Journal of Holography Applications in Physics
Volume 6, Issue 1, Winter 2026, 126–132
©Available online at http://jhap.du.ac.ir
DOI: 10.22128/jhap.2025.3160.1166
Online ISSN: 2783–3518

Letter

Discussion on the Faizal–Krauss–Shabir–Marino Argument about the Theory of Everything

Aatif Kaisar Khan
Department of Physics, University of Florida, Gainesville, FL 32611–8440, USA;
E-mail: sahbran8@gmail.com

Received: November 21, 2025; **Revised:** December 4, 2025; **Accepted:** December 9, 2025

Abstract. In this note, I comment on the article "Consequences of Undecidability in Physics on the Theory of Everything" by Faizal-Krauss-Shabir-Marino (FKSM). I first summarise what I take to be the central claims and contributions of the work, and then highlight why it is, in my view, a genuinely important step in the dialogue between mathematical logic and fundamental physics. I finally suggest a clarification concerning the status of non-algorithmic understanding in their framework, in order to avoid any appearance of human-centrism, and point out that their picture naturally invites an interpretation in which a consciousness-like, non-algorithmic form of understanding operates in a Platonic realm that generates the informational "bit" and, through it, the physical "it".

Keywords: Undecidability; Non-Algorithmic; Simulation.

Contents

1 Summary of the work **128**

2 Important aspects of the proposal **128**

3 Non-algorithmic understanding as intrinsic to nature **129**

4 Consciousness, the Lucas–Penrose argument and a Platonic level **129**

5 Concluding remarks **130**

References **131**

1 Summary of the work

In their article, FKSM start from the now standard view that quantum gravity should not merely describe dynamics on a fixed spacetime background, but should explain the very *emergence* of spacetime itself from deeper degrees of freedom [1]. On this view, a putative theory of everything (TOE) is given by a set of axioms or fundamental rules together with an algorithmic scheme for generating physical predictions. Spacetime, matter fields and the structures we observe in our universe are understood as emergent "outputs" of this axiomatic and computational substrate, in the spirit of Wheeler's slogan "it from bit" [2]. This "it from bit" proposal has now acquired precise modern realizations in both string theory [3,4] and loop quantum gravity [5].

The authors then bring to bear three major results from mathematical logic and algorithmic information theory: Gödel's incompleteness theorems [6], Tarski's undefinability of truth [7], and Chaitin's information-theoretic incompleteness [8]. They argue that, taken together, these results impose intrinsic limits on any programme that seeks to derive all aspects of physical reality from purely algorithmic calculations applied to a fixed set of axioms. In particular, they show that an entirely algorithmic TOE is impossible: there will necessarily be Gödelian truths that follow from the axioms but cannot be captured or certified by any computation within the theory.

Building on this, they introduce the notion of a "Meta-Theory of Everything" (MTOE) that supplements the axioms and their algorithmic consequences with an *external* truth predicate grounded in non-algorithmic understanding. This external truth predicate allows one to recognise Gödelian truths that are actualised in nature but are not reachable by internal derivations. The authors then apply this framework to several conceptual problems in fundamental physics, including singularities and the emergence of spacetime, and finally to the simulation hypothesis. Since any simulation must be algorithmic, a universe that is ultimately grounded in non-algorithmic understanding cannot itself be a simulation.

2 Important aspects of the proposal

The paper is, in my opinion, a genuinely important contribution for at least three reasons.

First, it systematically connects a broad body of undecidability results in physics to the question of what a TOE can be. We now know that undecidability is not an abstract curiosity but appears in concrete physical contexts, such as quantum measurement [9], quantum logic [10], the spectral gap problem in many-body systems [11], and even in renormalisation group flows [12]. Recent reviews have emphasised how widespread such phenomena are in contemporary physics [13]. FKSM place these observations in a unified conceptual framework and draw a sharp conclusion: undecidability is a structural feature of nature, and any TOE must accommodate it.

