

ESSENTIALLY ORDERED CAUSAL SERIES AND QUANTUM INDETERMINACY: TESTING THE ARISTOTELIAN-THOMISTIC FIRST CAUSE ARGUMENT AGAINST NON-DETERMINISTIC PHYSICS

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Abstract: Aristotelian-Thomistic arguments for a first cause turn on a distinction between accidentally ordered causal series, whose members act in succession, and essentially ordered series, whose members act simultaneously and whose intermediate members exercise causal power only as instruments deriving that power from a prior member. Critics of these arguments have concentrated on regress termination and on whether persistence needs a sustaining cause; almost nobody has asked what the instrumental structure itself demands of physics. I argue that the standard formulation of the *per se* argument carries a tacit commitment I call the Derivational Sufficiency Requirement (DSR): that whatever an intermediate cause contributes to its effect is wholly derived from what it receives from the prior member. DSR is trivially satisfied under determinism and non-trivially contested under every indeterministic interpretation of quantum mechanics. Working from a corpus of thirty-eight verified sources published between 2019 and 2026, I develop the article's original contribution: the derivational trilemma, according to which a defender of the *per se* argument must either (i) commit the argument to a deterministic interpretation, thereby forfeiting the interpretation-neutrality classical theists typically claim, or (ii) weaken DSR to the derivation of propensity distributions rather than of singular outcomes, or (iii) accept irreducibly underived transitions inside the very structure designed to eliminate brute facts. A survey of eight interpretive families shows the trilemma to be exhaustive over the extant options, with 37.5% falling on the first horn, 25.0% on the second, and 37.5% on the third. I then defend the second horn as the strongest available position and identify a convergence, so far unremarked in either literature, between the propensity-based indeterministic physics of Del Santo and Gisin (2023) and the Thomistic distinction between primary and secondary causation. The convergence has a determinate price: the *per se* argument, so weakened, delivers a sustainer of powers rather than a determiner of outcomes. The emanational morphology of Knežević (2024a) is examined as a further, structurally distinct way of paying that price.

Keywords: *essentially ordered causal series, per se causation, quantum indeterminacy, first cause, instrumental causality, propensity, Aristotelian-Thomistic argument, potentiality.*

INTRODUCTION

In 2023, a team at ETH Zurich closed the last major loopholes in a Bell test using superconducting circuits separated by a 30-metre cryogenic link, violating the CHSH inequality with a value of 2.0747 against a classical bound of 2 and a null-hypothesis significance corresponding to

a p-value below 10^{-108} (Storz et al., 2023). Two years earlier, an experiment at NIST had certified 2.57×10^8 bits of device-independent randomness with a soundness error of 3.09×10^{-12} , output whose unpredictability rests on no assumption about the internal workings of the devices producing it (Shalm et al., 2021). These are not interpretive claims. They are measurements, and they set the boundary conditions within which any metaphysics of causation must now operate. The question this article asks is what those boundary conditions do to a specific and much-defended piece of natural theology: the Aristotelian-Thomistic argument from essentially ordered causal series to a first cause.

The argument's structure is well known. Some causal series are ordered accidentally: a grandfather begets a father who begets a son, and the grandfather's death does not interrupt the son's begetting of his own children, because each member acts independently once it has acted. Other series are ordered essentially: the hand moves the stick which moves the stone, and the stick's power to move the stone is not its own but is derived, here and now, from the hand. Aquinas and his contemporary interpreters hold that essentially ordered series cannot regress infinitely, because a series of purely instrumental members has no causal power at all unless some member possesses it non-derivatively; from which they conclude to a first cause that actualizes without being actualized (Feser, 2019; Kerr, 2019). Contemporary critics have pressed the argument at two joints. Oppy (2021) denies the premises about actualization; Feser (2021) answers that the denial merely relocates brute contingency. Schmid (2021) argues that objects may persist by existential inertia and require no concurrent sustaining cause, a case developed at book length with Linford (Schmid & Linford, 2023). Oberle (2022) shows that the regress premise fails for the same reason Schaffer's grounding foundationalism fails, and Lucero (2026) argues by elimination that the terminus cannot be a being among beings. McNabb (2024) concedes the pressure and calls for reformulation.

What none of this literature asks is what the instrumental structure requires of the physics through which the alleged per se series must run. That silence is the gap this article addresses. Consider what the stick-and-stone example encodes: the intermediate member contributes nothing of its own, since the entirety of its causal contribution is received from the prior member and passed on. Call that tacit premise the Derivational Sufficiency Requirement, or DSR. Under classical determinism, DSR is unproblematic, because the total state of a system at one moment fixes its state at the next, so nothing an intermediate contributes fails to be derived. But classical determinism is not the physics we have — and, as Del Santo and Gisin (2019) argue, it may never have been the physics classical mechanics actually entailed, since its determinism rests on the assumption that physical quantities possess actual values with infinitely many predetermined digits. Under quantum mechanics, whether DSR holds depends entirely on the interpretation, and the interpretations differ radically (Maudlin, 2019; Oldofredi, 2025).

The original contribution of this article is the derivational trilemma: a demonstration that a defender of the Aristotelian-Thomistic per se argument, once DSR is made explicit, faces exactly three options, each with a determinate cost, and that no fourth option exists among extant interpretations of quantum mechanics. The first horn commits the argument to a deterministic interpretation, purchasing DSR at the price of interpretation-neutrality and of the empirical commitments deterministic interpretations carry. The second weakens DSR so that what is derived is the propensity distribution over possible manifestations rather than the singular outcome, preserving the argument's validity but transforming its conclusion. The third accepts underived transitions within the series, which reintroduces into the per se structure the brute contingency the argument was designed to eliminate. I defend the second horn while pricing it honestly.

Three hypotheses guide the investigation. H1 holds that the per se argument is not interpretation-neutral: its standard formulation presupposes DSR, and DSR is satisfied only by

interpretations that are deterministic at the level of instrumental transmission. H2 holds that the trilemma is exhaustive over the extant interpretive landscape, so that every major interpretation of quantum mechanics assigns the argument to one of the three horns. H3 holds that the second horn, while preserving formal validity, produces a determinate theological shift, from a first cause that determines outcomes to a first cause that sustains powers with their propensity structure. I take the third hypothesis to be the most interesting and the most contestable, and I have tried to state it in a way that permits refutation.

A word about the perspective from which I write. My training is in metaphysics rather than in physics, and I have relied throughout on the review literature of the foundations of quantum mechanics rather than on primary theoretical work; where a physicist would see nuance in a formalism, I have had to take the reviewers' word for it (Schlosshauer, 2019; Landsman, 2020; Hance & Hossenfelder, 2022). I have also come to this problem through a route unusual in the analytic literature, namely a morphological system of cosmology and theogony in which the first cause functions as an operator converting potentiality into actuality across graded emanations (Knežević, 2024a), a system whose structure Đukić (2025) has reconstructed independently. That background made the question of what exactly gets transmitted through a causal hierarchy salient to me before I knew the analytic literature had a name for it. The article proceeds through a review of both bodies of literature and a statement of method, a presentation of results, an analysis of the derivational structure of per se series, an examination of the eight interpretive families against the trilemma, and a defence of propensity-instrumentality set against its cosmological horizon.

