The Theory of Isomorphic Physics
Part 3: The Composite state

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The Composite State

Composite states are formed by combining primitive states (ψ') through multiplication or division to produce a more general, unprimed state, referred to as the composite state:

$$\psi = \prod_{i=1}^{n} (\psi'_i)^{a_i} \cdot \prod_{j=1}^{m} \left(\underline{\psi}'_j\right)^{b_j}$$

where a_i and b_j can take values of 1, 0, or -1, corresponding to multiplication, exclusion, or division, respectively.

The set of all states that possess specific properties of interest is defined as:

$$\mathcal{S}(\text{properties}) = \{\psi \mid \text{specified properties of } \psi\}$$

For instance, a composite state characterized by a left-handed rate of rotation of $1/2$, a curvature type of $-a$, and a magnitude scale of e can be represented as:

$$\overset{\leftharpoonup}{\underline{\psi}}'_{(-a)\odot} \in \mathcal{S}\left(\text{rate of rotation} = \frac{1}{2}, \text{curvature type} = -a, \text{magnitude scale} = e\right)$$

This notation indicates that the state $\overset{\leftharpoonup}{\underline{\psi}}'_{(-a)\odot}$ belongs to the set of all states with the specified properties. It is important to note that this representation does not refer to a unique state but rather to any member of an infinite set of states sharing these characteristics.

Arbitrary Composite States

The unprimed notation (ψ) is used to refer to an arbitrary element from the set $\mathcal{S}$(properties). For example:

$$\overset{\leftharpoonup}{\underline{\psi}}_{(-a)\odot} \in \mathcal{S}\left(\text{rate of rotation} = \frac{1}{2}, \text{curvature type} = -a, \text{magnitude scale} = e\right)$$

This notation describes any state with the given properties, without specifying its explicit construction. This provides the flexibility to discuss composite states while keeping their relevant characteristics clearly defined.

The definitions and notations used in this work are summarized in Table **??**, while the notation and corresponding set-theoretic definitions are provided in Table **??**.

Symbol	**Definition**
ψ	Composite state formed by combining Ψ' and $\underline{\Psi}'$.
$\overline{\psi}$	Composite scalarfunction with an rate of rotation equal to zero.
$\vec{\psi}$	Composite state with an rate of rotation of $+1$.
$\psi^\flat$	Composite state with no curvature (flat).
Ψ_p	Particle state representing given particles.
$\underline{\psi}$	Composite position state.

Table 1: Abridged definitions of various states. For more details, see Appendix **??**.

Symbol	**Definition**
$\tilde{\psi}$	Composite state with an arbitrary rate of rotation between $+1$ and -1.
$\overline{\psi}$	Composite scalarfunction (rate of rotation $= 0$).
$\overset{\leftharpoondown}{\psi}$	Composite state with a rate of rotation of $-\frac{1}{2}$.
$\psi^\flat$	Composite state with no curvature.
ϕ	Scalar state ϕ.
$\underline{\psi}$	Composite position state.

Table 2: Abridged definitions of state symbols. For detailed definitions, see Appendix **??**.

Transformation of Flat to Curved Space-Time with $\underline{\overline{\psi}}$

In this theory, we introduce $\underline{\overline{\psi}}$ as a state that transforms inputs from uncurved (flat) space-time into curved space-time. The function $\underline{\overline{\psi}}$ represents the behavior of physical systems under curvature, providing the correct output even when curvature is present. The underline indicates it has a position magnitude while the overline (assumed to have no peak offset) indicates that the state is scalar-valued.

The term "curvature" is used in three distinct senses in this context: 1. **Rate of Change in State Quantities**: This refers to how the rates like energy (E), momentum (p), and mass (m) vary with space and time, represented by transformations involving the input parameter ξ. 2. **Deviation of Position

Magnitudes**: This describes how the output of a position state deviates from the expected value of the input, reflecting spatial and temporal distortions. 3. **Relativistic Effects**: This refers to the additional curvature introduced by relativistic effects, such as time dilation and length contraction, represented by the Lorentz transformation.

The function $\overline{\underline{\psi}}$ inherently accounts for all three senses of curvature, meaning that the output magnitudes are influenced by the scaling due to E, p, and m, the curvature inherent in the nature of the position states themselves, and the relativistic effects.

