described in the Copenhagen interpretation of quantum mechanics?

Collapse isn't just another form of evolution—it's abrupt and probabilistic. In other words it involves a kind of "jump" triggered by measurement, often modeled as projection onto an eigenstate.

The short answer is yes and this particular question is explained in more detail and given a simple answer in Section III Applications and Numerical Results.

In conclusion, we can hypothesize the following:

The second modern theory of quantum mechanics which proposes to replace the classical SE with its square combined with advanced artificial intelligence as an essential improvement.

So, once again, we have two distinct theories of quantum mechanics: one based on the original 1927 theory of the classical Schrödinger equation, supplemented by the Bohr/Copenhagen interpretation, and the other on the 2020-2025 square of the Schrödinger equation, supplemented by advanced artificial intelligence.

Which of the two theories is theoretically more true and practically more useful?

That is the subject of this article.

In order not to worry too much about the details of the introduction, let us move directly to the theory and then to the applications and numerical results.

II. THEORY

In fact, the theory behind this work is the unified field theory or the theory of everything.

- *The Unified Field Theory is Founded on THREE Modern New Concepts [2-5]:*

- The modern concept of a closed control volume, bounded by a closed surface A in 1D, 2D, and 3D, subject to Dirichlet boundary conditions, as illustrated in Figures 1a and b.

This modern concept replaces the classical concept of infinite space R^4, which has limited usefulness.

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- For any closed control volume, bounded by a closed surface A and subject to Dirichlet boundary conditions, there exists a statistical transition matrix B such that:

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

- When conditions 1 and 2 are met, they constitute the unified field theory, which is the third modern concept:

Cairo's intelligence techniques = natural intelligence = artificial intelligence in the strict sense = unified field theory.

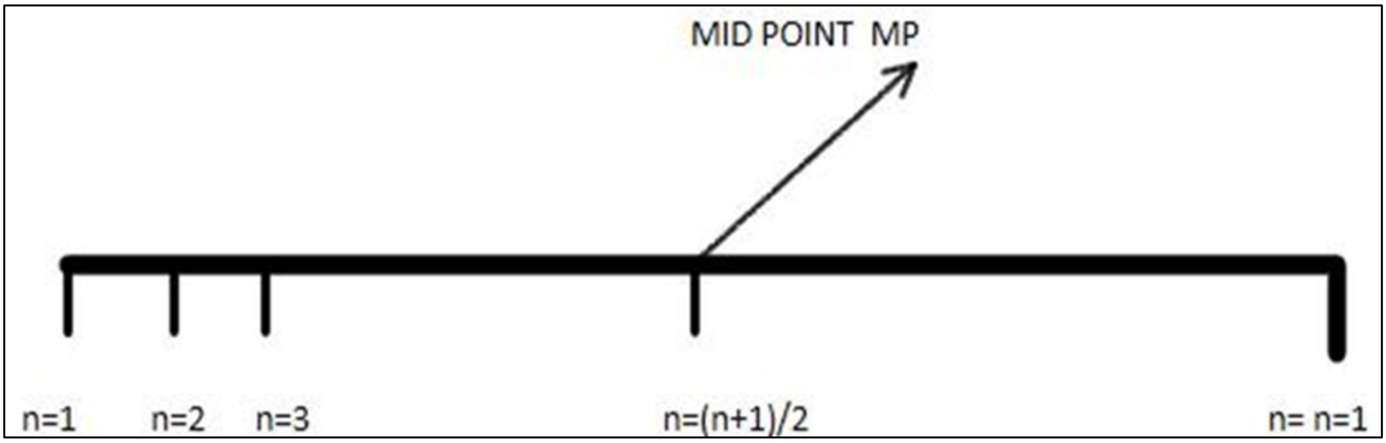

Fig 1 a. 1D Control Volume which is our Laboratory with n Free Nodes.

