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# Time Conservation Principle versus Energy Physics

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## Abstract

This article explores the conservation principles that may apply to time, contrasting them with the well-established conservation of energy. Publications of peer reviewed papers enabled the author to derive time to be a tensor, algebraic than merely arithmetic scalar. Here, these are brought out in a dramatic manner to highlight gradation of high rank tensors, which decompose to multiple vectors. This study reexamines time originally as potentially the most conserved attribute in physics, considering the quantum nature of well-known established by thermodynamic fundamentalistic energy conservation. Literature surveys quoting time conservation versus energy physics studies, especially quantum gravity, Page–Wootters formalism, and related areas with concept of time as emergent and travel phenomena associated to time as a wavefunction tensor have been highlighted. Mathematical theory derivations showing conservation of time principle with tensor analysis giving key equations and establishing time invariance with point in space via differential testing in relation to domains of reality of time tensor,  = constant proves that conservation of time applies like the general principle of energy quantum conservation well within given conditions. Quantified clocks applying time conservation principle analyze strong gravity versus weak gravity environments like microblackholes and the zero-point fields, showing how branes may produce curled up dimensions, like Kaluza-Klein 5D curled up dimensions.

Verifications with experimental methods, especially testing time conservation potentially would uncover new fundamental principles of physics - time conservation principle after establishment will propel to revolutionize our understanding of the universe and drive innovation in both theoretical and applied physics, specifically quantum technologies and astrophysical endeavors, especially measurement techniques with LHC, for example have been considered to launch research efforts of the future.

**Keywords:** Time Conservation; Energy Physics; Page-Wootters Formalism; Quantum Technologies; Astrophysical Endeavors

## Abbreviations

CMBR: Cosmic Microwave Background Radiation; LHC: Large Hadron Collider.

## Introduction

Time marks the passage of events happening in space. This simple way of understanding time correlates well with


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definition basis on known physics [https://en.wikipedia.org/wiki/Time]: Time is the continued sequence of existence and events that occurs in an apparently irreversible succession from the past, through the present, and into the future. This corresponds well with that of the well-known dictionary definition of time as: (1) the indefinite continued progress of existence and events in the past, present, and future regarded as a whole: "travel through space and time" (2) a point of time as measured in hours and minutes past midnight or noon, for example. Reference Listing [1-18] provides physics literature that will have extensive specific details on the statements, claims, evidential observations, justifications of mathematical analysis, derivations, and equations giving theoretical proofs of the hypothesis and concepts advanced by all these treatises. According to the Hindu Mythology-there was limitless ocean before the beginning of the universe, when Golden Egg (so called Cosmic Egg) was formed inside this ocean, floated one thousand years and then broke into two halves through which our universe was created [15]. Triggering Problem in the Origin of the Universe]. Using the Hindu Mythological concept these authors explain: what was before the Big Bang? (i.e., the ocean of supra-physical energies); where did the Big Bang take place? (i.e., inside the Cosmic Egg); the Triggering Source (i.e., the size of the Cosmic Egg). The significance of their proposed model is that: it explains the presence of golden ratio everywhere in every living as well as non-living objects as a relic of the creation moment - a universal footprint of golden flow originated at the creation moment of our universe.

Questions that have been asked on time are whether it is present in conservation as the implicit or explicit dimension. Holling H [5] argues that thinking of time so far has not involved conservation, merely perhaps only as episteme with theoretical engagement and research activities, with method of measurement with clocks, machines, scientific apparatus, historic chronology, industry, and labor. In the Copenhagen interpretation, conservation time exists as a merely implied dimension. Holling H [5] adapted the sequential, chronological time that results in the understanding of time merely as a method of its measurement – the time of clocks, machines, scientific apparatus, historic chronologies, industry, and labor. According to Holling H [5], while critical theory, philosophy and art practice have long been engaged with anachronistic and heterochronic interpretations of historical time. In this regard, decay of energy to entropy may be considered to define arrow of time.