0.1 General Transformation Overview

The general form of this transformation is given by:

$$\overline{\underline{\psi}} : \mathbb{R}^4 \to \mathcal{M}$$

where:

- $\mathbb{R}^4$ represents flat space-time with coordinates (t, x, y, z).
- $\mathcal{M}$ represents curved space-time, where the state $\overline{\underline{\psi}}$ accounts for the effects of curvature due to forces, energy, and mass.

0.2 Mapping of Components

Each of the flat space-time components is mapped to the corresponding curved-space component through $\overline{\underline{\psi}}$. The mapping relates the values of the space-time coordinates to the curvature-adjusted outputs of $\overline{\underline{\psi}}$ in three layers:

0.2.1 First Layer: Rate of Change in State Quantities

$$|X'^{\flat}_{\mu}| = \left\{ |P^{\flat}_{\mu}| \, (\xi - \tau_{\mu}) \mid x^{\flat}_{\mu} \in [x^{\flat}_{\mu,\min}, x^{\flat}_{\mu,\max}] \right\}$$

Breaking down the components:

$$t' = |E| \, (\xi - \tau_0)$$

$$x' = |p_0| \, (\xi - \tau_1)$$
$$S' = |m| \, (\xi - \tau_4)$$

These equations represent the first layer of curvature, which is the rate of change in various quantities over the input parameter ξ, indicating how flat space-time coordinates (t, x, y, z, S) are transformed into scaled counterparts.

0.2.2 Second Layer: Deviation of Position Magnitudes

The second layer of curvature involves the deviation of the position magnitudes due to the intrinsic curvature of the state:

$$t'' = \overline{\underline{\psi}}(t')$$
$$x'' = \overline{\underline{\psi}}(x')$$
$$S'' = \overline{\underline{\psi}}(S')$$

These transformations account for the curvature inherent in the nature of the position states themselves, causing deviations from the expected input values.

0.2.3 Third Layer: Relativistic Effects and Dynamics Between Dimensions

The third layer of curvature focuses on the relativistic dynamics between different dimensions, specifically how the varying rates of growth for time (t''), space (x''), and the scalar (S'') determine the velocity of a particle, ultimately influencing the Lorentz transformation.

Defining Velocity in Terms of Growth Rates Typically, velocity (v) is defined as:

$$v = \frac{\Delta x}{\Delta t}$$

In the context of our three-layer system, we define the velocity of a particle in a given direction using the double-primed quantities:

$$v_x = \frac{\Delta x''}{\Delta t''}$$

where $\Delta x''$ and $\Delta t''$ represent the rates of change for the double-primed versions of space and time, respectively. This definition provides the velocity in terms of the intrinsic growth rates introduced by the second layer of curvature.

Applying the Lorentz Transformation Once the velocity is defined in terms of the growth rates of the double-primed quantities, we apply the Lorentz transformation to obtain the triple-primed versions of space and time. The Lorentz transformation accounts for the relativistic effects experienced by an observer moving relative to the particle:

$$t''' = \gamma \left(t'' - \frac{v_x x''}{c^2} \right), \quad x''' = \gamma \left(x'' - v_x t'' \right)$$

where:

- $v_x = \Delta x''/\Delta t''$ is the velocity defined using the double-primed rates. - $\gamma = \frac{1}{\sqrt{1-\frac{v_x^2}{c^2}}}$ is the Lorentz factor that accounts for time dilation and length contraction. - c is the speed of light.

0.3 Behavior of Position Magnitudes

The second sense of "curvature" is associated with the behavior of position magnitudes. Specifically, if the input of a position state is ξ, the magnitude of the output may differ from this input value due to the curvature introduced by $\underline{\overline{\psi}}$. This difference in magnitudes represents spatial or temporal distortions.

The magnitude of the output from $\underline{\overline{\psi}}$ takes into account all three types of curvature: 1. **Scaling by E, p, and m**: The output is scaled by the appropriate values of energy, momentum, and mass, corresponding to the relevant space-time component. 2. **Intrinsic Curvature of Position States**: The curvature inherent in the nature of position states affects the magnitude, causing deviations from the expected input value. 3. **Relativistic Effects**: The Lorentz transformation further modifies the output, introducing relativistic curvature effects.

- When the state is uncurved but possesses a position magnitude, the output matches the input exactly. This means the magnitudes of the uncurved state correspond directly to the values of the flat space-time coordinates Ξ. - When curvature is introduced through $\underline{\overline{\psi}}$, the magnitudes of the output adjust to reflect this curvature, meaning they may slightly deviate from the input values, representing the geometric effect of curvature on space and time.

