

DEEP AND DEEPER DISAGREEMENTS IN METAPHYSICS OF SCIENCE

Desacuerdos profundos y muy profundos en Metafísica de la Ciencia

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Abstract

This paper bridges the epistemology of disagreement and metaphysics of science by advancing the idea that disagreements in scientific ontology can be understood as instances of deep disagreement exhibiting varying degrees of depth. We first establish the core features of deep disagreements and argue that standard accounts fail to accommodate their gradable nature. Taking the debate between empiricist and metaphysical stances in scientific ontology as a paradigmatic case, we show how this disagreement satisfies all criteria for deep disagreement. We then develop a framework, building on recent work in the epistemology of disagreement, showing how the depth of disagreements correlates with the generality of principles in conflict. Through a detailed case study of debates about modality in scientific ontology, we demonstrate three levels of depth: disagreements between perspectives (deepest), disagreements within perspectives about specific domains (intermediate), and disagreements within sub-positions (shallowest). This analysis reveals that deep disagreements in metaphysics of science are not monolithic but exhibit a rich structure that explains both their persistence and the differential progress possible across different debates. Our framework provides both theoretical insight into the nature of philosophical disagreement and practical guidance for understanding the limits and prospects of metaphysics of science.

Key words: Deep Disagreement; Metaphysics of Science; Scientific Ontology; Epistemic Perspectives; Modality.

Resumen

Este artículo conecta la epistemología del desacuerdo y la metafísica de la ciencia al proponer que los desacuerdos en ontología científica pueden entenderse como instancias de desacuerdo profundo que exhiben diversos grados de profundidad. Primero establecemos

las características centrales de los desacuerdos profundos y argumentamos que las explicaciones estándar fallan en acomodar su naturaleza gradual. Tomando el debate entre las *stances* empirista y metafísica en ontología científica como un caso paradigmático, mostramos cómo este desacuerdo satisface los criterios para ser considerado un desacuerdo profundo. Luego, basándonos en trabajos recientes en epistemología del desacuerdo, desarrollamos un marco teórico que muestra cómo la profundidad de los desacuerdos se correlaciona con la generalidad de los principios en conflicto. A través de un estudio de caso detallado de debates sobre modalidad en ontología científica, demostramos tres niveles de profundidad: desacuerdos entre perspectivas (más profundos), desacuerdos dentro de perspectivas sobre dominios específicos (intermedios), y desacuerdos dentro de sub-posiciones (menos profundos). Este análisis revela que los desacuerdos profundos en metafísica de la ciencia no son monolíticos sino que exhiben una estructura rica que explica tanto su persistencia como el progreso diferencial posible a través de diferentes debates. Nuestro marco proporciona tanto una perspectiva teórica sobre la naturaleza del desacuerdo filosófico como una orientación práctica para entender los límites y perspectivas de la metafísica de la ciencia.

Palabras clave: Desacuerdo profundo; Metafísica de la ciencia; Ontología científica; Perspectivas epistémicas; Modalidad.

1. Introduction

The metaphysics of science, like most areas of philosophy, is characterized by a series of disagreements and disputes. Some of these appear to have a somewhat superficial character within the general framework of metaphysics of science. For instance, among dispositionalist accounts of natural properties, Mumford (2004) argues that all properties should be regarded as dispositions, while Molnar (2003) considers some very specific cases (e.g. geometrical and spatiotemporal properties) can not be accommodated to the dispositionalist framework and must be thought of as categorical.

Other disagreements, however, appear to be much deeper. Some of these center on the very nature of metaphysics of science as a discipline—its objects, methods, and relationship to science itself. These disagreements seem to represent instances of radical disputes involving fundamentally different conceptions of what metaphysics of science is and how to generate warranted knowledge within it.

While there have been some systematic treatments of philosophical disagreements in the context of metaphysics of science, the specific notion of deep disagreement has not been sufficiently explored in this area. The epistemology of disagreement, by contrast, has given considerable attention to deep disagreements in recent years. This extensive literature, despite its internal differences, focuses on investigating disagreements that are

difficult or impossible to resolve, that are long-lasting and systematic, and that occur not due to misunderstandings or performance errors but are deeply rooted in central aspects of the epistemic lives of the disagreeing parties.

