The Theory of Isomorphic Physics

Part 1: Realigning Relativity and Classical Physics with Quantum Mechanics

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Metaphysics

This theory posits that the fundamental nature of the universe can be described by equations that are isomorphic to physical reality. It posits that these mathematics manifest as a unique wavefunctions and eigenfunctions that are put on unique quaternion valued 4x4 matrices that form a group, and the probability distributions and eigenvalues we get from multiplying these wavefunction and eigenfunctions with their conjugates. These eigenvalues will satisfy relativistic equations like the energy momentum relationship and the equation for Minkowski spacetime. It will also have a strong connection to the time evolution of the Schrodinger equation. However, aside from these central points of contact with canonical physics, this theory will otherwise argue to keep any and all other concepts and expectations out of it, trying to maximize the ability of these illustratively powerful mathematics to speak for themselves. In short this theory is composed of the math, first and foremost, as this is what, in theory, maps to physical reality, descriptions of that math, and arguments and motivations for why nothing beyond this math is relevant.

Reconsidering the Role of Units and Dimensional Analysis in Fundamental Physics

In this theory, we reject the classical dependence on units and dimensional analysis, arguing that the fundamental building blocks of the universe are wavefunctions, eigenfunctions, and eigenvalues. Traditional physical concepts such as energy, momentum, mass, and time should be understood through their relationship to wavefunctions rather than as entities constrained by classical units like mass (m), length (L), or time (T).

Angular frequency (ω) and wavenumber (k) are key parameters that describe the behavior of wavefunctions. In this framework, ω represents the wavefunction's rate of oscillation in time, while k reflects the spatial oscillation or contraction of the wavefunction. These quantities, typically tied to classical units (e.g., ω with units of T^{-1} or energy with mL^2/T^2), are treated here as purely mathematical scalars. By shifting away from traditional dimensional analysis, we avoid the complications that arise from trying to interpret wavefunctions within the confines of classical units.

The cracks in dimensional analysis appeared when Minkowski put space and time on the same footing. His reformulation of spacetime as a four-dimensional continuum challenged the conventional separation of space and time, showing that they could be unified into a single framework governed by the same fundamental rules. In light of this, dimensional analysis—so heavily dependent on treating space and time as distinct dimensions—began to lose its coherence when applied to the quantum realm.

Planck's constant ($\hbar$)—often understood as a fundamental constant that bridges the quantum and classical worlds—can be interpreted in this theory as describing the wavefunction's constant rotation through the complex plane. When viewed as a feature of the wavefunction's dynamics rather than a bridge between unit systems, $\hbar$ becomes a complex function that is an aspect of the wavefunction itself.

This rejection of dimensional analysis goes further by centering wavefunctions, probability distributions, and their associated eigenfunctions and eigenvalues as the true fundamentals of the universe. Classical physics and its reliance on dimensional analysis are, in this context, seen as analogs to Newtonian gravity: useful, but incomplete and ultimately flawed in their treatment of quantum phenomena. Concepts such as mass, length, and time, traditionally measured by a scale, ruler, or clock, become mere interfaces or points of contact with the more fundamental wavefunction-based reality. This theory reframes classical quantities like energy, momentum, and mass in terms of wavefunction dynamics, using their magnitudes rather than their classical units:

- **Energy (E)** is proportional to the angular frequency (ω), which governs the rate of change of the energy eigenfunction.
- **Momentum (p_i)** is proportional to the wavenumber (k_i), reflecting the spatial variation of the momentum eigenfunction.
- **Mass (m)** is proportional to the scalar k_4, where mass behaves as a rate of change for a scalar-valued wavefunction with an eigenvalue S.
- **Planck's reduced constant ($\hbar$)** is interpreted as the wavefunction in one dimension, where k or ω is set to 1.

By focusing on magnitudes—scalar quantities devoid of units—the theory highlights that the fundamental constituents of reality are wavefunctions, not the classical dimensional properties we have long relied on. In this scalar-based framework, physical quantities emerge from the dynamics of wavefunctions rather than from dimensional associations, offering a cleaner, more mathematically coherent view of the universe.

Eigenfunctions, Eigenvalues, and the Role of S in MST

This theory provides a framework for obtaining eigenfunctions that, when multiplied by their conjugates, yield sets of eigenvalues. These eigenvalues represent fundamental physical quantities. By collapsing the wavefunction to a position eigenfunction in the absence of forces, we obtain scalar eigenvalues for t (time), x, y, z (spatial dimensions), and S (a scalar component).