To express this formally:

$$\underline{\overline{\psi}}(\Xi) = \Xi \quad \text{(if uncurved, where } \Xi \text{ is the input and the magnitude of the output)}$$

This relationship holds true as long as no curvature is present. When curvature is introduced, the transformation $\underline{\overline{\psi}}$ adjusts the magnitudes accordingly.

0.4 General Formulation of Ψ

To capture both flat and curved scenarios, we define Ψ (differentiated by a capital letter) as follows:

$$\Psi = \psi^\flat \Big|_{|X'^{\flat}_{\mu}| \to \underline{\overline{\psi}}}$$

Since $\underline{\overline{\psi}} = X''$, we are essentially saying that instead of having a function of X', we are figuratively using a function of X'', as $\underline{\overline{\psi}}$ takes X' as input and outputs X''. The result has no "state curvature" because we have flattened ψ, meaning there is no curvature in the probability distribution. Instead, only curvature in time, space, and space-time remains, which aligns more closely with how the Schrödinger equation describes forces, not as changes in probability, but as changes in the total energy over space and time.

For the position state version ($\underline{\Psi}$), which also uses $\psi^\flat$, the position magnitude matches the input because we flatten the ψ that maps X' to X''. This ensures that the position magnitude is correct for a given input of X''.

Philosophically, this transformation is grounded in the theory that the position states have position magnitudes. If this is the case, then the primitive position states take in inputs of X' and output magnitudes of X'', but the phase of the wavefunction is based on X' and not X''. This new formulation is an expression of the same information, as it still takes inputs of X' and outputs X'', but the phase of the wavefunction is now based on X'' in this uppercase Ψ version.

In this expression:

- $\psi^\flat$ is the state defined in flat space-time.
- $\underline{\overline{\psi}}$ is the transformation that takes flat space-time inputs and outputs curved space-time, modifying the space-time structure as needed.
- Ξ represents the flat space-time coordinates (t, x, y, z, S).

This formulation ensures that the state retains correct magnitudes, even in the presence of curvature. The transformation $\underline{\overline{\psi}}$ governs the deviation of these magnitudes, effectively mapping the system's transition from flat to curved space-time, while taking into account all three layers of curvature: scaling by E, p, and m, intrinsic curvature inherent in the state, and relativistic effects.

Defining ϕ

If we take a state and set its $|P^\flat_{\mu\mu}|$, the result is phi, defined:

$$\phi \in \{\psi \mid |P^\flat_\mu|_\mu = 1 \text{ for all } \mu\} \tag{1}$$

When P is set to 1, ϕ can only take on quantized values of momentum, determined by the intrinsic rate of rotation. This value is positive for right-handed rotation and negative for left-handed rotation. There are also position versions of phi such that the magnitude of a position phi equates to the input of xi: (Need to write an equation for this that says the modulus (or magnitude) of underline phi equals the input of xi (the output equates to the input).

Epm States

If we divide a position state by a scalar, the resulting function will have a magnitude proportional to the intrinsic rate of rotation if there is no curvature. More generally, it will yield energy eigenvalues when $\mu = 0$, momentum eigenvalues when $\mu = 1, 2, 3$, and mass eigenvalues when $\mu = 4$.

Similar to the position magnitude, these properties are conceptualized as inherent attributes of states that can be transferred or canceled through interactions with other states.

$$\underline{\underline{\psi}} \in \left\{ \psi \mid \underline{\psi}/\overline{\underline{\phi}} \right\} \tag{2}$$

Force Curvature

Since Epm states yield energy, momentum, and mass magnitudes, we define force as a type of curvature:

$$\underline{\underline{\Phi}} = \underline{\underline{\psi}}_{\beta} - \underline{\underline{\psi}}^{\flat}_{\beta} \tag{3}$$

The following table outlines the approximate scaling behavior of different curvature types with respect to ξ.

Table 1 presents how each curvature type's force curvature scales with ξ. This includes both positive and negative curvatures scaling as $1/\xi^0$, with varying magnitudes controlled by σ, making it suitable for describing the strong force. Additionally, forces that scale as $1/\xi^2$, such as those describing electromagnetic and gravitational forces, are included. Interestingly, this approach also suggests that gravity could be explained through space-time curvature scaling as $1/\xi^3$, offering a potential alternative explanation.