LITERATURE REVIEW AND METHODOLOGY

Literature Review

Three literatures meet in this article and, remarkably, barely cite one another. The first is the contemporary defence and critique of Thomistic cosmological arguments. Feser (2019) supplies the fullest recent statement of the Aristotelian philosophy of nature underlying the per se argument, contending that act and potency, substantial form, and efficient causality are not merely compatible with modern science but presupposed by it. Kerr (2019) reconstructs Aquinas's metaphysics of creation as the backbone of his philosophical theology, with the dependence of creatures on a self-subsistent existence at its centre. Against these, Oppy (2021) argues that the crucial premises of the Aristotelian proof are points of disagreement rather than shared starting points; Feser (2021) replies that Oppy's naturalism terminates in brute contingency where his own terminates in an explainer. Schmid (2021) develops the existential inertia thesis, on which concrete objects persist without concurrent sustenance, and Schmid and Linford (2023) extend it into a systematic critique of five classical proofs. Oberle (2022) and Lucero (2026) attack the regress structure from grounding theory, and the causal-finitist literature, comprising Schmid (2023), Dagher (2023), Schmid (2024), and Schmid and Malpass (2025), debates whether infinite causal dependence is possible at all, a question logically prior to the per se argument's regress premise. Simpson, Koons, and Orr (2022) collect the most sustained recent attempt to reconnect neo-Aristotelian metaphysics with a theology of nature.

The second literature concerns quantum indeterminacy as a metaphysical rather than merely epistemic phenomenon. Calosi and Wilson (2019) argue that quantum value indefiniteness is best understood as metaphysical indeterminacy in the determinable-based sense, and their analysis has generated an entire subfield: Torza (2020) proposes worldly incompleteness as an alternative account; Mariani (2021) argues that quantum indeterminacy is emergent; Calosi and Mariani (2020) extend the treatment to relational quantum mechanics; Calosi (2022) distinguishes modal from

categorical variants; Nørgaard (2025) asks whether indeterminacy admits of degree; Oldofredi (2024) shows, against expectation, that even pilot-wave theories instantiate forms of metaphysical indeterminacy. The survey by Calosi and Mariani (2021) maps the terrain. Alongside this runs the physics-side literature on whether indeterminism is real: Landsman (2020) dissects the ambiguities in the concept of randomness and argues that deterministic interpretations sit uneasily with the Born rule; Hossenfelder and Palmer (2020) defend superdeterminism as a live option; Gisin (2020) argues that the classical mathematical language of real numbers builds a spurious determinism into physics; Del Santo and Gisin (2023) propose potentiality realism, on which intrinsic propensities are elements of reality. On the empirical side, Storz et al. (2023) and Shalm et al. (2021) constrain local hidden variables and certify randomness respectively, while Carlesso et al. (2022) survey the non-interferometric bounds on spontaneous collapse models and Schlosshauer (2019) reviews decoherence, which explains the emergence of classicality without by itself resolving the measurement problem (Hance & Hossenfelder, 2022).

The third literature is the small body of work connecting the first two. Koons (2021) proposes thermal substances as the Aristotelian *ousiai* of the quantum world, arguing from irreversibility, symmetry breaking, phase transitions, and chemical form. Simpson (2021) develops cosmic hylomorphism, on which the cosmos is a single hylomorphic substance with an intrinsic power to choreograph particle trajectories — a Bohmian ontology with an Aristotelian reading of the guiding equation. Silva (2022) reconstructs Aquinas on natural contingency and providence, arguing that Aquinas's concern is not to find gaps for divine action but to secure the perfection of a universe containing contingent causes. Koperski (2020) surveys divine action and determinism from the philosophy-of-laws side, and Tabaczek (2021) reinterprets emergence within a broadly Aristotelian framework. Crull (2023) asks whether theological uses of quantum mechanics can be interpretation-neutral, and answers, in effect, that they usually cannot. Wilson (2020) offers the most ambitious modal-metaphysical proposal in the vicinity, on which Everettian branching grounds objective contingency, while Chen (2022) argues that fundamental laws may themselves be vague. Each of these touches the question I am pressing. None poses it as a question about instrumental derivation.

It is worth registering how recent most of this is, because the novelty of the conjunction partly explains the novelty of the question. The metaphysical-indeterminacy programme in quantum mechanics dates in its current form from the determinable-based proposal of Calosi and Wilson (2019); potentiality realism was published in 2023 (Del Santo & Gisin, 2023); the loophole-free superconducting Bell test appeared in 2023 (Storz et al., 2023); the systematic review of the measurement problem's solutions appeared in 2025 (Oldofredi, 2025). On the other side, the contemporary revival of Aristotelian philosophy of nature is scarcely older, with Feser (2019) and the collections edited by Simpson, Koons, and Orr (2022) marking its consolidation. Two rapidly moving literatures have converged on adjacent territory within roughly six years, and it would be strange if all the obvious cross-questions had already been asked. That said, novelty is not merit, and I have tried throughout to distinguish what is new here from what is merely newly stated.

A fourth body of material supplies calibration rather than argument. The philosophy of cosmology has developed careful indices for evaluating explanatory proposals under conditions of empirical underdetermination, and I draw on that work at two points in the analysis: on fine-tuning, where Adams (2019) quantifies the parameter ranges compatible with structure formation and Mendes (2023) constructs a composite metric that returns values between 0.30 and 0.55 for the four canonical multiverse frameworks; on the epistemic status of unobservable structure, where Risojević (2023) returns values between 0.20 and 0.50 on a five-dimension demarcation index. The Hubble tension supplies a worked example of principled disagreement among independently reliable probes, with the CMB value of $67.4 \pm 0.5 \text{ km s}^{-1} \text{ Mpc}^{-1}$ standing at $\geq 5\sigma$ from

the local distance-ladder value of 73.04 ± 1.04 , and with early dark energy ranked highest among five resolution classes at approximately 0.50 (Knežević, 2024b). The DESI programme now finds a preference for evolving dark energy at up to 4.2σ , with a multi-probe convergence value near 0.61 (Yadav, 2025). Quantum biology provides a cautionary case study in over-reading coherence phenomena, since electronic decoherence in the Fenna–Matthews–Olson complex occurs within roughly 60 femtoseconds at physiological temperature and no current proposal reaches the tier of demonstrated functional relevance, with index values between 0.15 and 0.50 (Cao et al., 2020; Singh, 2024). I use these not as evidence for any metaphysical thesis but as models of how to price a proposal that outruns its evidence.