When squared, these eigenvalues must sum to zero, under they philosophy that the universe and particles came from nothing and therefore must equate to nothing, thus yielding the Minkowski spacetime (MST) relation. In this theory, this summation to zero functions as a wave equation, ensuring that the wavefunction possesses properties that enforce this zero-sum structure. The eigenvalue S, derived from a scalar function, plays a crucial role in solving the MST zero equation. While S does not affect the phase of the wavefunction directly, it contributes to the dynamics through its role in ensuring the total sum equals zero.

Key Equations

The key equations that form the backbone of this theory are:

- Magnitude of $E = \omega$ = magnitude of the energy eigenfunction
- Magnitude of $p_i = k_i$ = magnitude of the momentum eigenfunction
- Magnitude of $m = k_4$ = magnitude of the mass eigenfunction (where mass is a rate of change for a scala
- Magnitude of $\hbar$ = wavefunction in 1D with k or ω set to 1

Planck's Constant as the Default Wavefunction

This theory proposes a novel interpretation of Planck's constant, $\hbar$, as representing the wavefunction in the absence of space or time curvature. Rather than using the wavefunction to determine the wavenumber k, and then applying Planck's constant to find momentum p via $p = k\hbar$, this theory suggests an inverse process.

We begin with $\hbar$, which in this context is the wavefunction at a default rate, metaphorically represented as e^{ix}. This default wavefunction, without any spatial or temporal curvature, serves as the baseline. Space is then "contracted" around this wavefunction to form e^{ikx}, where k defines the spatial frequency, and $\hbar$ remains as a constant that scales the process. This contraction of space around the wavefunction can be interpreted as the process by which the wavefunction "emerges" from Planck's constant, fitting the conceptualization that wavefunctions are part of the most fundamental building blocks of the universe, not classical physics bridged by $k\hbar$.

In this interpretation, dimensional analysis—which traditionally requires k and $\hbar$ to find momentum—becomes a figurative, metaphorical tool rather than a fundamental principle. The wavefunction itself is primary, and Planck's constant is understood as the wavefunction in its simplest, default form. The spatial contraction described by e^{ikx} is simply a modification of the default wavefunction, not an application of dimensional units like mass, length, or time. In this way, we can conceptualize the way magnitude of momentum in terms of the way it moves the probability distribution when in wave packets, again serving this theory's conceptualization of these principles all ultimately connecting to the dynamics we measured as a child with scale, ruler and watch.

Extension of the Energy-Momentum Relation and Growth Rates

The rate of change of the wavefunction with respect to time (t) is proportional to energy (E), while the rates of change with respect to spatial dimensions (x, y, z) correspond to momentum components. This theory extends this idea by positing that the rate of change of the scalar component S is proportional to mass (m).

This extension aligns with the energy-momentum relation:

$$-E^2 + p^2 + m^2 = 0.$$

In this framework, the Minkowski spacetime relation becomes:

$$(\omega t)^2 + (k_x x)^2 + (k_y y)^2 + (k_z z)^2 + (mS)^2 = 0,$$

where ω, k_x, k_y, k_z, and m ensure that the eigenvalues sum to zero. This equation aligns with the energy-momentum relation:

$$-\omega^2 + k^2 + m^2 = 0,$$

which is isomorphic to:

$$-E^2 + p^2 + m^2 = 0.$$

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Inputs into the Wavefunction and Position Eigenfunctions

In the context of this theory, we treat space, time, and space-time (S) as inputs into the wavefunction, unifying them into a single scalar input, denoted as ξ. This input reflects the fundamental relationship between space, time, and mass within the wavefunction and its corresponding eigenfunctions. While this concept does not make sense within a point-particle framework, it will be shown to be sensible within the context of wavefunctions existing as fields over all space and time.

To express this unification mathematically, we begin by noting that the components of space and time (as well as the scalar S component) are proportional to energy, momentum, and mass, respectively. These proportionalities manifest through scaled versions of the inputs, such that:

$$\omega t = t' \quad \text{(scaled by energy } E\text{)},$$
$$k_x x = x' \quad \text{(scaled by momentum } p_x\text{)},$$
$$mS = S' \quad \text{(scaled by mass } m\text{)}.$$

Here, t', x', and S' are the scaled (or contracted) versions of time, space, and the scalar component mass, determined by the particle's energy, momentum, and mass. The scaling factor in each case is associated with angular frequency ω, wavenumber k_x, and mass m, respectively.

