QB7 – Correspondence Between Coherence-Gated Interaction and the Quantum Measurement Framework in Scalar–Conformal NUVO Systems

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Abstract

We establish the correspondence between the deterministic coherence-gated interaction framework developed in QB3–QB6 and the standard formalism of quantum measurement. In QB4, interaction events were identified with projectors on a finite-dimensional representational space, and in QB5 it was shown that admissible weight assignments on these events take a unique quadratic form. QB6 demonstrated that this quadratic form is realized as the asymptotic frequency of interaction events generated by deterministic transport.

In the present work, we show that this structure provides a direct structural correspondence with the quantum measurement framework. Transported states are identified with quantum state vectors, projector-valued event channels with measurement outcomes, and coherence-gated interactions with measurement processes. The quadratic frequency law derived in QB6 corresponds to the Born rule.

Within this correspondence, the statistical structure of quantum mechanics is interpreted as arising from deterministic interaction dynamics, without the introduction of probabilistic postulates or collapse assumptions. The resulting framework provides a direct structural correspondence between closure-based dynamics and the operational structure of quantum theory.

1 Introduction

In QB3–QB6 [1, 2, 3, 4], we developed a structural and dynamical framework for scalar–conformal NUVO systems. In QB3, states were represented as unit vectors in a finite-dimensional inner product space associated with closure configurations. In QB4, interaction events were identified with projectors on this space, forming a complete and mutually exclusive event algebra. In QB5, it was shown that any admissible assignment of weights to such events must take a unique quadratic form. Finally, QB6 established that this quadratic form is realized as the asymptotic frequency of interaction events generated by deterministic transport and coherence-gated interaction.

These results determine both the structure of the state space and the realized distribution of interaction events. However, they have been formulated entirely within the internal language of closure-based dynamics and coherence geometry. The relation of this framework to the standard formalism of quantum mechanics has not yet been made explicit.

The purpose of the present work is to establish this relation. Specifically, we show that the structures developed in QB3–QB6 correspond directly to the elements of the quantum measurement

[*]Bibliography is provisional. Cross-references to companion NUVO-series papers (M-, SR-, Q-, QB-, QM-series) will be updated with Zenodo DOIs in subsequent versions.

framework. In this correspondence, transported states are identified with quantum state vectors, projector-valued event channels with measurement outcomes, and coherence-gated interactions with measurement processes.

Under this identification, the quadratic frequency law derived in QB6 corresponds to the Born rule. The statistical structure associated with quantum measurement is thus represented as arising from deterministic interaction dynamics within the NUVO framework.

The analysis proceeds by first summarizing the relevant structural and dynamical results from QB3–QB6. We then establish the correspondence between the representational space and quantum state vectors, between projector algebras and observables, and between coherence-gated interactions and measurement processes. Finally, we show how the frequency law derived in QB6 reproduces the standard quantum-mechanical prediction for measurement outcomes.

This work introduces no new dynamical assumptions and does not modify the framework developed in QB3–QB6. Its purpose is to make explicit the connection between that framework and the standard formalism of quantum theory.

2 Summary of Structural and Dynamical Results

We summarize the structural and dynamical results established in QB3–QB6 that will be used to define the correspondence with the quantum measurement framework. No new results are introduced in this section.

2.1 State Representation

In QB3, the state of a system was represented by a unit vector

$$\Psi \in \mathcal{V}_H^{\mathrm{fin}},$$

where $\mathcal{V}_H^{\mathrm{fin}}$ is a finite-dimensional complex inner product space associated with a fixed closure configuration. The inner product

$$\langle \cdot, \cdot \rangle_H$$

encodes coherence relations between admissible configurations.

2.2 Event Structure

In QB4, interaction events were identified with projectors

$$P \in \mathsf{P}(\mathcal{V}_H^{\mathrm{fin}}),$$

forming a complete and mutually exclusive event algebra. Orthogonal projectors represent mutually exclusive event channels, and any orthogonal decomposition

$$\sum_\alpha P_\alpha = I$$

provides a complete classification of admissible interaction outcomes.