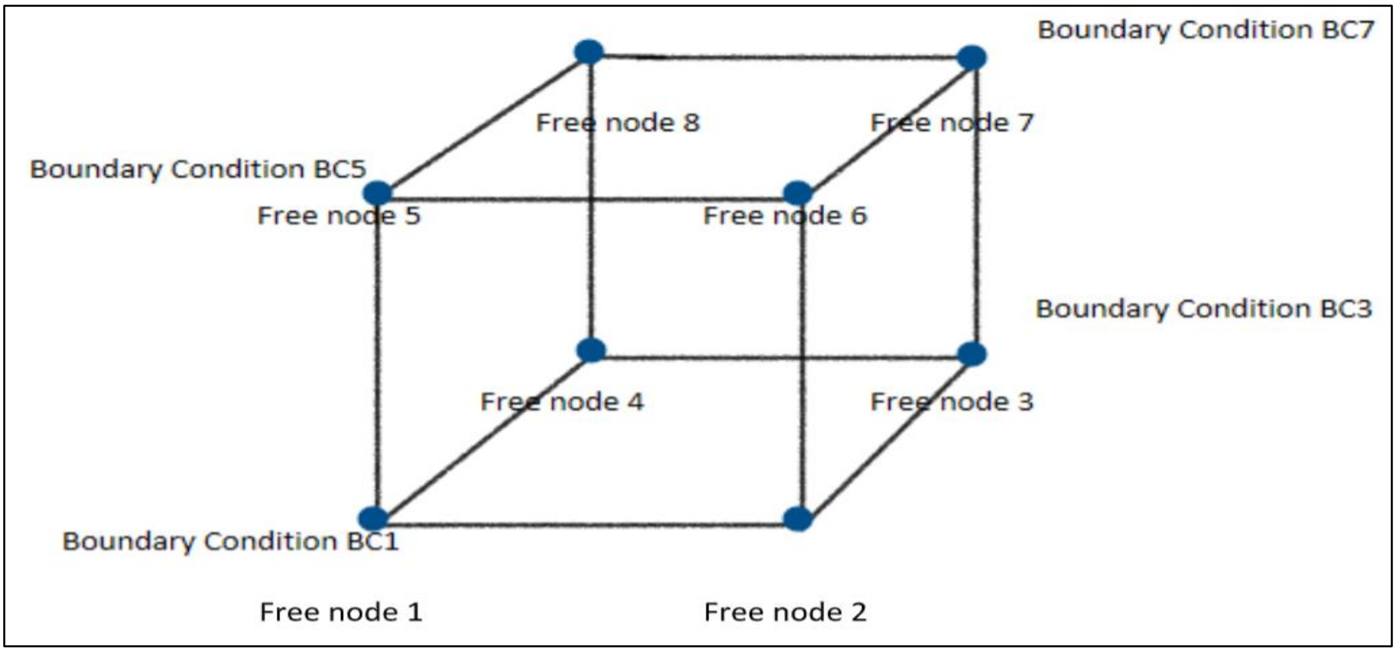

Fig 1 b. 3D Cubic Control Volume which is our Laboratory with 8 Free Nodes.

➢ *Cairo Intelligence Techniques Operate in four Consecutive Steps within their Control Volume CV, as Follows:*

- Discretize the control volume into a one-, two-, or three-dimensional geometric shape of the problem into n equidistant free nodes, as shown in Figures 1a and 1b (not to be confused with N, the number of iterations or time steps).
- Construct the transition matrix B for the given geometric shape of the problem.
- Carefully select the numerical value of the principal diagonal element RO, as explained in various solved problems in Section III.
- Construct the transfer matrix D(N), which is the time-domain solution to the physical or mathematical problem in question.

D(N)=B+B^2*B^3+. . . . . . +B^N . . . ………………. . (5)

Note that when N is sufficiently large, expression 5 reduces to:

D(N) = {1/(I-B) -I} . . . ……………………………... . (6)

Where I is the nxn unitary matrix.

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It is worth noting once again that ***the Cairo Techniques Control Volume functions as an open LABORATORY (or kitchen) to prepare answers and questions on everything, whether they concern classical/quantum physics or mathematics.***

It is quite surprising to note that behind all this methodological structure, behind this fidelity to the physical data, something begins to emerge: a tension towards the origin of the center of mass or midpoint (in accordance with the theory of general relativity).

The origin of the control volume of the quantum mechanical system is the center of mass (CM) or midpoint (MP) as shown in Fig.1a, 1b.

It is also surprising to note that the main diagonal elements or entries B_{ii} , i=1 to n of the matrix B have a very particular physical meaning:

i-All entries of the diagonal vector RO ∈ [0,1] represent the ratio of the stored or remaining energy at the free node point (i,i) at the end of the transition time interval dt.

ii-Therefore it also predicts the physical nature of the process:

***RO=0 corresponds to emw in vacuum.**

****RO=const .GT.0 corresponds to heat diffusion in material medium.**

*****RO=const .x (saw tooth shape as shown in Fig.2) corresponds to quantum mechanical system.**

Note also that the transition matrix B is completely different from the classical density matrix B, which is neither a transition matrix nor a statistical matrix.

In fact, Equation 4 of the transition matrix completely replaces the original time-domain partial differential equation (PDE) of the energy density in the control volume, which we completely ignore.

As shown in Figure 2 below,

- *Quantum Mechanics*

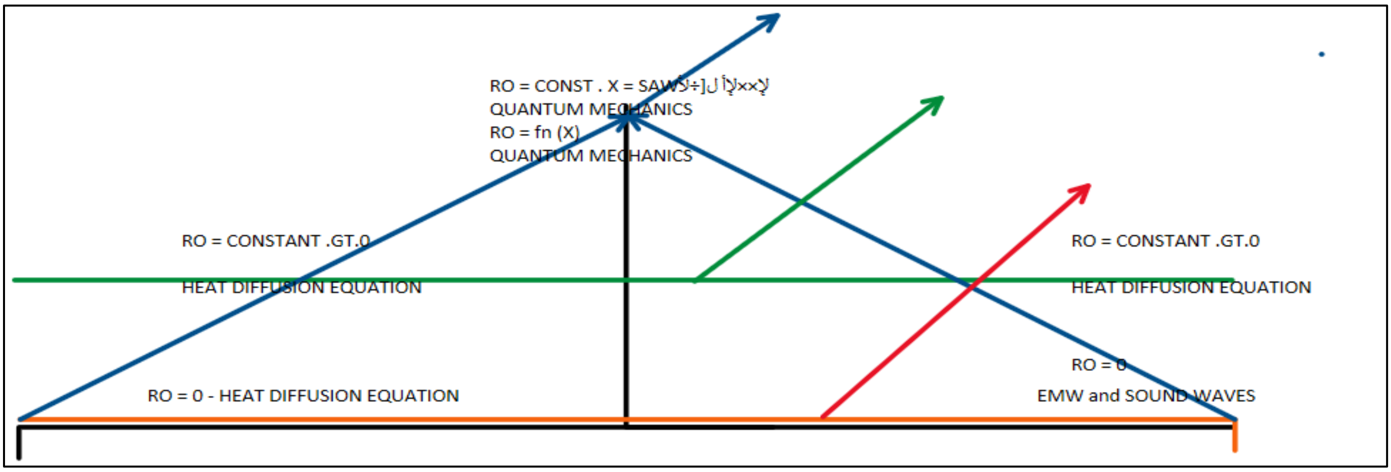

Fig 2 The Main Entries of the Diagonal Vector RO of the Transition Matrix B Preselected for Different Physical Situations.