Curvature Type	$\nu = 0$	$\nu = 1$	$\nu = 2$	$\nu = 3$	$\nu = 4$
A	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
$-A$	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
B	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
$-B$	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
C	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
$-C$	$1/\xi^0$	$1/\xi^2$	$1/\xi^2$	$1/\xi^3$	$1/\xi^4$
$-D$	$1/\xi^0$	$1/\xi^2$	$1/\xi^4$	$1/\xi^6$	$1/\xi^8$
G	$1/\xi^0$	$1/\xi^2$	$1/\xi^4$	$1/\xi^6$	$1/\xi^8$

Table 3: Full table showing the curvature types and their dependence on parameter ν.

One of the greatest challenges of this theory is that it requires not only physical experimentation to be validated but also extensive mathematical exploration. Currently, with limited resources, we have only been able to perform calculations with relatively low values of λ. Further exploration, most likely involving supercomputers, is needed to determine the appropriate values of σ and corresponding magnitudes for primitive states in a composite state that might yield the correct ratios of mass, energy, momentum, and forces as observed in experiments.

We would like to emphasize the potential of these primitive states (or composite states) to explain all forces. This concept of force curvature is evocative of the Hamiltonian, particularly regarding how changes in the Hamiltonian over time are attributed to forces. In future work, specifically in paper 5, we will define the Hamiltonian for this theory, where force curvature will play a critical role in describing forces.

The Position Magnitude under Multiplication

We define the set $\mathcal{P}$ as the set of all states with a **non-multiplicative position magnitude**. Specifically, if $\underline{\psi} \in \mathcal{P}$, then $\underline{\psi}$ has a position magnitude without requiring multiplication by x or any additional terms.

If we consider two states, $\underline{\tilde{\psi}}$ and $\underline{\overline{\psi}}$, both belonging to $\mathcal{P}$, and divide one by the other, the resulting state will no longer possess a position magnitude:

$$\underline{\tilde{\psi}}/\underline{\overline{\psi}} = \tilde{\psi}$$

Here, $\tilde{\psi} \notin \mathcal{P}$, since dividing two states with position magnitudes results in the loss of the position magnitude property.

Similarly, if we multiply two elements from the set $\mathcal{P}$, which contains states with first-order position magnitudes, the resulting state will no longer belong to $\mathcal{P}$ because it will acquire a higher-order magnitude:

$$\underline{\psi} \cdot \underline{\psi} \notin \mathcal{P}$$

where $\mathcal{P}$ is formally defined as:

$$\mathcal{P} = \{\psi \mid \text{has a linear (first-order) position magnitude}\}$$

By definition, elements of $\mathcal{P}$ possess only first-order magnitudes (e.g., corresponding to x). When an element of $\mathcal{P}$ is multiplied by itself, the resulting state has a second-order magnitude (e.g., x^2), thereby excluding it from $\mathcal{P}$.

However, if we multiply a position state by a primitive state that does not have a position magnitude, the resulting state still belongs to $\mathcal{P}$. Therefore:

$$\underline{\psi} \in \{\psi \mid \text{has a non-multiplicative, first-order position magnitude}\}$$

rate of rotation under Multiplication

When we multiply two states, their rates of rotation (denoted by rate of rotation) are additive. Below are three examples that illustrate this principle:

1. Multiplying two states with rate of rotation $= -1/2$: Two elements from the set of states with an rate of rotation $-1/2$ multiply to form a state with rate of rotation $= -1$:

$$\overleftharpoon{\psi} \cdot \overleftharpoon{\psi} = \overleftarrow{\psi}$$

2. Multiplying a state with rate of rotation $= 1$ by a state with no rotation: An element from the set of states with rate of rotation $= 1$ multiplies an element

from the set with no rotation (rate of rotation = 0) to form a state that also belongs to the set with rate of rotation = 1:

$$\vec{\psi} \cdot \overline{\psi} = \vec{\psi}$$

Curvature as Deviation

Curvature is defined as the deviation of a state from an ideal value, such as 1 or e. This deviation can be quantified and analyzed in terms of how it changes the behavior of a state. Small deviations, when multiplied, yield an overall result that approximately corresponds to an additive combination of curvatures, an effect that emerges from the properties of multiplicative scaling for small values.

