



The Genesis of Structure - Can a Synthesis of Group Field Theory and Condensed Matter Theory Provide a Universal Blueprint?

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Among existing paradigms, the framework of dynamical systems is arguably one of the most powerful. Nevertheless, at the level of structure generation, it typically manifests as linear or quasi-linear evolution within a continuous or discrete state space. As a result, it provides a rather unnatural representation for structures exhibiting fractal, hierarchical, or self-similar organization. Moreover, dynamical systems generally presuppose a fixed spatiotemporal background, rather than constructing the spatiotemporal dimensions from the generative process itself. From an ontological standpoint, they lack an account of “structure generation” as a mode of existence.

In contrast, generative grammar offers a distinct perspective: centered on symbolic rewriting rules, it effectively characterizes the hierarchical generation of structure. However, its symbolic alphabet is typically discrete and finite, rendering it cumbersome when applied to the generation of continuous or smooth geometric structures. To extend its applicability to such cases, one must treat sub-continuous geometric configurations as “words” or primitive units, giving rise to frameworks commonly referred to as geometric grammars.

Beyond these established frameworks, the intersection of Group Field Theory (GFT) and condensed matter theory appears to offer a particularly promising avenue. GFT provides a formalism for describing the generation of discrete structures without positing concrete entities as ontological primitives. Instead, it takes abstract algebraic structures—groups—as the

fundamental ontology, and, crucially, it does not presuppose any pre-existing spatiotemporal background.

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Complementarily, condensed matter theory supplies a mechanism for the emergent transition from discrete to continuous spacetime. Through the introduction of condensate states and mean-field approximations, GFT can, in the macroscopic limit, manifest continuous and smooth spacetime geometries.

The combination of abstract ontological commitment (eschewing predefined concrete entities), background independence, and the capacity to model both discrete and continuous structures renders Group Field Theory, in conjunction with condensed matter theory, a compelling candidate for a general framework of structural generation.

Generative Grammar # Physics # Field Theory # Structure

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