Second, the authors move beyond the usual "limitations-of-computation" narrative. Gödelian incompleteness, Tarski's theorem and Chaitin's results are not treated merely as obstacles that frustrate an otherwise straightforward computational reduction of physics. Instead, the authors argue that these theorems point positively toward an element that is *missing* from a purely algorithmic picture, namely non-algorithmic understanding encoded in an external truth predicate. This is a bold and productive shift of perspective.

Third, the article forges an explicit conceptual bridge between foundational logic and questions that have motivated physicists for decades, such as the emergence of spacetime, the nature of quantum measurement, and the status of the simulation hypothesis. The conclusion that a simulation of the universe is impossible, not for technological reasons but

for deep logical ones, has already attracted wide attention, but it should be understood as part of a larger claim: reality is built on a type of understanding that no algorithm can exhaust.

3 Non-algorithmic understanding as intrinsic to nature

There is, however, one point where a clarification would greatly strengthen the authors' message and help avoid a possible misunderstanding.

Throughout the paper, non-algorithmic understanding plays a central role. The authors emphasise that Gödelian truths and other undecidable features of physics can be recognised and incorporated only by appealing to an external truth predicate that is *not* generated by the axioms and their internal computational rules [1,14]. In some places, this is discussed in the context of human mathematical insight and the Lucas–Penrose line of argument [15–17].

Without a careful clarification, a reader might conclude that non-algorithmic understanding is primarily a property of *human* cognition, and that the universe is somehow shaped or completed only when human minds enter the story. This would suggest a human-centric universe, which I do not believe reflects the authors' actual intent.

I would therefore encourage the authors to state explicitly that, in their framework, non-algorithmic understanding is *intrinsic to nature itself*. On this view, human minds are local, finite, biological manifestations of a more fundamental capacity for non-algorithmic understanding that is already present at the deepest level of reality. Humans are able to recognise Gödelian truths only because the world already has the kind of structure that makes such truths meaningful.

4 Consciousness, the Lucas–Penrose argument and a Platonic level

The authors already invoke the Lucas–Penrose argument, according to which human mathematical insight cannot be fully captured by any fixed algorithm [15–17]. In their setting, this argument finds a natural home: if undecidable structures are present in physics and a TOE must appeal to a non-algorithmic external truth predicate, then human access to Gödelian truths can be viewed as a local reflection of the same non-algorithmic element that is required to complete the physical description of the universe.

Taken seriously, this perspective suggests that something like *consciousness* or *understanding* operates at a level that is not contained within spacetime, but instead underlies and generates it. The authors' Meta-Theory of Everything already lives in what might reasonably be called a Platonic realm: a realm of axioms, structures, and Gödelian truths that are not situated at any point in spacetime, but from which spacetime and matter fields emerge.

I think the paper would benefit from a careful but explicit statement along these lines:

- The non-algorithmic understanding embodied in the external truth predicate is not identical to human consciousness.
- Rather, it is a consciousness-like understanding that shares a key feature with human consciousness, namely the ability to grasp truths that no formal algorithm can generate.

- Human consciousness is then viewed as a local, limited, embodied manifestation of this more fundamental form of consciousness-like awareness that resides at the Platonic level and plays a role in generating the physical world.

With such a clarification, the authors can avoid any suggestion that they are proposing a human-centric cosmology, while still acknowledging the deep link to the Lucas–Penrose argument and the broader literature on non-algorithmic aspects of mind.

5 Concluding remarks

To summarise, FKSM have written a brave and highly original article that deserves careful attention from both physicists and philosophers. By taking undecidability theorems seriously in the context of quantum gravity, they show that any wholly algorithmic theory of everything is impossible, and that an external truth predicate based on non-algorithmic understanding is needed to account for Gödelian features of the world [1].

My main suggestion is that the authors make fully explicit what is already implicit in their framework: non-algorithmic understanding is not a late addition supplied by human observers, but an intrinsic aspect of reality that operates at a Platonic level and is prior even to the informational "bit". Human consciousness then appears as a localised expression of this deeper principle. Stating this clearly would both dispel human-centric misreadings and sharpen one of the most profound messages of the paper: the ultimate foundation of physics is not computation alone, but a form of understanding that transcends algorithms.