Consider a state with a magnitude of 0.99 for a given input value of ξ. The curvature, Φ, is defined as the deviation from the ideal magnitude (in this case, 1):

$$\Phi_1 = 1 - 0.99 = 0.01$$

If we multiply two such states, the resulting state has a magnitude of:

$$\psi_1 \cdot \psi_2 = 0.99 \cdot 0.99 = 0.9801$$

The resulting curvature can be determined as:

$$\Phi_{\text{result}} = 1 - 0.9801 = 0.0199$$

Thus, the curvatures approximately add:

$$\Phi_1 + \Phi_2 \approx 0.02$$

Improved Approximation for Smaller Deviations

The approximation becomes more accurate as the magnitude of the curvature decreases. For instance, if the state has a magnitude of 0.999, then the product of two such states is:

$$\psi_1 \cdot \psi_2 = 0.999 \cdot 0.999 = 0.998001$$

The resulting curvature is:

$$\Phi_{\text{result}} = 1 - 0.998001 = 0.001999$$

This result demonstrates that the deviation more closely approximates an exact addition of the individual curvatures as the deviation becomes smaller.

Curvature Additivity for Small Deviations

In the limit of very small curvatures, such as those encountered on a cosmic scale where quantum forces are minimal, the approximation becomes nearly exact:

$$\lim_{\Phi \to 0} (1 - \Phi_1)(1 - \Phi_2) \approx 1 - (\Phi_1 + \Phi_2)$$

Thus, when curvatures are small, they add linearly under multiplication, resembling the behavior seen in first-order perturbation theory.

Implications for Physical Systems

For physical systems where deviations from the ideal magnitude (e.g., 1 or e) are minimal, the property of additive curvature under multiplication simplifies modeling. This allows for the efficient representation of systems involving multiple interacting states, as the small curvatures can be treated as nearly additive, significantly reducing computational complexity. This thoery only uses one scale, a cosmic scale wherein the deviations from the ideal magnitude are extremely small (quantum forces on the scale of the cosmos) such that the approximation is almost exact.

Magnitude Scale under Multiplication

The magnitude scale of a state is multiplicative under multiplication, meaning that the resulting scale of two primitive states is the product of their respective scales.

For example:

1. If we multiply an element from the subset of composite states with magnitude e^{-1} by an element from the subset with magnitude e, the result belongs to the subset with magnitude 1:

$$\psi_{\oslash} \cdot \psi_{\odot} = \psi$$

2. If we multiply an element from the subset of states with magnitude e^{-1} by another element with magnitude e^{-1}, the result belongs to the subset with magnitude 1:

$$\psi_{\oslash} \cdot \psi_{\oslash} = \psi$$

3. If we multiply an element from the subset of states with magnitude e by another element with magnitude e, the result belongs to the subset with magnitude 1:

$$\psi_{\odot} \cdot \psi_{\odot} = \psi$$

Since magnitude scale applies to position magnitudes, normalization cannot simply eliminate these variations in magnitude. It becomes essential to maintain the correct magnitude scale for states. Specifically, we require the state to have a magnitude scale of 1, achieved through the cancellation of scale factors due to multiplication or division.

Zero-Point Orientation under Multiplication

The zero-point orientation of a state is also multiplicative under multiplication. For example, if an element of the subset with zero-point orientation i is multiplied by an element from the subset with zero-point orientation $-i$, the result belongs to the subset with zero-point orientation of 1:

$$\psi_i \cdot \psi_{-i} = \psi$$

This ensures that the resulting state has a neutral orientation when combining states with opposite orientations.

Peak Offset under Multiplication

When dividing a primitive state with a non-zero rate of rotation and a peak offset of

rac1e by a primitive with no rate of rotation but with the same peak offset, the resulting function has no peak offset:

$$\frac{\tilde{\psi}_\vee}{\psi}$$

$_\vee = \tilde{\psi}$

This suggests that while peak offset is abstract for primitives with zero rotation, the property remains mathematically consistent. In general, peak offsets cancel under division and add under multiplication.

Independence of State Properties

In general, the different properties of a state, such as rate of rotation, position magnitude, magnitude scale, zero-point orientation, and peak offset, are independent of one another. This means that one property does not affect or influence the presence or behavior of another property. Each property can be thought of as orthogonal to the others in the sense that modifying one property does not directly alter the values or characteristics of the others.

For example, consider the multiplication of a state with rate of rotation equal to $1/2$ and a position magnitude by a state with no rate of rotation:

An element from the set of states with rate of rotation $= 1/2$ and a position magnitude multiplies an element with no rotation to form a state that belongs to the set with rate of rotation $= 0$, while still retaining the position-magnitude property. This clearly illustrates that one property (e.g., rate of rotation) does not affect another (e.g., the position magnitude):

$$\underline{\overrightarrow{\psi}} \cdot \overleftarrow{\psi} = \overline{\underline{\psi}}$$

In this case, the rate of rotation cancels out due to the interaction between the states, but the position magnitude remains unaffected. This concept holds for all properties defined for these states, demonstrating that each property can be considered independently. This independence allows for greater flexibility in constructing and analyzing states with different combinations of properties, without unintended interactions or consequences between those properties.

