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PARIṆĀMATRAYA AND CONTEMPORARY PHYSICS: ANALYZING ONTOLOGICAL EQUIVALENTS IN QUANTUM DYNAMICS, TEMPORAL TRANSFORMATION, AND ENTROPY

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Abstract

This study explores the conceptual relationship between the Yogic doctrine of Pariṇāmatraya—the threefold process of transformation through dharma (धर्म), Lakshana (लक्षण), and avasthā—and selected principles in modern physics, particularly quantum mechanics, thermodynamics, and entropic dynamics (Patañjali, 2019; Wheeler & Zurek, 1983). While these traditions emerged in very different intellectual and historical contexts, both are concerned with a common question: how change occurs within an ordered reality.

The analysis undertaken in this study suggests that Pariṇāmatraya can be interpreted as a sophisticated ontological framework for understanding transformation. In this framework, dharma (धर्म) may be compared with the persistence of underlying structures and conservation principles that govern physical systems (von Neumann, 1955; Bennett & DiVincenzo, 2000). Lakshana (लक्षण), understood as the temporal transformation along with characteristic marking a particular phase of transformation, bears interesting similarities to emergent properties and measurement-related phenomena that become manifest under specific conditions (Zurek, 2003; Schlosshauer, 2007). Likewise, avasthā, which refers to the changing condition of an entity through time, invites comparison with thermodynamic evolution and the irreversible processes associated with increasing entropy (Boltzmann, 1896; Prigogine & Stengers, 1984).

The purpose of these comparisons is not to suggest that classical Yogic thinkers anticipated modern scientific theories in a literal sense. Rather, the parallels point to a shared concern with continuity, change, and temporal development. By bringing these perspectives into dialogue, the study highlights the possibility that ancient philosophical models and contemporary scientific frameworks may offer complementary insights into the nature of transformation. Such a comparative approach opens new avenues for examining the relationship between persistence and novelty, order and change, and the temporal unfolding of physical reality.

Keywords: *Parinamatraya, quantum mechanics, thermodynamics, entropy, ontology, temporal transformation, conservation laws, emergence*

INTRODUCTION

The nature of change has remained one of the most enduring questions in both philosophy and science. Across cultures and intellectual traditions, thinkers have sought to understand how things transform over time while retaining some degree of continuity and identity. Whether expressed through metaphysical reflections on becoming or through scientific theories describing physical processes, the tension between permanence and change continues to occupy a central place in attempts to explain reality.

Within the Yogic tradition, Patañjali's concept of *Pariṇāmatraya* (the threefold transformation) offers a sophisticated account of how change unfolds. Elaborated in the *Yoga Sūtras* and the classical commentarial tradition, Pariṇāmatraya consists of *dharma pariṇāma* (transformation of properties), *lakṣaṇa pariṇāma* (transformation of characteristics or temporal marks), and *avasthā pariṇāma* (transformation of states or conditions). Together, these three dimensions describe how an entity undergoes change while preserving an underlying continuity that allows it to remain identifiable throughout the process (Patañjali, 2019).

Modern physics, although emerging from a very different epistemological and methodological framework, addresses a remarkably similar concern. Quantum mechanics investigates the evolution of physical systems and the emergence of

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observable properties, thermodynamics examines the transformation of energy and matter, and entropy provides a framework for understanding irreversibility and temporal directionality in physical processes (Wheeler & Zurek, 1983; Prigogine & Stengers, 1984). While these scientific theories are grounded in mathematical formalism and empirical verification, they nevertheless engage with questions concerning persistence, transformation, and the nature of temporal evolution.

This study explores whether the conceptual structure of Pariṇāmatraya can serve as a meaningful ontological framework for interpreting certain aspects of contemporary physical theories. From this perspective, *dharma pariṇāma* may be viewed as corresponding to underlying structural or informational continuities that persist through transformation, analogous to conservation principles and invariant features of physical systems. *Lakṣaṇa pariṇāma*, which concerns the distinguishing characteristics manifested at different moments, may be compared with the emergence and observation of physical properties in quantum systems. *Avasthā pariṇāma*, referring to successive states through which an entity passes, offers an intriguing parallel to thermodynamic evolution, entropy-driven change, and the temporal progression of physical systems.

The objective of this article is not to suggest that classical Yogic thinkers anticipated modern scientific discoveries, nor to reduce one framework to the other. Rather, it seeks to establish a comparative philosophical dialogue between two distinct traditions that address the problem of transformation from different perspectives. The study asks whether the ontological insights embedded in Pariṇāmatraya can provide a complementary interpretive lens through which contemporary discussions of quantum dynamics, thermodynamic processes, and entropic evolution may be reconsidered.