The primary objective of this work is to bridge these two areas of study by showing that some disagreements in metaphysics of science can be adequately understood as instances of deep disagreement. We take as our central case study the disagreement between empiricist and metaphysical stances or perspectives in the context of scientific ontology, this being a historically and conceptually central part of the development of contemporary metaphysics of science.

Characterizing disagreements in metaphysics of science as deep disagreements illuminates the nature of these disputes, their underlying dynamics, and the specific epistemic principles that generate them, as well as identifying which aspects might open paths for resolution or conciliation. In this sense, the metaphilosophical analysis of these disputes proves valuable for understanding the debates within metaphysics of science, its inherent limits, and its future prospects. At the same time, we expect that analyzing deep disagreements specific to metaphysics of science through the categories offered by the epistemology of disagreement will prove equally fruitful for the latter discipline, as these concrete cases provide rich material for testing and refining theories about the nature and varieties of philosophical disagreement.

In this context, a particularly important question concerns whether deep disagreements admit of degrees. Indeed, the very notion of *depth* suggests the possibility of gradation. Various authors have defended this idea and offered different approaches for determining such degrees. The analysis of deep disagreements in metaphysics of science provides a fruitful framework for understanding what occurs when deep disagreements exhibit different degrees of depth and for illustrating how these degrees manifest concretely in the context of scientific ontology. Thus, our analysis of deep disagreements in metaphysics of science also aims, reciprocally, to illuminate and refine the conceptual categories of the epistemology of disagreement employed throughout this work.

The paper proceeds as follows. In Section 2, we provide a comprehensive characterization of deep disagreements, examining their core features and the problem of accommodating degrees of depth. We justify our adoption of the epistemic principles framework for analyzing these disagreements. Section 3 examines the disagreement between empiricist and metaphysical stances in scientific ontology, demonstrating that it constitutes a paradigmatic case of deep disagreement. We show how this

disagreement satisfies all the criteria for deep disagreement and explain why it proves so persistent. In Section 4, we turn to the question of degrees of depth. Using disagreements about the ontological status of modality as a case study, we show how disagreements can occur even within a shared stance and demonstrate how differential application of shared epistemic principles leads to varying depths of disagreement. Finally, Section 5 draws together our conclusions about the nature of deep disagreements in metaphysics of science and their implications for both metaphysics of science and the epistemology of disagreement.

2. Deep Disagreement: Features and Gradability

In this section, we will present a comprehensive characterization of deep disagreements, paying special attention to the question of their gradability. As we will see, the ability to recognize degrees of depth in these disagreements is fundamental for developing a less idealized theoretical framework that is more suitable for analyzing real disputes in the metaphysics of science.

2.1 Core features of deep disagreements

The epistemology of disagreement has awakened growing interest in philosophical discussion in recent decades. In particular, special attention has been paid to how some persistent and seemingly superficial disagreements actually originate in deep disagreements that sink their roots into our belief systems and norms. The concept was introduced by Robert Fogelin in his 1985 work, where he used the qualification of “deep” to describe disagreements that have existed for a long time and whose resolution is simply impossible to achieve. The reason, according to Fogelin (1985, p. 5), is that deep disagreements are the result of a clash of framework propositions (cf. Pritchard 2011; 2021). These propositions are considered as “hinges” or “foundations” on which our beliefs and knowledge are built.

Other characterizations of deep disagreements focus not on foundational propositions but on the fundamental principles that articulate our epistemic lives. Lynch (2010) focuses on disagreements in which we can identify common goals alongside competing methods that are circularly justified and lack shared higher-order arbitration. Such disagreements, according to Lynch, are characterized by the adoption of different fundamental epistemic principles that can only be justified circularly.