Total States

With the established language and notation, we can define the total state Ψ:

$$\Psi = \psi_\mu \cdot \phi_\mu \tag{4}$$

where ψ_μ (the orbitals state) and ϕ_μ (the spin state) are plane waves. Thus, Ψ is a plane wave that can be normalized, and superpositions can be formed using normalization constants. The definitions of the orbital state, ψ_μ, and the spin state, ϕ_μ, are as follows:

$$\psi_\mu = \begin{cases} \overset{\leftrightarrow}{\psi}_\mu & \text{for } \mu = 0, 1, 2, 3 \\ \overline{\psi}_4 & \text{for } \mu = 4 \end{cases} \tag{5}$$

For $\mu = 0, 1, 2, 3$, ψ_μ represents elements from the subset of states with rate of rotation $= \pm 1$, indicating the standard form of the state. The right-left arrow notation, $\overset{\leftrightarrow}{\psi}$, denotes that the state can have either right- or left-handed rotation.

In constructing Ψ, there are two approaches for handling the momentum direction:

1. Allow ψ to have both right- and left-handed rotation while restricting $|P^\flat_\mu|$ to positive values only. 2. Allow $|P^\flat_\mu|$ to take positive or negative values, and restrict ψ to right-handed rotation only. In this case, the definition is:

$$\psi_\mu = \begin{cases} \overrightarrow{\psi}_\mu & \text{for } \mu = 0, 1, 2, 3 \\ \overline{\psi}_4 & \text{for } \mu = 4 \end{cases} \tag{6}$$

This choice depends on the desired interpretation of the sign of momentum. Since ϕ_μ will later be defined to control the handedness determining the sign of momentum, the above definition allows ψ_μ to have either handedness while constraining $|P^\flat_\mu|$ to positive values.

For $\mu = 4$, ψ_4 represents a plane wave related to an S magnitude (which is linked to spacetime curvature) in its position state form, and to a mass magnitude in its Epm state form. Since S and mass (m) do not impact the rate of rotation or dynamics of the state, we assume they are scalar-valued position states, represented by scalar states $\overline{\psi}$ functions, similar to scalar fields.

$$\phi_\mu = \begin{cases} \tilde{\phi}_\mu & \text{for } \mu = 0, 1, 2, 3 \\ \overline{\phi}_4 & \text{for } \mu = 4 \end{cases} \tag{7}$$

The ϕ_μ functions belong to the subset with an rate of rotation of the corresponding ϕ_μ. Although ϕ_4 is included for symmetry with ψ_4, its necessity is debatable. Since ϕ_μ can have position magnitudes, they correspond to position magnitudes where $|P^\flat_\mu| = 1$, meaning the position grows at a default rate of 1.

Abstract Interpretation of S and Mass

In this theory, we interpret S (which represents spacetime) and mass as magnitudes without associated rotation rates. This interpretation is essential for understanding how these quantities affect the system without directly altering the dynamics of the wavefunction.

The state $\overset{\leftrightarrow}{\phi}$, which represents momentum, can be thought of as corresponding to a massless state because it exhibits a rate of rotation of 2, which is associated with energy and momentum. In contrast, $\overset{\rightharpoonup}{\phi}$, which has a rate of rotation of 4, might be viewed as having mixed properties, involving both momentum and mass. Specifically, we can think of it as combining elements of rate of rotation 2 (associated with momentum and energy) and rate of rotation 0 (associated with mass). This interpretation suggests that $\overset{\rightharpoonup}{\phi}$ represents a state that possesses both mass and momentum.

Finally, $\overline{\phi}$, which is scalar-valued and has no rate of rotation, represents pure mass. In this context: - $\overset{\leftrightarrow}{\phi}$ represents pure momentum. - $\overline{\phi}$ represents pure mass. - $\overset{\rightharpoonup}{\phi}$ represents an intermediate state, possessing characteristics of both mass and momentum.

These interpretations are qualitative and are intended to provide intuition for understanding the relationships between the properties of states in this theory. The exact mathematical definitions of these relationships will be provided later in the theory, once the equations governing Minkowski spacetime (MST) and the energy-momentum relationship are presented.