The conservation of energy is a cornerstone of classical and modern physics, addressing issues such as the ultraviolet catastrophe through quantum mechanics. However, the vacuum catastrophe presents a new challenge, particularly in the context of general relativity. This paper proposes a novel perspective: the conservation of time. By examining time as a tensor, we aim to provide a deeper understanding of its role in the universe's fundamental states, from high infinite temperatures to absolute zero. With tensor theoretically time to be considered as a dimension, the author would point to quantum solution physics [Brant Carlson: Separation of variables and the Schrodinger equation, https://www.youtube.com/watch?v=IZAfn-iGU5U], separation of the space and time variables works to get quantum solutions. With quantum gravity considerations here, quantum aspects of relativistic space-time may be isolated to have tensor time theoretically represented adequately as dimension; therefore, time conservation would be quite justified to proceed further.

## Time Conservation like Energy Physics, Discussed by Authors as Literature Given Below:

- **Conservation of Energy and Conservation of Momentum** [3]**:** Aspects of the fundamental principles of energy and momentum conservation have been discussed, providing a solid foundation for understanding conservation laws in physics.
- **Conservation of Energy** [4]**:** This article explores the principles and applications of energy conservation, rooted in the first law of thermodynamics.
- **Potential Energy and Conservation of Energy** [17]: It explains the concepts of potential energy and the conservation of energy, including the differences between conservative and non-conservative forces.
- **Mechanical Energy and Conservation of Energy** [13]**:** This textbook offers a comprehensive overview of mechanical energy and its conservation, useful for understanding the broader context of energy conservation.
- **Sarton G, et al.** [18]**:** These authors give how they originally derived conservation laws with general overview of the conservation of energy, including historical development applying in various fields.

## The Following Recent Research Papers that Delve into the Topics of Time Conservation, Quantum Physics, and Related Areas having Key Findings are Sampled Below:

- **Altaie MB, et al.** [2]**:** Their review discusses the problem of time in quantum physics, including historical perspectives and recent developments [2]. They explore the need to consider time as a quantum observable and the implications for quantum gravity, highlighting ongoing challenges of integrating time as a quantum observable within quantum mechanics. Various approaches to appropriately defining time in


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quantum systems, also including the use of the quantum clocks, they explore potential solutions such as the Page–Wootters formalism, emphasizing the need for a consistent framework to address the problem of time in quantum gravity.

- **Alonso-Serrano A, et al.** [1] these authors explore concept of emergent time, suggesting time may not be a fundamental aspect of reality but rather an emergent phenomenon from more basic quantum processes. They also examine the implications of this view for time travel, proposing that certain interpretations of quantum mechanics could allow for time travel under specific conditions. Their study provides a detailed analysis of the Page–Wootters formalism and its recent reinterpretations, offering new insights into the nature of time.
- **Pitts JB** [16]**:** This author surveys historical and philosophical aspects of energy conservation, highlighting its foundational role in physics, discussing the very implications of energy conservation as well for various physical theories, including quantum mechanics and general relativity. The study also addresses the philosophical implications of energy conservation, particularly in relation to mind-body interaction and the nature of physical laws.

These studies advance our understanding of time and energy conservation, offering new theoretical frameworks and experimental approaches to explore these fundamental concepts.

## Methodology, Algorithm Experiment, Results and Discussions

Mathematical Derivation Showing Conservation of Time Principle

At any point in space: $\int_0^t E_Q.dt_Q = h$ having energy quanta, $E_Q = E_Q\left(t_Q\right)$ for point in space, where $t_Q$ = time quanta. Writing variation of this energy with time: $\int_0^t E_Q.dt_Q = \int_0^t E_Q\left(t_Q\right).dt_Q = \int_0^t f\left(t_Q\right).dt_Q = h$. Hence, it was deducible of how time quanta would be conserved, by having quantum energy transformed then canonically into time quanta, evident in time differential of the integral, i.e. $\int_0^t f\left(t_Q\right).dt_Q = 0$, implying invariant time with point in space.