Methodologically, the study adopts a qualitative and comparative philosophical approach. Primary textual sources from the Yogic tradition, particularly the *Yoga Sūtras* and classical commentaries, are examined to establish the conceptual foundations of Pariṇāmatraya. These concepts are then analyzed alongside selected theoretical constructs from quantum mechanics, thermodynamics, and entropy theory through a process of conceptual mapping and ontological comparison. The analysis does not seek historical causation or direct equivalence between the two systems. Instead, it focuses on identifying structural parallels, explanatory convergences, and points of philosophical resonance concerning continuity, transformation, and temporality. By employing this interdisciplinary and interpretive methodology, the study aims to illuminate how ancient philosophical reflections on change may contribute to contemporary conversations regarding the dynamic nature of reality.

Through this dialogue between Yoga philosophy and modern physics, the article argues that Pariṇāmatraya provides a valuable process-oriented ontology capable of enriching current discussions on transformation, persistence, and the unfolding of physical reality across time.

THE ONTOLOGICAL STRUCTURE OF PARINAMATRAYA

एतेन भूतेन्द्रियेषु धर्मलक्षणावस्थापरिणामा व्याख्याताः॥ प.यो.सु-३/१३

Patanjali explains three types of parinaamas as dharma (धर्म) parinama, Lakshana parinama and Avastha parinaama as three levels of transformations of the basic elements.

धर्म परिणाम-(Dharma (धर्म)): The Invariant Foundation

Within the framework of *Pariṇāmatraya*, *dharma (धर्म)* refers to the underlying nature or constitutive principle that endures throughout processes of change (Whicher, 1998; Bryant, 2009). Rather than implying a rigid or unchanging substance, *dharma (धर्म)* points to the continuity that makes transformation possible. What persists is not necessarily a fixed entity but the structural principle, relational organization, or latent capacity that allows different manifestations to emerge while maintaining an identifiable connection to what preceded them (Chapple, 2008).

In the context of Patañjali's *Yoga Sūtras*, *dharma (धर्म)* may be understood as that which preserves coherence amid the continuous flow of change (Yoga Sūtras III.13–15; Swami Harihārananda Aranya, 1983). The concept emphasizes that transformation does not occur in isolation from continuity; rather, change unfolds upon an underlying basis that remains intelligible across different states and conditions. From this perspective, reality is neither absolutely static nor characterized by complete discontinuity. Instead, *dharma (धर्म)* represents the enduring principle through which successive transformations are connected, providing a basis for understanding how persistence and change coexist within a single process (Larson, 1979).

This understanding is particularly significant within the theory of *Pariṇāmatraya*, as it explains how an entity can undergo modification without losing its fundamental identity. The transitions from one state to another are therefore not viewed as the creation of something entirely new, but as the manifestation of different possibilities already grounded within the continuing framework of *dharma (धर्म)*. In this sense, *dharma (धर्म)* serves as the ontological basis that links continuity with transformation and permanence with becoming.

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LAKṢAṆA PARIṆĀMA AND THE TEMPORAL STRUCTURE OF REALITY

Within the framework of Pariṇāmatraya, Lakṣaṇa (लक्षण) refers to the temporal characteristics through which a phenomenon is situated in relation to time. Unlike Dharma (धर्म), which denotes the underlying continuity of a thing, Lakṣaṇa concerns its temporal designation as past (*atīta*), present (*vartamāna*), or future (*anāgata*). According to Patañjali and Vyāsa, these temporal modes are not separate realities that come into existence and disappear in succession. Rather, they represent different temporal aspects of the same underlying entity (Bryant, 2009; Woods, 1914).

Vyāsa's interpretation suggests that past, present, and future are all grounded within the same substrate (*dharmin*). What changes is not the existence of these temporal states themselves but their mode of manifestation. **A future state does not emerge from non-existence, nor does a past state vanish into nothingness. Instead, the future becomes manifest as the present, and the present recedes into the past, while all three temporal determinations remain connected within a continuous process of transformation.** Lakṣaṇa-pariṇāma therefore describes the transition of an entity through temporal designation rather than a change in its fundamental existence.

This view offers a distinctive understanding of time. Ordinary experience presents reality as a sequence in which the present alone appears real, while the past has disappeared and the future has yet to exist. However, the Yogic account challenges this assumption by proposing that temporal distinctions are modes of appearance rather than indicators of absolute existence or non-existence. The present is simply the currently manifest aspect of a broader temporal continuum that also includes past and future states. Temporal succession is thus understood as a shift in manifestation rather than a process of creation and destruction.