We also introduce a key equation describing the preservation of proportionality between different particles' momenta and positions:

$$|P^\flat_{\mu,\alpha}|(x^\flat_{\mu,\alpha,u} - x^\flat_{\mu,\alpha,l}) \approx |P^\flat_{\mu,\beta}|(x^\flat_{\mu,\beta,u} - x^\flat_{\mu,\beta,l}).$$

This equation reveals that the magnitudes of the universe, in terms of position eigenfunctions, remain consistent across particles. An increase in the particle's momentum results in a proportional contraction of its position, ensuring a constant product Px for all particles.

Proof of Scaling Using the Pythagorean Theorem

We now demonstrate how this scaling unifies the Minkowski spacetime (MST) and the energy-momentum relation, using the Pythagorean theorem.

Consider a triangle where the legs are scaled coordinates of time, space, and mass. Specifically, let:

$$t' = \omega t, \quad x' = k_x x, \quad S' = mS,$$

represent the scaled versions of the time, space, and scalar mass components. These components, when squared, form the basis of the Minkowski spacetime interval (MST):

$$t'^2 + x'^2 + S'^2 = 0.$$

Simultaneously, energy, momentum, and mass obey the energy-momentum relation:

$$E^2 = p_x^2 + m^2.$$

Both the energy-momentum relation and the MST can be interpreted as triangles satisfying the Pythagorean theorem, where the components t', x', and

S' represent the legs of a triangle, and the hypotenuse corresponds to energy, momentum, and mass. The scaling of ξ, as an input into the wavefunction, simply scales the entire triangle, preserving the underlying relationships.

Connection to Quantum Mechanics

This framework also aligns with the dynamics of wavefunctions. The contraction of space, time, and spacetime components, proportional to E, p, and m, respectively, governs how the wavefunction evolves. This results in the classical dynamics we observe after decoherence, where particles appear to move at varying rates through space and time, but in reality, all particles evolve at the same fundamental rate. The variation arises purely due to the contraction of space and time around the wavefunction, dictated by the energy and momentum of the particle.

Incorporating τ_μ

To localize the position eigenfunctions and describe where they "grow out" from, we introduce a shift parameter τ_μ. This parameter allows us to shift the starting point of each eigenfunction, effectively localizing the wavefunction to a specific point in space and time. The probability distribution for collapsing to a particular point is given by evaluating the amplitude of the wavefunction at the primed coordinates of space or time. This incorporation of τ_μ into the theory allows us to reconcile the continuous nature of fields with the idea of point particles.

Conclusion

By treating space, time, and mass as inputs into the wavefunction, we unify them into a single scalar quantity ξ, which scales according to energy, momentum, and mass. This approach connects the Minkowski spacetime interval and the energy-momentum relation, demonstrating that both relationships hold at every input ξ. Additionally, the introduction of τ_μ allows us to reconcile the field nature of the theory with point particles, completing the picture of how the wavefunction governs the behavior of particles in space and time.

Scalar Nature of ωt and Implications for ω and t

In traditional quantum mechanics, the term ωt, where ω is the angular frequency and t is time, is often used to describe the phase evolution of the wavefunction. Notably, ωt is scalar-valued, meaning it does not inherently possess vector properties, and this is crucial to the behavior of wavefunctions as complex-valued functions that evolve in time.

Given that ωt is a scalar, it is reasonable to extend this reasoning to argue that both ω and t may be treated as scalars individually within the framework of this theory. Here, ω represents the rate of temporal oscillation and t represents time. Since both are inputs into the wavefunction that result in a scalar phase factor, their individual scalar nature becomes plausible.

Similarly, for spatial terms like kx, where k is the wavenumber and x is position, we observe a scalar behavior as well. Just as with ωt, kx is scalar-valued and governs the spatial oscillation of the wavefunction. This again suggests that k and x may themselves be considered scalar quantities in this theory.

This perspective strengthens the argument that we do not need to rely on classical vector notions of space and time within this wavefunction-based theory. Instead, we can conceptualize ω, t, k, and x as scalars that interact in a fundamentally scalar-valued wavefunction, simplifying the mathematical structure and avoiding unnecessary classical complications.