2.3 Structural Weight Assignment

In QB5, it was shown that any assignment

$$\mu : \mathsf{P}(\mathcal{V}_H^{\text{fin}}) \to [0, 1]$$

satisfying normalization, additivity over orthogonal projectors, and noncontextuality must take the form

$$\mu(P) = \mathrm{Tr}(\rho P),$$

for a unique positive operator ρ with unit trace. In the pure-state case, this reduces to

$$\mu(P_\Phi) = |\langle \Phi, \Psi \rangle_H|^2.$$

2.4 Deterministic Transport and Interaction

In QB6, states were taken to evolve deterministically along worldlines,

$$\Psi : \tau \mapsto \Psi(\tau),$$

with normalization preserved. Interaction events were defined as discrete occurrences along the worldline, determined by coherence-gating conditions derived from the transport geometry.

2.5 Frequency Realization

QB6 further established that the asymptotic relative frequency of interaction events associated with a projector P is given by

$$\lim_{T\to\infty} \frac{N_P(T)}{N_{\text{tot}}(T)} = \mathrm{Tr}(\rho P),$$

under admissible transport regimes. Thus, the quadratic form identified in QB5 is realized as the deterministic frequency law of interaction events.

Origin in scalar-modulated closure structure. All structures summarized above ultimately arise from the scalar-modulated return condition established in Q2 [5],

$$k \oint_\gamma \lambda_{\text{eff}}(x, u)\, ds = L_\gamma.$$

This condition determines the admissible closure-compatible configurations and thereby fixes the representational space, projector algebra, and coherence structure used throughout QB3–QB7. The correspondence with quantum mechanics therefore rests on structures derived from closure geometry rather than independently introduced formal elements.

2.6 Summary

The framework developed in QB3–QB6 provides:

- a finite-dimensional state space with inner product structure,
- a projector-based event algebra,
- a unique quadratic assignment of weights on this algebra,

- and a deterministic interaction dynamics in which these weights are realized as event frequencies.

These elements form the basis for the correspondence with the quantum measurement formalism developed in the following sections.

3 Identification of States

We now establish the correspondence between the state representation developed in QB3 and the notion of state vectors in the standard quantum-mechanical formalism.

This identification is representational: the vector Ψ encodes closure-based coherence structure rather than introducing an independent probabilistic state object.

3.1 Represented States

In QB3, the state of a system was represented by a unit vector

$$\Psi \in \mathcal{V}_H^{\mathrm{fin}},$$

where $\mathcal{V}_H^{\mathrm{fin}}$ is a finite-dimensional complex inner product space. The normalization condition

$$\langle \Psi, \Psi \rangle_H = 1$$

is preserved under deterministic transport.

The vector Ψ encodes the coherence structure of admissible configurations associated with a fixed closure configuration. It is not introduced as a probabilistic object, but as a deterministic representation of the system state.

3.2 Correspondence with Quantum State Vectors

In the standard quantum-mechanical formalism, the state of a system is represented by a unit vector in a Hilbert space. The correspondence is therefore given by the identification

$$\Psi \in \mathcal{V}_H^{\mathrm{fin}} \quad \longleftrightarrow \quad \text{quantum state vector.}$$

The inner product $\langle \cdot, \cdot \rangle_H$ plays the role of the Hilbert space inner product, and the normalization condition coincides with the standard normalization of quantum states.

3.3 Phase Equivalence

As in the standard formalism, the physical content of the state is invariant under multiplication by a global phase. That is, the vectors Ψ and $e^{i\theta}\Psi$ represent the same physical state, since they yield identical coherence contents

$$\langle \Psi, P\Psi \rangle_H = \langle e^{i\theta}\Psi, P(e^{i\theta}\Psi) \rangle_H$$

for all projectors P.

Thus, physical states correspond to equivalence classes of vectors under global phase transformations.

