EVERYONE MOVES ON: THE RECURSIVE TRAP AT THE FOUNDATION OF THE META-THEORY OF EVERYTHING

A CRITICAL NOTE ON FAIZAL, KRAUSS, SHABIR, AND MARINO (2025)

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ABSTRACT. Faizal, Krauss, Shabir, and Marino have produced a correct and important result: no purely algorithmic formal system can serve as a complete foundational account of physics. We agree with the diagnosis, agree with the Gödel–Tarski–Chaitin argument, and agree that the universe is not a simulation. We reach the same conclusion independently and by a different route, which we take as evidence that both arguments are pointing at something real. Our concern is narrower and structural. Their proposed resolution—the Meta-Theory of Everything, grounded in non-algorithmic understanding via an external truth predicate and inference mechanism R_{nonalg}—contains an undefined element at its load-bearing center. We show that every attempt to define this element generates a new triple requiring the same definition—a vicious infinite regress with no termination, structurally identical to the foundational gap the framework was designed to escape. This regress is not new. It has appeared across two and a half thousand years of formal thought—from the Pythagoreans through Descartes and Leibniz to Von Neumann and Wittgenstein. Everyone who has stood at this boundary has named the gap and moved on. We do not claim to resolve it here. We claim only that R_{nonalg} is not a resolution—it is the gap, renamed. We describe the shape of what genuine resolution would require, leave the question open, and note that impossibility has not been proved. Only difficulty has.

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"Whereof one cannot speak, thereof one must be silent."
— Wittgenstein, *Tractatus Logico-Philosophicus*, §7

"The nature of to apeiron is eternal and does not age,
and it encompasses all the worlds."
— Anaximander, fragment (DK 12 B3)

1.

The history of physics is partly a history of well-motivated declarations. When nineteenth-century electromagnetism required a medium for propagation, the response was not unreasonable. Something had to be there. Maxwell's equations described waves, and waves require a medium; the equations pointed at a gap, and a name was provided. Luminiferous ether. An undefined substance with precisely those properties the physics required—no more, no less, always conveniently whatever was needed. This was not foolishness. It was the natural move when the shape of a gap is visible but its interior is not. The ether had gravitational pull. Fresnel, Stokes, Lorentz, and Michelson—some of the finest scientific minds of the era—spent careers trying to characterize it, not because they were careless but because the gap was real and the pull was real and the alternative was to stand at the edge of what physics could say and look directly into the silence.[1]

The ether was eventually refuted—not by argument but by experimental evidence that made its central function redundant. It is tempting to conclude that the lesson was learned. It was not. In 1931, over a hundred academics published essays opposing Einstein's theory of relativity on philosophical and ideological grounds.[2] When informed of the book, Einstein's response was precise: "If I were wrong, then one would have been enough." The remark is worth holding. What makes a gap in our understanding dangerous is not the number of people who fill it with a name. It is whether the name is a genuine answer or a placeholder for one. A hundred declarations do not constitute a definition.

Faizal et al. (2025) have done something important and, we think, substantially correct. Working from Gödel's incompleteness theorems (Gödel, 1931), Tarski's undefinability theorem (Tarski, 1936), and Chaitin's information-theoretic incompleteness (Chaitin, 1975), they have proved that the gap at the foundation of physics is not a temporary artifact of incomplete knowledge. It is structural. No finite, consistent,

[1]The history of the ether debate and its experimental refutation is well documented. See (Whittaker, 1951). Our point is not the physics but the structure of the move: a real gap, a named placeholder, careers spent trying to characterize the placeholder rather than examining the gap.

[2]See (Israel et al., 1931). Of the contributors, only one was a physicist; the remainder were philosophers, mathematicians, and critics with ideological objections. Einstein's retort is quoted in (Hawking, 1988), p. 178. The structure of the objection—many names arrayed against a single idea—is precisely what Einstein's response dissolves.

arithmetically expressive formal system can serve as a complete foundational account of physics. Certain truths will always lie beyond algorithmic derivation. The string theory program, the loop quantum gravity program, the Wheeler *it-from-bit* program (Wheeler, 1989)—each, in their analysis, reaches into a gap it cannot fill by algorithmic means. Each, in a precise technical sense, does ether. The ether here is not a luminiferous medium but an algorithmic completeness that the Gödel–Tarski–Chaitin triad demonstrates to be unreachable from within any formal system of the required kind.

We agree. The diagnosis is correct. The argument is airtight, and the conclusion—that the universe cannot be a simulation, since any simulation is itself an algorithmic system and therefore inherits these limits—follows cleanly. We arrive at the same conclusion independently and by a different route, which we take as evidence that both arguments are tracking something real about the structure of the problem rather than artifacts of any particular framework.

Our concern is not with the diagnosis. It is with what happens next.

2.

Before examining Faizal et al.'s construction directly, we need to establish something about the problem they are addressing. The gap at the foundation of formal systems is not a recent discovery. It has appeared, with remarkable consistency, across two and a half thousand years of careful thinking by people who were not careless and were not missing obvious things. Each time it appeared, the person who found it did something with it. The pattern of what they did is the subject of this section. We ask the reader to hold off on the formalism for a few pages and simply watch the shape recur.