Symmetric Growth of t, x, and S

This framework suggests that time (t), space (x, y, z), and the scalar component (S) do not fill space instantaneously but instead expand symmetrically at specific rates. This symmetric expansion satisfies both the Minkowski space-time relation (MST) and the energy-momentum relation. Most importantly, it adheres to the zero-sum equation, providing a possible explanation for how the universe could be derived from nothing: the universe is represented by a probability distribution collapsing to a set of eigenvalues that sum to zero.

A Non-Gauge Theory

This theory posits that there exists an unknown (and, in practical terms, unknowable) mathematical structure capable of mapping one-to-one and onto physical reality. This implies that we can, in principle, operate from a single, universal perspective, where the complete mathematical framework (an enormously complex set of equations describing every particle and interaction in the universe) maps isomorphically to physical reality. Thus, only one universal perspective is needed. While this idea is philosophical in nature, in practice, we will rely on approximation methods to work within manageable limits.

The implications of this stance are significant: it removes the need for tensor products to describe or unify quantum systems. Since there is only one universal system in which all particles exist, tensor products, traditionally used to handle quantum entanglement between systems, become unnecessary. Entangled particles, in this framework, are naturally part of the same universal system. While this approach simplifies the theory by avoiding the complexity of tensor products, it introduces new challenges due to the practical vastness and complexity of modeling such a universal system.

Not an Operator Formalism

In this theory, wavefunctions possess intrinsic properties, such as position eigenvalues, without the need for external operators. For example, the "eigen-primitives" $(\underline{\psi})$ carry intrinsic position eigenvalues, and this occurs naturally, without needing to multiply the wavefunction by a position operator such as $\hat{x}$. These eigen-properties are considered natural attributes of the wavefunctions, which can be transferred or altered through interactions.

This is a departure from the conventional operator formalism, where eigenvalues are obtained through the action of operators on wavefunctions. In the operator formalism, the physical mechanism through which operators act is often abstract, and the process of measurement is less intuitively clear. By contrast, in this theory, eigen-properties are well-defined and inherent, leading to a more direct and natural picture of how particles attain or lose eigenvalues.

Additionally, this framework suggests that possessing or acquiring an eigen-property may drive the collapse of a wavefunction into an eigenstate. The compatibility or incompatibility of these eigen-properties with certain states influences whether a particle remains in a superposition or collapses into a specific eigenstate. Thus, this theory presents a more physically grounded and intuitive understanding of eigenvalues, treating them as real, transferable properties rather than abstract results of operator action.

Notes: 2. Alternative to the Schrödinger Equation If your theory does not employ a direct analog of the Schrödinger equation (or the time-evolution of wavefunctions through standard operators like $^{H)}, thiswouldbeanimportantpointtohighlight.Insteadoftime-evolvingoperators, you'rerelyingonintrinsicpropertiesofwavefunctions, meaningyoumaybetreatingtimeoren$

You might want to clarify how wavefunctions in your theory evolve over time (if at all) and how this compares to the operator-based evolution in traditional quantum mechanics.

3. Treatment of Gravity and Curvature Your theory's handling of space-time curvature, particularly in the context of general relativity, seems to suggest an intrinsic curvature tied to wavefunction properties, with potential explanations of forces as curvatures in eigenvalues. This is quite different from the gauge field approach of the standard model (e.g., gravity as curvature in the metric tensor in general relativity).

Clarifying how your theory naturally handles space-time curvature (without tensors or fields) in a way that is compatible with general relativity could be an important selling point. You might describe how the theory leads to curved space-time through eigenvalue deviations, potentially offering new insights into quantum gravity.

4. Absence of a Classical Limit If your theory lacks a classical limit in the way traditional quantum mechanics reduces to Newtonian mechanics at large scales (through decoherence, expectation values, etc.), this might be another point worth discussing. Is there an equivalent in your framework where the probabilistic nature of quantum systems reduces to classical deterministic behavior at macroscopic scales? If not, how does your theory view the transition between quantum and classical regimes?

5. Eigenvalues and Superpositions without Collapse Your theory seems to treat eigenvalues as intrinsic properties of wavefunctions, which could imply a different treatment of superposition and measurement. If the measurement process in your theory does not invoke a collapse of the wavefunction (or uses a different mechanism for collapse), this would be worth addressing explicitly. Are eigenvalues stable under measurement, or do they "snap" into defined states only during certain interactions? How does your theory handle quantum measurement?