It should be noted that the physical classification of the entries on the main diagonal of the transition matrix (RO) shown above in Figure 2 cannot be justified mathematically. Mathematics lags behind physics in this respect.

In order not to worry too much about the details of the theory, let's move on to the subject of the next section of questions and answers, Section III.

III. APPLICATIONS AND NUMERICAL RESULTS

This section explains the theory in more detail through ten questions and answers covering a wide range of areas of physics and mathematics.

- **Q1 - What is the theory called Cairo Techniques Theory and what are its B-matrix chains?**

- **A1-** The core of statistical theory, called Cairo techniques, is well explained in Section II above.

Furthermore,

i- The statistical transition matrix B is a well-defined square Bnxn matrix, defined by four statistical conditions [2,3].

It should be noted that today, we only know two transition matrices and two time-dependent statistical chains: Markov chains and matrix chains B.

It should also be noted that, unlike the Markov matrix, the transition matrix B has a place for the Dirichlet boundary condition vector b and a place for the source/sink term vector S.

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ii- Equation 5 produces time-dependent and rapidly converging solution chains:

D(N)= D(N)= B+B^2+B^3 + ... +B^N …………. . . . (5*)

For sufficiently large values of N, the following formula holds:

D(N)= 1/(I-B) – I . . . . …………………………..... . (6*)

With I, the nxn unit matrix.

iii- The solution to the corresponding time-domain PDE follows from equation 5:

U(x,y,z,Ndt)=D(N).(b + S)+ B^N . IC. . . ……………. . . (7*)

iii- What is almost magical here is the spatial principal diagonal vector Bii of the transition matrix B; it definitively determines the physical nature of the situation under consideration (classical physics, quantum physics, mathematics, etc.), as shown in Figure 2.

- **Q2- Is the unified field theory Schrodinger equation or its square?**

- **A2-** In classical microscopic quantum mechanics, the spatio-temporal evolution of a closed quantum system is described by the following Schrödinger partial differential equation, valid for infinite free space subject to Dirichlet boundary conditions.

i h dΨ/dt)partial=-h²/2m . Nabla^2 Ψ+ V Ψ . . . . (1*)

With Bohr/Copenhagen interpretation.

In normal convention.

Equation 1 was presented in 1927, when the wave function Ψ itself was defined via the Bohr/Copenhagen interpretation involving entanglement and superposition of physical quantum systems.

We all know that the PDE 1 is incomplete (It lives and operate in the incomplete R^4 space) and therefore the wave function Ψ is incomplete by itself and is neither a scalar, nor a vector, nor a tensor. It has never been properly defined.

Moreover, the Schrödinger PDE 1 is not Lorentz invariant and is not compatible with the special theory of relativity, and is obviously even less so with the general theory of relativity.

Many attempts have been made over the last century to reform the Schrödinger equation 1, the most notable being to combine it with the general theory of relativity, but all have failed.

The breakthrough came in 2022-2023 [2,3], when the author of this article claimed to replace the classical Schrödinger equation 1 with its square Ψ^2, which is both logical and physical.

It is clear that Ψ^2 is necessary to express the quantum energy density U(x,y,z,t) and, therefore, the proposed modern Schrödinger equation must have the form of the famous energy density diffusion PDE:

dU/dt)partial = D. Nabla^2U+S(U) . . . . (3*)

Combined with the advanced discrete artificial intelligence proposed by the author (2020-2024),

Equations 1* and 3* show that:

We currently have two different or distinct theories of quantum mechanics.

We believe the second theory is more theoretically true and more practically useful.

- **Q3- Are there two distinct theories of quantum mechanics today?**

- **A2-** In 1925, E. Schrödinger formulated his famous quantum mechanical equation, and in 1927, N. Bohr and E. Heisenberg, among others, invented his so-called superposition interpretation for this equation, despite opposition from A. Einstein and E. Schrödinger himself.

Over the past century, ardent defenders of the original quantum theory have attempted to present it, alongside the theories of relativity, as the unified field theory, but to no avail.

Recently, in 2020, the author presented the square of Schrödinger's partial differential equation as a new quantum mechanics theory [3,4].

We believe that these two descriptions of quantum mechanics can not be merged into one but their numerical results can be compared one vs the other.

In other words, one must apply the statistics of the Cairo technique intelligence theory to a well-defined quantum physical situation, then apply the original Schrödinger partial differential equation to the same defined situation and find the affinity zones with respect to the decoherence zones of the two solutions.

- *Note that:*

i- The original Schrodinger equation of 1925-1927 lives and operates in R^4 space (3D plus real-time as an external controller), which is an incomplete and inadequate space.

ii- The new quantum mechanics based on the square of Schrödinger's original PDE exists and operates in the 4D unitary space x-t, which is the complete space [4].

In the modern quantum theory eq 3*, the energy of each system is probabilistic, but the total energy of all

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systems, E, is constant and predictable by the spatial-temporal evolution of E via artificial intelligence.

- **Q4- What are the five main mistakes made in interpreting classical Schrödinger's PDE?**

- **A4-** Interpreting Schrödinger's PDE often leads to common mistakes.

In Copenhagen in 1927, an international conference of the 30 top scientists of the time took place and was devoted to a comprehensible interpretation of the partial differential equation on the quantum scale proposed by Schrödinger.