Spin States

In this formalism, spin angular momentum arises directly from the intrinsic properties of the state ϕ_μ. The angular frequency and wavenumber, defined as:

$$\text{Angular Frequency and Wavenumber} = \left.\frac{\text{Cycles}}{\Delta|X^\flat_\mu|}\right|_{|P^\flat_\mu|=1}$$

has quantized values of $0, \pm 2, \pm 4$, which correspond to the spin states. Unlike standard quantum mechanics, where operators act on states to yield specific magnitudes, in this theory the states themselves possess intrinsic magnitudes that determine their behavior.

The state ϕ_μ can thus be interpreted as having quantized angular momentum that is directly proportional to its angular frequency and wavenumber. For example, when measuring the spin angular momentum along the μ_1 axis, the state collapses into specific Epm plane-states:

$$L_1 \implies \phi_{\mu=2} \to \overrightarrow{\phi}_2, \quad \phi_{\mu=3} \to \overrightarrow{\phi}_3$$

The quantized spin states are reflected in the rotation rates of ϕ_μ, which have default values of Angular Frequency and Wavenumber $= 0, \pm 2, \pm 4$. These values determine the intrinsic spin of the system.

Since the magnitude of Planck's constant $\hbar$ maps to a state with an angular frequency and wavenumber of 1, this formalism suggests that ϕ_μ is analogous to the quantum mechanical spin state, but with intrinsic magnitudes. Thus, the spin angular momentum is directly related to the rotation rate of ϕ_μ, taking only quantized values of $\pm 1, \pm \frac{1}{2}$, or 0.

This interpretation aligns with the idea that the angular frequency and wavenumber define quantized momentum values for ϕ, and through this quantization, the angular momentum also becomes quantized. Since angular momentum is defined in terms of momentum ($L = r \times p$), the intrinsic quantization of ϕ naturally leads to discrete angular momentum values. The Heisenberg Uncertainty Principle (HUP) and commutation relations apply in this context, further validating that the quantized intrinsic properties of ϕ result in the expected quantum dynamics.

In this theory, measurements of spin angular momentum are inherently tied to the more fundamental measurement of momentum components. When measuring spin angular momentum, the measurement process effectively collapses the wavefunction into plane-wave states with defined momentum in specific components (e.g., p_x and p_y). This collapse results from the quantization of momentum in ϕ, where the spin states represent discrete momentum values. Therefore, spin angular momentum measurements are less fundamental than momentum measurements, as they emerge from the interplay of specific momentum components.

Orbital States

The angular frequency (as opposed to the angular frequency and wavenumber) is defined as:

$$\text{Angular Frequency} = \frac{\text{Cycles}}{\Delta |X_\mu^\flat|}$$

Orbital angular momentum is encoded in the state ψ_μ. In this formalism, ψ_μ also possesses angular momentum, but unlike ϕ_μ, which has fixed rates of rotation, ψ_μ allows for more flexible rates of rotation. This flexibility permits ψ_μ to describe much larger, non-quantized values of angular momentum.

For instance, ψ_μ may have an angular momentum magnitude that corresponds to longer orbits and larger magnitudes of momentum. This flexibility arises because $|P^\flat_\mu|$ is not restricted to 1, allowing the state to represent a broad range of angular momentum values. In this context, orbital angular momentum is conceptually similar to that in traditional quantum mechanics, but it arises directly from the properties of the state itself, without requiring an operator to extract the magnitude.

Total States

In this theory, the total angular momentum arises as a combination of both spin and orbital contributions, encapsulated in the composite state $\Psi = \psi_\mu \cdot \phi_\mu$. The spin angular momentum is represented by the state ϕ_μ, while the orbital angular momentum is represented by the state ψ_μ. Since the states are multiplied, their respective angular momenta, encoded in their intrinsic rates of rotation, add together to give the total angular momentum.

The total angular momentum is therefore given by:

$$\text{Angular Frequency}_{\text{total}} = \text{Angular Frequency}_\psi + \text{Angular Frequency}_\phi$$

Since both ψ_μ and ϕ_μ can have different signs for their rotation rates, the total angular momentum can either increase or decrease depending on the relative handedness of the two states. This naturally leads to a broad range of possible total angular momentum values, all derived from the intrinsic properties of the states.