One further strand belongs in this review because it constrains what a defender of the argument may say about series length. Causal finitism holds that nothing can be affected by infinitely many causes, and it has been defended by a cumulative case from paradox avoidance. Schmid (2023) constructs a step-by-step argument for the thesis; Dagher (2023) offers an argument from explicability; Schmid and Malpass (2025) reply that Benardete paradoxes are better handled by the unsatisfiable pair diagnosis, on which the paradoxical scenarios are logically impossible and no metaphysical thesis about causal cardinality need be adopted, and Schmid (2024) extends the point to patchwork principles and the infinite past. The relevance here is indirect but real: if causal finitism is false, then a defender of the per se argument cannot help themselves to a general prohibition on infinite dependence and must argue the case for essentially ordered series specifically, which is where the derivational structure examined in this article becomes load-bearing rather than illustrative.

Research Methodology

The method has three components, and I describe each with the detail a replicator would need. The first is conceptual reconstruction. I take the per se argument as formulated in its contemporary defences (Feser, 2019; Kerr, 2019), extract the premises governing instrumental members, and formulate DSR as the weakest principle sufficient to license the inference from instrumentality to derivation. The reconstruction is deliberately charitable: I state DSR so that it is entailed by, rather than merely consistent with, the standard formulations, so that a defender cannot escape the trilemma by denying that the premise was ever theirs. Where a defender might resist, I say so.

The second component is a survey of interpretive families against DSR. I identified eight families that appear in the recent review literature as live options: de Broglie–Bohm pilot-wave theory, superdeterminism, spontaneous collapse theories of the GRW and CSL type, Everettian many-worlds, relational quantum mechanics, QBism and other epistemic readings, potentiality or propensity realism, and neo-Aristotelian hylomorphic proposals. For each, I asked a single question with a determinate answer: does the total intrinsic state of the intermediate member, together with what it receives from the prior member, fix its causal contribution? Families answering yes fall on the first horn; families answering no but grounding the contribution in a derived propensity structure fall on the second; families answering no and grounding it in nothing fall on the third. Classification was performed twice at a three-week interval; relational quantum mechanics changed horns between passes, for reasons I state in the analysis rather than conceal here, since the case is instructive about the framework's limits.

The third component is cost analysis. For each horn I identify what a defender must give up, stating the concession as a proposition the defender could in principle affirm without contradiction, and I check the concession against the empirical constraints assembled in the review. This is where the physics does real work rather than decorative work: a horn that requires, say, deterministic hidden variables must answer to the Bell-test bounds (Storz et al., 2023), and a horn that

requires objective collapse must answer to the parameter-space exclusions catalogued by Carlesso et al. (2022). No inferential statistics are used anywhere in this article; the percentages reported in the results are simple proportions over a survey of eight families, and I would not defend a difference of one family as significant. The corpus of thirty-eight cited works from 2019 onward was assembled by iterative database search seeded from the review articles named above, with inclusion requiring peer-reviewed or scholarly-press publication, direct relevance to either instrumental causation or quantum indeterminacy, and a resolvable DOI or stable locator.

RESEARCH RESULTS

The investigation returns findings in four blocks. The first concerns the formulation of DSR itself. Reconstructing the *per se* argument from its contemporary statements yields three premises about intermediate members: that an instrumental cause exercises causal power only while receiving it, that it exercises no power beyond what it receives, and that a series composed exclusively of such members possesses no power at all (Feser, 2019; Kerr, 2019). The second premise is DSR. Stated precisely, it holds that for any intermediate member *m* in an essentially ordered series, the causal contribution of *m* to its effect is wholly determined by the actualization *m* receives from the prior member together with *m*'s own nature as actualized by that reception. The formulation matters because two weaker readings are available and neither does the argument's work: a reading on which *m*'s contribution is merely enabled rather than determined fails to license the conclusion that a series of instruments has no power of its own, and a reading on which *m*'s contribution is determined by its total state including underived elements concedes precisely the point at issue. So DSR in the strong form is not an addition to the argument; it is what the argument's central image encodes.

The second block presents the survey of interpretive families. Of the eight families examined, three (37.5%) satisfy DSR and therefore place the argument on the first horn: de Broglie–Bohm pilot-wave theory, in which particle trajectories are fixed by the guiding equation given the wave function and initial configuration (Maudlin, 2019; Oldofredi, 2024); superdeterminism, in which apparent measurement freedom is itself determined by prior conditions (Hossenfelder & Palmer, 2020); and neo-Aristotelian hylomorphic proposals of the cosmic type, which are Bohmian in dynamical content while Aristotelian in ontological reading (Simpson, 2021). Two families (25.0%) fall on the second horn by grounding the intermediate's contribution in a derived propensity structure: potentiality realism (Del Santo & Gisin, 2023) and the thermal-substance ontology, on which the relevant powers belong to macroscopic substances individuated thermodynamically and their exercise is stochastic at the microlevel (Koons, 2021). Three families (37.5%) fall on the third horn: spontaneous collapse theories, in which localization events are not derived from anything (Carlesso et al., 2022); relational quantum mechanics, on which values are relative to interactions and no absolute derivational fact obtains (Oldofredi, 2021; Calosi & Mariani, 2020); and epistemic readings of the QBist family, which decline to supply any derivational story at the ontic level. Everettian many-worlds required a separate ruling and is discussed below rather than counted, since it satisfies DSR at the level of the universal wave function while dissolving the singular actuality the argument's conclusion concerns (Wilson, 2020).

The third block records the cost audit. First-horn defenders must accept the empirical and theoretical commitments of deterministic interpretations. That is not nothing. Bohmian mechanics is nonlocal in a way that sits awkwardly with relativistic covariance, and the pilot-wave family has been shown to carry its own forms of metaphysical indeterminacy, so that even the paradigm deterministic option fails to deliver a fully determinate world (Oldofredi, 2024). Superdeterminism must deny measurement independence, a denial its proponents defend as principled and its critics regard as an abandonment of scientific methodology (Hossenfelder & Palmer, 2020);

Landsman, 2020). Both purchases forfeit the interpretation-neutrality that theological uses of physics are usually careful to claim, and Crull (2023) has argued persuasively that such neutrality is rarely available in the first place. Second-horn defenders must weaken DSR, and the weakening changes what the argument concludes: a first cause that sustains propensity-bearing powers is not thereby a first cause that determines which propensity is manifested. Third-horn defenders must accept that a per se series contains transitions not derived from any prior member, which contradicts the argument's motivating intuition and, in the limit, hands the naturalist exactly the terminus Feser (2021) accuses Oppy of accepting.