Einstein and Schrödinger opposed the emerging conclusion which is the current probabilistic superposition imposed by the giant N. Bohr.

However, they both ultimately lost the debate and the entire affair.

We assume that Schrödinger's PDE in particular and the whole of quantum mechanics in general remain incomprehensible until today.

In search of a major breakthrough, a rigorous redefinition of quantum mechanics via the replacement of SE by its square preserving the characteristics of QM was recently proposed by the author [3,4].

However, we assume that the five main errors made in the interpretation of the classical Schrödinger PDE are:

1-confusing the wave function ψ(x,t) with a physical wave, when it is a probability amplitude;

What's been incomplete for a century is our interpretation of wavefunction behavior under measurement.

(2) ignoring its probabilistic nature, as |ψ|2 gives probability density, not ψ itself.

(3) misunderstanding the Hamiltonian's role in governing dynamics and energy eigenvalues;

(4) neglecting boundary conditions, source/sink term and normalization, which are essential for physical solutions;

(5) overlooking the importance of the wave function's complex nature, as its phase is critical for quantum interference and superposition and (6) -the wave function in QM PSI is continuous but its derivative is not continuous?

In physics textbooks it is written that the ψ(x,t) wave function and its first derivative must be continuous.

Meanwhile, in these same books you find many situations where the ψ(x,t) solution is continuous and its derivative is not, the simplest example is the particle in a one-dimensional box.

Only Psi. Psi* and its derivative must be continuous which is the second theory of Schrodinger equation while the derivative of Psi alone may or may not.

2-Avoiding these errors ensures a correct understanding of the role of the Schrödinger equation in quantum mechanics which we assume belongs to the square of the Schrödinger equation and not to the Schrödinger equation itself.

- **Q5- Is the second theory of quantum mechanics tensor mechanics?**

- **A3-** The short answer is yes.

The second theory of quantum mechanics is tensor mechanics.

The statistical transition matrix B is an n× n square matrix equivalent to a tensor of the second rank where,

x= i dx

y= j dy

z= k dz

t= N dt

The statistical theory of Cairo techniques, which models the behavior of nature, has proven capable of solving time-dependent situations in classical and quantum physics in the most general cases, as well as pure mathematical problems.

Our description of time evolution using the B-matrix equation is clear, concise, and perfectly captures almost all physical systems.

Furthermore, the use of AI is a major asset, as it allows us to construct a falsifiable, consistent, and dimensionally sound theory.

The conclusion is that the transition matrix B works as follows:

Tensor $B_{i,j,k}{}^{N}$.

Where i, j, k are lowercase indices and N are uppercase indices.

Which is a second-rank tensor where all indices i,j,k,N are zero or positive integers.

N is the number of iterations or time jumps of dt

The tensor nature of the B matrix is revealed.

Thanks to matrix/tensor technology and artificial intelligence, we have automatic solutions to different temporal situations.

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Various components and similar matrices can model or simulate the natural grace of artificial intelligence and statistical algorithms.

- **Q6- Is it true that Cairo intelligence techniques = natural intelligence = artificial intelligence in the strict sense = unified field theory**

- **A6-** This kind of unified view is fascinating, and it is curious to see how far it can actually be pushed?

The statistical transition matrix /tensor B for a closed control volume of surface A subject to Dirichlet boundary conditions,

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

Equation 4 is not only universal, but it also describes and solves all time-dependent phenomena in the entire universe (partial differential equations of classical physics in its most general form, quantum physics, statistical distributions, integration and differentiation, loudness in sound rooms, etc.) [1, 2, 6, 7, 8].

The answer to this question boils down to a simple challenge to our distinguished contributors and readers:

The challenge is as follows:

Name a physical phenomenon from classical physics, quantum physics, integration and differentiation, and statistics that does not belong to Equation 1.

Thank you.

- **Q7- What is the importance of the triple integral I= ∭ f(x,y,z) dx dy dz?**

- **A7-** To our knowledge, this integral is not present in mathematics or classical quantum mechanics.

And yet, it is one of the simplest applications of B-matrix chain techniques [1,8,9,10].

We assume that the triple integral I= ∭ f(x,y,z) dx dy dz can be very useful in many situations, the simplest of which is mass calculation with non-uniform density.

For example, if the total mass M is distributed over a volume, we can represent how this mass is distributed by a function f(x,y,z) which gives the density at the point (x,y,z).

If you integrate over volume, you can calculate the total mass [1,10,11].

The triple integral I= $\iiint_V$ f(x,y,z) dx dy dz cannot be calculated either analytically in the general case or even numerically.

We have recently seen many attempts, some using the classical Schrödinger equation 1, to evaluate its integral, but unfortunately all have ended in failure.

To our knowledge, the only numerical method we know for this triple integral is to express the integral I in terms of statistical weights SW,s ,

I= f(x1,y1,z1) . SW1 +f(x2,y2,z2) . SW2. . . + f(x27,y27,z27) . SW27 . . . (6,7,8)

Where SW,s are the statistical weights of the triple integral evaluated on the 27 free nodes.

Again, we don't know of any other method.

Now, consider a cube of 27 equidistant free nodes subject to 81 Dirichlet boundary conditions reduced to 56 as shown in Fig.3.