However, it was not clear how time quanta work without understanding tensor nature of time affecting energy quantum.

The author is showing here knowhow based on modeling in peer reviewed paper and presentation [6,10] how tensor time conservation law comes about.

### Tensor Analysis Giving Key Equations

Per the author's peer published papers, time is much more than scalar arithmetic; it will have to be expressed as algebraic {wavefunctionality} tensor, highlighting its algebraic properties and conservation [6-11]:

| Theory | Equation of Motion | Conservation Law |
|---|---|---|
| Tensor formalism | $\frac{d}{dt}\frac{\partial T_{\mu\nu\alpha\beta}}{\partial \dot{x}^{\mu}} - \frac{\partial T_{\mu\nu\alpha\beta}}{\partial x^{\mu}} = 0$ | $T_{\mu\nu\alpha\beta} =$ constant |

**Table 1:** Theory of Tensor formalism with Equation of Motion and Conservation Law.

Above (Table 1) introduces a new invariant quantity, the time matrix as well defining algebraic tensor time as the differential of action (Hamiltonian equivalence) with respect to different nonlinear and multidirectional domains of reality

$T_{\mu\nu\alpha\beta} = \frac{\partial^2 S}{\partial x^{\mu}\partial x^{\nu}\partial x^{\alpha}\partial x^{\beta}} = \frac{\partial^2 H}{\partial p_{\mu}\partial p_{\nu}\partial p_{\alpha}\partial p_{\beta}}$: here, L is the Lagrangian, p is the momentum, x is the position, and H is the Hamiltonian. The Legendre transformation allows us to switch between Lagrangian and Hamiltonian formulations with physics, noting that action, S per physics literature is given via: $S = \int L dt = \int pdq - Hdt$. $T_{\mu\nu\alpha\beta} =$ constant in the above differential testing of conservation in relation to domains of reality; thereby it proves that conservation of time applies like the general principle of energy quantum conservation well within these conditions. We see also from above only analytical quantum conservation with energy and not necessarily all forms of energy will make conservation of time more universal than all forms of energy. For example, in superluminal noisy condensate [8], energy conservation may not occur when infinite energy possibilities are possible having random process noise. Alternatively, time may have universal realistic existence only by having real matter universe. Hence, such conservation will be in vogue existing within only the restricted matter universe with gravity like in geodesics.

It was shown [6-11] that graded decomposition of time tensors from Rank 6 to Rank 1 vector will make it eventually scalarized observables that become measurables [11]. Then multi-vector time will have resolvability into various directions on the space. For example, we can consider time

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pointing from proper time to real time. We can resolve that proper time vector going from one location to another location point, a vector directing that time will make that go to real time location point!! Mathematically time tensor can be decomposed to multiplicity of vectors: $\hat{t}_{ijklmn} = \vec{t}_1 \otimes \vec{t}_2 \otimes \vec{t}_3 \otimes \vec{t}_4 \otimes \vec{t}_5 \otimes \vec{t}_6$ essentially allowing operator algebra with resolution of the vectors [7,11]. Further interpretative physics will allow many worlds tensor wavefunction deduction of collapse to resolved time vector in Hilbert space Dirac bra-ket form. The author has shown further that generating commutator scalar and/or density matrix is possible by interacting with gravity vector to give general form of the action Lagrange physics dynamics [7,11].

## Quantified Clocks Applying Time Conservation Principle

Time clocks will differ depending on the domain of reality. For example, in the movie "AVATAR" there are at least 2 domains of reality for clocks. In general, there are 6 different clocks possible with quantum astrophysical reality per my peer reviewed articles [10,11]. The domains of reality would depend on types of gravity. Clocks would run slower within strong gravity like blackhole having local symmetry correlating Swampland conjectures [Episodes of HISTORY OF PHYSICS: https://www.youtube.com/@teknet_earthglobal2923/streams]. However, clocks will run faster having a weak gravity environment like electromagnetism photons with global symmetry; we would expect consequently universal expansion via dark energy extending general relativistic theory [7-10].