The Pythagoreans, in the fifth century BCE, built their cosmology on a structural claim: the nature of everything that exists consists of two fundamental principles in combination. Aristotle reports it directly in the *Metaphysics*: "the Pythagoreans posited the Unlimited (*to apeiron*) and the Limit (*peras*) as the fundamental principles of all things" (*Metaphysics* A.5, 986a) (Aristotle, 1984). The testimony of Philolaus, the Pythagorean whose fragments survive most reliably, confirms it: "the nature of the cosmos and of everything in it consists of unlimiteds and limits" (Philolaus, DK 44 B1) (Kirk et al., 1983). The limit is what gives things form, boundary, knowability. The unlimited is what underlies them, what they are bounded *from*, the unformed substrate that resists complete capture. But the Pythagoreans knew that limit and unlimited alone are not enough to produce the world. Something must bring them together. Plato systematizes this in the *Philebus*, where Socrates divides all existing things into three irreducible kinds: the Unbounded (*apeiron*), the Bound (*peras*), and the Mix (*meikton*)—"all the things that are now in the universe" falling into exactly these three, with the Mix being a genuine third kind, not reducible to the other two (*Philebus* 23c4–26d10) (Plato, 1997). Three. The world requires three. Remove the Mix and you have two principles staring at each other across a gap that produces nothing.

The Pythagoreans and Plato could not tell you what the Mix was at its foundation. They named it, described its effects, and moved on.

Anaximander of Miletus, working a century before Philolaus, had already identified the deepest version of the problem. The regress that every definite thing generates—water requires what water is made of; fire requires what fire is made of; every grounded thing requires a more fundamental ground—cannot be stopped by naming another definite thing, because any definite thing inherits the problem. Anaximander's answer was *to apeiron*: not a substance, but the boundless, generative source from which all determinate things emerge and to which they return. The ancient testimony preserved by Simplicius is precise on this point: the *apeiron* "embraces all things and governs all" (Simplicius, *In Phys.* 24.13, preserving Theophrastus; DK 12 A15) (Kirk et al., 1983). It is not passive. It is not a null background. It is active—the origin of opposites through its own movement, the source from which determinate things arise through separation, the condition to which they return.[3] Anaximander refused to stop the regress by naming another substance. He named the boundary rather than what lies beyond it.

Descartes, two millennia later, divided reality into thinking substance and extended substance — *res cogitans* and *res extensa* — and introduced God as what scholars of his theory call the *tertium quid*: the third thing that bridges the two, guarantees their correspondence, and whose operation at that junction cannot itself be examined without immediately raising the question it was installed to answer.[4]

Leibniz, a generation later, conceived the most ambitious version of the project: a *characteristica universalis* — a symbolic language capable of representing every possible idea with perfect precision — paired with a *calculus ratiocinator* that could operate on those symbols and derive all truths mechanically, the whole enterprise grounded in an encyclopedia of human knowledge encoded in the system. The combination, if achieved, would be a genuine Theory of Everything for thought. But the calculus he actually built required something he could not supply — a definition of what happens when the difference goes to zero. He declared it infinitely small, named the infinitesimal, and moved on.[5]

[3]The active, governing character of *to apeiron* distinguishes Anaximander's move from a simple declaration of ignorance. He is not saying "we don't know what's at the bottom." He is saying the bottom has a specific positive character—generativity, boundlessness, governance—that cannot be captured by naming it as any particular thing. The Internet Encyclopedia of Philosophy classifies Anaximander as "the first metaphysician" for precisely this reason: his inquiry is into the nature of the foundational principle itself, not merely its cosmological products. For the primary fragments and their context, see (Kirk et al., 1983), §§101–117. The phrase "embraces and governs all" is preserved in Simplicius, *In Physica* 24.13, reporting Theophrastus. We return to the significance of this characterization in Section 5.

[4]For the *tertium quid* as the structural third in Descartes' system, see Smith, K. (2025). Descartes on Ideas. In Nolan, L. (ed.), *The Cartesian Mind*. New York: Routledge (Smith, 2025).

[5]Spinoza, contemporary with Leibniz, constructed the same triple by a different route: Substance (what exists in itself and is conceived through itself), Attribute (what the intellect perceives as constituting the essence of substance), and Mode (the modifications of substance). Substance requires no other concept to be conceived — it is the declared bottom, self-grounding by definition. The

The early modern program — the most ambitious attempt in Western intellectual history to derive all truth from formal first principles — had arrived at the same boundary by a different road, and responded with the same move.

Wittgenstein, in 1921, arrived at the same wall from the direction of language and logic. The *Tractatus Logico-Philosophicus* identifies the mandatory triple of any representation: the objects configured, the logical space within which they are situated, and the picturing relation that connects representation to fact (Wittgenstein, 1922). The triple is load-bearing—remove any element and representation collapses. But the triple cannot name itself from within. The logical space cannot describe its own limits from inside those limits. The system cannot say what makes it a system. Wittgenstein's response is the last sentence of the book: "Whereof one cannot speak, thereof one must be silent." This is not a conclusion. It is the wall, named honestly. He stopped. He did not declare a solution. He did not name a new substance at the bottom. He went silent—which, we note, is the most intellectually honest response anyone in this long tradition managed. It is not, however, a resolution. Silence and structure are different things.[6]

Gödel then formalized the wall (Gödel, 1931): any finite, consistent, arithmetically expressive formal system contains true statements it cannot prove, and cannot prove its own consistency. Tarski showed that no such system can define its own truth predicate without generating paradox (Tarski, 1936). Chaitin demonstrated that there is a finite upper bound on the complexity of what any formal system can derive, above which everything is formally inaccessible (Chaitin, 1975). Three independent formalizations of the same wall, each approaching from a different direction, each arriving at the same result.

The reader has now seen the pattern. The Pythagoreans. Plato. Anaximander. Descartes. Leibniz. Wittgenstein. Gödel–Tarski–Chaitin. The same three-element structure. The same undefined thing at the base—the Mix that cannot be reduced, the *apeiron* that cannot be declared, the silence at the end of the *Tractatus*, the unprovable true sentence. Each time, someone brilliant encountered it, named it

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question of what makes a thing self-grounding is not answered. It is the axiom. For Leibniz's three pillars, see (Leibniz, 1989).