6. Non-Gauge Approach to Forces In standard physics, forces are usually described by gauge fields (e.g., the electromagnetic field). You could contrast this by explaining that your theory doesn't employ gauge fields, but instead describes forces through the curvature of wavefunctions or eigenvalue dynamics. This offers an alternative way of thinking about force interactions, particularly when dealing with gravity or the strong force.

7. Multiple Types of Wavefunctions If your theory introduces distinct types of wavefunctions (e.g., "primitive wavefunctions," "natural wavefunctions," "eigen-primitives"), it may be helpful to explain early on why these different forms are necessary. You could discuss how these different wavefunctions serve different roles (e.g., describing intrinsic properties, interactions, or large-scale behavior) and why the diversity of wavefunction types is a natural consequence of your approach.

Introduction

In this paper, I present a new interpretation of physical reality based on a general theory of wavefunctions. This theory diverges from the traditional frameworks of quantum mechanics and general relativity by emphasizing magnitudes over units and incorporating curvature in position eigenvalues. It aims to describe all physical systems using a unique wavefunction framework that naturally integrates with spacetime, momentum, and forces.

By exploring both the mathematical and philosophical implications of this theory, I argue that it offers a more complete and rigorously testable model of physical reality. The generality of the framework makes it infinitely broad, yet it remains testable by modern computational tools. This paper serves as a foundation for future exploration and computational testing of the theory's predictive potential.

Magnitudes and the S-Eigenvalue

One of the core features of this theory is its focus on magnitudes rather than physical units like mass, length, and time. I introduce an eigenvalue S, whose rate of change is proportional to mass. This provides a natural extension of the energy-momentum relation, allowing us to incorporate mass without needing explicit units. The S-eigenvalue plays a central role in mapping between wavefunctions and spacetime.

This approach is further enhanced by defining wavefunctions that inherently respect the symmetries of Minkowski spacetime (MST) and the energy-momentum relation. By focusing on magnitudes, this theory reduces the reliance on specific units, allowing for a more abstract and general description of physics.

Curved Position Eigenvalues

A key departure from traditional wavefunctions is the curvature in position eigenvalues. In this theory, position eigenfunctions are allowed to curve, providing a bridge to general relativity. The curvature of position eigenvalues introduces the potential to describe forces, including gravity, through changes in the curvature of the energy or momentum eigenfunctions over time or space.

$$\underline{\Phi} = \underline{\psi}^\flat - \underline{\psi}$$

Here, $\underline{\Phi}$ represents the curvature of the position eigenvalue, which can vary based on the value of ρ. This curvature is key to understanding how the theory describes the dynamics of forces through wavefunctions.

Eigenfunctions and Their Isomorphism to Standard Quantum Mechanics

An important feature of this theory is its ability to map onto traditional quantum mechanics when curvature is removed. The position, momentum, and energy eigenfunctions in this theory are isomorphic to the standard wavefunctions used in quantum mechanics. The differences arise when curvature is introduced, allowing the theory to extend into more general dynamics.

The position eigenvalue $\underline{\psi}$, for instance, becomes identical to the standard ψ in the absence of curvature, while the momentum and energy eigenfunctions similarly map to their classical counterparts. This shows that the theory retains a close connection to traditional quantum mechanics but extends beyond it when additional curvature is introduced.

Normalization and Probability: The Parentheses Notation

A unique feature of this theory is its use of parentheses notation, an analog to Dirac's bra-ket notation. In parentheses, we sum over the 4x4 matrices containing wavefunctions. This provides a normalized framework for describing probabilities and ensures that the total system adheres to the expected values of the theory.

$$(\alpha|\beta) = \frac{1}{4}\int_{\mu=0}^{4} d\xi_\mu \sum_{i,j} \alpha_{ij}^* \beta_{ij}$$

This notation allows us to treat multiple particles within the same system while maintaining their individual normalizations. For example, when summing several wavefunctions, the normalization follows straightforwardly:

$$\left(\sum_n \alpha_n^\flat \middle| \sum_n \alpha_n^\flat\right) = n$$

This notation also ensures that all elements in a superposition remain normalized, providing a natural framework for understanding superpositions of particles.

Zero Equations: The Wave Equation of the Theory

To ensure both normalization and physical accuracy, the theory incorporates "zero equations," which serve as the wave equations of the system. These equations enforce that eigenvalues and forces sum to zero, aligning the theory with Minkowski spacetime and the energy-momentum relation.