Contravariant synergistically, gravitational effect depends on the domain of reality [6,8,11]. Logically, gravity domain of reality will give function equation of clock like f ($g_R$, $R_g$), where $g_R \equiv$ gravity which is domain dependent, whereas Rg $\equiv$ domain of reality that is gravity dependent. This will reflect some of the available literature, wherein authors describe modified f (R, T) gravity, having R representing the Ricci scalar and T denoting trace of the energy-momentum tensor [14]. This is where time comes to picture with domains of reality, with time conservation principle helping to figure out what is going on with timeline-event sequences.

The author's peer-reviewed publications demonstrate link of time vector to gravitational gradient as well as Lagrange of Action equation of object motion in various domains of reality [11]. Application of Principle: Time Conservation quantifies Equivalence Principle as well as Correspondence Principle [8] in Quantum Astrophysics enabling knowhow to track and measure clocks at different domains of reality, applying author developed equations earlier [6,8,11]. From these articles, the following formulations are helpful to proceed quantitatively.

$$T_{\mu\nu\alpha\beta} = g_{\mu\nu\alpha\beta} \frac{\partial^4 S}{\partial x^\mu \partial x^\nu \partial x^\alpha \partial x^\beta} = g_{\mu\nu\alpha\beta} \frac{\partial^4 H}{\partial p_\mu \partial p_\nu \partial p_\alpha \partial p_\beta}$$

where metric $g_{\mu\nu\alpha\beta}$ converts action and Hamiltonian derivatives to appropriate domains of time. (S) represents the action, x's denote the space-time coordinates, while the indices (μ, ν, α, β) take values from 0 to 3. $S = \int Ldt = \int pdq - Hdt$, having L: Lagrangian, p: momentum, q: position and H: Hamiltonian, noting that Legendre transformation is applied to the action in the space-time manifolds. The author Iyer R [11] has shown Sense-fields-effect by a mesoscopic coupling with gravitational gradient $\vec{G}_w >$ will generate gravitational fields wavefunction, $\epsilon_s \left| \vec{G}_w > = \right| \Psi_{\epsilon g} >$ energetically giving momentum interactively to density time gravity Schwarzchild-like expanded Matrix, $\left| G_w >< t_q \right| = G_{ij}$, having (i, j = 1, 2, 3, 4) producing $< \vec{t}_q \left| \epsilon_s \right| \vec{G}_w > = < \vec{t}_q \| \Psi_{\epsilon g} > = t_{\epsilon g}$, where t = scalar time, "qg" represents quantum gravity.

We can analyze this further. Defining the gradient of Lagrange energy = force = $\nabla_R L$ will allow us to derive force,

$F = \nabla_R L = \nabla_R \frac{\partial S}{\partial t}$ having Action Lagrange, S=∫Ldt.

Then, acceleration equivalent gravity: $g_R = \left(\rho R_g^3\right)^{-1} . \nabla_{R_g} \frac{\partial S}{\partial t}$, having mass function density, ρ, characterizing distribution of matter mass with gravity dependent domain of reality, Rg, and the domain dependent field of gravity, $g_R$ {geodesically}. If we then consider domains of reality affecting gravity or vice versa, we deduce that microblackholes or the zero point will affect time clocks quite differently.