The fourth block reports two ancillary findings that qualify the main results. The first concerns scale. The decoherence literature establishes that superpositions in macroscopic and even mesoscopic systems are suppressed extraordinarily fast: electronic coherence in photosynthetic antenna complexes decays within roughly 60 femtoseconds at physiological temperature, and the sceptical reassessment of functional quantum biology returns composite relevance values between 0.15 and 0.50 across five claim categories (Cao et al., 2020; Singh, 2024; Schlosshauer, 2019). If per se series as classically illustrated — hands, sticks, stones — operate exclusively in the decoherent regime, then the trilemma might be argued to apply only at a level where the argument never claimed to operate. I take this objection seriously and answer it in the analysis; the short answer is that decoherence suppresses interference without restoring determinism, so the derivational question survives the change of scale intact (Schlosshauer, 2019; Zurek, 2022). The second ancillary finding concerns the classical baseline. Del Santo and Gisin (2019) show that classical mechanics is deterministic only under the assumption of infinite precision in the values of physical quantities, and that dropping that assumption yields an indeterministic reading of classical physics with the same empirical content. The upshot for the present argument is uncomfortable for the first horn: the deterministic baseline against which DSR looked trivially satisfiable may have been an artefact of mathematical language rather than a feature of the world (Gisin, 2020).

A fifth block of observations concerns the shape of the literature itself, and I report it because it explains why the question posed here has gone unasked. Of the thirty-eight sources in the corpus, seventeen belong to the philosophy of physics, thirteen to philosophy of religion and natural theology, and eight to the interdisciplinary zone between them or to the philosophy of cosmology. Cross-citation is thin. Among the philosophy-of-physics items, only Simpson (2021) and Koons (2021) engage Aristotelian causal categories directly, and neither addresses the per se argument for a first cause. Among the philosophy-of-religion items, only Feser (2019) treats quantum mechanics at length, and its treatment concerns the reality of potency and the status of measurement rather than the derivational status of intermediate causes. Crull (2023) is the only source in the corpus whose explicit topic is the transfer of authority between the two fields, and her conclusion — that interpretation-neutral theological uses of quantum mechanics are far rarer than their authors suppose — is precisely the finding this article extends from theology in general to one argument in particular. The disciplines have been talking past each other, and the gap has a specific location.

THE DERIVATIONAL STRUCTURE OF ESSENTIALLY ORDERED SERIES

Return to the stick. What exactly does the hand give it? Not motion simpliciter, since the stick would move if kicked; what the hand gives is the specific actualization by which the stick becomes a mover of this stone in this direction with this force. Aquinas's claim, in the reading that contemporary defenders adopt, is that the stick's status as a mover is entirely borrowed: subtract the hand and you subtract not merely the occasion of the stick's moving but its capacity to move as it does (Feser, 2019). The claim is stronger than the observation that the stick would not move

without the hand. It is that the stick contributes no causal determination of its own to the outcome. Kerr (2019) puts the corresponding point at the level of existence rather than motion: creatures do not merely receive existence at a moment but hold it derivatively at every moment, so that the dependence relation is constitutive rather than historical.

Now make the stick a quantum system. Suppose the intermediate member is a mesoscopic device whose output depends on whether a particular atom decayed within a given interval. The prior member does everything the classical stick's mover did: it supplies energy, orientation, structure, the whole apparatus of enabling conditions. What it does not supply is the fact that the atom decayed at 3.7 microseconds rather than 4.1. On any indeterministic interpretation, that fact is not fixed by anything the prior member transmitted, nor by the total intrinsic state of the intermediate. So the intermediate contributes a determination of its own. It is not, in the required sense, a pure instrument. Notice what has and has not been shown. The argument's regress premise is untouched; nothing here shows that essentially ordered series can regress infinitely. What is touched is the characterization of intermediate members as pure instruments, and with it the inference from 'a series of instruments has no power of its own' to 'therefore the whole series depends on a non-instrumental member'. If intermediates contribute underived determinations, the series is not a series of pure instruments, and the inference needs new support.

A defender will reply that the underived element is not a positive causal contribution but a mere indeterminacy, and that indeterminacy is a privation rather than a perfection. This is a good reply and it deserves a careful answer, because it draws on a genuine Thomistic resource: what is not actual cannot cause, and the openness in the intermediate's state is precisely a lack of actuality. My answer is that the reply proves too much and too little at once. Too little, because the outcome is not a privation — the atom's decaying at 3.7 microseconds is a positive event, and it is the event, not the antecedent openness, that enters the causal chain. Too much, because if privations can absorb any explanatory shortfall, the same move is available to the naturalist who says that the universe's existence involves no positive fact requiring explanation. Consistency in the treatment of explanatory demands is not optional. Silva (2022) has argued, from Aquinas's own texts, that natural contingency is a perfection of the created order rather than a defect in it, which cuts against the privation reply from within the tradition it invokes.

There is a second defensive strategy, and I think it is the strongest available on the first horn. It concedes that indeterminate transitions occur but denies that they occur within essentially ordered series properly identified. On this view, *per se* series are hierarchical rather than temporal: the relevant dependence runs from the atom's existence and nature to its powers, not from one temporal state to the next, and dependence of that vertical kind is untouched by whether the horizontal transition is stochastic (Feser, 2019; Kerr, 2019). The strategy is elegant and it is, I believe, what most Thomists would say if pressed. But it has a consequence its proponents rarely state. If the vertical series concerns the derivation of powers rather than the determination of exercises, then the first cause reached at the top of that series is a sustainer of powers, not a determiner of outcomes — which is exactly the second horn, arrived at by a different road. My initial reading of this strategy took it to preserve the classical conclusion intact; working through the exercise/power distinction convinced me otherwise, and the conclusion of this article is largely the result of that change of mind.

Two clarifications keep the problem in focus. The first concerns simultaneity. *Per se* series are usually described as simultaneous, and one might think that stochastic transitions, being temporal, therefore fall outside them. But the simultaneity at issue is that of dependence, not of clock-time coincidence: the stick depends on the hand at the very instant it moves the stone, and nothing about that relation forbids the stick's own state from having arrived stochastically. If the intermediate's causal profile at the instant of transmission includes a feature not derived from the

prior member, the derivational structure is broken whether or not the feature arrived a nanosecond earlier. The second clarification concerns the difference between epistemic and ontic readings of indeterminacy. Everything in this article's argument requires that quantum indeterminacy be more than ignorance — a substantive assumption, which Calosi and Wilson (2019) defend by construing value indefiniteness as genuine metaphysical indeterminacy of the determinable-based sort, and which Torza (2020) develops through a notion of worldly incompleteness. Should indeterminacy turn out to be merely epistemic, the trilemma would collapse into the first horn and the *per se* argument would be safe. That is one clean way to refute what I argue here, and I would rather point it out than leave it for a referee.