The zero equation for position eigenvalues maps directly to the zero equation of Minkowski spacetime:

$$-t^2 + x^2 + y^2 + z^2 + S^2 = 0$$

Similarly, the zero equation for momentum eigenfunctions maps to the energy-momentum relation:

$$-E^2 + p_x^2 + p_y^2 + p_z^2 + m^2 = 0$$

In both cases, these zero equations ensure that the wavefunctions remain consistent with classical mechanics, while also extending the theory into curved eigenvalue space.

Superposition and Group Elements

Another important aspect of this theory is its group structure, where wavefunctions are placed on quaternion-valued group elements. These group elements allow for superpositions of up to four wavefunctions, each maintaining their individual normalizations. This suggests a natural explanation for phenomena like quantum entanglement and the Pauli Exclusion Principle (PEP).

The additive symmetries within these group elements allow for particles in superposition to remain consistent with the rules of the theory:

$$(G^\flat + X^\flat + Y^\flat + Z^\flat | G^\flat + X^\flat + Y^\flat + Z^\flat) = 4$$

The result here shows that all particles within a superposition maintain their individual normalizations, while interacting as a cohesive system. This provides insight into how multiple particles can coexist within the same system, without violating the normalization rules of the theory.

Concluding Remarks and Future Directions

This paper has introduced a general theory of wavefunctions, curvature, and eigenvalues that aims to describe all physical systems. The core ideas presented here—focusing on magnitudes, incorporating curvature, and using a more abstract framework—provide new perspectives on both quantum mechanics and general relativity.

While this paper has focused on the conceptual and mathematical foundations of the theory, future work will delve deeper into the specific predictions it makes. These include particle masses, superposition dynamics, and force interactions. The theory, while general, offers a vast landscape for computational and physical testing. As such, the next steps involve further computational exploration of the theory's subsets and predictions, as well as closer alignment with experimental data.

Everything as Fields: Wavefunctions, Probability Distributions, and Eigenfunctions

In this theory, the universe is built upon six fundamental entities, all of which are conceptualized as **fields** permeating space, time, and spacetime:

1. **Wavefunctions**: These represent the quantum states of systems and follow the logic of normalization. They are fields that exist everywhere, describing the probabilistic nature of particles.

2. **Probability Distributions**: Derived from the square of the wavefunction, these fields represent the likelihood of finding a particle in a specific state or location. The distribution is spread across space, rather than being confined to a single point.

3. **Position Eigenfunctions**: These fields represent possible values a particle can take in space. A measured particle's position is just one point (the zero point) in a broader field of position eigenvalues that exists throughout space.

4. **Position Eigenvalues (MST)**: These are the square of the position eigenfunctions, constrained by the zero equation of Minkowski spacetime, and represent spatial measurements. The eigenvalue fields pervade spacetime, indicating possible measured positions.

5. **Energy, Momentum, and Mass Eigenfunctions**: These are fields describing how energy, momentum, and mass relate to the system. They permeate space and time, continuously evolving and interacting with other entities.

6. **Energy, Momentum, and Mass Eigenvalues**: The square of these eigenfunctions, constrained by the zero equation of the energy-momentum relation, governs physical properties of particles in the universe.

In this framework, **point particles** are reinterpreted as the **zero points** in the field of position eigenvalues. This shift in perspective allows the entire universe to be described by interrelated fields, and all physical phenomena are manifestations of these six entities.

Resolving the Information Paradox

The **information paradox** arises in traditional physics because black holes appear to destroy information. However, in this theory, information is never lost because it is encoded in the **fields** that permeate space and time.

Since the six entities described above are all **fields** that extend throughout space, the concept of a particle's information being trapped inside a black hole becomes irrelevant. Even if a particle falls into a black hole, its **position eigenfunction** and **energy-momentum eigenfunctions** continue to exist as fields, with the particle acting as a source (or zero point) of these fields. The information associated with the particle is never localized solely within the black hole but remains spread out across spacetime.

As a result, black holes cannot trap or destroy information. Even as they evaporate, the fields corresponding to the particle's quantum properties continue to permeate the universe, preserving the continuity of information. This field-based perspective naturally resolves the information paradox, suggesting that information is never confined to a specific location but instead remains a part of the universal field structure.