Interestingly, this conception bears a striking resemblance to certain contemporary theories of time in physics and philosophy. The block-universe model associated with relativity theory holds that past, present, and future events all possess equal ontological status within a four-dimensional spacetime structure (Peterson & Silberstein, 2010; Slavov, 2020). From this perspective, the flow of time is not an objective feature of reality but a feature of how observers experience their position within spacetime. Although developed in a very different intellectual context, Lakṣaṇa-pariṇāma similarly suggests that temporal distinctions do not determine what exists; rather, they indicate different ways in which an already existing reality is manifested and experienced.

The comparison should not be taken to imply that Yoga philosophy anticipates modern physics in a literal sense. Nevertheless, both perspectives challenge the common assumption that only the present is real. In Lakṣaṇa-pariṇāma, past, present, and future are understood as interconnected aspects of a single ontological continuum. The concept therefore provides a sophisticated model for understanding temporal transformation, one in which continuity and change coexist without requiring the constant creation or destruction of reality. By framing temporal succession as a change in manifestation rather than a change in existence, Lakṣaṇa-pariṇāma offers a philosophical account of time that remains relevant to contemporary discussions concerning the nature of temporal reality.

अवस्था परिणाम (AVASTHA (अवस्था)): TEMPORAL EVOLUTION AND STATES

Within the framework of *Pariṇāmatraya*, ***avasthā*** refers to the changing condition or state through which an entity passes over time. It highlights the temporal dimension of transformation and draws attention to the manner in which change unfolds as a continuous process rather than as a series of isolated events. In Patañjali's account, transformation is not simply a matter of one state being replaced by another; rather, it involves an ordered progression in which successive states are connected through an underlying continuity while simultaneously exhibiting genuine difference.

Unlike a purely chronological understanding of time, *avasthā* concerns the structured evolution of a phenomenon. It emphasizes that change follows discernible patterns and occurs according to the inherent tendencies and capacities of a given entity. The focus is therefore not on time as an abstract sequence of moments, but on the way in which a phenomenon undergoes development through successive conditions. Each state emerges from preceding conditions while contributing to the formation of subsequent ones, creating a dynamic process of becoming.

An important aspect of ***avasthā*** is its emphasis on qualitative transformation. As an entity moves through different states, it does not merely repeat what has already existed; new conditions, configurations, and possibilities emerge. Although these developments remain grounded in the continuity of *dharma* (***धर्म***) and become observable through *Lakshana* (***लक्षण***), they nevertheless represent genuine modifications in the course of a phenomenon's evolution. In this respect, *avasthā* captures the creative and developmental character of change. The notion of *avasthā* implies a degree of irreversibility in the transformational process. Once a particular state has emerged and passed, the system does not simply return to its previous condition unchanged. Rather, each transformation leaves traces that contribute to the ongoing development of the entity. This understanding presents reality as a temporally structured process in which continuity and novelty coexist, allowing change to be understood not merely as movement through time but as the progressive unfolding of potentialities into new forms of existence.

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QUANTUM MECHANICS AND THE धर्म (DHARMA (धर्म)) PRINCIPLE

Conservation Laws as Dharmic Principles

One of the central insights of quantum mechanics is that certain physical quantities, such as energy, momentum, angular momentum, and electric charge, remain conserved despite the continuous transformations undergone by physical systems (Heisenberg, 1958; Dirac, 1958). Although the observable states of a system may change dramatically through interactions, measurements, or quantum evolution, these fundamental quantities remain invariant. In the context of the present study, such conservation principles provide an interesting point of comparison with the concept of *dharma (धर्म)* in *Pariṇāmatraya*, which denotes the underlying continuity that persists throughout processes of transformation.

This comparison becomes particularly significant in light of Noether's theorem, which established the profound relationship between conservation laws and symmetry principles in nature (Noether, 1918; Tinkham, 1964). According to this theorem, every fundamental symmetry corresponds to a conserved quantity, indicating that the stability observed within physical systems is rooted in deeper structural regularities. From this perspective, conservation is not merely the preservation of numerical quantities but the expression of an underlying order that remains intact despite ongoing change.

A similar logic can be observed in the Yogic understanding of *dharma (धर्म)*. While phenomena undergo modification and appear in different forms, an underlying principle of continuity enables these transformations to be understood as stages within a coherent process rather than as disconnected events. In this sense, *dharma (धर्म)* may be viewed as analogous to the symmetry-based conservation principles of modern physics, both serving as foundations that maintain coherence amid change. The comparison does not imply a direct equivalence between the two frameworks; rather, it highlights a shared concern with explaining how persistence can coexist with transformation.

Viewed in this way, quantum conservation laws offer a useful scientific parallel to the notion of *dharma (धर्म)*. They reveal that beneath the apparent variability of the physical world there exist enduring principles that remain unaffected by particular transformations. Both perspectives, though developed within different intellectual traditions, point toward the possibility that change is intelligible precisely because it unfolds against a background of underlying continuity (Wheeler & Zurek, 1983).