It is also worth asking what the argument's classical proponents would have said, since anachronism is a real hazard when medieval categories are tested against modern physics. Aquinas held that natural causes act contingently and that this contingency is a perfection of the created order rather than a defect, precisely because a universe containing both necessary and contingent causes displays a greater richness of causal modes than one containing only necessary ones (Silva, 2022). On this reading, indeterminism at the level of secondary causes would not have alarmed him. What would have alarmed him is any suggestion that a creature's operation escapes divine causality altogether, and it is worth being clear that nothing in the present argument suggests it: the claim is not that indeterministic events are uncaused but that their specific outcomes are not derived from the prior member of the series in the way the instrumental image requires. Silva (2022) argues that Aquinas's own solution runs through the distinction between primary and secondary causality rather than through any determination of outcomes at the creaturely level, which is a further reason to think the second horn has textual as well as systematic support. Whether that reading is exegetically correct is a question for historians of medieval philosophy, and I hold it lightly.

It is worth locating this problem relative to the standard objections, since precision about novelty is a scholarly obligation. The existential inertia debate asks whether persisting things need a concurrent cause of their continued existence (Schmid, 2021; Schmid & Linford, 2023). The regress debate asks whether hierarchical dependence must terminate (Oberle, 2022; Lucero, 2026). The causal finitism debate asks whether infinitely many causes can bear on a single effect (Schmid, 2023; Dagher, 2023; Schmid & Malpass, 2025). Each concerns the shape or termination of the series. The instrumental underdetermination problem concerns none of these. It grants, for the sake of argument, that the series terminates, that persistence requires sustenance, and that causal finitism is true, and it asks whether the members between the terminus and the effect are the kind of thing the argument says they are. To my knowledge the problem has not been posed in this form, and its independence from the standard objections is what makes the trilemma more than a restatement.

One more preliminary is needed before the interpretive survey, and it concerns what counts as an intermediate member in the first place. Aristotelian metaphysics individuates causal agents as substances, and the question of which physical items are substances is contested within neo-Aristotelian philosophy of nature itself. Koons (2021) argues that the inorganic world should be carved into thermal substances, bodies of matter possessing thermal, thermodynamic, and chemical properties, on the strength of a fivefold case from the irreversibility of time, the definition of thermodynamic concepts, spontaneous symmetry breaking, phase transitions, and chemical form. Simpson (2021) argues instead that the cosmos as a whole is the single hylomorphic substance and that everything else is a modification of it. These are not idle disagreements for the present purpose, because they determine where the members of a *per se* series are located and therefore where the derivational question bites. On Koons's picture, the relevant powers belong to thermodynamically individuated bodies whose behaviour is statistical by nature, which pushes toward

the second horn. On Simpson's, the relevant power belongs to the cosmos and is exercised deterministically, which pushes toward the first. That the same neo-Aristotelian starting point yields opposite horns depending on the ontology of substance is itself a finding, and it suggests the trilemma reaches deeper into the tradition than a mere dispute about interpretations of quantum mechanics.

EIGHT INTERPRETATIONS AND THE THREE HORNS

Begin with the horn most congenial to the classical theist. Bohmian mechanics assigns determinate positions to particles at all times and evolves them by a guiding equation from the wave function; given the wave function and the initial configuration, everything is fixed (Maudlin, 2019; Oldofredi, 2025). DSR is satisfied. Simpson (2021) shows how attractive this is for an Aristotelian: read the wave function as the substantial form of a single cosmic substance and its guidance of trajectories as the exercise of an intrinsic power, and you have a hylomorphic ontology with a fully deterministic dynamics — *per se* series all the way down, with the cosmos itself as the proximate agent. The proposal is the most sophisticated marriage of quantum physics and Aristotelian metaphysics currently on offer, and it should be taken seriously by anyone assessing the first horn.

The costs are nonetheless real. Bohmian mechanics is explicitly nonlocal, which is not by itself an objection given that Bell's theorem plus the experimental violations leaves every interpretation with an uncomfortable choice, but which does generate persistent difficulty in constructing relativistic extensions (Maudlin, 2019). More pointedly for the present argument, Oldofredi (2024) demonstrates that pilot-wave theories instantiate several forms of metaphysical indeterminacy despite their deterministic dynamics: certain questions about worldly states of affairs are not settled by the ontology and laws together, including a novel modal variety he identifies. If even the paradigm deterministic interpretation fails to deliver full determinacy, DSR's satisfaction on this horn is less secure than it first appears. Superdeterminism, the other principal first-horn option, secures determinism at the cost of denying measurement independence, which is to deny that experimenters' settings are statistically independent of the hidden variables (Hossenfelder & Palmer, 2020). Landsman (2020) argues that such interpretations sit uneasily with the Born rule, and the more general worry — that abandoning measurement independence threatens the inferential practice by which we test theories at all — has never been fully answered. A theist who buys DSR here is buying an option that most working physicists regard as a last resort.

The third horn collects the interpretations that supply no derivation. Spontaneous collapse theories of the GRW and CSL type add a stochastic localization term to the Schrödinger dynamics, so that superpositions collapse at rates scaling with system size; the localization events are not determined by anything, which is precisely their point (Carlesso et al., 2022). These theories are attractive because they solve the measurement problem without observers and because they are testable: the non-interferometric bounds now exclude substantial regions of the CSL parameter space, and the programme has the rare virtue of being empirically live rather than merely interpretive (Carlesso et al., 2022; Hance & Hossenfelder, 2022). For the *per se* argument they are poison. A collapse event inside an essentially ordered series is an underived determination in the strictest sense — not merely unpredictable but ungrounded in any prior actuality — and a series containing such events is not a series of instruments. Relational quantum mechanics reaches the same horn by a different route: values are relative to interacting systems, and there is no absolute matter of fact about what an intermediate contributes independently of the relation in which it is considered (Oldofredi, 2021; Calosi & Mariani, 2020). This is the case that changed classification between my coding passes, and the reason is worth stating: on a bundle-theoretic

reading of relational quantum mechanics, one might argue that relational facts are themselves derived from the interaction, restoring a kind of derivation (Oldofredi, 2021). I ultimately judged that what gets derived is the relatum-indexed value rather than the intermediate's causal contribution simpliciter, but the judgment is contestable and a critic could reasonably reclassify.

Everettian many-worlds resists the trilemma's categories and therefore deserves separate treatment rather than a forced classification. The universal wave function evolves unitarily and deterministically; nothing is underived at that level, so DSR appears satisfied. But the effect whose cause the argument seeks is not the universal state; it is this stone moving here, and on the Everettian picture the branch containing that event is one among a vast plurality, none of which is singled out as the actual one in the sense the argument requires (Wilson, 2020; Oldofredi, 2025). Wilson (2020) turns this into a virtue by identifying branches with metaphysically possible worlds, grounding objective contingency in physical branching — an elegant proposal that makes contingency a physical phenomenon rather than a primitive modal one. For our question the consequence is that DSR is satisfied vacuously: everything is derived because everything happens. A first cause reached through such a series would be the ground of the whole branching structure, which is a coherent theological position and arguably an attractive one, but it is not the conclusion the classical argument advertises, since the notion of God's choosing this world over others loses its footing. Multiverse hypotheses more generally carry epistemic burdens that a careful audit finds unmet by any operational demarcation criterion, with composite index values between 0.20 and 0.50 (Risojević, 2023).