3.4 Deterministic Interpretation

Within the NUVO framework, the state vector Ψ represents a deterministic configuration evolving along a worldline, as described in QB6. The evolution

$$\Psi(\tau)$$

is determined by the transport geometry and does not involve stochastic elements.

This differs from the conventional interpretation in which the state vector is often associated with probabilistic descriptions. In the present framework, all statistical features arise from interaction structure rather than from the state itself.

3.5 Summary

We identify the representational space $\mathcal{V}_H^{\mathrm{fin}}$ with the Hilbert space of quantum mechanics, and the transported state $\Psi(\tau)$ with a quantum state vector evolving deterministically. The state carries coherence information that determines the distribution of interaction events, rather than encoding probabilities directly.

4 Identification of Observables

We now establish the correspondence between the projector-based event structure developed in QB4 and the notion of observables in the quantum-mechanical formalism.

4.1 Projector Algebra as Event Structure

In QB4, interaction events were identified with projectors

$$P \in \mathsf{P}(\mathcal{V}_H^{\mathrm{fin}}),$$

forming a complete and mutually exclusive event algebra. Orthogonal projectors represent mutually exclusive event channels, and any orthogonal decomposition

$$\sum_\alpha P_\alpha = I$$

provides a complete classification of admissible interaction outcomes.

Each projector P therefore corresponds to a distinct event channel, determined by the subspace of closure-compatible configurations associated with P.

4.2 Observables as Projector-Valued Structures

In the standard quantum-mechanical formalism, an observable is represented by a self-adjoint operator A admitting a spectral decomposition of the form [6]

$$A = \sum_\alpha a_\alpha P_\alpha,$$

where $\{P_\alpha\}$ is a collection of orthogonal projectors and $\{a_\alpha\}$ are real eigenvalues.

Within the present framework, such a decomposition corresponds directly to a collection of projector-defined event channels, each associated with a possible outcome value a_α.

4.3 Correspondence

We therefore identify:

- projector $P_\alpha \longleftrightarrow$ measurement outcome channel,
- spectral decomposition $\sum_\alpha a_\alpha P_\alpha \longleftrightarrow$ observable with outcomes $\{a_\alpha\}$.

Under this identification, the structure of observables is entirely determined by the projector algebra already present in the NUVO framework.

4.4 Outcome Structure

An interaction event corresponds to the realization of one projector channel P_α within a given decomposition. The associated value a_α is interpreted as the outcome of the observable A.

Thus, the outcome structure of an observable is not introduced independently, but arises from the classification of interaction events provided by the projector algebra.

4.5 Interpretive Boundary

We emphasize that the observable A is not taken as a fundamental dynamical object in the present framework. Rather, it is a derived construct that encodes the labeling of projector-defined event channels by real values.

All physically relevant structure is contained in the projectors themselves and the interaction dynamics that determine which channel is realized.

4.6 Summary

We identify the projector algebra $\mathsf{P}(\mathcal{V}_H^{\mathrm{fin}})$ with the event structure underlying quantum observables, and the spectral decomposition of operators with the classification of interaction outcomes into projector-defined channels. This provides a direct correspondence between the event structure of the NUVO framework and the observable structure of quantum mechanics.

5 Interaction as Measurement

We now establish the correspondence between coherence-gated interaction events in the NUVO framework and the notion of measurement in the quantum-mechanical formalism.

5.1 Interaction Events

In QB6, interaction events were defined as discrete occurrences along a worldline at which coherence admissibility conditions are satisfied. These events arise from the interaction between a transported state $\Psi(\tau)$ and the ambient closure structure, and are determined entirely by the transport geometry and coherence properties of the system.

Each such event is associated with a unique projector

$$P \in \mathsf{P}(\mathcal{V}_H^{\mathrm{fin}}),$$

corresponding to a specific event channel, as established in QB4.