QUANTUM INFORMATION AND SUBSTRATE CONTINUITY

Among the various parallels that may be drawn between *dharma (धर्म)* and modern physics, the principle of quantum information conservation offers one of the most intriguing points of comparison (Bennett & DiVincenzo, 2000; Nielsen & Chuang, 2000). Contemporary developments in quantum theory suggest that even when a system appears to undergo decoherence, measurement, or wave-function collapse, information is not necessarily destroyed. Rather, it remains encoded within the broader quantum state through complex patterns of correlation and entanglement (Wheeler & Zurek, 1983; Zurek, 2003). What persists through transformation is therefore not a material substance in the classical sense, but an underlying informational structure that maintains continuity across changing physical conditions.

This perspective bears a noteworthy resemblance to the Yogic notion of *dharma (धर्म)*. As discussed earlier, *dharma (धर्म)* does not refer to a static entity that remains unchanged amidst transformation. Instead, it signifies the underlying principle or continuity that allows successive states to be understood as expressions of a single process. In a similar manner, quantum information theory suggests that despite apparent changes at the observable level, deeper structural relationships remain preserved. The continuity lies not in the persistence of particular forms but in the retention of the informational framework that connects those forms.

Further support for this comparison may be found in concepts such as the no-cloning theorem and quantum error correction. The no-cloning theorem establishes that an arbitrary quantum state cannot be copied perfectly, thereby preserving the uniqueness and integrity of quantum information (Wootters & Zurek, 1982). Quantum error-correction protocols, on the other hand, demonstrate that information can remain recoverable even when the physical systems carrying it are affected by noise and environmental interactions (Shor, 1995). These developments indicate that the preservation of information depends less on the permanence of a particular physical configuration and more on the stability of the underlying informational relationships.

Although the conceptual vocabulary of Yoga and quantum physics differs considerably, both frameworks draw attention to a form of continuity that survives transformation. From this perspective, *dharma (धर्म)* may be understood as analogous to the enduring informational order that remains present despite the changing states through which a system evolves. The comparison is not intended as a direct identification of the two concepts; rather, it serves to highlight a shared concern with explaining how persistence can be maintained within a world characterized by constant change.

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Wave Function Evolution and Dharmic Continuity

The Schrödinger equation provides the fundamental framework for describing the temporal evolution of quantum systems. Through unitary evolution, the quantum state changes continuously while preserving essential features such as probability normalization and the mathematical structure of the state space. Although the system may evolve through a wide range of possible configurations, the underlying principles governing its evolution remain unchanged. In this respect, unitary evolution offers an interesting point of comparison with the concept of *dharma (धर्म)* in *Pariṇāmatraya*, insofar as both emphasize continuity underlying processes of transformation.

From the perspective of quantum theory, this continuity is reflected in the preservation of coherence and the deterministic evolution of the wave function. The system changes, yet its evolution remains constrained by invariant principles that maintain the integrity of the quantum description. Similarly, in the Yogic framework, *dharma (धर्म)* denotes the enduring basis through which successive transformations remain connected and intelligible. The comparison suggests a shared concern with explaining how change can occur without implying complete discontinuity.

The well-known measurement problem introduces a further dimension to this discussion. While the Schrödinger equation describes a smooth and continuous evolution of the quantum state, the act of measurement appears to give rise to definite outcomes that are not straightforwardly accounted for by unitary evolution alone. This apparent transition from a range of possibilities to a specific observable state has generated extensive philosophical debate regarding the nature of quantum reality.

Viewed through the lens of *Pariṇāmatraya*, this tension may be interpreted as analogous to the relationship between *dharma (धर्म)* and *Lakshana (लक्षण)*. The continuous evolution of the wave function can be seen as representing an underlying continuity, whereas the emergence of a particular measurement outcome resembles the manifestation of specific characteristics or observable features. Although the comparison should not be taken as a direct equivalence, it highlights a common philosophical question present in both traditions: how stable underlying structures give rise to the concrete and differentiated phenomena that appear in experience.

EMERGENCE AND THE LAKSHANA PHENOMENON

Measurement and Property Emergence

The process of quantum measurement offers an intriguing point of comparison with the concept of *Lakshana (लक्षण)* within the framework of *Pariṇāmatraya* (von Neumann, 1955; Wheeler & Zurek, 1983). According to quantum theory, a system prior to measurement may exist in a superposition of possible states, without possessing a single definite value for a given observable (Schrödinger, 1935). It is only through interaction with a measuring apparatus or environment that a specific outcome becomes manifest. As a result, the properties observed in measurement are not always understood as fixed attributes that were simply waiting to be revealed; rather, they emerge through the measurement process itself (Zurek, 2003; Schlosshauer, 2007).