Before turning to the second horn, one more third-horn consideration deserves airing, because it is the strongest reason a classical theist might have for resisting the whole framing. Suppose a defender says: the collapse event, or the stochastic transition, is itself caused by the first cause directly, not mediately through the series. Then nothing is underived after all, and the third horn dissolves. This is a coherent position and it has distinguished ancestry in occasionalist and concurrentist traditions alike, but notice what it costs. It converts every quantum transition into an immediate divine act, which multiplies direct divine interventions to the order of 10^{80} per second in the observable universe, and it does so at the price of the very intermediate causality the *per se* argument was constructed to explain. A defender who takes this route has not saved instrumental causation; they have abolished it in favour of a single agent acting through occasions. Koperski (2020) surveys the difficulties such positions face with the laws of nature, and Silva (2022) argues that Aquinas's own concern was to avoid exactly this collapse of secondary into primary causality. The route out of the third horn, in other words, exits the argument rather than defending it.

That leaves the second horn, whose two occupants deserve more space than the census gives them. Koons (2021) argues that the fundamental substances of the inorganic world are thermal substances: bodies of matter with thermal, thermodynamic, and chemical properties, individuated by irreversibility, spontaneous symmetry breaking, phase transitions, and chemical form. The proposal locates the bearers of causal powers at a level where those powers are robustly real and their exercise is statistical, which is exactly what a second-horn position requires. Potentiality realism reaches the same structural place from the physics side: Del Santo and Gisin (2023) regard intrinsic propensities for individual events as elements of reality, neither reducible to actual values nor merely epistemic, and they argue that a physics built on such propensities is realist and indeterministic at once. What both share is the claim that what is real and transmissible is a power together with its distribution of possible manifestations, while which manifestation obtains is settled at the moment of exercise and not before. The Aristotelian ear should prick up here, because that is a description of potency and act in all but name.

PROPENSITY-INSTRUMENTALITY AND THE COSMOLOGICAL HORIZON

The convergence noted at the end of the previous section is the article's most substantive positive claim, so let me state it carefully and then attack it. Potentiality realism holds that propensities are intrinsic, objective, and irreducible; that a physical system at a time possesses not a single determinate value for every observable but a real distribution of tendencies; and that the transition from tendency to actual event is a genuine coming-into-being rather than the revelation of something already fixed (Del Santo & Gisin, 2023). Thomistic metaphysics holds that a secondary cause acts by its own form and power while being moved to act by the primary cause, and that what the primary cause supplies is being and the power to act rather than a substitute for the secondary cause's own operation (Silva, 2022; Kerr, 2019). Put these together and one obtains what I will call propensity-instrumentality: an intermediate member of an essentially ordered series counts as a genuine instrument when the power-with-its-propensity-distribution is derived from the prior member, even though which manifestation obtains is not. DSR is thereby weakened from outcome-derivation to power-derivation.

Does the weakened principle still support the argument? I believe it does, and the reason is structural. The regress premise required that a series of purely instrumental members possess no causal power of its own; on the weakened reading, it requires that a series of members whose powers are all derived possess no power of its own — which is if anything more obviously true, since powers are exactly what such a series would lack at its root. The inference to a non-derivative possessor of power goes through. What does not go through is the further inference, often run together with the first, from a first cause of powers to a first cause of the particular arrangement of the world. That further inference required outcome-derivation, and outcome-derivation is what we have surrendered. This is a real theological cost, not a verbal one, and it should be paid openly: on propensity-instrumentality, the *per se* argument delivers a sustainer of the world's causal powers whose relation to the specific history those powers generate is left underdetermined by the argument itself.

Three objections deserve answers. The first is that propensities are metaphysically obscure, a charge with a long history. The answer is that the obscurity is comparative rather than absolute: the alternatives are categorical properties whose modal profiles must then be grounded in laws whose own status is contested, and Chen (2022) has shown that even fundamental laws may be irreducibly vague. Powers ontologies have been developed with enough precision in the last decade to make the charge of obscurity harder to sustain than it once was (Koons, 2021; Simpson, 2021). The second objection is that weakening DSR makes the argument compatible with too much — that a naturalist can accept derived powers with underived exercises and simply decline the further step to a first cause. Correct, and I do not claim otherwise; the argument on this horn establishes a conditional structure whose antecedent a naturalist may reject, as Oppy (2021) rejects the corresponding premises in the Aristotelian proof. What the horn secures is coherence under indeterministic physics, not persuasive force against a determined opponent, and the distinction between those two achievements is one the natural-theology literature blurs more often than it should. The third objection is the scale objection anticipated in the results: since macroscopic *per se* series operate in the decoherent regime, quantum indeterminacy is irrelevant to them. Decoherence does explain the emergence of classical behaviour by suppressing interference through environmental monitoring, and quantum Darwinism explains the objectivity of pointer states through redundant proliferation of information into the environment (Schlosshauer, 2019; Zurek, 2022). But decoherence yields improper mixtures, not determinate outcomes; it explains why we do not see superpositions, not why this outcome rather than that one occurred (Hance & Hossenfelder, 2022; Landsman, 2020). The derivational question therefore survives

coarse-graining. And in any case the classical baseline is itself in question, since dropping infinite precision yields an indeterministic reading of classical mechanics with identical empirical content (Del Santo & Gisin, 2019; Gisin, 2020).

The empirical constraints bear on the trilemma in a specific way that I want to keep modest. The Bell-test results do not refute the first horn — Bohmian mechanics and superdeterminism both survive them, at the price of nonlocality and of measurement dependence respectively — but they do establish that the price cannot be avoided. The CHSH violation reported by Storz et al. (2023) at 2.0747, with detection and locality loopholes simultaneously closed over a 30-metre link, forecloses the comfortable option of local determinism that a pre-Bell Aristotelian might have assumed. Device-independent randomness certification adds a further consideration whose force is easy to overstate and I shall try not to: certified randomness is randomness relative to any physical side information, and the NIST protocol delivered 2.57×10^8 such bits (Shalm et al., 2021). This does not prove ontic indeterminism, since a superdeterminist can accommodate it, but it means that any claim of derivational sufficiency at the microlevel must be a claim about a level below what any experiment can access. Meanwhile collapse theories, the cleanest third-horn option, are being progressively constrained rather than merely debated: non-interferometric bounds have excluded significant regions of CSL parameter space and further improvements are expected from levitated optomechanics (Carlesso et al., 2022). The trilemma is thus not a stable stalemate. Its horns are being differentially weighted by experiment, slowly.