5.2 Measurement as Interaction

In the standard quantum-mechanical formalism, a measurement is associated with the realization of one outcome among a set of possibilities defined by a projector-valued decomposition. In the present framework, this structure arises directly from the classification of interaction events.

We therefore identify:

$$\text{measurement event} \quad \longleftrightarrow \quad \begin{array}{l}\text{coherence-gated interaction event within a specified} \\ \text{interaction context defined by the chosen projector decomposition.}\end{array}$$

Under this identification, the occurrence of a measurement corresponds to the realization of a specific projector channel through interaction.

5.3 Outcome Realization

Given an observable represented by a spectral decomposition

$$A = \sum_{\alpha} a_\alpha P_\alpha,$$

an interaction event determines a unique projector P_α, and hence a unique outcome value a_α.

Thus, the outcome of a measurement is identified with the projector channel realized at the interaction event.

5.4 Absence of Collapse Postulate

No additional postulate is introduced to describe the selection of an outcome. The realization of a particular projector channel is determined by the coherence-gated interaction structure and the deterministic evolution of the transported state.

The framework does not require the introduction of a collapse mechanism [6, 7]. Instead, outcome realization is identified with the occurrence of a specific interaction event within the deterministic evolution.

5.5 Event Sequence and Repeated Measurements

Repeated measurements correspond to sequences of interaction events along the worldline. The distribution of outcomes in such sequences is determined by the frequency law established in QB6.

Each event is treated as a distinct interaction, with its associated projector channel determined by the coherence structure at the time of interaction.

5.6 Interpretive Boundary

We emphasize that the present identification does not alter the operational structure of quantum measurement. It provides a representation of measurement processes in terms of coherence-gated interactions, without modifying the formal rules governing observables and outcomes.

The role of measurement is thus understood as the occurrence of interaction events within a deterministic dynamical framework, rather than as an independent postulate.

5.7 Summary

Measurement processes in the quantum-mechanical formalism are identified with coherence-gated interaction events in the NUVO framework. The realization of an outcome corresponds to the selection of a projector channel at the point of interaction, determined by the coherence structure of the transported state.

6 Emergence of the Born Rule

We now establish the correspondence between the frequency law derived in QB6 and the Born rule [8] in the quantum-mechanical formalism.

6.1 Frequency Law from QB6

In QB6, it was shown that, for a transported state $\Psi(\tau)$ and a projector $P \in \mathsf{P}(\mathcal{V}_H^{\text{fin}})$, the asymptotic relative frequency of interaction events satisfies

$$\lim_{T\to\infty} \frac{N_P(T)}{N_{\text{tot}}(T)} = \text{Tr}(\rho P),$$

under admissible transport regimes, where ρ is the operator uniquely determined by the structural conditions of QB5.

In the pure-state case $\rho = |\Psi\rangle \langle\Psi|$, this reduces to

$$\lim_{T\to\infty} \frac{N_{P_\Phi}(T)}{N_{\text{tot}}(T)} = |\langle\Phi, \Psi\rangle_H|^2.$$

6.2 Correspondence with the Born Rule

In the standard quantum-mechanical formalism, the Born rule assigns to each projector P the probability

$$\mathbb{P}(P) = \text{Tr}(\rho P),$$

and, for pure states,

$$\mathbb{P}(P_\Phi) = |\langle\Phi, \Psi\rangle|^2.$$

Comparing these expressions with the frequency law obtained in QB6, we identify

$$\mathbb{P}(P) \quad \longleftrightarrow \quad \lim_{T\to\infty} \frac{N_P(T)}{N_{\text{tot}}(T)}.$$

Thus, the Born rule corresponds to the asymptotic frequency of coherence-gated interaction events in the NUVO framework.

6.3 Interpretive Clarification

Within this correspondence, the quantities $\mathbb{P}(P)$ are not introduced as fundamental probabilities, but as the limiting frequencies of deterministic interaction events. The quadratic form arises from the coherence structure of the transported state and the projector algebra, as established in QB5 and QB6.