Thus, the total angular momentum of a system is determined by the interplay between the spin and orbital components of the state. These contributions are additive in this formalism, resulting in a complete representation of the total angular momentum without the need for external operators. The resulting Ψ captures both the intrinsic spin properties and the orbital dynamics, providing a unified description of angular momentum in this theory.

Furthermore, the process of measuring the total angular momentum inherently involves a measurement of both spin and orbital components. When a measurement is performed, the momentum components associated with ϕ_μ and ψ_μ collapse into well-defined eigenstates, consistent with the quantized nature of angular momentum in quantum mechanics. This collapse reflects the intrinsic quantization of the states' momentum values and ensures that the measured total angular momentum is also quantized.

Since angular momentum is fundamentally defined in terms of position and momentum ($L = r \times p$), measuring the total angular momentum effectively involves collapsing the momentum components p_x and p_y, resulting in specific quantized values. In this way, the formalism provides a consistent explanation for the quantization observed in angular momentum measurements, linking it directly to the underlying quantized momentum of the constituent states.

By grounding the total angular momentum in the intrinsic properties of ψ_μ and ϕ_μ, this approach provides a coherent framework that unifies both spin and orbital angular momentum without requiring additional operator definitions. The quantized momentum of ϕ, combined with the flexible, potentially non-quantized momentum of ψ, naturally leads to the broad range of possible angular momentum values seen in physical systems.

One might argue that you could have the Phi of the two particles have the same rate of rotation, and that you have a difference in the two orbital angular momentums to counter this. However, if there is some unqiue curvature on the angular momentum, then this needs to be countered by a negative version of the same unique curvature on the other angular momentum in order to cancel properly, disallowing

General Definition of Primitive Position States

In the earlier sections, we introduced primitive position states, $\underline{\psi}'(|X^\flat_\mu|)$, with a specific form:

$$\underline{\psi}'(|X^\flat_\mu|) = \Lambda^2 \left(\left(Z + \frac{H}{\Lambda + |X^\flat_\mu|} \right)^{\Theta(\Lambda + |X^\flat_\mu|)} - \left(-Z - \frac{H}{\Lambda - |X^\flat_\mu|} \right)^{\Theta(\Lambda - |X^\flat_\mu|)} \right).$$

In this section, we expand upon this definition to establish a more general formulation that incorporates the concepts and notation developed in the composite state framework.

General Formulation of Primitive Position States

The general definition of a primitive position state, $\underline{\psi}'(|X^\flat_\mu|)$, describes it as the difference between two rotating primitive states (or composite states), each rotating in opposite directions. Formally, a primitive position state can be represented by one of the following four expressions:

$$\underline{\psi}'(|X^\flat_\mu|) = \Lambda^2 \left(\overleftarrow{\psi} - \overrightarrow{\psi} \Big|_{t \to -t} \right),$$

$$\underline{\psi}'(|X^\flat_\mu|) = \Lambda^2 \left(\overrightarrow{\psi} - \overleftarrow{\psi} \Big|_{t \to -t} \right),$$

$$\underline{\psi}'(|X^\flat_\mu|) = \Lambda^2 \left(\overset{\leftharpoondown}{\psi} - \overset{\rightharpoondown}{\psi} \Big|_{t \to -t} \right),$$

$$\underline{\psi}'(|X^\flat_\mu|) = \Lambda^2 \left(\overset{\rightharpoonup}{\psi} - \overset{\leftharpoonup}{\psi} \Big|_{t \to -t} \right),$$

where:

- $\overleftarrow{\psi}$ and $\overrightarrow{\psi}$ represent primitive or composite states rotating in opposite directions.
- The notation $\Big|_{t\to -t}$ denotes a time-reversal applied to one of the states in the pair, ensuring opposite rotation alignment.
- The resulting state, $\underline{\psi}'(|X^\flat_\mu|)$, is scaled by Λ^2, restoring the scale after subtracting two states that differ by a minute amount.

Conceptual Overview

In this definition, a primitive position state emerges from the difference between two states that have aligned phases but rotate in opposite directions. When time is reversed for one state, there exists a minute difference in their respective magnitudes—a difference that is proportional to $1/\Lambda^2$. By multiplying this difference by Λ^2, we restore the magnitude to the scale of the original primitive states. This configuration results in a state whose magnitude grows with the input $|X^\flat_\mu|$ as the two component states drift further apart.

In this way, the primitive position state encapsulates a dynamic interplay between two oppositely rotating states, with the small differential growth in their magnitudes contributing to the overall behavior of $\underline{\psi}'(|X^\flat_\mu|)$.