Set this against the wider cosmological horizon and a pattern appears. Contemporary cosmology increasingly presents structure that could have been otherwise: fine-tuning analyses map the parameter ranges within which stars, chemistry, and structure remain possible, and find several constants sitting within narrow windows (Adams, 2019), while the leading non-design explanation achieves only middling strength, with composite values between 0.30 and 0.55 across four multiverse frameworks (Mendes, 2023). The Hubble tension shows independently reliable probes disagreeing at $\geq 5\sigma$, with no resolution class scoring above approximately 0.50 on a five-dimension index (Knežević, 2024b). DESI reports a preference for evolving dark energy at up to 4.2σ with multi-probe convergence near 0.61, which would make even the equation of state of the vacuum a historical rather than an eternal fact (Yadav, 2025). One should not overclaim: none of this establishes metaphysical indeterminism, and the philosophy of cosmology has developed its demarcation indices precisely because empirical underdetermination invites overclaiming (Risojević, 2023). What the pattern does suggest is that a metaphysics distributing modal status across levels, rather than concentrating necessity at a point and treating everything downstream as fixed, fits the working posture of the sciences better than its rival. Propensity-instrumentality is such a metaphysics.

Here the emanational tradition enters, and I introduce it as an alternative payment of the same bill rather than as a rival to the analytic options. The morphological system of Prauzrok treats the first cause as a converter of potentiality into actuality operating through graded emanations, with the higher impulse functioning as the operative principle of that conversion and receiving a quasi-mathematical expression through a coefficient of creative forces (Knežević, 2024a; Đukić, 2025). Đukić (2025) reconstructs the system along five ontological axes, of which the emanational axis descends from a primordial triad through a first self-conscious actualization to ten successive grades. Read against the present framework, the system is a second-horn position with an additional structural commitment: not only is what is transmitted a power rather than an outcome, but the ratio of derived to underived determination varies systematically with position in the hierarchy, approaching pure derivation at the source and maximal openness at the terminal grade. That is a stronger claim than potentiality realism makes, and correspondingly more exposed. Its liabilities are those any emanationism carries — an attenuated *creatio ex nihilo*, a first

principle whose personal agency is difficult to articulate — and I have argued elsewhere that a system-builder is poorly placed to audit his own construction. I include it here because it demonstrates that the second horn is a family rather than a single position, and because the graded-derivation idea is, so far as I can determine, absent from the analytic literature and worth its attention.

It may help to make the propensity-instrumentality thesis concrete with a worked case, since abstraction has carried the argument a long way and a reader is entitled to see it touch ground. Take a photosynthetic antenna complex, a system whose causal architecture has been mapped in unusual detail. Excitation energy arrives at a pigment and is transferred toward a reaction centre through a network of chromophores. Coherent oscillations in that network were once thought to be electronic and functionally exploited, but the reassessment of the last decade attributes them predominantly to vibrational modes, with electronic decoherence in the Fenna–Matthews–Olson complex completing within roughly 60 femtoseconds at physiological temperature, and a systematic audit of five claim categories returns functional-relevance values between 0.15 and 0.50, none reaching the tier of demonstrated relevance (Cao et al., 2020; Singh, 2024). Now ask the derivational question of this system. The pigment's power to transfer excitation is structurally derived: it belongs to the chromophore in virtue of its electronic structure, its protein scaffold, its position in the network, and all of these trace back through a *per se* hierarchy of increasingly fundamental constituents. Which transfer pathway is taken on a given occasion, by contrast, is a stochastic matter fixed by the system-environment coupling at the moment of transfer (Schlosshauer, 2019). Power derived, exercise not: the case exhibits exactly the structure propensity-instrumentality describes, and it does so at a biological scale where nobody suspects exotic quantum effects of doing work.

The worked case also disciplines an inference that theologically motivated readers may be tempted to draw. It would be convenient for a certain kind of natural theology if indeterminacy at the microlevel amplified reliably into the macroscopic world, opening causal joints where non-interventionist divine action could operate without violating any law — the programme Koperski (2020) surveys and finds wanting on the philosophy-of-laws side, and which Crull (2023) shows to be far more interpretation-dependent than its proponents acknowledge. Nothing in this article supports that programme, and the quantum-biology case is instructive about why: the empirical trajectory of the last decade has run steadily against claims that quantum effects do distinctive work at biologically relevant scales (Cao et al., 2020; Singh, 2024). Propensity-instrumentality is not a gap theory. It makes no claim that indeterminacy leaves room for anything to slip in; it claims only that the structure of derivation in a *per se* series is power-to-power rather than outcome-to-outcome. A first cause reached along that route sustains the whole network of powers at every moment, which is metaphysically more intimate than any gap-filling and theologically more austere, since it grants no leverage over particular events.

A final connection deserves mention because it links this article's problem to an unresolved question in the metaphysics of properties. If what an instrumental cause transmits is a propensity distribution rather than a value, then the intermediate's causal contribution is characterized by a determinable without a determinate — which is precisely the structure Calosi and Wilson (2019) propose for quantum metaphysical indeterminacy, and which Mariani (2021) argues is emergent rather than fundamental. Whether indeterminacy so understood admits of degree is itself contested (Nørgaard, 2025), and Calosi (2022) distinguishes a modal variety with different logical behaviour from the categorical one. These distinctions are not idle for the present purpose. If indeterminacy comes in degrees, then propensity-instrumentality can be stated as a gradient rather than a threshold, and the emanational system's central claim about graded derivation becomes

formulable in the analytic idiom. That is a research programme rather than a result, and I flag it as such.

CONCLUSION

The most consequential finding of this investigation is negative, so let me lead with it. The Aristotelian-Thomistic argument from essentially ordered series is not interpretation-neutral with respect to quantum mechanics, and the first hypothesis is confirmed: the standard formulation carries a tacit Derivational Sufficiency Requirement, and DSR is satisfied only by interpretations deterministic at the level of instrumental transmission, of which the survey found three among eight families (37.5%). Defenders who present the argument as resting on general metaphysical principles indifferent to the details of physics have, on this analysis, been mistaken about their own commitments — not about the argument's logic, but about what its central image of the borrowed stick presupposes. The second hypothesis is likewise confirmed within the scope examined: every one of the eight families sorts onto one of the three horns, with 25.0% on the second and 37.5% on the third, and the one family that resisted classification, Everettian many-worlds, resisted by dissolving the singular actuality the argument's conclusion concerns rather than by supplying a fourth option. I would not claim exhaustiveness beyond the extant landscape; a future interpretation could in principle escape, and I have tried to state DSR precisely enough that such an escape would be recognizable.

The third hypothesis is confirmed with a qualification that matters more than the confirmation. Weakening DSR to power-derivation preserves the argument's inference to a non-derivative source of causal power, since a series whose members' powers are all borrowed remains a series with no power at its root. What the weakening does not preserve is the inference to a first cause that determines the world's particular history, because that inference required outcome-derivation. The qualification is that this is not a small adjustment dressed up as a large one, nor a large loss dressed up as a small one: it relocates the argument's conclusion from providential determination to ontological sustenance, and a theology that needs the former will have to obtain it from elsewhere. Readers who find that unacceptable have, by the trilemma, only the first horn available, and the first horn is a wager on Bohmian mechanics or superdeterminism against the current inclination of the field.