This feature of quantum mechanics bears a noteworthy resemblance to the role of *Lakshana (लक्षण)* in Yogic philosophy. As discussed earlier, *Lakshana (लक्षण)* refers to the distinguishing characteristics through which a phenomenon becomes manifest at a particular stage of transformation. These characteristics are not entirely independent of the underlying reality, nor are they reducible to it. Instead, they arise through the interaction of deeper structural principles with specific conditions and circumstances. In this sense, *Lakshana (लक्षण)* represents the observable expression of an ongoing process rather than a collection of permanently fixed qualities.

The comparison becomes particularly interesting when viewed in relation to *dharma (धर्म)* and *avasthā*. Within *Pariṇāmatraya*, observable characteristics emerge from the interaction between an enduring ontological basis (*dharma (धर्म)*) and the temporal unfolding of transformation (*avasthā*). Similarly, quantum measurement may be understood as a process through which particular observable properties become manifest from an underlying quantum state under specific interactional conditions. What appears in experience is therefore shaped not only by what underlies a system but also by the processes through which that system evolves and becomes observable.

The purpose of this comparison is not to suggest that quantum measurement and *Lakshana (लक्षण)* describe identical phenomena. Rather, both frameworks raise a similar philosophical question: how do determinate and observable characteristics arise from a deeper level of reality that is not itself immediately given in experience? By drawing attention to this shared concern, the comparison highlights the relevance of *Lakshana (लक्षण)* as a conceptual category for understanding emergence, manifestation, and the appearance of observable properties within processes of transformation.

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Quantum Decoherence and Environmental Emergence

Quantum decoherence theory provides a useful framework for understanding how classical phenomena emerge from an underlying quantum reality. According to this approach, interactions between a quantum system and its surrounding environment gradually suppress quantum interference effects, giving rise to the stable and determinate properties associated with the classical world. As a result, the familiar behaviour of macroscopic objects can be understood not as independent of their quantum foundations, but as emerging from them through ongoing interactions with environmental degrees of freedom.

This process offers an interesting point of comparison with the concept of *Lakshana (लक्षण)* in *Pariṇāmatraya*. Just as *Lakshana (लक्षण)* refers to the observable characteristics that become manifest through processes of transformation, classical properties in decoherence theory emerge from an underlying quantum substrate under particular relational conditions. The observable features of a system are therefore not entirely separable from the interactions through which they arise. What appears at the macroscopic level is shaped by both the underlying structure of the system and its engagement with a broader context.

From this perspective, emergence cannot be understood solely in subjective terms as a matter of observation, nor solely in objective terms as a property existing independently of all relations. Rather, the characteristics that become manifest arise through dynamic interactions between systems and their environments. In a similar way, *Lakshana (लक्षण)* denotes qualities that emerge within a process of transformation while remaining connected to deeper ontological principles. The significance of these qualities lies not merely in their appearance but in the fact that they express the relationship between underlying continuity and manifest change.

Although decoherence theory and the Yogic doctrine of *Pariṇāmatraya* belong to distinct intellectual traditions, both draw attention to the importance of relational processes in the emergence of observable phenomena. The comparison suggests that what appears as a stable property may be better understood as the outcome of ongoing interactions through which latent possibilities become manifest in a particular form. In this sense, *Lakshana (लक्षण)* provides a valuable philosophical category for interpreting emergence as a process that links underlying structures with observable reality.

Entanglement and Non-Local Properties

Quantum entanglement provides another illuminating point of comparison with the concept of *Lakshana (लक्षण)*. One of the most distinctive features of entangled systems is that certain properties cannot be fully attributed to the individual particles that compose the system. Instead, these properties arise from the correlations that exist between the components, such that the system must be understood as an interconnected whole rather than as a collection of independent parts. The significance of entanglement therefore lies not merely in the behaviour of individual entities, but in the relational structure that links them together.

This relational character bears an interesting resemblance to the Yogic understanding of *Lakshana (लक्षण)*. Within the framework of *Pariṇāmatraya*, observable characteristics do not exist in complete isolation from the processes and conditions through which they arise. Rather, they emerge as manifestations of an underlying reality operating within a particular context. In this sense, *Lakshana (लक्षण)* directs attention to qualities that become evident through relationships and interactions rather than through self-contained substances possessing fixed attributes.

From the perspective of quantum theory, entangled systems demonstrate that some properties are fundamentally relational. The correlations observed between entangled particles cannot always be reduced to properties that each particle possesses independently. Instead, the meaningful characteristics of the system emerge at the level of the relationship itself. Such findings challenge purely reductionist accounts of reality and suggest that relational structures can possess explanatory significance in their own right.

