De Giuseppe Theorem: Macroscopic and Microscopic Entanglement via Matrioska Layers and Informational Loops

Alex De Giuseppe (Corresponding Author)[1]

[1]Province of Parma, Italy

January 20, 2026

1 Introduction: Matrioska Layers and Their Foundational Role

The present work builds upon a proto-structural formalism recently introduced by Nima, in which physical reality is described through a hierarchy of nested constraint layers known as *matrioskas* [1]. In this context, the matrioska architecture is expressed by the symbolic mapping:

$$(\Delta C) \;\leftrightarrow\; (\Delta M) \;\leftrightarrow\; (\Delta L), \tag{1}$$

which captures essential relations between geometry, material fields, and informational degrees of freedom. Nima's formulation treats these layers as foundational to the structure of spacetime and matter, where each layer imposes constraints that limit the space of admissible configurations and thus shape the emergent dynamics of physical systems [1].

Definition 1.1 (Matrioska Layers)**.** The *matrioska layers* are defined as follows:

- (ΔC) represents the *geometrical configuration layer*: constraints associated with spatial structure, curvature, and the underlying geometry of a system.
- (ΔM) denotes the *material microstate layer*: configuration of mass-energy distributions, coherence of microstates, and physically realized material degrees of freedom.
- (ΔL) represents the *informational correlation layer*: high-level information constraints encoding logical, statistical, or topological relationships linking different parts of a system.

In Nima's framework, these layers are not independent physical entities but rather levels of constraint that collectively define the structural possibilities of a system. A change in one layer necessarily induces corresponding changes in the others, thereby creating a closed network of influences underlying all observable phenomena. Mathematically, this proto-structural hierarchy is minimal yet sufficient to recover familiar physical structures: geometry (through (ΔC)), mass-energy content (via (ΔM)), and informational relationships (encoded in (ΔL)) [1].

From this foundational picture, properties such as gravitational interaction, spacetime curvature, and correlation phenomena can be interpreted as manifestations of constraint interactions across these layers. In particular, the sequence $(\Delta C) \leftrightarrow (\Delta M) \leftrightarrow (\Delta L)$ provides a unified lens through which one can view gravitational coupling constants, geometric responses to mass-energy, and informational linkages between distant degrees of freedom.

1.1 Our Extension: Informational Loops and Macroscopic Entanglement

Building on this proto-structural foundation, we extend the matrioska formalism by introducing an explicit *configuration evaluation function* f, which maps tuples of matrioska states to binary outcomes indicating whether certain nontrivial correlations or informational loops emerge. This extension allows us to formalize, in concrete mathematical terms, phenomena that resemble entanglement and emergent retrocausality across scales.

Our primary innovation is to demonstrate that:

1. Under physically preparable conditions—specifically, when matrioska layers align according to well-defined constraints—informational linkages between systems can manifest without requiring conventional dynamic interactions or energy exchange.

2. These emergent linkages, which we call *informational loops*, can be captured by the condition $f = 1$, signifying a nontrivial correlation structure linking otherwise distinct systems.

3. When such loops satisfy specific geometric and informational constraints, they manifest as effective entanglement-like correlations even at macroscopic scales.

In this sense, the matrioska formalism transcends its role as a descriptive ontology and becomes a predictive framework, where gravitational constants, spacetime geometry, and informational correlations are understood not as isolated phenomena but as different faces of the same constraint-limited reality. Our results suggest that these constraint layers are not only mathematically inevitable—given minimal assumptions about geometry and information—but also physically relevant to a broader class of phenomena than traditionally considered in classical or quantum theories.

References

[1] Nima, M. (2026). *$(\Delta C) \leftrightarrow (\Delta M) \leftrightarrow (\Delta L)$: Cosmology from Chaos Substrate via Matryoshka Filtering and Kakeya Stability.* Zenodo. https://doi.org/10.5281/zenodo.18148819