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Letter

Reply to "Discussion on the Faizal-Krauss-Shabir-Marino Argument about the Theory of Everything"

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Abstract. We clarify that we present a non-anthropocentric framework in which nature itself instantiates both algorithmic and non-algorithmic truths. While computable structures such as solutions of the Einstein equations are realized independently of human description, we argue that Gödelian non-algorithmic truths are likewise objectively actualized in physical reality. Although the Lucas-Penrose argument is superficially similar, it concerns the nature of human consciousness, whereas our claim is fundamentally different in scope. We apply this reasoning to the structure of reality itself, independent of human consciousness. Consequently, objections based on the possible inconsistency of human reasoning are not applicable here, since assuming nature itself to be inconsistent is not tenable, as it would collapse the distinction between true and false physical claims.

Keywords: Algorithmic Completeness; Non-Computable Structures; Semantic Truth in Physics; Axiomatizability Limits; Foundations of Physical Law; Mathematical Realism.

We are writing this clarification to ensure that our position on the meta-theory of everything is not misinterpreted as anthropocentric [1,2]. To avoid any possible misunderstanding, we stress that our position is not anthropocentric.

Computational statements, such as concrete solutions to the Einstein field equations in general relativity, are instantiated in nature, and we subsequently discover and identify them. The fact that a particular spacetime metric solves the Einstein equations is not created by our mathematics; it is a structural fact about the world that holds whether or not

any human ever writes it down. Our role is descriptive and diagnostic, not constitutive: we uncover and formalize relations that are already realized in the dynamics of nature. In this sense, syntactic computation is not merely a feature of our representational practices but an intrinsic aspect of reality itself. Physical systems implement law-governed behavior that can be structurally represented by formal computations, irrespective of whether any cognitive agent recognizes or emulates such computations. These syntactic processes operate autonomously within nature's dynamics; human reasoning does not generate them but merely mirrors and encodes abstract computational patterns that are already enacted in the physical world.

In complete analogy, Gödelian statements are actualized in nature as well. These are non-algorithmic truths: facts that cannot be captured by any fixed computational procedure, yet are still objectively valid. Such Gödelian truths are not "mental artifacts" or merely features of formal languages; they are realized in the same underlying reality that realizes algorithmic, computational facts. We may gradually identify and interpret them, but their truth does not wait for our recognition. They belong to the fabric of reality in precisely the way that solutions of the Einstein equations do. Just as syntactic, algorithmic computational processes are an intrinsic feature of nature's law-governed dynamics, so too are semantic, non-algorithmic processes. Nature does not operate solely through mechanically enumerable rules; it also instantiates irreducible semantic relations whose validity transcends any algorithmic computational description within a fixed formal system. These non-algorithmic processes are not imposed by observers but arise from the same physical reality that supports algorithmic computation. In this sense, semantic understanding is not merely an epistemic overlay supplied by human cognition, but reflects an objective, non-computable aspect of reality's structure. Thus, the existence of Gödelian non-algorithmic truths in nature stands in exact analogy to the existence of algorithmic, computable truths.

It is therefore essential to emphasize that our perspective is not human-centric. We are not claiming that non-algorithmic facts arise from human cognition, linguistic choices, or subjective interpretation. Rather, we claim that nature itself instantiates both algorithmic and non-algorithmic structures: spacetime evolves according to Einstein's equations independent of our writing them down, and Gödelian truths are likewise actualized independent of our discovering them. Otherwise, one might mistakenly infer that such a framework privileges human thought, when in fact it is explicitly intended as a non-anthropocentric account of how algorithmic and non-algorithmic truths exist in nature. Our argument rests on Gödel's incompleteness theorems [3], which delimit what any formal system can capture. Lucas [4] and later Penrose [5,6] applied this perspective to human consciousness, arguing for a fundamentally non-algorithmic component in human mathematical understanding. No fixed Turing-computable formal system exhausts the truths accessible to an idealized mathematician, since for any such system there exists a Gödel sentence the mathematician can recognize as true while the system cannot prove it. This has been taken to imply that human thought is not equivalent to any Turing machine [7,8]. Our claim is fundamentally different in scope. It concerns not human understanding of reality, but reality itself, independent of any human observer. In this sense we generalize the Lucas-Penrose idea from mind to world. Reality instantiates Gödelian, non-algorithmic truths that cannot be derived or certified by any single sound, axiomatizable Theory of Everything. Concretely, no purely algorithmic Theory of Everything can be both complete and consistent for all physically meaningful questions. Some non-algorithmic Gödelian truths will be actualized in the physical world, and cannot be captured by any purely algorithmic computation.