A comparable insight can be found in the concept of *Lakshana (लक्षण)*. The characteristics that become manifest in a phenomenon are not merely passive reflections of an underlying substrate; they arise through the interaction of underlying principles, conditions, and temporal processes. Consequently, observable properties are best understood as emerging within a network of relations rather than as isolated features detached from context. While quantum entanglement and *Lakshana (लक्षण)* belong to different intellectual traditions and address different questions, both emphasize the importance of relationality in understanding how characteristics become manifest.

Viewed in this way, entanglement offers a useful analogy for appreciating the dynamic and relational nature of *Lakshana (लक्षण)*. In both cases, what becomes observable is shaped not only by what exists independently, but also by the patterns of connection through which phenomena are constituted and expressed. This shared emphasis on relational emergence provides another point of dialogue between Yogic philosophy and contemporary physics.

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THERMODYNAMICS, ENTROPY, AND AVASTHA (अवस्था)

The Second Law and Temporal Asymmetry: Avasthā and Thermodynamic Irreversibility

The concept of *avasthā* within *Pariṇāmatraya* finds a compelling parallel in the thermodynamic description of irreversible processes. The second law of thermodynamics establishes a fundamental temporal asymmetry in nature by stating that the entropy of an isolated system tends to increase over time (Clausius, 1865; Boltzmann, 1896). This tendency introduces a clear directionality to physical processes, distinguishing past states from future states and providing what is commonly referred to as the "arrow of time" (Prigogine, 1980; Penrose, 2004). In this respect, *avasthā* may be interpreted as a conceptual framework for understanding temporally ordered transformation, wherein systems evolve through successive states according to identifiable patterns.

Unlike the reversible dynamics that characterize many fundamental physical laws, thermodynamic processes often exhibit irreversibility. The progression toward equilibrium is not merely a rearrangement of existing components but a transformation that alters the macroscopic condition of the system. Such processes reflect the essential feature of *avasthā*: transformation as a structured temporal development rather than a static succession of states (Prigogine & Stengers, 1984).

Entropy, Information, and Transformation

The relationship between thermodynamic entropy and information theory further enriches this comparison. Developments in statistical mechanics and information theory have demonstrated that entropy can be understood not only in energetic terms but also in relation to information and uncertainty (Shannon, 1948; Jaynes, 1957). As entropy increases, the amount of accessible information concerning the precise microstate of a system decreases, resulting in a change in the informational organization of the system (Landauer, 1961; Bennett, 1982).

From the perspective of *Pariṇāmatraya*, this informational dimension resonates with the notion of *avasthā* as qualitative transformation. Successive states are not simply chronological moments; they embody changes in organization, structure, and informational content. Consequently, temporal evolution involves the emergence of new configurations that cannot be fully reduced to the mere rearrangement of pre-existing conditions (Wheeler, 1989; Zurek, 1989).

Entropy Production and Non-Equilibrium Dynamics

The significance of *avasthā* becomes particularly evident in non-equilibrium thermodynamics, where systems evolve through irreversible processes while continuously producing entropy. Such processes transform available free energy into less useful forms and generate the temporal asymmetries observed in natural systems. Rather than representing isolated events, these transformations constitute organized patterns of evolution that unfold over time.

Within the interpretive framework proposed here, entropy production may be viewed as an expression of the dynamic interplay between continuity and change. Conserved quantities and underlying physical constraints provide the structural continuity of a system, while observable macroscopic properties emerge through ongoing interactions and fluctuations. The resulting irreversible evolution bears a conceptual resemblance to the relationship among *dharma (धर्म)*, *Lakshana (लक्षण)*, and *avasthā* in the Yogic account of transformation.

This perspective is further supported by principles such as the fluctuation–dissipation theorem and Onsager's reciprocal relations, which demonstrate how irreversible macroscopic behaviour arises from the interaction of underlying physical regularities and observable fluctuations. Although these scientific concepts are not equivalent to the categories of *Pariṇāmatraya*, they suggest a comparable concern with understanding how continuity, manifestation, and temporal development are integrated within a single process of transformation.

ENTROPIC DYNAMICS AND INTEGRATED TRANSFORMATION

The Arrow of Time and Structured Evolution

One of the most intriguing problems in modern physics concerns the emergence of temporal asymmetry from underlying laws that are, in many cases, fundamentally time-symmetric. While the microscopic equations governing physical interactions generally do not distinguish between past and future, macroscopic systems exhibit a clear temporal directionality through irreversible processes and entropy increase. This transition from symmetry at the fundamental level to asymmetry at the observable level provides an illuminating point of comparison with the Yogic doctrine of *Pariṇāmatraya*.

From this perspective, the invariant principles that govern physical systems may be viewed as analogous to *dharma (धर्म)*, which represents the underlying continuity that persists through transformation. The observable characteristics that emerge at the macroscopic level, including irreversible behaviour and thermodynamic order, bear comparison to

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Lakshana (लक्षण), as they constitute the manifest features through which a system becomes identifiable. The resulting temporal development, expressed through the directional evolution of physical systems, may in turn be related to *avasthā*, which emphasizes the succession of states through time.