[6]Russell, introducing the *Tractatus* in 1922, offered what may be the most backhanded endorsement in the history of philosophy: "As one with a long experience of the difficulties of logic and of the deceptiveness of theories which seem irrefutable, I find myself unable to be sure of the rightness of a theory, merely on the ground that I cannot see any point on which it is wrong." Wittgenstein considered Russell's introduction a misunderstanding of his work. The anecdote is worth holding: even the most careful reader of the *Tractatus* managed to miss what Wittgenstein thought he had said. Silence, it turns out, is easy to misread.

with appropriate seriousness, and moved on.[7] The moving on is not a failure of nerve. It is what you do when you can see the shape of a gap but not its interior structure.

What we are about to show is that Faizal et al., having diagnosed this pattern in every algorithmic framework they examine, have reproduced it in their own solution. This is not a failure of their argument. It is confirmation that the gap is real, the pull is real, and the wall is exactly as hard as they say it is.[8]

3.

Hilbert's foundational program, made fully explicit in the 1920s, named what every formal system since Euclid had quietly assumed (Hilbert, 1928). To generate proofs, a system requires exactly three things: a language in which statements can be formed, a set of axioms from which derivations begin, and inference rules that make derivations valid. These are not three things Hilbert invented. They are three things he named—the minimum structure without which proof is not possible. Language, axioms, rules: remove any one and the system cannot generate a single theorem. This triple is not architecture that formal systems choose. It is what *formal system* means.

When Faizal et al. encode the computational core of quantum gravity as a formal system, they write:

$$F_{\mathrm{QG}} = \left\{ L_{\mathrm{QG}},\ \Sigma_{\mathrm{QG}},\ R_{\mathrm{alg}} \right\}$$

Language. Axioms. Inference rules. It is Hilbert's triple, now bearing the notation of contemporary theoretical physics. This is not a criticism. It could not have been otherwise. The triple is the load-bearing structure of any system capable of generating proofs, and a theory of quantum gravity that generates predictions must generate proofs. Faizal et al. inherited the triple from the entire tradition we traced in Section 2—from Plato's *meikton* to Wittgenstein's picturing relation—without being able to do otherwise, because no one can. The triple is what you get when you try to think formally about anything.

Their diagnosis from here is correct. Gödel's first incompleteness theorem guarantees that F_{QG}, being finite, consistent, and arithmetically expressive, contains true

[7] Peirce spent decades classifying all possible relations — between signs, between concepts, between things — and arrived at a result he considered among the most important in philosophy: triadic relations are irreducible (they cannot be broken down into combinations of simpler two-term relations), and no relation of degree higher than three is genuinely irreducible beyond triads. In other words, three is both the minimum and the sufficient structure for any genuine relation. One thing relating to another is a dyad — symmetrical, reversible, nothing new generated. But the moment a third element enters as a genuine mediating term, something irreducibly new exists that no combination of two-term relations can capture. The pattern documented in this section is, on Peirce's analysis, not coincidence but necessity. See (Peirce, 1931–1958), CP 1.292–1.298.

[8] The pattern established in this section—a triadic structure with an undefined or unresolvable third element—runs from ancient cosmology through modern formal systems without interruption. The reader will find that the argument of Sections 3 and 4 follows directly from recognizing this pattern in Faizal et al.'s construction.

sentences it cannot derive.[9] Tarski's undefinability theorem bars the construction of an internal truth predicate for F_{QG} within F_{QG} itself. Chaitin's bound establishes a finite ceiling on the complexity of what F_{QG} can derive, above which everything is formally inaccessible. Together these results mean that F_{QG} cannot be complete, cannot certify its own soundness, and cannot reach the truths that matter most at the Planck scale. The algorithmic program, as Faizal et al. argue, is not merely incomplete in practice. It is incomplete in principle.

Their response is the Meta-Theory of Everything:

$$\mathrm{MToE} = \left\{L_{\mathrm{QG}} \cup \{T\},\ \Sigma_{\mathrm{QG}} \cup \Sigma_T,\ R_{\mathrm{alg}} \cup R_{\mathrm{nonalg}}\right\}$$

Still a triple. The language is enlarged to include a truth predicate T. The axioms are enlarged with four carefully stated conditions governing T: soundness for F_{QG} (S1), reflective completeness (S2), modus-ponens closure (S3), and trans-algorithmicity (S4).[10] The rules are enlarged with R_{nonalg}. The triple propagates because it must—this is not a choice Faizal et al. made but a consequence of what formal systems are. Plato could not have built a world from two things. Faizal et al. could not have built a meta-theory from two components. The structure is invariant.

Now examine what each component of MToE receives.

$L_{\mathrm{QG}} \cup \{T\}$—the enlarged language. Defined. T is introduced as a truth predicate symbol with specified behavior.

$\Sigma_{\mathrm{QG}} \cup \Sigma_T$—the enlarged axioms. Defined. Conditions S1 through S4 are stated with care and govern the behavior of T explicitly.

$R_{\mathrm{alg}} \cup R_{\mathrm{nonalg}}$—the enlarged rules. Here Faizal et al. write:

> *"a non-effective external truth predicate rule that certifies T-truths."*

Read that again: a non-effective external truth predicate rule that certifies T-truths. That sentence is the entirety of what MToE says about R_{nonalg}. It is not a definition. It is a description of what R_{nonalg} would do—certify T-truths—not of what R_{nonalg} is. The difference between describing a function's output and defining a function is not pedantic. It is the difference between a theory and a placeholder.

