IPI Letters

ISSN 2976 - 730X
IPI Letters 2025,Vol 3 (2):C6-C7
https://doi.org/10.59973/ipil.201

Received: 2025-05-05
Accepted: 2025-05-23
Published: 2025-05-25

Communication

Gödel Limits and Prime-Lattice Quantum Logic within the Universal Model Framework

Marco Gericke[1,*]

[1] Information Physics Institute, Hamburg, Germany

*Corresponding author: marcogericke54@googlemail.com

Gödel's incompleteness theorems shattered the dream of a fully closed axiomatic world. Any consistent system rich enough for arithmetic harbors true statements it cannot prove and is incapable of demonstrating its own consistency. Quantum theory, formulated on orthomodular (non-Boolean) lattices, appears at first to be immune to these purely mathematical constraints, yet practical quantum-information work confronts analogous boundaries. When a universal quantum computer attempts to decide whether a unitary algorithm halts on its own description, measurement disturbance plays the role of Gödelian self-reference: asking the question perturbs the answer. In delayed-choice or quantum-eraser experiments, path and interference behave like mutually unprovable propositions—the acquisition of one truth renders its complement formally inaccessible. A concise operator form of this impasse can be written as:

$$\hat{O}\,|\psi\rangle = \lambda\,|\psi\rangle \tag{1}$$

where the observable $\hat{O}$ encodes "halts on self," yet any projective read-out collapses $|\psi\rangle$ and destroys the very eigen-relation. Thus, unmeasured quantum truth resembles an undecidable Gödel sentence: real but empirically unreachable without overturning the system's prior axioms.

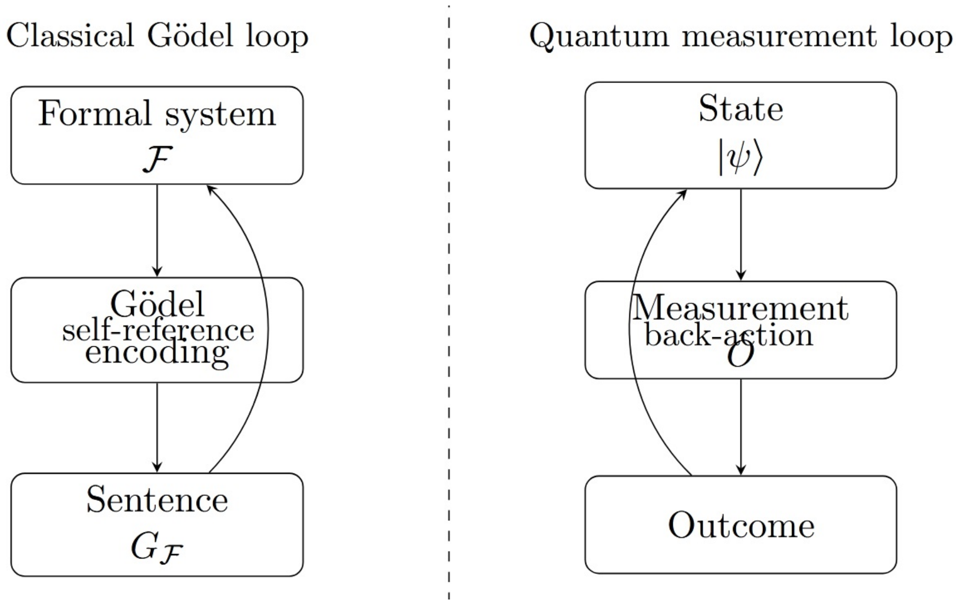

Figure 1: Left: Gödelian self-reference in arithmetic forms a loop of undecidability. Right: quantum measurement creates an analogous loop; observation alters the state, restricting simultaneous truths.

Within the *Universal Model Framework* (UMF) these undecidable regions take geometric form. UMF proposes that reality rests on a prime-indexed Sierpiński lattice whose self-similar recursion supplies both spacetime texture and informational flow. Gödel loops correspond to closed prime cycles on this lattice, while quantum shade regions outline quasi-fractal frontiers where computability and measurability fail together. The framework thus portrays nature as lawful yet inherently open: prime order ensures coherence, but recursive incompleteness keeps discovery endless. Recognizing such structural limits redirects quantum-computing effort toward questions inside, not beyond, our provable domain and re-anchors foundational physics in an arithmetic Logos that is precise, generative, and permanently incomplete.

References

[1] K. Gödel, Monatshefte für Mathematik und Physik 38, 173 (1931).

[2] G. Birkhoff and J. von Neumann, Ann. Math. 37, 823 (1936).

[3] S. Aaronson, "Quantum Gödel Analog," arXiv:1803.10589.

[4] M. Gericke, "Universal Model Framework," IPI Letters 2(3), C3 (2024).