The identification therefore provides a representation of the Born rule in terms of event frequencies, without modifying its formal role within the quantum-mechanical framework.

6.4 Summary

The Born rule is identified with the asymptotic frequency law of coherence-gated interaction events. This establishes a direct correspondence between the statistical predictions of quantum mechanics and the deterministic interaction dynamics of the NUVO framework.

7 Interpretation of Probability

We now clarify the interpretation of probability within the correspondence established in the preceding sections.

7.1 Probability as Frequency

From Section 6, the quantity assigned by the Born rule,

$$\mathbb{P}(P) = \mathrm{Tr}(\rho P),$$

is identified with the asymptotic relative frequency of interaction events,

$$\mathbb{P}(P) \quad \longleftrightarrow \quad \lim_{T\to\infty} \frac{N_P(T)}{N_{\mathrm{tot}}(T)}.$$

Thus, within the present framework, probability is represented by the limiting frequency of coherence-gated interaction events along a worldline.

7.2 Deterministic Origin

The underlying evolution of the transported state $\Psi(\tau)$ is deterministic, and the occurrence of interaction events is governed by coherence-gating conditions derived from the transport geometry. No stochastic elements are introduced at the level of state evolution or event generation [9].

The statistical structure arises only at the level of event counting, through the distribution of interaction events across projector-defined channels. This distribution is determined by the coherence content of the transported state, as established in QB6.

7.3 Operational Role

Within the quantum-mechanical formalism, probabilities are used to predict the distribution of outcomes in repeated measurements. Under the correspondence established here, these predictions are identified with the asymptotic distribution of interaction events generated by deterministic dynamics.

Thus, the operational role of probability is preserved, while its interpretation is given in terms of event frequencies rather than fundamental randomness.

7.4 Interpretive Boundary

The present framework does not require the introduction of intrinsic randomness or probabilistic state descriptions. At the same time, it does not modify the formal use of probabilities within quantum mechanics. The Born rule continues to provide correct predictions for measurement outcomes, now understood as frequency limits of interaction events.

7.5 Summary

Probability is identified with the asymptotic frequency of coherence-gated interaction events. This interpretation arises from the deterministic structure of the NUVO framework and provides a consistent account of the statistical predictions of quantum mechanics.

8 Correspondence with Quantum Formalism

We now summarize the correspondence between the structures developed in QB3–QB6 and the standard elements of the quantum-mechanical formalism.

8.1 Structural Correspondence

The results established in the preceding sections define a direct mapping between the NUVO framework and the formal structure of quantum mechanics:

NUVO Framework	**Quantum Formalism**
$\Psi \in \mathcal{V}_H^{\mathrm{fin}}$	state vector in Hilbert space
projector P	measurement projector
projector decomposition $\{P_\alpha\}$	measurement outcome set
coherence content $\langle \Psi, P\Psi \rangle_H$	Born weighting (amplitude squared)
interaction event	measurement event
event frequency $\dfrac{N_P}{N_{\mathrm{tot}}}$	probability $\mathbb{P}(P)$

Each element of the quantum-mechanical formalism is thus identified with a corresponding structure arising from coherence geometry and interaction dynamics.

8.2 Operator Representation

Observables in quantum mechanics are represented by self-adjoint operators with spectral decompositions

$$A = \sum_\alpha a_\alpha P_\alpha.$$

Within the present framework, this corresponds to assigning numerical values a_α to projector-defined event channels. The operator A serves as a compact representation of the outcome structure associated with a given set of interaction channels.

8.3 Measurement Structure

Measurement processes correspond to coherence-gated interaction events. Each such event realizes a unique projector P_α, and the associated value a_α is identified as the measurement outcome.

Repeated measurements correspond to sequences of interaction events, whose distribution is determined by the frequency law established in QB6.