Before concluding that R_{nonalg} is simply undefined, we should try harder. A mechanism may be partially specifiable even when its full definition is absent. If we can recover the domain—the set of objects R_{nonalg} operates over—from the existing apparatus, we have made genuine progress toward a definition. The domain is indeed recoverable: R_{nonalg} presumably operates over sentences in $L_{\mathrm{QG}} \cup \{T\}$, the enlarged language, which is defined. We have the inputs. That is something. It is not nothing.

But a function is not its domain. What R_{nonalg} does to sentences in that domain—the actual mechanism of non-algorithmic certification, the procedure by which a sentence is recognized as T-true—is not specified anywhere in MToE. S1 through S4

[9] The formal presentation of Gödel's first incompleteness theorem follows Faizal et al.'s own notation. We adopt it here to make clear that our analysis operates within their framework rather than imposing one from outside.

[10] The four conditions S1–S4 are stated in Faizal et al. (Faizal et al., 2025). We do not contest any of them. Our concern is with the third component of MToE—the rules—not with the axioms governing the truth predicate, which are carefully stated.

describe properties that the outputs of this mechanism must satisfy. They do not describe the mechanism. Knowing that a function must produce outputs with certain properties is not the same as knowing what the function is. The operation remains undefined and, as we will show in the next section, unrecoverable.

This is not a gap Faizal et al. overlooked. It is a gap they could not have filled. R_{nonalg} is the load-bearing element of MToE—the thing that does what F_{QG} cannot, the thing that reaches the truths Gödel and Tarski put beyond formal reach. It is, precisely, the thing that would have to exist outside the system in order to complete it. And the moment you try to define it, you discover why it resists definition. We take up that discovery in Section 4.

What we can say here is this. The component of MToE that was supposed to resolve Wittgenstein's silence—to go beyond the last sentence of the *Tractatus* and say something where he said nothing—is itself silent. Σ_T speaks carefully about T. R_{nonalg} does not speak at all. It is named. It is assigned a role. It is given a domain. It is not defined.

In the long tradition we traced in Section 2, this has a name. Anaximander called it *to apeiron*. Plato called it *meikton*. Wittgenstein called it the limit of language. Von Neumann, as we will see, called it the empty set and declared it into existence by axiom. Faizal et al. call it R_{nonalg}.

4.

What follows is an instance of what David Foster Wallace, in his study of the mathematics of infinity, termed the Vicious Infinite Regress—the VIR (Wallace, 2003).[11] We adopt his term because his characterization is exact: a regress is vicious not merely because it continues indefinitely but because completing it is a precondition for the very thing it was supposed to support. The regress we demonstrate below is precisely vicious in this sense. To define R_{nonalg}, you must first have R_{nonalg}.

We approach what follows not as critics but as collaborators. If a definition of R_{nonalg} exists within or adjacent to the MToE framework, we want to find it. The domain is recoverable, as we established in Section 3. Let us now attempt the operation itself.

R_{nonalg} certifies T-truths. To certify anything systematically, a mechanism requires at minimum three things: a language in which the objects of certification are expressed, principles determining what counts as valid certification, and a procedure

[11]Wallace, D.F. (2003). *Everything and More: A Compact History of ∞*. W.W. Norton & Company, New York, §§2a–2b. Wallace's epistemological example of the VIR—to know that x you must know that you know that x, which requires knowing that you know that you know that x, ad infinitum—is structurally identical to what we demonstrate here: to define R_{nonalg} you must have R_{nonalg}. The logical structure is the same. We are grateful to him for naming it with precision, and he will appear again in these pages. The frequency is deliberate: his characterization of the VIR, his treatment of the concentric circles paradox, and the methodological approach of his philosophical thesis—see Wallace, D.F. (1985/2010). Richard Taylor's 'Fatalism' and the Semantics of Physical Modality. In Cahn, S.M. and Eckert, M. (eds.), *Fate, Time, and Language: An Essay on Free Will*. Columbia University Press, New York—all shaped this paper in ways that seemed to us worth acknowledging openly rather than obscuring.

for performing it. This is not a claim about R_{nonalg} specifically. It is a claim about any mechanism that does anything systematically—the same structural observation we traced from Philolaus through Hilbert. No certifying mechanism can be described with fewer than these three components. The triple is not optional.

One might object that R_{nonalg}, being non-algorithmic, need not have the structure of a formal certifying mechanism. But this objection proves too much. A mechanism with no describable structure is not a non-algorithmic mechanism. It is no mechanism at all. The demand that R_{nonalg} have some structure is not a demand that it be algorithmic. It is a demand that it exist.

Call them L', Σ', and R'. Then:

$$R_{\text{nonalg}} = \{L',\ \Sigma',\ R'\}$$

We have made progress. R_{nonalg} now has internal structure. But look at R'—the inference mechanism of this expanded system, the thing that actually performs the certification that R_{nonalg} was supposed to perform. R' has exactly the same problem R_{nonalg} had. It is the operational core. It requires definition. We try again:

$$R' = \{L'',\ \Sigma'',\ R''\}$$

And R'':

$$R'' = \{L''',\ \Sigma''',\ R'''\}$$

And R''':

$$R''' = \{L'''',\ \Sigma'''',\ R''''\}$$

The page fills. The equation grows. Each honest attempt to define the undefined element at the base produces a new triple with a new undefined element at its base. There is no bottom to find because every proposed bottom has the same structure as the thing above it, requiring the same definition, generating the same expansion.

This is the VIR. It is vicious in Wallace's precise sense: we cannot define R_{nonalg} without first having something that does what R_{nonalg} was supposed to do—and that something requires the same definition, and so on without termination. The regress is not an inconvenience. It is a structural feature of what is being asked for. Faizal et al. require a mechanism that operates outside the algorithmic domain, that certifies truths beyond formal reach, that does what no formal system can do—and they require this mechanism to be definable within or adjacent to a formal system. These requirements are in direct tension. The moment you try to define the mechanism, you have brought it inside the formal domain, which is precisely where Gödel showed such a mechanism cannot live.