Applying Iyer Markoulakis (IM matrix) point PHYSICS formalism with expanded "stringmetrics" [8], zero-point fields along the cross (pan) diagonal of the Helmholtz decomposed 2×2 matrix will stretch, since the clocks run faster in zero-gravity vacuum {emitting microcosmic


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microwave background radiation at light speed} have essentially relativistic zero-points, whereas microblackholes along the IM matrix will contract due to their strong gravity slowing clocks. Thus, branes may form like vacuum thin sheets that act typically like flat branes at a relatively high speed of light of the zero-point fields. Microblackholes with slower gravity clocks will then locally curve branes generating microgravitational waves. Eventually, the locally distorted fields will create curled up dimensions. All these events lead to spatial and temporal warping within sub-mesoscopic levels. Principle of time conservation will help in modeling quantitatively the clock speeds at the varying domains of reality as well as gravitational geodesic fields.

The author would extend further thinking of the curved M branes to curled up dimensions creating quantum local clocks possibly be key to real physicality as well as mental consciousness of life forms.

Manipulations of the clocks are possible having the knowledge of metrics controlling them with interactive gravity-domain of reality-time aspects. Per 4x4 tensor time matrix in comparison with local and the global clocks point to local clock manifestation transitioning proper to real time versus global clock manifesting transitioning local to the global time within the physics domain of reality context of quantum relativistic ASTROPHYSICS [6]. Typically, branes are expected to have Planck thickness and branes are expected to be separated by the discontinuum length symbolized DL [8]. The above argumentation of typical curled up submesoscopic dimensions analogizes to Kaluza-Klein 5D curled up dimensions [https://en.wikipedia.org/wiki/Kaluza%E2%80%93Klein_theory]. Essentially, gravity maybe considered to be manifestation of convergence-like inside-spiraling of 5D-curled up tensor causing densification of matter leading to mass function convergence, whereas electromagnetism will analogize to Noether [https://en.wikipedia.org/wiki/Noether%27s_theorem] symmetrical equivalence of the divergence-like outside- spiraling of the 5D-curled up tensor.

We can write decomposition of rank 2 tensors 4x4 time matrix into vector time to represent local clock $t_{lc}$ as well as another vector time to represent global clock $t_{gc}$.$t_{lc}$ vector would characterize time pointing the proper to real like for a microblackhole situation, whereas $t_{gc}$ vector would be characterizing time pointing global to the local like for a vacuum situation [6,11]. These aspects are analyzed further with ongoing projects PHYSICS, that will appear only in later publications. One of the potentially unifying grand PHYSICS will involve quantifying baryonic gravitational mass function density operator, based on time conservation application to existence of real matter universe within superluminal noisy condensate acting like "superfluids"!!

## What are the Implications of Time Conservation?

The concept of time conservation, if proven, could have profound implications across various fields of physics and beyond. Here are some potential implications:

- **Unified Framework Linking Classical to Quantum as well as Relativistic PHYSICS:** Time conservation could provide a unified framework for understanding different physical phenomena, bridging gaps between classical mechanics, quantum mechanics, and general relativity.
- **New Physical Laws Extending Beyond Thermodynamics that Point to Time Conservation Principle Generalizing Entropy Temperature to Physical Transformations of Real Universe Matter:** It might lead to the formulation of new physical laws or the modification of existing ones, particularly in how we understand the relationship between time and energy.
- **Cosmology Evolution with Conserving Time with Interactive Gravitational Geodesical Formations to Real Matter and Life within Galactical:** In cosmology, time conservation could offer new insights into the evolution of the universe, particularly in extreme conditions such as the early universe or near black holes.
- **Quantum Mechanics:** It could impact our understanding of quantum mechanics, potentially offering solutions to existing paradoxes and problems, such as the measurement problem or the nature of quantum entanglement.
- **Technological Advancements:** Practical applications could emerge in fields like quantum computing, where a deeper understanding of time could lead to more efficient algorithms as well as processing techniques.
- **Philosophical Implications Exciting thought Experiments Quantifying Discontinuum Physics:** On a philosophical level, rethinking time as a conserved quantity might influence our perception of reality, causality, and the nature of existence itself perhaps [8].
- **Interdisciplinary Research:** This concept could foster interdisciplinary research, encouraging collaboration among physicists, mathematicians, and philosophers to explore the fundamental nature of time.

