On the Von Neumann Character of Collapse-Selection Ontology

Stephen Garner

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Abstract

In classical computational architecture, the von Neumann model is distinguished by a unification of program and data within a single memory space, allowing instructions to be treated as objects subject to transformation. In this note, we identify a structural correspondence between this architecture and the ontology of Quantum Collapse Geometry (QCG). We argue that collapse-selection dynamics exhibit a "von Neumann character" at the ontological level: the distinction between generative law and configuration is not primitive but emerges from the same admissibility structure. Observable laws correspond to invariant residues of collapse acting on relational configurations, and these invariants may themselves function as effective generators at higher descriptive layers. This perspective clarifies the recursive structure of emergence in QCG and situates physical law as a stabilized, re-entrant feature of the same process that generates observable structure.

1 Introduction

In standard formulations of physics, a sharp distinction is maintained between *state* and *law*. States evolve according to fixed dynamical rules, which are taken as externally specified and ontologically prior. This separation is conceptually analogous to the Harvard architecture in computation, where program instructions and data reside in distinct memory spaces.

By contrast, the von Neumann architecture[1] unifies these domains: instructions and data occupy the same addressable structure, allowing programs to be treated as manipulable objects within the system itself. This unification enables self-modification, recursion, and the emergence of higher-order computational behavior.

The purpose of this note is to identify and formalize an analogous structural feature within Quantum Collapse Geometry (QCG). We argue that QCG exhibits a *von Neumann character* at the ontological level: the structures that function as effective "laws" are not externally imposed but arise as invariant configurations under the same collapse-selection dynamics that govern all relational structure.

2 Collapse-Selection as a Unified Substrate

Let

- Σ denote the relational configuration space,
- $\Phi : \Sigma \to \Sigma$ the collapse-selection operator,
- $P : \Sigma \to \mathcal{O}$ the descriptive projection.

In QCG, collapse is primitive. Observable structure corresponds to configurations that persist under iteration:

$$\text{Fix}(\Phi) = \{x \in \Sigma \mid \Phi(x) = x\}.$$

No separate object corresponding to "law" is introduced at this level. Instead:

- admissibility determines which configurations persist,
- persistence defines observable structure,
- effective dynamics arise only after projection and coarse-graining.

Thus, both "state" and "law" arise from the same relational substrate under the same selection process.

3 The Von Neumann Analogy

In a von Neumann system:

- memory M contains both data and instructions,
- execution interprets elements of M as operations,
- programs may be modified as data within M.

The defining feature is the absence of a primitive separation between instruction and operand. The QCG correspondence may be summarized as:

Computational Structure	**QCG Structure**
Memory M	Relational configuration space Σ
Instructions	Collapse-stable invariant structure
Data	Relational configurations
Execution	Iteration of Φ
Program modification	Cross-layer reconfiguration

Effective "laws" correspond to invariant structures within that persist under , rather than externally specified generative rules.

4 Emergence of Law as Stabilized Structure

Let

$$I = \text{Fix}(\Phi)$$

denote the invariant sector.

Under coarse-graining:

$$\Sigma' \sim I,$$

with induced effective dynamics G_λ.

At this level:

- invariant structures function as effective primitives,
- laws correspond to stability conditions under G_λ,

- higher-level dynamics emerge from the same selection process acting on reduced structure.

This induces a recursive transformation:

$$\text{primitive} \ \rightarrow \ \text{invariant} \ \rightarrow \ \text{effective primitive}.$$

5 Separation of Generation and Description

QCG maintains a structural distinction between:

- **generation**: collapse-selection acting on Σ,
- **description**: effective laws defined on $\mathcal{O}$ or Σ'.

Generation precedes description:

$$\Sigma \xrightarrow{\Phi} \mathrm{Fix}(\Phi) \xrightarrow{P} \mathcal{O}.$$

The von Neumann character lies in the shared substrate, not equivalence of roles.

6 Implications

6.1 Law as Emergent

Physical laws arise as invariant residues of collapse-selection.

6.2 Recursive Emergence

Invariant structure becomes generative at higher levels.

6.3 Structural Universality

Selection, persistence, and invariance appear across domains.

6.4 Constraint on Ontologies

Frameworks separating law and state encounter structural limits.

7 Conclusion

The von Neumann architecture unifies program and data within a single structure. An analogous feature appears in QCG: law and state arise from the same relational substrate under collapse-selection.

Invariant structures may be reinterpreted as generative primitives at higher levels, yielding a recursive architecture in which structure both arises from and constrains itself.

This establishes a bridge between computation and physics, at the level of generative architecture rather than formal mechanism.

Positioning Within the QCG Program

This note should be read as a structural bridge within the QCG series, connecting the layered emergence framework of B1, the transport constraints of B14, and the abstraction of invariant families. From B1, invariant structure becomes generative at higher layers. From B14, observable structure depends on admissibility transport. The present work unifies these insights by identifying the von Neumann character of QCG: laws are invariant residues within the same relational substrate. Invariant families provide the correct level of abstraction, completing the shift from operator-centric to structure-centric formulation.

Forward Outlook. This perspective will be extended to domains such as large language models, where collapse-geometry transfer governs learning dynamics, and to ethics, where autonomy and responsibility emerge from admissibility and information transport across descriptive layers.

References

[1] John Von Neumann. “First Draft of a Report on the EDVAC”. In: *IEEE Annals of the History of Computing* 15.4 (1993), pp. 27–75.