It is worth pausing here, because there is an obvious objection. Faizal et al. might respond that R_{nonalg} is intentionally non-constructive—that requiring a definition is itself the wrong demand, that non-algorithmic understanding by its nature resists formal specification. This is a serious point and deserves a serious response.

The response is this. There is a difference between a mechanism that is non-constructive and a mechanism that is undefined. A non-constructive existence proof in mathematics establishes that something exists without providing a procedure for finding it—but it does establish existence, and it does so by argument. What MToE provides for R_{nonalg} is neither a constructive definition nor a non-constructive existence argument. It provides a name and a description of desired outputs. That is not enough. An entity whose existence has not been established, constructively or otherwise, and whose operation has not been characterized, is not a theoretical posit. It is a placeholder. The distinction matters because placeholders do not do theoretical work. They mark where theoretical work needs to be done.[12]

The VIR shows that the theoretical work required here is not merely incomplete. It is self-defeating: every attempt to do it generates a new instance of the same incompleteness. This is not because Faizal et al. were insufficiently careful. It is because they were asking for something that the structure of the problem makes impossible to deliver from within a formal framework. They diagnosed this impossibility in every algorithmic approach to quantum gravity. The diagnosis was correct. The gap at the foundation of any purely formal system cannot be filled from inside that system. What they did not see—and what the VIR makes visible—is that R_{nonalg} is not outside the formal system. It is a formal object, named and assigned properties within MToE, and it therefore inherits exactly the incompleteness it was designed to remedy.

This structure—a mechanism requiring three components with an undefined third—is not something Faizal et al. invented. The page has been filling. Before it fills any further, notice what it has been filling with.

Leibniz wanted to represent every possible idea in a symbolic language—the *characteristica universalis*—operate on those symbols mechanically with a *calculus ratiocinator*, and ground the whole enterprise in an encyclopedia of human knowledge. Written out:

$$[\text{world, understood}] = \left\{\, \textit{characteristica universalis},\ \textit{calculus ratiocinator},\ \textit{encyclopedia} \,\right\}$$

The calculus he built required something he could not supply. He declared it infinitely small, named the infinitesimal, and moved on.

Descartes divided everything into thinking substance and extended substance, with God as the *tertium quid*—the third thing that bridges the two and guarantees their correspondence:

$$[\text{world, bridged}] = \left\{\, \textit{res cogitans},\ \textit{res extensa},\ \textit{tertium quid} \,\right\}$$

The *tertium quid* does not speak from inside the system. It is named. It is assigned a role. It is not defined.

Loop quantum gravity inherits the same structure directly:

$$[\text{spacetime, quantized}] = \left\{\, L_{\text{QG}},\ \Sigma_{\text{QG}},\ R_{\text{alg}} \,\right\}$$

Language. Axioms. Inference rules. Every slot defined. This is the correct setup, and Faizal et al. are right that it is incomplete. Their response is the Meta-Theory

[12] The objection we consider here—that non-algorithmic understanding might legitimately resist formal specification—is the strongest available defense of MToE and deserves explicit engagement rather than dismissal. Our response does not rule out the existence of non-algorithmic understanding. It rules out the claim that R_{nonalg} constitutes a theoretical account of such understanding, as opposed to a placeholder for one.

of Everything:

$$\text{MToE} = \left\{ L_{\text{QG}} \cup \{T\},\ \Sigma_{\text{QG}} \cup \Sigma_T,\ R_{\text{alg}} \cup R_{\text{nonalg}} \right\}$$

Now treat it as algebra. There is no reason not to. These are equations. Solve for R_{nonalg}:

$$R_{\text{nonalg}} = \text{MToE} - \left\{ L_{\text{QG}} \cup \{T\},\ \Sigma_{\text{QG}} \cup \Sigma_T,\ R_{\text{alg}} \right\}$$

R_{nonalg} is MToE minus everything that has been defined. It is not a component of the theory. It is the theory minus its components. It is what remains when you subtract everything specifiable from the whole. This is not our characterization of R_{nonalg}. This is Faizal et al.'s own equation, solved for the unknown.

Compare this to everyone else in the parade. Descartes' *tertium quid* was undefined but described—it guaranteed correspondence between thinking and extended substance, it was God, it had a location and a function and a theological argument behind it. Leibniz's encyclopedia was incomplete but real—it was a project, a thing that could in principle be built, something whose shape was known even if its completion was not. Wittgenstein, in 1921, gave the general form of every proposition:

$$[\text{world, depicted}] = \left[\, p,\ \xi,\ N(\xi) \,\right]$$

The picturing relation—$N(\xi)$—is the third component. It cannot be said. But Wittgenstein knew exactly what it was doing and why it could not be said. He wrote an entire book explaining the structure of the thing that could not be explained. The slot was not empty. It was silent for a reason he articulated with complete precision.

But look at what Wittgenstein left visible before the silence.

In §§2.011–2.013 of the *Tractatus*, he describes the structure of the *object*—the simple thing that elementary propositions are about. Every object, he writes, has three inseparable properties. First, constituency: the object is essentially a possible constituent of atomic facts—it cannot be thought without the possibility of factual participation. Second, connexion: every possible combination the object can enter into is already fully determined within the object itself—nothing external can add to it. Third, space: the object cannot be thought without the space of possible atomic facts it inhabits—you can think that space empty, but you cannot think the object outside it. Three:

$$[\text{object}] = \left\{ \textit{constituency},\ \textit{connexion},\ \textit{space} \right\}$$

This is not the representation triple. This is underneath it. The objects that populate p already contain, within themselves, the three-element structure that makes them elements of any possible fact at all. Wittgenstein was not at one level of the wall. He was three levels down—describing the structure of the bricks the wall is made of. And at the bottom of the object's triple, in §2.013, is *the space*: the thing that cannot be removed and cannot be thought away. You can think it empty. You cannot think the object outside it.