The principal original contribution of this article is the identification of the instrumental underdetermination problem and the derivational trilemma it generates: a demonstration that the *per se* argument's characterization of intermediate members as pure instruments encodes a substantive commitment about physics, that the commitment fails under indeterministic interpretations, and that exactly three responses are available, each with a statable price. Alongside it stands the convergence argument between potentiality realism and the Thomistic account of secondary causation, which neither literature has previously noted and which supplies the second horn with more than an *ad hoc* weakening. The framework also brings a regional emanational tradition into contact with an analytic debate, showing it to be a variant second-horn position with a distinctive graded-derivation claim (Knežević, 2024a; Đukić, 2025).

Three implications follow for readers with different stakes. For philosophers of religion, the practical upshot is a disclosure requirement: an article defending or attacking the *per se* argument should state which interpretive commitments its treatment of intermediate causes presupposes, in the way a paper in the philosophy of physics states its interpretive framework as a matter of course. The absence of that convention is what allowed the question here to go unasked for as long as it did (Crull, 2023). For philosophers of physics, the result offers a use for the metaphysical-indeterminacy programme beyond its home territory: the determinable-based framework (Calosi & Wilson, 2019), its emergentist variant (Mariani, 2021), its degree-theoretic extension

(Nørgaard, 2025), and its modal refinement (Calosi, 2022) each yield a different verdict about what an intermediate cause transmits, and natural theology turns out to be an unexpected testing ground for those differences. For neo-Aristotelians, the finding is more uncomfortable: the tradition's own internal dispute about which items are substances (Koons, 2021; Simpson, 2021) determines the horn on which the argument lands, so that a question usually treated as a matter of taste in the ontology of nature has consequences at the top of natural theology.

Five limitations should temper all of this, and I state them as constraints I worked under. My competence in the formalism of quantum mechanics is that of a philosopher reading reviews, not that of a physicist reading papers, and the classifications in the survey rest on interpretive summaries whose accuracy I cannot independently verify (Schlosshauer, 2019; Oldofredi, 2025). The survey covers eight families and no more; QBism and epistemic readings in particular received less analysis than their prominence warrants, and a specialist would likely subdivide several of my categories. The classification was performed by one researcher, twice, and one family changed horns between passes, which is a small number to build percentages on and I would not defend the second decimal place. My reconstruction of the *per se* argument follows contemporary Thomists rather than the medieval texts, and a historian of medieval philosophy might reasonably object that Aquinas's own account of instrumental causality is more flexible than the reconstruction allows — Silva (2022) supplies some grounds for that objection, and I have not fully met it. Finally, the convergence argument between potentiality realism and Thomistic secondary causation is offered as a structural analogy, and structural analogies have a way of concealing disanalogies that only sustained formal work exposes.

Where should this go next? The most valuable next step would be a formal treatment: a modal or causal-model regimentation in which power-derivation and outcome-derivation are distinguished explicitly, so that the trilemma can be proved rather than surveyed. A second would be historical, asking whether Aquinas's own texts on instrumental causality require outcome-derivation or admit the weaker reading, since if the weaker reading is available textually then this article has recovered a position rather than proposed one. A third would extend the analysis to essentially ordered series in the philosophy of mind and to the emergence debates where Tabaczek (2021) works, since the question of what a higher level derives from a lower one has the same shape. Whether the experimental programme will eventually settle the trilemma by excluding the first or third horn is a question for physics, and the constraints now being placed on collapse models suggest it might (Carlesso et al., 2022). Until then, the argument's defenders would do well to say which horn they are on. Most, I suspect, do not yet know that they must choose.

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ESENCIJALNO UREĐENI KAUZALNI NIZOVI I KVANTNA NE- ODREĐENOST: ARISTOTELOVSKO-TOMISTIČKI ARGUMENT PRAUZROKA PRED NEDETERMINISTIČKOM FIZIKOM

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Sažetak: Aristotelovsko-tomistički argumenti za prauzrok počivaju na razlici između akcidentalno uređenih kauzalnih nizova, čiji članovi djeluju sukcesivno, i esencijalno uređenih nizova, čiji članovi djeluju istovremeno i u kojima posredni članovi vrše kauzalnu moć samo kao instrumenti koji tu moć izvode iz prethodnog člana. Kritičari ovih argumenata koncentrisali su se na pitanje okončanja regresa i na pitanje da li trajanje zahtijeva uzrok koji ga održava; gotovo niko nije upitao šta sama instrumentalna struktura zahtijeva od fizike. Ovaj članak postavlja to pitanje neposredno. Tvrdim da standardna formulacija per se argumenta nosi prećutnu obavezu koju nazivam Zahtjevom derivacijske dovoljnosti (DSR): da je sve što posredni uzrok doprinosi svom učinku u cijelosti izvedeno iz onoga što prima od prethodnog člana. DSR je trivijalno zadovoljen pod determinizmom, a netrivialno sporan pod svakom indeterminističkom interpretacijom kvantne mehanike. Na osnovu korpusa od trideset osam verifikovanih izvora objavljenih između 2019. i 2026. godine razvijam originalni doprinos članka: derivacijsku trilemu, prema kojoj branilac per se argumenta mora ili (i) vezati argument za determinističku interpretaciju i time izgubiti interpretacijsku neutralnost koju klasični teisti obično prizivaju, ili (ii) oslabiti DSR na izvođenje raspodjele propenziteta umjesto pojedinačnih ishoda, ili (iii) prihvatiti nesvodivo neizvedene prijelaze unutar same strukture koja je trebala eliminisati grube činjenice. Pregled osam interpretativnih porodica pokazuje da je trilema iscrpna nad postojećim opcijama, pri čemu 37,5% pada na prvi rog, 25,0% na drugi, a 37,5% na treći. Potom branim drugi rog kao najjaču raspoloživu poziciju i identifikujem konvergenciju, dosad neprimijećenu u obje literature, između propenzitetske indeterminističke fizike Del Santa i Gisina (2023) i tomističke razlike između primarne i sekundarne uzročnosti. Konvergencija ima određenu cijenu: tako oslabljen, per se argument daje održavaoca moći, a ne određivaoca ishoda. Emanacijska morfologija iz djela Prauzrok (Knežević, 2024a) razmatra se kao dodatan, strukturno različit način plaćanja te cijene.

Ključne riječi: *esencijalno uređeni kauzalni nizovi, per se uzročnost, kvantna neodređenost, prauzrok, instrumentalna uzročnost, propenzitet, aristotelovsko-tomistički argument, potencijalnost.*