8.4 Statistical Correspondence

The Born rule,

$$\mathbb{P}(P) = \mathrm{Tr}(\rho P),$$

is identified with the asymptotic frequency of interaction events,

$$\mathbb{P}(P) \quad \longleftrightarrow \quad \lim_{T\to\infty} \frac{N_P(T)}{N_{\mathrm{tot}}(T)}.$$

Thus, the statistical predictions of quantum mechanics are reproduced by the deterministic interaction dynamics of the NUVO framework.

8.5 Summary

The correspondence established above shows that the formal structure of quantum mechanics can be represented within the NUVO framework through coherence geometry, projector-based event classification, and deterministic interaction dynamics. No modification of the standard formalism is required; rather, the formal elements are given a structural and dynamical interpretation.

9 Structural Clarifications Underlying the Correspondence

The correspondence established in the preceding sections identifies the structures of the transport-closure framework with the formal elements of quantum mechanics. In particular, transported states correspond to vectors in a complex representational space, interaction events correspond to projectors, and the asymptotic frequency law derived in QB6 reproduces the quadratic weighting rule.

To ensure that this correspondence is interpreted correctly, we record two structural clarifications that underlie the mapping: (i) the ontological status of measurement events, and (ii) the role of phase normalization in the emergence of the complex representation.

These clarifications do not introduce new assumptions. They make explicit the structural interpretation already implicit in the transport-closure framework.

9.1 Measurement as Coherence-Gated Interaction

Within the scalar–conformal NUVO framework, interaction events are not primitive or observer-defined objects. They arise as structural features of exchange transport.

As established in Q8 [10], a bundled structure transported along a continuous worldline does not interact continuously with the surrounding exchange sector. Instead, interaction is governed by holonomic coherence conditions involving the compatibility of the transported closure structure with the ambient scalar geometry. Interaction occurs only at spacetime points where this compatibility is satisfied.

Accordingly, a measurement event is identified with a coherence-gated interaction between a transported bundled structure and an external system. These events occur at discrete points along an otherwise continuous trajectory and are the same events counted in the deterministic frequency law of QB6.

The discreteness of these events does not arise from stochastic assumptions or external measurement postulates. It follows from the structure of coherence itself. In general, transport through the scalar–conformal geometry introduces mismatch between the local closure state of the bundle and the ambient scalar configuration. Coherence can therefore only be restored within a finite geometric tolerance.

This finite tolerance imposes a minimal interaction resolution: coherence conditions are satisfied only at isolated points along the worldline. The resulting interaction structure is therefore intrinsically discrete, even though the underlying transport is continuous.

In this way, the event structure required for the formulation of measurement is derived entirely from deterministic transport and coherence conditions, without the introduction of probabilistic or observer-dependent assumptions.

9.2 Phase Normalization and Representation Scale

The phase variable introduced in Q10 [11] arises as a cumulative geometric quantity associated with transport of closure structures. This phase is not assumed to be periodic and is governed by a system-dependent coherence scale determined by closure compatibility conditions.

We denote this intrinsic scale by Φ_c. It characterizes the total phase accumulation required for closure of an admissible transport cycle and depends on the underlying exchange geometry of the system.

In constructing a complex representation of the transport system [12], it is convenient to introduce a normalized phase variable. This is achieved by selecting a reference scale Φ_0 and defining a dimensionless phase

$$\theta = \frac{\phi}{\Phi_0}.$$

The choice of Φ_0 is representational and does not introduce new physical structure. However, when Φ_0 is identified with the intrinsic coherence scale Φ_c, the normalized phase variable becomes periodic with period 2π. In this representation, the complex encoding of the transport state acquires the familiar form used in quantum mechanics.

It is important to emphasize that this 2π periodicity is not a fundamental property of the underlying transport system. It arises only at the level of representation, as a consequence of normalizing the phase by the coherence scale of the system.

The underlying phase accumulation remains a geometric quantity determined by transport and closure structure, and need not exhibit universal periodicity across different systems. The appearance of a universal 2π phase is therefore a feature of the chosen encoding, rather than a primitive element of the physical framework.

9.3 Continuous Transport and Discrete Interaction Structure

The preceding clarifications may be summarized in a unified structural picture.