To apeiron. Two and a half thousand years later. In the notation of formal logic. By a man who then went silent and never said why.

Every other figure in this tradition—including a Greek philosopher who did not have the number zero—left more in the third slot than MToE contains. R_{nonalg} is defined entirely by subtraction. We note this not to embarrass but to be precise. The algebra is theirs. We have only solved it.

It is worth pausing on what the word *forced* means here. The regress is not an inconvenience that a more careful construction might avoid. It is not a gap that additional axioms might close. It is what the structure of the problem produces when you look at it honestly—when you follow the notation where it actually leads rather than where you need it to go.

5.

The VIR does not terminate because every proposed bottom has the same structure as the thing above it.[13] This is not a new observation. It is one of the oldest observations in the history of formal thought—and the history of how people have responded to it is instructive, because there are only two responses available, and one of them has never been fully executed as a mathematical program.

The first response is declaration. You stop the regress by asserting that something exists at the bottom and prohibiting further inquiry into what that something is made of. This is what John von Neumann did when he built the natural numbers out of nothing.

Von Neumann's construction is one of the most elegant in mathematics (Von Neumann, 1923). Every natural number is a set containing all the natural numbers that came before it. Zero contains nothing. One contains zero. Two contains zero and one. Three contains zero, one, and two. Written out:

$$
\begin{aligned}
0 &= \emptyset \\
1 &= \{0\} = \{\emptyset\} \\
2 &= \{0, 1\} = \{\emptyset, \{\emptyset\}\} \\
3 &= \{0, 1, 2\} = \{\emptyset, \{\emptyset\}, \{\emptyset, \{\emptyset\}\}\}
\end{aligned}
$$

The construction works. It is genuinely beautiful. Every number is made only of structure—only of sets and the membership relation between them—with no prior assumptions about what numbers are or what arithmetic means. From nothing, everything. The whole tower of natural numbers unfolds from a single declared object at the base.

That object is $\emptyset$: the empty set.

Here is the child's question. Look at the construction. One is $\{\emptyset\}$—brackets containing the empty set. Two is $\{\emptyset, \{\emptyset\}\}$—brackets containing two things in brackets. Three is brackets containing three things in brackets. Every number, without exception, is brackets. The entire edifice is brackets all the way down.

Except zero.

Zero is $\emptyset$. Not $\{\}$. The symbol $\emptyset$ is a name—a placeholder, a bookkeeper's mark—for the concept of a set with no members. But look at what a set with no members actually is when you try to write it: $\{\}$. Brackets. Empty brackets are still brackets.

[13]For the VIR as a formal argumentative tool and its historical roots in Zeno's paradoxes, see (Wallace, 2003), §§2a–2b.

Brackets are a set. A set containing nothing but the fact of its own existence as a set is a set that contains itself. And a set that contains itself violates the axiom of foundation—the axiom ZFC introduced specifically to prevent this. Von Neumann could not write $\{\}$ in his own system. His own rules prohibited it. So he wrote $\emptyset$ instead—the word "nothing" in place of the thing itself—declared it the empty set, and kept going.

The child's question is this: where are the brackets? Try asking it. Find a working mathematician and ask, with genuine curiosity, why the empty set has no brackets when every other set in the construction does. Ask it the way a four-year-old asks why—simply, directly, without embarrassment. Then ask why that is not considered an open emergency in foundations. You will receive one of three responses—a technically sophisticated answer that does not address the question, a change of subject, or a look that suggests you have misunderstood something too basic to explain. What you will not receive is a direct answer to the child's question. Because there isn't one.

Not derived. Not constructed. Declared. The regress stops here because the axiom says so. This is the same regress Zeno identified two millennia before Von Neumann—the one that formal thought has always stepped around rather than through.[14]

Von Neumann looked at the naked singularity at the bottom of mathematics and declared it clothed—an axiom, a robe that works, a foundation the kingdom stands on without anyone asking what the foundation stands on. He seems to have thought this an honest version of the move. Faizal et al. have looked at the same singularity, proved its nakedness more carefully than anyone before them, and then—having seen it—declared it clothed by a different robe entirely: one that cannot be examined, cannot be found, and certifies truths from a position no one can locate.

ZFC then manages the self-reference this creates with the axiom of foundation: no set may contain itself, no infinite descending chains of membership are permitted. This keeps the hierarchy well-founded and the mathematics coherent. It also, quietly, prohibits exactly the self-referential structure that makes Gödel's diagonal argument work—the argument that Faizal et al. use as their primary proof weapon. The formal system whose incompleteness grounds the entire MToE project is built on a foundation specifically designed to prohibit the structure that makes incompleteness visible.[15]

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[14] There is a tradition in set theory that takes the child's question seriously. Non-well-founded set theory, developed rigorously by Peter Aczel (Aczel, 1988), removes the axiom of foundation and permits sets to contain themselves—including, in particular, a set $\Omega = \{\Omega\}$ that is its own sole member. This is not a curiosity. It is the honest response to what $\emptyset$ actually is when examined rather than declared. That non-well-founded set theory remains a minority position in foundations says something about the sociology of mathematics that we leave as an exercise for the reader.