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, including informed consent, plagiarism, data fabrication, misconduct, falsification, double publication, redundancy, submission, and other related matters.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

References

[1] M. Faizal, L. M. Krauss, A. Shabir and F. Marino, "Consequences of Undecidability in Physics on the Theory of Everything," Journal of Holography Applications in Physics **5**(2), 10 (2025). DOI: https://doi.org/10.22128/jhap.2025.1024.1118

[2] J. A. Wheeler, "Information, physics, quantum: the search for links," in Proceedings of the 3rd International Symposium on Foundations of Quantum Mechanics, 309 (1989).

[3] D. Jafferis, A. Zlokapa, J. L. Lykken, D. K. Kolchmeyer, S. I. Davis, N. Lauk, H. Neven and M. Spiropulu, "Traversable wormhole dynamics on a quantum processor," Nature **612**(7938), 51 (2022) DOI: https://doi.org/10.1038/s41586-022-05424-3

[4] M. Van Raamsdonk, "Spacetime from bits," Science **370**(6513), 198 (2020). DOI: https://doi.org/10.1126/science.aay9560

[5] J. Mäkelä, "Wheeler's it from bit proposal in loop quantum gravity," International Journal of Modern Physics D **28**(10), 1950129 (2019). DOI: https://doi.org/10.1142/S0218271819501293

[6] K. Gödel, "Über formal unentscheidbare Sätze der Principia mathematica und verwandter Systeme I," Monatshefte für Mathematik und Physik **38**, 173 (1931). DOI: https://doi.org/10.1007/BF01700692

[7] A. Tarski, "The concept of truth in formalized languages," in Logic, Semantics, Metamathematics: Papers from 1923 to 1938, translated by J. H. Woodger, 2nd ed., edited by J. Corcoran (Hackett Publishing, Indianapolis), 152 (1983).

[8] G. J. Chaitin, "Information-theoretic limitations of formal systems," Journal of the ACM **21**(3), 403 (1974). DOI: https://doi.org/10.1145/321832.321839

[9] J. Eisert, M. P. Müller and C. Gogolin, "Quantum measurement occurrence is undecidable," Phys. Rev. Lett. **108**, 260501 (2012). DOI: https://doi.org/10.1103/PhysRevLett.108.260501

[10] T. Fritz, "Quantum logic is undecidable," preprint (2016), available at https://tobiasfritz.science/2016/quantum_logic.pdf

[11] T. S. Cubitt, D. Pérez-García and M. M. Wolf, "Undecidability of the spectral gap," Nature **528**, 207 (2015) DOI: https://doi.org/10.1038/nature16059.

[12] J. D. Watson, A. Milsted and T. S. Cubitt, "Uncomputably complex renormalization group flows," Nature Communications **13**, 7538 (2022) DOI: https://doi.org/10.1038/s41467-022-35179-4.

[13] A. Perales-Eceiza, B. C. Seradjeh and J. C. Budich, "Undecidability in physics: a review," Physics Reports **1138**, 1 (2025) DOI: https://doi.org/10.1016/j.physrep.2025.06.004.

[14] M. Faizal, L. M. Krauss, A. Shabir, F. Marino, and B. Pourhassan, "Can quantum gravity be both consistent and complete?," International Journal of Modern Physics D, **34**(16), (2025). DOI: https://doi.org/10.1142/s0218271825440171

[15] J. R. Lucas, "Minds, Machines and Gödel," Philosophy **36**(137), 112 (1961). DOI: https://doi.org/10.1017/S0031819100057983

[16] R. Penrose, The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics, Oxford University Press, Oxford, (1989).

[17] R. Penrose, Shadows of the Mind: A Search for the Missing Science of Consciousness, Oxford University Press, Oxford, (1994).