Stemming from these main trends, Ranalli (2021) identifies two main theoretical frameworks for understanding deep disagreement: the Wittgensteinian theory and the theory of fundamental epistemic principles. According to the Wittgensteinian theory (Fogelin, 2005; Hazlett, 2014; Godden & Brenner, 2010), deep disagreements are about fundamental commitments or hinge commitments. These are commitments that fulfill a particular epistemic role: they are presuppositions upon which large parts of a worldview or a certain area of research rest. There are two main variants of this approach. According to certain positions (Wittgenstein, 1969 §§ 341-343; Pritchard, 2011, p. 528), our practice of giving and receiving reasons requires some presuppositions that are exempt from epistemic support. On this view, hinge commitments are not subject to rational evaluation but rather make possible the rational evaluation of other beliefs. According to other positions (Wright, 2004, 2014; Hazlett, 2014; Williams, 1991), hinge commitments may or may not be justified, but they exhibit a non-standard epistemic status whereby a subject is entitled by default to adopt such commitments insofar as they lack evidence or other indicators that the commitment is false or irrational.

The second theory maintains that deep disagreements are about fundamental epistemic principles. The distinctive characteristic of these principles is that it is not possible to offer reasons in their favor without presupposing the principle itself. In other words, any justification of a fundamental epistemic principle is ultimately epistemically circular: to justify the principle, one must apply it (Lynch, 2010). A fundamental epistemic principle is one that claims the reliability of basic methods that can not be defended without using that very method.

While both frameworks offer valuable insights, we will focus primarily on the epistemic principles approach, as it provides the most suitable theoretical tools for analyzing the specific types of disagreements found in the metaphysics of science. The epistemic principles framework captures an important feature of these disagreements: they are not only about factual beliefs, but also involve normative claims regarding the best methods to form such beliefs. As we will see, disagreements in scientific ontology arise from the adoption of conflicting epistemic perspectives or stances that centrally include different epistemic principles about which methods are reliable and what kinds of evidence are relevant in determining ontological commitments. When such disagreements persist and parties exchange reasons over time, the discussion often shifts to debates about which epistemic approach is most appropriate for the domain in question.

Contrary to Fogelin's seminal characterization, many approaches to deep disagreements present them as resolvable by rational means. Of

course the plausibility of this is closely tied to what counts as a resolution of a disagreement and as rational means. But just for the sake of simplicity let's assume as one of the central features of deep disagreements that they could be either hard or impossible to resolve by rational means depending on the circumstances.

Surveying the relevant literature, Ranalli (2021) also identifies four basic characteristics that deep disagreements exhibit:

Genuine disagreement: Deep disagreements constitute cases of genuine disagreement and not mere verbal disagreements or misunderstandings. Two subjects are in disagreement when they adopt incompatible doxastic attitudes toward the same proposition.

Reason-sensitivity: In deep disagreements, both parties seek to offer reasons in favor of their position, even when it may be disputed whether what they offer constitutes (or not), in effect, a genuine reason. They are active disagreements in which participants defend their positions and do so by what they consider rational means. In other words, they are not just reasoning past each other.

Systematicity: Deep disagreements do not put isolated propositions into play, but rather a set of interrelated propositions that form a perspective on the world or on a certain domain of inquiry. Although they may appear to start as a disagreement about a single proposition, they are actually about many related propositions, some of which are constitutive of the agent's worldview.

Persistence: Deep disagreements are persistent, that is, they are very difficult to resolve and usually long-lasting in time. This seems to be fundamentally due to the fact that, unlike what occurs with many ordinary disagreements, deep disagreements are not due to a cognitive failure or performance error on the part of any of the subjects involved. Their resolution (if there ever is one) is not as quick as in other disagreements, even when the parties are willing to reflect and listen to their opponents.

Other features have been highlighted in the literature. Pritchard (2023) takes as central the fact that deep disagreements are both objectively weighty and of great subjective import to the parties involved. These and other similar features are perhaps difficult to define precisely across different domains of discourse but, more importantly, are not central to the task of investigating the nature of persistent disagreements within the metaphysics of science. We therefore take these four characteristics as the desiderata that any adequate theory of deep disagreement must be able to explain.

