Toward a Correspondence Between Collapse-Selection Dynamics and Standard Quantum Formalism

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Abstract

Previous work has developed collapse-selection dynamics as a generative framework capable of producing interference structure, measurement outcomes, statistical behavior, and admissibility structure in minimal systems. However, these constructions were formulated in a language distinct from standard quantum formalism. In this note, we identify structural correspondences between collapse-selection dynamics and key elements of quantum theory, including state description, projection, measurement, and probability. The goal is not to derive or replace quantum mechanics, but to provide a translation between frameworks. We show that standard quantum descriptions admit interpretation as effective representations of collapse-stabilized relational structure, suggesting a pathway for connecting generative collapse models with established physical formalisms.

1 Introduction

Collapse-selection dynamics have been introduced as a generative framework in which physical structure arises through iterative constraint and selection processes. In a series of minimal models, this framework has been shown to reproduce key qualitative features associated with quantum systems, including interference-like behavior, definite measurement outcomes, statistical distributions, and admissibility structure.

Despite these results, the framework has been expressed in a language that differs from standard quantum formalism. Since physical evaluation is typically conducted within established mathematical structures, it is necessary to clarify how collapse-selection dynamics relate to familiar quantum concepts.

The aim of this note is to identify structural correspondences between collapse-selection dynamics and standard quantum description. This paper does not attempt a derivation of quantum mechanics from collapse-selection principles, nor does it propose a replacement for existing theory. Instead, it provides a translation layer between frameworks, showing how standard quantum structures may arise as effective descriptions of collapse-driven dynamics.

2 Minimal Formal Structure of Collapse-Selection Dynamics

We summarize the minimal ingredients of the collapse-selection framework.

Let Σ denote the space of relational configurations. A collapse operator

$$\Phi : \Sigma \to \Sigma \tag{1}$$

acts on configurations through iterative dynamics:

$$x_{n+1} = \Phi(x_n) \tag{2}$$

We define the set of fixed points:

$$\mathrm{Fix}(\Phi) = \{x \in \Sigma \mid \Phi(x) = x\} \tag{3}$$

and the admissible set:

$$\mathcal{A} = \{x \in \Sigma \mid \lim_{n\to\infty} \Phi^n(x) \in \mathrm{Fix}(\Phi)\} \tag{4}$$

A descriptive projection

$$P : \Sigma \to \mathcal{O} \tag{5}$$

maps relational configurations to observable descriptions.

In this framework, generative selection via Φ precedes descriptive projection via P.

3 Correspondence with Quantum Description

Summary of Correspondence

For clarity, we summarize the structural mapping between standard quantum formalism and collapse-selection dynamics:

Standard Quantum Mechanics	**Collapse-Selection Dynamics (QCG)**
State vector / density description	Relational configuration / admissible sector
Projection operator	Collapse operator / fixed-point selection
Eigenstate	Collapse-stable fixed point
Decoherence / coarse-graining	Descriptive reduction after selection
Measurement outcome	Stable fixed-point sector
Probability	Measure over admissible configurations / basins
Effective evolution	Repeated collapse-ordered dynamics

We now identify structural correspondences between collapse-selection dynamics and standard quantum concepts.

3.1 States and Descriptions

In standard quantum mechanics, states are represented by vectors or density operators that encode observable correlations.

In collapse-selection dynamics, relational configurations in Σ represent pre-descriptive structure. Observable states arise after collapse has acted and projection has been applied.

Thus, Hilbert-space descriptions may be interpreted as effective encodings of collapse-stabilized relational configurations. In this sense, the Hilbert-space formalism encodes correlations among collapse-stabilized relational configurations.

3.2 Projection and Collapse

In quantum mechanics, projection operators select outcomes associated with measurement.

In collapse-selection dynamics, the operator Φ drives configurations toward fixed-point sectors. These fixed points correspond to collapse-stable outcomes.

Projection in standard quantum theory corresponds structurally to fixed-point selection under collapse dynamics.

3.3 Measurement

In standard quantum mechanics, measurement is treated as an update of the system's state.

In collapse-selection dynamics, measurement is not a primitive operation. Instead, it corresponds to the descriptive registration of a configuration that has already stabilized under collapse.

Thus, measurement outcomes correspond to fixed-point sectors of the collapse dynamics.

3.4 Probability

In quantum mechanics, probabilities are given by the Born rule.

In collapse-selection dynamics, statistical behavior arises from the distribution of initial configurations across basins of attraction within the admissible set.

Outcome frequencies are determined by measures over these basins, and Born-like scaling may emerge under symmetry and consistency constraints on the ensemble structure.

Thus, probability can be interpreted as arising from the geometry of admissible configurations rather than intrinsic randomness.

3.5 Effective Dynamics

Standard quantum theory describes evolution through linear dynamics combined with measurement updates.

In collapse-selection dynamics, evolution is governed by iterative application of the collapse operator. Standard quantum descriptions may be interpreted as effective representations that encode unresolved relational structure in a compact form.

From this perspective, quantum formalism may correspond to an effective descriptive regime of collapse-selection dynamics rather than to the fundamental generative level.

4 Fixed-Point Regimes and Effective Quantum Structure

The preceding correspondences suggest that familiar quantum structures may arise as effective descriptions of stable sectors of collapse-selection dynamics.

- Fixed points correspond to stable outcome sectors,
- Interference-like structure arises from phase-stable relational configurations,
- Measurement corresponds to selection of collapse-stable configurations,
- Statistical behavior reflects measures over admissible sets.

Taken together, these features indicate that quantum formalism may be interpreted as a descriptive framework for collapse-stabilized relational structure.

5 Scope and Limitations

This correspondence is structural rather than derivational. In particular, this paper does not claim:

- a derivation of Hilbert space or quantum axioms,
- a replacement for standard quantum mechanics,
- a complete dynamical theory,

- experimental validation of collapse-selection dynamics.

Instead, it identifies a consistent mapping between frameworks sufficient to support further formal development.

6 Open Directions

Several directions remain for future work:

- formal representation of the collapse operator in operator-theoretic terms,
- development of density-like descriptions of admissible sectors,
- extension to continuous and field-theoretic systems,
- connections to decoherence and open-system dynamics.

7 Conclusion

Collapse-selection dynamics and standard quantum formalism need not be treated as competing descriptions. Instead, quantum formalism may be interpreted as an effective descriptive language for stable sectors generated by collapse-selection dynamics.

The value of this perspective lies not in replacing established theory, but in providing a coherent generative interpretation beneath it, clarifying how structure, measurement, and probability may arise from collapse-driven processes.