The significance of this comparison lies not in establishing a direct equivalence between Yogic philosophy and contemporary physics, but in highlighting a shared concern with the relationship between continuity, manifestation, and change. Statistical mechanics demonstrates how macroscopic properties emerge from the collective behaviour of underlying microscopic constituents, producing temporal asymmetries that are not immediately evident at the fundamental level. Similarly, *Pariṇāmatraya* describes transformation as a process in which enduring principles, observable characteristics, and temporal development are inseparably interconnected.

Viewed in this way, the arrow of time may be understood as more than a physical phenomenon; it also serves as an example of how continuity and novelty coexist within a single process of transformation. The framework of *Pariṇāmatraya* offers a philosophical lens through which these relationships can be interpreted, suggesting that invariant structures, emergent manifestations, and temporal evolution are not isolated aspects of reality but mutually dependent dimensions of an ongoing process of becoming.

INFORMATION INTEGRATION AND COMPLEXITY

Complexity, Emergence, and the Dynamics of Transformation

Recent developments in complexity science, systems theory, and information integration have renewed interest in understanding how novel forms of organization emerge from relatively simple underlying structures. Complex systems are characterized by their ability to maintain stability while simultaneously adapting, reorganizing, and generating new patterns of behaviour. This interplay between continuity and novelty offers an interesting point of comparison with the framework of *Pariṇāmatraya*.

Within such systems, certain structural regularities remain preserved despite ongoing change, providing a degree of continuity across different stages of development. At the same time, new properties and patterns emerge through the interactions among system components, giving rise to forms of organization that cannot be fully understood by examining the individual elements in isolation. The temporal unfolding of these interactions further contributes to the development of increasingly complex configurations. Viewed through the lens of *Pariṇāmatraya*, these dynamics may be interpreted in terms of the relationship among *dharma (धर्म)*, *Lakshana (लक्षण)*, and *avasthā*, where continuity, manifestation, and temporal evolution function as interconnected dimensions of a single transformational process.

Such a perspective is particularly valuable because it avoids reducing emergence either to pure determinism or to mere randomness. Novelty arises within constraints, yet it cannot always be predicted solely from the initial conditions of a system. The emergence of complexity therefore reflects a dynamic interplay between stability and transformation, a theme that lies at the heart of both contemporary complexity theory and the Yogic understanding of change.

QUANTUM THERMODYNAMICS AND AN INTEGRATED PERSPECTIVE

The growing field of quantum thermodynamics further illustrates the convergence of concepts that were once treated separately within physics. By bringing together quantum coherence, thermodynamic irreversibility, and information-theoretic approaches, this field seeks to understand how energy, information, and temporal evolution interact across different scales of physical reality. Rather than viewing these domains as independent, contemporary research increasingly emphasizes their mutual interdependence and their role in shaping the behaviour of physical systems.

From a comparative perspective, these developments invite reflection on whether *Pariṇāmatraya* can serve as a useful philosophical framework for interpreting such interconnected processes. The concept of *dharma (धर्म)* highlights the persistence of underlying structures and constraints; *Lakshana (लक्षण)* draws attention to the observable properties and emergent characteristics that arise through interaction; and *avasthā* emphasizes the temporal progression through which systems evolve. Together, these three dimensions provide a conceptual model for understanding transformation as a unified process rather than as a collection of isolated events.

While it would be inappropriate to claim that the categories of *Pariṇāmatraya* directly correspond to contemporary scientific concepts, the parallels are nevertheless suggestive. Both approaches seek to explain how continuity can coexist with novelty, how observable properties emerge from deeper structures, and how temporal evolution contributes to the ongoing formation of complex realities. In this sense, the dialogue between Yogic philosophy and modern physics may offer a broader conceptual vocabulary for examining the interconnected nature of transformation across physical, informational, and ontological domains.

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ONTOLOGICAL IMPLICATIONS AND FUTURE DIRECTIONS

Process Ontology and Relational Reality

The comparison between *Pariṇāmatraya* and selected developments in modern physics points toward an understanding of reality that emphasizes processes, relations, and transformation rather than static and self-contained substances. Across fields such as quantum mechanics, thermodynamics, and complexity theory, physical systems are increasingly understood in terms of interactions, networks of dependence, and dynamic patterns of organization. In this context, change is not viewed as something that happens to otherwise isolated entities; rather, it is a fundamental feature of reality itself.