Transport of closure structures through scalar–conformal NUVO space is continuous and governed by admissible worldline evolution. Along such trajectories, phase accumulates as a geometric measure of transport and exchange interaction.

Interaction events, however, occur only at discrete points determined by coherence conditions. These events correspond to the restoration of compatibility between the transported closure state and the ambient scalar geometry, subject to the finite tolerance imposed by geometric mismatch.

The resulting structure consists of continuous transport punctuated by discrete interaction events. The frequency of these events reflects the underlying phase evolution of the system, and the asymptotic distribution of such events yields the quadratic weighting law derived in QB6.

This structure provides the bridge between deterministic transport dynamics and the statistical framework of quantum measurement, completing the correspondence established in the present work without the introduction of probabilistic postulates or measurement axioms.

10 Scope and Limitations

The correspondence established in the present work is subject to the structural and dynamical conditions developed in QB3–QB6. We summarize here the domain of applicability of the results.

10.1 Finite-Dimensional Setting

The analysis is formulated within a finite-dimensional representational space $\mathcal{V}_H^{\mathrm{fin}}$, as introduced in QB3. The correspondence with the quantum-mechanical formalism is therefore established at this level. Extensions to infinite-dimensional Hilbert spaces are not addressed in the present work.

10.2 Admissible Transport Regimes

The identification of probabilities with event frequencies relies on the existence of well-defined asymptotic limits

$$\lim_{T\to\infty} \frac{N_P(T)}{N_{\mathrm{tot}}(T)}.$$

As discussed in QB6, this requires admissible transport regimes in which the relevant time averages converge. The present work does not establish general conditions for such convergence, but assumes that the systems under consideration exhibit stable long-time behavior.

10.3 Coherence-Preserving Dynamics

The correspondence between coherence content and the quadratic form

$$\mathrm{Tr}(\rho P)$$

is obtained under coherence-preserving or stationary transport conditions. More general time-dependent or strongly non-stationary regimes are not analyzed here.

10.4 Single-System Framework

The formulation is restricted to single transported states within a fixed closure configuration. Extensions to multi-system configurations, entanglement structures, and interacting subsystems require further development beyond the scope of the present work.

10.5 Interpretive Scope

The present framework provides a representation of the quantum-mechanical formalism in terms of deterministic coherence-gated interaction dynamics. It does not modify the operational structure of quantum mechanics, nor does it introduce new predictive elements at this stage.

10.6 Summary

The results of this work apply to finite-dimensional systems with coherence-preserving transport and well-defined asymptotic event frequencies. Within this domain, the correspondence with the quantum measurement framework is established. Extensions beyond this domain remain open for future investigation.

11 Outlook

The correspondence established in this work provides a direct mapping between the deterministic coherence-gated interaction framework of QB3–QB6 and the standard formalism of quantum measurement. Within this mapping, the structural elements of quantum mechanics are identified with components of closure-based dynamics, and the statistical predictions of the Born rule are realized as asymptotic frequencies of interaction events.

The next stage of development is to extend this correspondence beyond the measurement framework to the full dynamical structure of quantum mechanics. In particular, the evolution of transported states $\Psi(\tau)$ must be related to the standard dynamical equations governing quantum systems, including the Schrödinger equation [13] and its generalizations.

Further work is also required to extend the present framework to multi-system configurations, where the structure of entanglement and composite systems can be analyzed within the coherence-based formalism. This includes the development of tensor-product structures and the treatment of interacting subsystems.

In addition, the analysis of non-stationary transport regimes and the role of time-dependent coherence structures remain open areas of investigation. These extensions will be necessary to establish the full scope of applicability of the present framework.

The results obtained in QB6 and QB7 provide a foundation for these developments by establishing the connection between deterministic interaction dynamics and the statistical structure of quantum theory. The subsequent papers in the series will build on this foundation to develop a complete dynamical and operational correspondence with quantum mechanics.

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