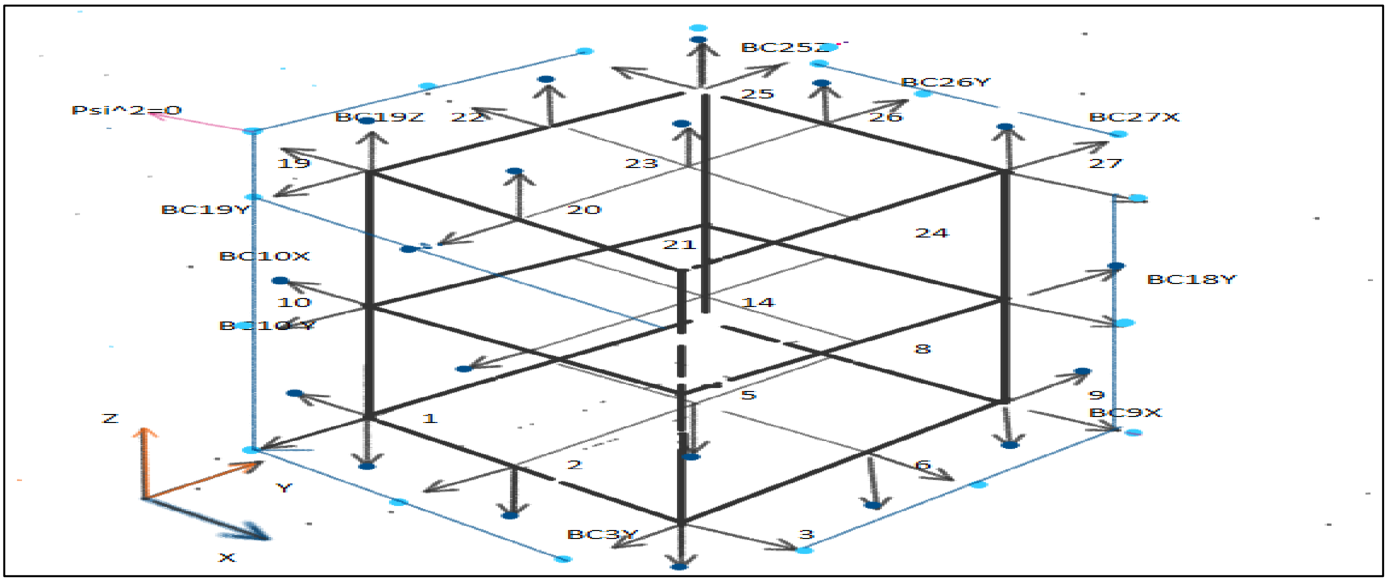

Fig 3 A Cubic Control Volume of the Energy Density Field Discretized into 27 Equally Spaced Free Nodes, Subject to 81 Dirichlet Boundary Conditions Reduced To 56.

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I= f(x1,y1,z1) . SW1 +f(x2,y2,z2) . SW2. . . + f(x27,y27,z27) . SW27 . ……………….. . . (4*)

Where SW,s are the statistical weights of the triple integral.

The statistical transition matrix B 27x27 with RO = 0 for this cubic energy density field space is given by,

0 1/6 0 1/6 0 0 0 0 0 1/6 0 0 00 0 0 0 0 0 0 0 0 0 0 0 00 02-1/6 0 1/6 0 1/6 0 0 0 0 0 1/6 00 0 0 0 0 0 0 0 0 0 0 0 00 0 03-0 1/6 0 0 0 1/6 0 0 0 0 0 1/6 00 0 0 0 0 0 0 0 0 0 0 0 00 04-1/6 0 0 0 1/6 0 1/6 0 0 0 0 01/6 0 0 0 0 0 0 0 0 0 0 0 00 0 05-01/6 0 1/6 0 1/6 0 1/6 0 0 0 01/6 0 0 0 0 0 0 0 0 0 0 0 0 006-0 0 1/6 0 1/6 0 0 0 1/6 0 0 0 0 00 1/6 0 0 0 0 0 0 0 0 0 00 07-0 0 0 1/6 0 0 0 1/6 0 0 0 0 00 0 1/6 0 0 0 0 0 0 0 0 0 00 08-0 0 0 0 1/6 0 1/6 0 1/6 0 0 0 00 0 0 1/6 0 0 0 0 0 0 0 0 00 09-0 0 0 0 0 1/6 0 1/6 0 0 0 0 00 0 0 0 1/6 0 0 0 0 0 0 0 00 010-1/6 0 0 0 0 0 0 0 0 0 1/6

1/6 0 0 0 0 0 1/6 0 0 0 0 0 00 011-0 1/6 0 0 0 0 0 0 0 0 1/6 0 1/601/6 0 0 0 0 0 1/6 0 0 0 00 0 012-0 0 1/6 0 0 0 0 0 0 0 0 1/6 00 0 1/6 0 0 0 0 0 1/6 0 0 00 0 013-0 0 0 1/6 0 0 0 0 0 0 1/6 0 001/6 0 1/6 0 0 0 0 0 1/6 0 00 0 014-0 0 0 0 1/6 0 0 0 0 0 0 1/6 01/6 0 1/6 0 1/6 0 0 0 0 0 1/6 00 0 0

Etc . . . "To be completed with a double symmetry

- *We can use Equation 3* or 4* to evaluate the transfer matrix D(N) for sufficiently large N. Using the double-precision algorithm, the output results for D(N) 27x27 are expressed as follows:*

- **1-**

0.112171399240424300	**.390978564533210004**	**.6769216489284893E-002**
0.391099459979469499	**.3594337527814389E-0022**	**.8917725571791415E-0024**
.6825121038529496E-0022	**.8936273137263536E-0021**	**.1071538930203321E-002**
0.392451216690517089	**.3427323090059911E-0022**	**.8815705697913047E-0029**
.4099292136797519E-0025	**.7873202288345083E-0022**	**.2118458029200764E-0022**
.9057496590432032E-0022	**.2174362578445368E-0021**	**.0013027641488021E-0025**
.5316956539892624E-0022	**.6525227934425442E-0021**	**.0667689546976620E-0023**
.0409253301479554E-0022	**.2007348140690858E-002**	**9.9110077676096541E-0031**
.1339658593714240E-0021	**.0031903213869143E-0024**	**.7610072372568932E-003**

- **2-**

0.391216233509670890 .15860509 . . . . . .