From the perspective of *Pariṇāmatraya*, transformation may be understood through the interrelationship of *dharma (धर्म)*, *Lakshana (लक्षण)*, and *avasthā*. These categories do not describe separate aspects of reality but complementary dimensions of an ongoing process. *Dharma (धर्म)* refers to the continuity that persists through change, *Lakshana (लक्षण)* to the characteristics that become manifest in particular contexts, and *avasthā* to the temporal progression through which transformation unfolds. Considered together, they present a view of reality in which persistence, manifestation, and development are inseparable from one another.

Although the conceptual foundations of Yogic philosophy differ from those of modern science, both traditions exhibit a growing recognition that relationships and processes play a central role in the constitution of reality. The parallels identified in this study therefore suggest the possibility of interpreting transformation not as a movement between fixed states, but as a relational process through which continuity and novelty emerge together.

INFORMATION AND THE DYNAMICS OF TRANSFORMATION

A particularly significant theme connecting contemporary physics and *Pariṇāmatraya* is the increasing importance of information as a foundational explanatory concept. In quantum theory, information is closely related to the description of physical states and their evolution. In thermodynamics, informational considerations have become central to understanding entropy, irreversibility, and the organization of physical systems. Similar developments within complexity science further highlight the role of information in the emergence of order and adaptive behaviour.

These developments invite the possibility of interpreting *Pariṇāmatraya* through an informational lens. Within such a reading, *dharma (धर्म)* may be associated with the preservation of underlying informational structures that maintain continuity across transformation. *Lakshana (लक्षण)* may be understood in terms of the patterns and characteristics that become manifest as information is organized in particular ways. *Avasthā*, in turn, can be viewed as the temporal dimension through which informational configurations develop, evolve, and give rise to new forms of organization.

Such an interpretation should not be regarded as a direct translation of classical Yogic concepts into the language of information theory. Rather, it serves as a philosophical framework for exploring common questions concerning continuity, emergence, and temporal development. The significance of this comparison lies in its ability to bring together insights from distinct intellectual traditions, suggesting that transformation may be understood as a process involving the preservation, manifestation, and evolution of informational structures across time.

Viewed in this way, *Pariṇāmatraya* offers a conceptual model that resonates with contemporary efforts to understand reality as an interconnected and evolving system. Whether approached through the language of philosophy or physics, the study of transformation increasingly points toward a world in which relations, information, and process occupy a more fundamental role than static entities or isolated substances.

DISCUSSION AND CONCLUSIONS

The concept of Pariṇāmatraya provides a remarkably sophisticated framework for understanding change, continuity, and temporality. Through the interconnected notions of Dharma-pariṇāma, Lakṣaṇa-pariṇāma, and Avasthā-pariṇāma, Patañjali and Vyāsa present a dynamic ontology in which reality is neither static nor fragmented, but continuously unfolding through structured transformation. Dharma-pariṇāma highlights the persistence of an underlying substrate through changing manifestations, Lakṣaṇa-pariṇāma explains the temporal organization of existence across past, present, and future, and Avasthā-pariṇāma describes the progressive modification of states over time.

Although formulated within a philosophical and contemplative tradition, these three dimensions of transformation exhibit striking conceptual parallels with several foundational ideas in modern physics. Dharma-pariṇāma resonates with contemporary understandings of quantum dynamics, where underlying quantum states persist while manifesting different observable configurations. Lakṣaṇa-pariṇāma finds intriguing similarities with modern discussions of temporality, particularly eternalist and block-universe interpretations of spacetime, which regard past, present, and future as equally grounded within a unified temporal structure. Avasthā-pariṇāma, in turn, mirrors the thermodynamic

evolution of physical systems, where matter undergoes continuous state changes accompanied by entropy, aging, and irreversible temporal development.

These parallels should not be interpreted as evidence that classical Yoga philosophy anticipated modern scientific theories in a literal sense. Rather, they demonstrate that both traditions, despite their vastly different methodologies and historical contexts, grapple with similar fundamental questions concerning the nature of reality, change, and time. The language and explanatory frameworks differ, yet both seek to understand how continuity persists amidst transformation and how temporal processes shape the world we experience.

Viewed in this light, Pariṇāmatraya offers more than a metaphysical doctrine of change; it provides a comprehensive process-oriented ontology that remains relevant to contemporary interdisciplinary discussions. By bringing Yogic philosophy into dialogue with modern physics, new possibilities emerge for understanding reality as an evolving continuum in which persistence, temporality, and transformation are inseparable dimensions of existence. Such a dialogue not only enriches our interpretation of classical Indian thought but also highlights the enduring value of philosophical inquiry in exploring questions that continue to challenge both science and metaphysics.

FURTHER SCOPE

The present study opens avenues for deeper interdisciplinary research between Yogic philosophy and contemporary scientific theories of reality. Future investigations may explore the relationship between Pariṇāmatraya and emerging developments in quantum information theory, complexity science, and systems dynamics

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