[15] The structural irony here operates on two levels. The first: the axiom of foundation prohibits infinite descending membership chains—the set-theoretic version of the self-referential descent that Gödel's diagonal argument performs. ZFC's own foundation, applied consistently, would prohibit the proof technique that establishes the incompleteness results on which MToE is built. The systems are carefully managed so this tension does not produce contradiction—but it illuminates why the VIR at the base of MToE is not accidental. The second, and deeper: the axiom of the empty set must be declared *before* the axiom of foundation can be stated, because if the foundation axiom came first, the empty set's own existence would be prohibited by it. The foundation of the system is exempted from the rule written to protect it. ZFC knows the crack is there. It grandfathers

Faizal et al. did the same thing. R_{nonalg} is their axiom of the empty set. It must exist at the base of MToE for everything above it to function. It is declared into existence by the construction rather than derived within it. The prohibition—the move that keeps MToE from collapsing into the VIR—is the insistence that R_{nonalg} is non-algorithmic, external, meta-logical: it lives, by definition, outside the domain where the regress operates. But this prohibition is structurally identical to the axiom of foundation. It stops the descent not by resolving what is at the bottom but by forbidding the question.

This is not a criticism of Von Neumann. It is a description of what the problem does to everyone who takes it seriously—and Faizal et al. took it seriously. The regress was waiting for them too, as it has been waiting for everyone who has stood at this boundary with sufficient honesty to see what is actually there. In 1928, at that boundary, the axiomatic program itself—ZFC, the axiom of foundation, the professional consensus that foundations were settled—erected a sign prohibiting entry. So everyone moved on. And then no one had anywhere left to go.

This is the first response. It is the response the entire tradition has made, from the Pythagorean *meikton* through Von Neumann's $\emptyset$ through R_{nonalg}. Name the bottom. Prohibit descent. Move on.

The second response—the one that has never been fully executed as a mathematical program—belongs to Anaximander.

Anaximander saw the regress as clearly as anyone. He understood that naming another definite substance at the bottom merely pushes the question down one level. His response was not to name a substance. It was to characterize the bottom itself—not as a thing but as a *generative structure*. The ancient testimony is precise on this point. Theophrastus, preserved in Simplicius, reports that for Anaximander the *apeiron* "embraces all things and governs all" (*In Phys.* 24.13; DK 12 A15) (Kirk et al., 1983). It is not passive. It is not a null background waiting to be declared. It is active—the origin of opposites through its own movement, the source from which determinate things emerge through a process of separation, the condition to which they return. It has character. It has structure. It produces.

Anaximander was not saying that we do not know what is at the bottom. He was saying that the bottom has a specific positive nature—generativity, boundlessness, governance—that cannot be captured by naming it as any particular thing, because particular things are precisely what emerge from it. The bottom is not a thing. It is what makes things possible. And this, crucially, is a geometric observation disguised as a metaphysical one.

The geometry is simple enough to draw on a napkin. Take any two circles sharing a center—one small, one large. The larger circumference is longer. It ought to contain more points. But connect any point on the outer circle to the center, and that radius meets the inner circle at exactly one point—no point on the inner circle is missed, no point is double-counted. The cardinality of both circumferences is identical despite the difference in size. Extension and number come apart. The boundary between the

the crack in, then makes inquiry into it illegal. The house is built on a foundation that officially prohibits the crack that runs through it.

finite and the infinite is not uniform, not featureless—it has internal structure that projection from a center reveals.[16]

The Greeks had this picture. Hipparchus used stereographic projection—mapping the sphere onto the plane through a pole—in the second century BCE, resolving a singular point into the full horizon of the projected plane, revealing that the point at infinity has directional content that the projection makes visible.[17]

Mathematics has been resolving singularities into structured spaces of directions for four centuries. Desargues showed in the seventeenth century that parallel lines, which appear to never meet, meet at a point at infinity—and that point is not empty but a genuine location, the vanishing point that perspective painters had already learned to see. Riemann completed the complex plane into the Riemann sphere in 1851, adding a single point at infinity that resolves the singular behavior of complex functions—the point that seemed like an exception turns out to be the most symmetric point of all. Hironaka proved in 1964 that any algebraic singularity whatever—not just these examples, but any singularity in any algebraic variety, in any dimension—can be resolved by a sequence of blow-ups into a smooth space where the singular locus is replaced by a structured exceptional divisor. This is not a conjecture. It is a theorem, for which Hironaka received the Fields Medal. The resolution is always available. The boundary is never featureless.[18]

Anaximander was pointing at precisely this. *To apeiron* is not the empty set declared by fiat. It is what the empty set was quietly assuming—that the bottom has structure, that the boundary is populated rather than empty, that what lies at the foundation is not featureless but populated with the content that declaration conceals. He lacked the formal apparatus to say this. The mathematics that would have let him say it had to wait two millennia. But the observation was his, and it has been buried under declarations ever since.

[16]This geometric fact—that two concentric circles of different sizes contain the same number of points, demonstrable by radii projection—is presented accessibly in (Wallace, 2003), §2c, where Wallace describes it as one of those problems that are "real problems, not just irksome or counterintuitive but mathematically profound." The connection between this cardinality paradox and the structure of the foundational boundary we describe in this section is our own observation. We invoke Wallace here because the geometric intuition was first made vivid to us through his account, and crediting the sources of one's intuitions is a more honest practice than presenting them as arrived at in a vacuum.

[17]Projective geometry offers a suggestive alternative to the axiomatic declaration. The real number line can be recovered from the real projective line by resolving the behavior at infinity—the singular boundary point is replaced by a structured space of directions rather than declared empty. Whether this geometric path provides a genuine foundational alternative to the axiomatic declaration, or merely relocates it, is a question we leave open. We note only that the geometric path exists and that its mathematical credentials are impeccable.

[18]The reader who wishes to experience this directly may perform the following exercise. Draw the two concentric circles from the passage above—one large, one small, sharing a center. Now add a third: the center point itself, understood as a circle whose circumference and area are both zero. Recall the rule established by the radii construction: the number of points on any circumference is independent of its size. Apply this rule to the third circle. Note what follows.