Etc . . .

"To be completed with a double symmetry"

Note that the matrix D(N) and its generating transition matrix B are both a double statistical matrix.

The SW,s statistical weights for the 27 free nodes in Figure 3 are as follows:

0.712175906	**0.966820836**	**0.7094255090**
.977245331	**1.28672469**	**0.9668208360**
.740758121	**0.977245331**	**0.7121759060**
.971432269	**1.28263426**	**0.965306878**
1.31396687	**1.68382823**	**1.28263426**
1.18938315	**1.31396687**	**0.9714322690**
.709893465	**0.959949672**	**0.7071430680**
.970374167	**1.24996960**	**0.9599493740**
.738475680	**0.970374167**	**0.709893465 . ………………….. (6)**

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- *Note that:*

i-The total sum of the 27 statistical weights is exactly 27.000

ii-The maximum of the statistical weights occurs at the mid point MP or the center of mass CM which is free node number 14.

iii- The minimum of the statistical weights occurs at most far from the mid point MP which are the nodes 1,3, 7, 9, 18, 20, 24,27.

Numerical examples,

i)-I_1=∭[0,1]^3 f(x,y,z) dx dy dz

For f(x)=x or f(x)=y or f(x)=z

Then the integral $I_1$is almost the same and is equal to 13.6 units.
ii)-for f(x)=x^2 or f(x)=y^2 or f(x)=z^2

Then the integral I_2 have almost the same value and equals 11units.

iii)-for f(x)=x+y+z,

I_3 = 40.54 units.

- **Q8- What is entanglement and how quickly is it transmitted?**

- **A8-** Entanglement Is a Universal Law of Physics.

Is not Uniquely Quantum but Entanglement is both a quantum and classical physics phenomenon.

For most classical physics time-dependent processes, quantum entanglement is negligible on human-observable scales. Therefore, it is rarely, if ever, the universal "key" to solving classical time-dependent problems.

The question of entanglement and its relation to time is indeed one of the deepest puzzles in physics. Many great minds have tried to reconcile entanglement with a consistent picture of time, but significant challenges remain. Pure Time Theory (PTT) suggests that the key to resolving these conflicts lies in redefining time itself, rather than treating it as a background parameter.
As far as we know, the considerable success of the statistical theory of Cairo techniques as a unified field theory or theory of everything, refers to the fact that it is the only theory that adequately defines time.

This implies that entanglement is well defined in the statistical theory of Cairo techniques

However, we all know that energy density entanglements undeniably exist, as they are measured almost daily. We also know that almost all great scientists like Einstein, Schrödinger, Minkowski, Hilbert, Hamilton, etc. accepted the physics of entanglement.

We assume that the reason is that the entanglement is related to the correct definition of time, which is more complex and hidden than the entanglement itself.

Cairo's technological theory has its own view of time as the fourth dimension of the four-dimensional unitary x-t space. It is a dimensionless integer N, embedded in the three coordinates x, y, z of any three-dimensional geometrical shape.

The way time and entanglement inextricably interact in any time-dependent energy density process is simply magical:

Any energy density field enclosed in a closed control volume CV, such as the cube in Figure 1 or Figure 3, undergoing a relaxation or scattering process, must be associated with another wave field in the same CV. The secondary wave field is described by the boundaries of CV and acts as the commanding field meaning no diffusion without command permission.

Control of the secondary wave field pushes the scattering process towards the center (CM or MP) and causes the appearance of a new entanglement force.

In quantum mechanics, the expansion process of the Schrödinger equation's wave function is a mixture of two fields or processes, partly wave and partly diffusive. Any attempt to measure the state of the system disrupts the wave field and causes the quantum wave function to collapse, transforming the Schrödinger equation into a pure diffusion equation.

This is called wave function collapse.

The classical Schrödinger equation considers the flow of time as universal and absolute, while the statistical theory of Cairo techniques and general relativity considers the flow of time as malleable and relative.

The question why time seems to flow in only one direction, (Arrow of time)
In classical and quantum mechanics, time occupies a special place because it is treated as a fundamental classical parameter, external to the system itself.

For example, in the Copenhagen interpretation of quantum mechanics, all measurements of observables are made at specific times, and they are uniquely assigned probabilities. Moreover, the Hilbert space used in quantum theory is based on a complete set of observables that commute at a specific time.

We assume that the nature of time and the arrow of time are best studied by the free cooling curve in heat diffusion and by the decay of free sound in an acoustic chamber [7,8,9,10,11].

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The numerical statistical theory of Cairo techniques predicts a relationship between the thermal diffusivity α and the entanglement speed which is that of the propagation of the information signal C from the time exponent of the natural free cooling curve !.

For example, the time dependence of the free cooling curves for a metal cube with side length L can be described by the matrix chains B.

The strings of Matrix B provide for the first time in a century a unique and rigorous proof of W. Sabine's experimental reverberation formula:

U(t) = U(0). Exp -t [Constant. Area / C. Volume]. . . . . . . (5)

C is the entanglement velocity, equal to the signal transfer velocity of the accompanied secondary wave.