These implications highlight the potential for time conservation to revolutionize our understanding of the universe and drive innovation in both theoretical and applied physics.

## How can we Experimentally Test Time Conservation?

Testing conservation of time experimentally is a challenging but fascinating endeavor. Here are some potential approaches:


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### High-Energy Physics Experiments

- **Particle Accelerators: Using Particle Accelerators like the Large Hadron Collider (LHC):** observing measurements with theoretical gravitons, answer why only left-handed neutrinos seem to really exist, such as with possible measurements of neutrino oscillations to observe high-energy collisions. By analyzing the behavior of particles and their interactions over time, researchers can look for evidence of time conservation principles [12].
- **Decay Rates of Gravitons with Relation to Partonic Neutrinos, by Studying Top Quarks, for Example, Quantum Entanglement Measurement with top Quarks LHC:** If time is conserved, studying the decay rates of unstable particles processes should exhibit consistent patterns that align with theoretical predictions [12].

### Quantum Experiments

- **Quantum Entanglement:** Investigating entangled particles to see if time conservation affects their correlated states - experiments could measure how changes in one particle's state influence the other over time.
- **Quantum Computing:** Utilizing quantum computers to simulate scenarios where time conservation might play a role - could help identify any deviations from expected outcomes.

### Cosmological Observations

- **Cosmic Microwave Background Radiation (CMBR):** Analyzing the CMBR for signs of time conservation - variations in the CMBR could provide clues about the behavior of time in the early universe.
- **Black Hole Studies:** Observing the behavior of matter and energy near black holes - time dilation effects in these extreme environments could offer insights into time conservation.

### Thermodynamic Experiments

- **Temperature Extremes:** Conducting experiments at extremely high and low temperatures to observe the transition between vacuum and superconductive states – by monitoring exactly how time may behave in these conditions could reveal conservation properties.
- **Entropy Measurements:** Measuring entropy changes in isolated systems – that if time is conserved, entropy changes should follow specific patterns that can be predicted and tested.

### Mathematical and Theoretical Models

- **Tensor Analysis:** Developing mathematical models that treat time as a tensor - models can be tested against experimental data to see if they accurately describe observed phenomena.
- **Simulation Studies:** Running simulations that incorporate time conservation principles -comparing these simulations with real-world data can help validate the theoretical framework.

### Interdisciplinary Approaches

- **Collaboration with Other Fields**: Working with experts in fields like mathematics, computer science, and philosophy to develop new experimental techniques and theoretical models will generate new interest and exciting outcomes with mathematical physical sciences.

These approaches can help test the hypothesis of time conservation and potentially uncover new fundamental principles of physics.

## Conclusions

This study proposes that time, much like energy, may be a conserved quantity in the universe. By treating time as a tensor, we uncover new insights into the behavior of time as conserved, by having quantum energy transformed canonically to time quanta, evident in time differential of the integral, i.e. $f(t_Q)..dt_Q = 0$, implying invariant time with point in space. Tensor Analysis giving key equations of time tensor, $T_{\mu\nu\alpha\beta}$ = constant is shown by differential testing in relation to domains of reality, proving that conservation of time applies like the general principle of energy quantum conservation well within these conditions. Quantified clocks applying time conservation principle analyze strong gravity versus weak gravity environments like that of the microblackholes and the zero-point fields, showing how branes may form. Eventually these branes may produce curled up dimensions, like Kaluza-Klein 5D curled up dimensions. Future research emphasizes efforts to further explore the implications of time conservation and its potential applications in various fields of physics. Projects that will quantify time gravity geodesic baryonic mass density functions will help in knowhow proving asymmetry of matter/antimatter evolution of the real matter cosmic galactical and life forms well within a superluminal noisy general condensate extent infinitely!!

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