Two and a half thousand years of moving on. Because standing at the boundary and examining its structure directly, rather than declaring it empty and ascending, is genuinely hard. And it seems to require something like geometry.[19]

What genuine resolution of the VIR would look like—we can now say this precisely—is a construction that replaces declaration with examination. Rather than asserting that something exists at the bottom and prohibiting the question of what it is, such a construction would exhibit the internal structure of the bottom directly. It would show that the boundary has structure—that what lies at the foundation is not featureless but populated with the content that declaration conceals. Whatever such a construction looks like, it will not contradict what Von Neumann built. It will reveal what his declaration was quietly assuming. It will be congruent with the empty set—not replacing it, but showing what it was pointing at when it declared the bottom and moved on.

Whether such a construction exists we address in our conclusion.

6.

Faizal et al. open their paper with a precise observation: singularities in classical models mark precisely those regions where the informational degrees of freedom can no longer be captured by the spacetime geometry. Every framework that approaches this boundary eventually breaks down—not because the physicists were careless but because the singularity is genuinely attractive. It pulls. String theory felt the pull: strings were supposed to underlie spacetime, but strings vibrate, vibration requires a medium, and a medium requires the geometry that strings were supposed to replace. Loop quantum gravity felt the pull: spin foam amplitudes were supposed to generate spacetime from pure combinatorics, but specifying the transition measure requires geometric input that the framework was supposed to derive. The Wheeler program felt the pull: if information is more fundamental than spacetime, a bit is still a distinction, and a distinction requires a context, and a context requires exactly the framework the bit was supposed to replace. Each approached the boundary, found the gap, and filled it with the best available name. This is Faizal et al.'s diagnosis and it is correct.

We observe, with genuine admiration for the clarity of that diagnosis, that R_{nonalg} is that pull. It is not a resolution of the singularity. It is the singularity, renamed. The boundary that swallows every purely algorithmic framework has its own gravitational field and it does not spare the frameworks built to escape it. It should be no surprise that one might feel this pull while writing a paper about it. The wall is

[19]'t Hooft, after deriving the structure of special and general relativity from first principles alone—locality, causality, a speed limit, and the demand that forces be derivable from straight-line motion—observes that "the actual laws of physics known to hold in our universe are quite close to what we constructed purely by mental considerations," suggesting that a sufficiently intelligent entity "could perhaps have 'guessed' nature's laws of physics from such first principles" ('t Hooft, 2017). Anaximander was attempting precisely this kind of structural derivation in 610 BCE—reasoning from the character of the foundational boundary toward the laws governing what emerges from it—without the formal apparatus to complete it. Whether that apparatus now exists is the question this paper leaves open.

real. The silence at the foundation of every formal system—Von Neumann's silence, Wittgenstein's silence, Plato's *chora*,[20] Anaximander's *to apeiron*, R_{nonalg}—is real.

The ether theorists were not foolish. They saw the gap correctly but filled it with a name instead of a structure. One hundred academics lined up behind that name and Einstein's response cut through that number directly to the logic: if the name is wrong, one correct argument is enough. The economy of that response applies here too. It does not matter how carefully R_{nonalg} is described, how many conditions govern its outputs, how precisely its domain is specified. If the operation itself is not defined, the description is not a theory. It is a placeholder. And placeholders, however carefully labeled, do not resolve the Vicious Infinite Regress. They instantiate it.[21]

What is needed is not another layer above the system. What is needed is a resolution of the boundary itself—a construction that replaces the silence at the foundation not with a declaration and not with a prohibition but with something that has genuine structure. Not a name for the gap. Something like the geometry of the gap.[22]

We believe such a construction exists. We do not claim to produce it here. We note only that it would have to be congruent with ZFC's empty set—not replacing it but revealing the structure that the declaration of emptiness was pointing at without seeing. Any genuine resolution of the Vicious Infinite Regress at the foundation of formal systems will not contradict what Von Neumann built. It will show what he was looking at when he declared the bottom and moved on.[23]

We leave this question open. Not from despair. From confidence that Anaximander was pointing at something real when he named the boundary rather than what lies beyond it. That Wittgenstein's silence has structure. That the boundary is not nothing.

We note that impossibility has not been proved. Only difficulty has.

And difficulty is not the same thing.

[20]In the *Timaeus* (48e–52d), alongside the eternal Forms and the world of Becoming, Plato introduces a "third kind" (*triton genos*)—the *chōra* (Receptacle, space)—as the necessary ground in which becoming takes place. He is explicit about the structure: "being and space and becoming, three distinct things" (52d, Zeyl trans., in (Plato, 1997)). The *chōra* is apprehensible, he adds, "by a sort of bastard reckoning, hardly trustworthy." Section 2 of this paper draws on the *Philebus*. We have not run out of Plato.

[21]The return of the Einstein observation here is deliberate. Section 1 invokes it as an epistemic principle—what matters is whether a single correct argument exists, not how many names surround the gap. Section 6 applies that principle to R_{nonalg} directly. The one correct argument is the Vicious Infinite Regress demonstrated in Section 4. The number of conditions Faizal et al. place on T does not change what R_{nonalg} is or is not.

[22]We share Faizal et al.'s conviction that such an object would be actualized in nature (Faizal et al., 2025). The dispute is about whether R_{nonalg} is that object or a placeholder for it.

[23]The claim that a genuine resolution would be congruent with ZFC's empty set rather than replacing it is not a gesture of false modesty. It is a structural claim: any construction that genuinely exhibits what the declaration of emptiness was pointing at will, by exhibiting it, validate the declaration retroactively. Von Neumann was not entirely wrong to declare the empty set. He was pointing at something real that he lacked the tools to examine directly.

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