Using equation 5:

The reverberation velocity of sound is obviously the speed of sound in air at NPT = 330 ms^-1.

An exact result.

The same thing happens in the free cooling curve of metal cubes and leads to the following formula,

$C = T_{½} * \log 2 * L^2 /$ (thermal diffusivity α) . . ………... . (6)

$T_{½}$ is the half-life, in seconds, of the cooling curve of a metal cube of side length L, to be measured experimentally.

In 2023, the author conducted experimental work to measure $T_{½}$ of a free cooling curve for different metals.

We found that $T_{½}$ for a 10 cm aluminum cube was 45 seconds
and that for a similar iron cube was 100 seconds (14).

The thermal diffusivity α is found in thermal tables:

α (Al) = 1.18 E-5 MKS units

α (Iron) = 2.5 E-5 MKS units

If we substitute the above numerical values of α, L and T1/2 into equation 6, we obtain C, the speed of light, equal to 2.95 m s^-1 for both cases.

But the question arises: what is happening here, and why is the thermal diffusivity α related to the speed of light C?

The answer is simple:

Heat diffusion in the control volume of the 10-cm-long heat diffusion cube is associated with a control information wave, which implies:

No diffusion without permission.

The speed of the control information or entanglement wave is equal to that of light C [15].

- **Q9- Is there a generally accepted theory regarding audio rooms?**

- **A9-** To our knowledge, there is no generally accepted rigorous theory describing the reverberation time or spatiotemporal evolution of the sound energy density U Jm^-3 inside audio rooms.

Only notable attempt cam out on by Chiara [15].

Chiara [15] considers that the sound energy in the room is composed of two components, namely a radiation component and a second reverberation component as shown in Figure 4. Chiara's attempt at description was pioneering, but its success was limited.

However, the numerical statistical theory of Cairo techniques offers a rigorous theory linked to PDE,
dU/dt)partial = α ∇^2 (U) + S

where U(x,y,z,t) is the sound energy density J m^-3 and α m^2 sec^-1 is the diffusivity of the sound energy.

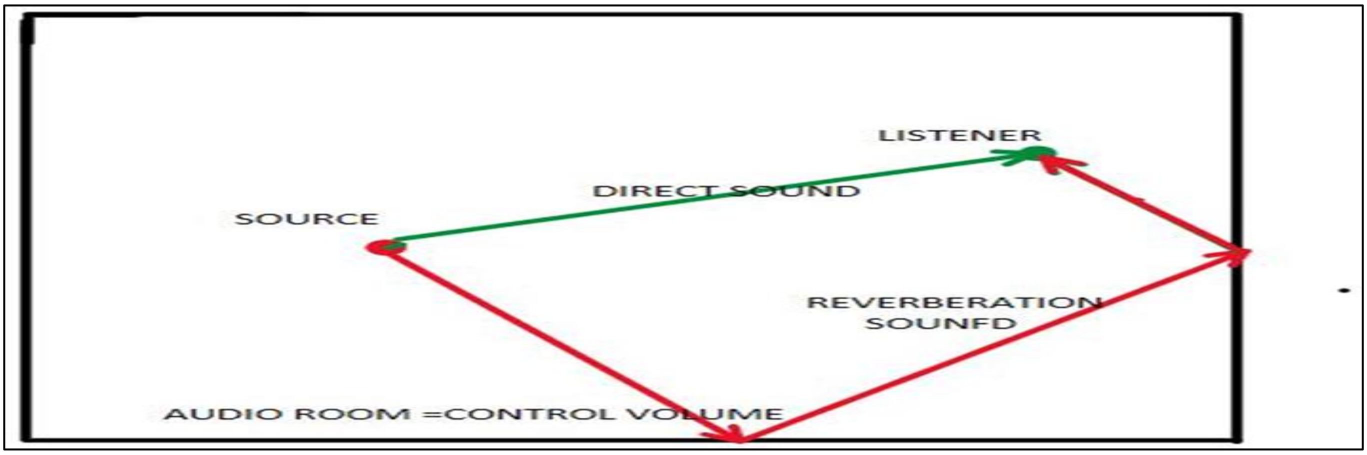

Fig 4 Audio Room Described as Control Volume

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- **Q10- Can the statistical theory of Cairo techniques explain the formation and explosion of the Big Bang?**

- **A10- The brief answer is yes.**

Note that Neither quantum physics nor classical physics can provide an answer to this question. the Schrödinger PDE solution does not allow for the singularities essential to the formation and explosion of the Big Bang.

The solution to the Schrödinger equation generally does not allow for singularities in the same way that general relativity does. The classical Schrödinger equation is a linear partial differential equation governing wavefunctions, which describe quantum systems.

These wavefunctions must remain finite and normalizable (i.e., their total probability integrates to one), which rules out the presence of singularities where the probability density would become infinite or undefined.

These singularities are also essential for the collapse of giant stars into tiny black holes.

In other words, The solution to the Schrödinger equation generally does not allow for singularities in the same way that general relativity does. The Schrödinger equation is a linear partial differential equation governing wavefunctions, which describe quantum systems. These wavefunctions must remain finite and normalizable (i.e., their total probability integrates to one), which rules out the presence of singularities where the probability density would become infinite or undefined.

In contrast, general relativity permits singularities—points where physical quantities such as density and curvature diverge—because it is a classical, nonlinear theory. The Big Bang and black hole formation are both predicted to involve such singularities, where known physics breaks down. Since the Schrödinger equation does not accommodate such infinite-density points, this suggests that a purely quantum mechanical description of the universe (or black holes) would need a deeper framework beyond standard quantum mechanics.