A standard family of objections to the Lucas-Penrose argument is based on the assumption that human mathematical reasoning may be inconsistent [9–11]. These objections have been addressed in depth in the subsequent literature [12]. However, both critics and defend-

ers agree that the debate reduces to a clear disjunction: either human mathematical thought is inconsistent, or it involves a genuinely non-algorithmic component. We do not attempt to resolve this disjunction here. The subject of our argument is not human thought but the structure of reality. The relevant disjunction for our purposes is the following: either reality is fully captured by a sound Theory of Everything, in which both algorithmic and non-algorithmic structures are actualized in the physical world, or reality itself is inconsistent. The latter option, that reality is inconsistent in the sense relevant to Gödel's theorem, is not viable. Whatever else one may say about the universe, the empirical success of science presupposes a robust stability of physical facts. While we may model physical systems using inconsistent or approximate theories, the underlying reality those theories aim to describe cannot itself be Gödel-inconsistent without collapsing the distinction between true and false physical claims. Thus, even though it is logically consistent to suppose that human reasoning could be inconsistent, it is untenable to suppose that the structure of physical reality itself is inconsistent.

We now address a comment on our work raised in [13], which suggests that our framework invites an interpretation in which non-algorithmic understanding is functionally consciousness-like, without being identical to human consciousness. We propose the following clarification, closely aligned with that observation. This non-algorithmic understanding, functionally represented in our work [1,2] by Tarski's external truth predicate [14], is definitively not human consciousness. Rather, it is "consciousness-like" only in a structural sense: it exhibits the key feature that motivates the Lucas-Penrose argument, namely the capacity to actualize Gödelian truths that cannot be generated or certified by any fixed formal computational algorithm. In technical terms, it is based on a non-algorithmic notion of semantic validity [14] that no Turing machine can decide [7,8]. A common criticism targets Penrose-Hameroff's specific proposal for realizing non-algorithmic effects in the brain, namely orchestrated objective reduction in microtubules [6,15]. Although early objections [16] have been addressed [17], and supporting evidence from quantum biology has since emerged [18–21], our argument does not depend on the validity of this proposal. We do not attribute a brain or body to the external truth predicate, any more than actualized solutions of the Einstein equations possess such features. Both computational processes that generate algorithmic truths and the external truth predicate that actualizes Gödelian truths are intrinsic features of nature itself. It may be that the human ability to grasp Gödelian truths may be related to the brain being a quantum system [17], and to the fact that both quantum measurement [22] and quantum logic [23] exhibit Gödelian features. We take no position in this debate. Rather, motivated by the "it from bit" perspective, our external truth predicate operates at a level more fundamental than either physical structure ("it") or informational structure ("bit"). Schematically, this hierarchy may be summarized as: external truth-predicate-based semantic layer (consciousness-like) $\longrightarrow$ informational (bit) $\longrightarrow$ physical (it) $\longrightarrow$ human brains and consciousness. In this sense, we agree with the structural comments raised in [13], as well as with the clarifications suggested therein.

Finally, we emphasize that our framework should not be confused with a Wigner-von Neumann-type reading of the Copenhagen interpretation, in which wave-function collapse is tied to conscious observation in the sense of Wigner's reflections on the mind-body problem [24,25]. On the contrary, we explicitly acknowledge that the quantum measurement problem remains open, with multiple competing approaches and interpretations, and we do not base our work on any particular interpretational scheme. Our framework is orthogonal to these debates: it is not an interpretation of quantum mechanics, but a structural claim about the existence of algorithmic and non-algorithmic truths in nature. Accordingly, our use of terms such as non-algorithmic understanding or consciousness-like should not be confused

with human consciousness, as in Wigner-von Neumann-type readings of the Copenhagen interpretation [24,25]; rather, it refers solely to the realization of Gödelian truths that cannot be generated or certified by any fixed computational algorithm.

The last decade has seen an increasing body of work on undecidability in physics. Examples include undecidability in quantum measurements [22], undecidability in quantum logic [23] and the undecidability of the spectral gap in many-body systems [26]. More recently, comprehensive surveys have systematized such undecidable phenomena in physics [27], indicating that incompleteness is not merely a property of abstract mathematical theories but is also reflected in the structure of the physical universe itself.

Data Availability

The manuscript has no associated data or the data will not be deposited.

Conflicts of Interest

The author declares that there is no conflict of interest.

Ethical Considerations

The author has diligently addressed ethical concerns, such as informed consent, plagiarism, data fabrication, misconduct, falsification, double publication, redundancy, submission, and other related matters.

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