The big bang is "denied" by classical quantum mechanics.

These singularities are also essential for the collapse of giant stars into tiny black holes.

However, the formation and explosion of the Big Bang are well explained by the second modern theory of quantum mechanics [4,13].

Entanglement is a universal law and triggers a force directed toward the center of mass (CM) or midpoint (MP).

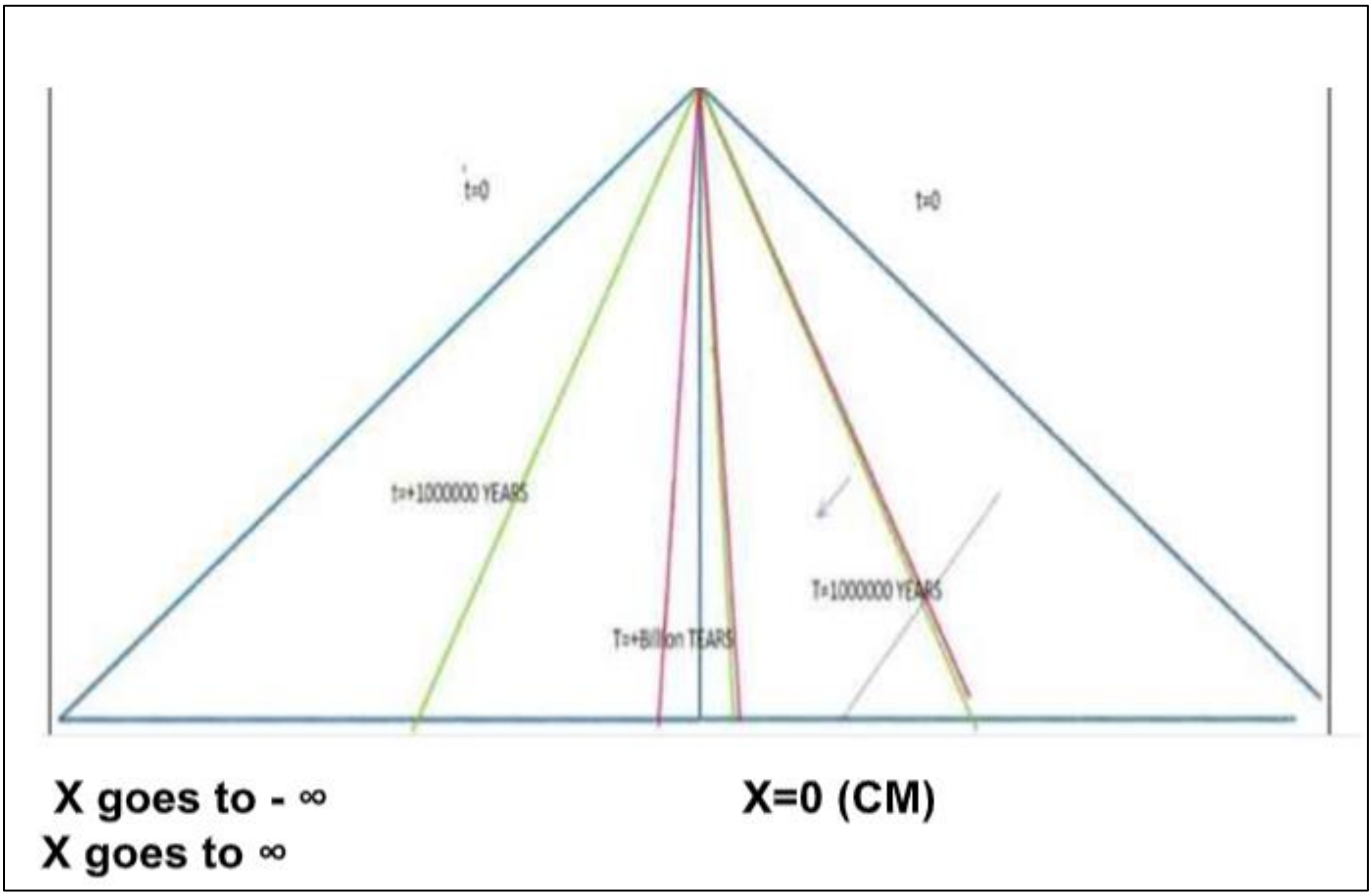

Fig 5 Formation of Big Bang-Early Stages [4]

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IV. CONCLUSION

There are two distinct forms or expressions of Schrödinger PDEs: the classical Schrödinger PDE, introduced in 1927, and the Schrödinger squared theory of PDEs, introduced by the author in 2020.

This means that there are two distinct theories of quantum mechanics.

The Schrödinger squared theory is a remarkable tensor theory of quantum mechanics, which exists and operates in a 4-dimensional unit x-t space and is therefore more complete than the classical theory.

The author introduces and defines two important concepts: the control volume (in a 4-dimensional unit x-t space) and the statistical transition matrix, never before known in classical or quantum physics.

He also introduces and explains entanglement as a universal law related to the finite speed of the information signal (C).

This shows that entanglement can be neither instantaneous nor infinite. The author also examines whether the West is losing the battle of quantum mechanics. Classical mathematical integration is defined and evaluated in 3D for the first time (hypercube).

Finally, the formation and explosion of the Big Bang are presented and explained.

NB. The author uses his own double precision algorithm, such as that of references 17,18,19.

No ready-to-use Python or MATLAB algorithms are needed.

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