2.2 *The problem of degrees*

Having established these core features, we must address a puzzling aspect of deep disagreements as they appear in philosophical practice. While Fogelin and Lynch provide compelling accounts of what makes certain disagreements “deep,” their frameworks struggle with a phenomenon that practitioners regularly observe: not all deep disagreements seem equally deep. Some appear more entrenched and fundamental than others, suggesting that depth itself might be a matter of degree rather than an all-or-nothing property.

This observation is particularly relevant for metaphysics of science, where we find a spectrum of disagreements ranging from relatively tractable disputes about specific theoretical details to seemingly intractable conflicts about the very nature of scientific knowledge. Understanding this gradability is not merely a theoretical nicety—it has practical implications for how we approach different debates and calibrate our expectations for philosophical progress.

As Aikin (2019) observes, the very concept of depth is a gradable one. If, when speaking of deep disagreements, we intend to use the term “deep” as we do in ordinary talk, it is easy to see that disagreements can be more or less deep. However, both Fogelin’s and Lynch’s frameworks describe deep disagreements in ways that fail to adequately capture graduality.

In Fogelin’s case, deep disagreement is characterized as contexts in which there is not enough common ground for argumentative practices and hence it is impossible to achieve a resolution by rational means. What sets apart deep disagreements from normal contexts is this impossibility, and there are no degrees of possibility.

In Lynch’s account, degrees of depth can hardly be conceived, as it claims that a disagreement is deep when the parties adopt different, incompatible fundamental epistemic principles. And a fundamental principle is one that can only be defended in a circular way, which means that a principle being fundamental is determined by whether non-circular reasons are possible. Again, possibility has no degrees. According to this view, either an epistemic principle is fundamental or it is not. And either the parties to a disagreement adopt different fundamental epistemic principles or they do not.

If we stick to these classical notions, we struggle to find cases of deep disagreement in the real world. Meanwhile, as we depart from this over-idealized notion, we find that many disputes exhibit the features of deep disagreements and thus could and should be regarded as deep disagreements. However, we also find that some of them seem to be deeper

than others. This intuitive gradability is not merely a theoretical nicety—it reflects the actual structure of debates in metaphysics of science, where disagreements clearly vary in their depth and fundamental character. Any adequate theory of deep disagreement must be able to account for these degrees of depth.

3. Deep Disagreement between Epistemic Stances in Scientific Ontology

Metaphysics of science is a relatively autonomous field of knowledge that emerged from the convergence of philosophy of science and analytic metaphysics over recent decades. At its core, it seeks to develop scientifically informed metaphysical proposals while using metaphysical analysis to elucidate scientific concepts. This dual mission—grounding metaphysics in science while clarifying science through metaphysics—has generated fundamental disagreements about the field's proper methods, scope, and epistemic standards.

Different approaches to naturalistic metaphysics already hint at different underlying epistemic commitments. Some philosophers, like Ladyman and Ross (2007, p. 65), advocate for metaphysics to be “derived from” science, suggesting that metaphysical problems can be solved through sufficient knowledge of the relevant science. Others, like Paul (2012, p. 5), see science and metaphysics as sharing methodology but addressing distinct questions, with metaphysics focusing on features that are “metaphysically prior” to scientific accounts. Still others, following Stanford (2017, p. 137), conceive of metaphysics of science as applying metaphysical tools to articulate the content scientific theories already possess. What unites these approaches is their content naturalism—the conviction that metaphysical theories should not conflict with our best scientific theories (Emery, 2023). Yet crucially, these different conceptions already reveal fundamental disagreements about the appropriate methods and epistemic standards for developing a scientifically informed metaphysics.

A fundamental and historically foundational area of inquiry within the metaphysics of science is what is usually called *scientific ontology*—that is, philosophical reflection on what ontology we should “read” from our best science. On the one hand, its historical importance stems from the fact that many contemporary debates in the metaphysics of science are outgrowths of the seminal debates over scientific realism that inaugurated what Psillos (2020) calls *the realist turn in the philosophy of science*. The development of many topics of great importance to contemporary debates in the metaphysics of science, such as issues around dispositions, causality,

and *de re* modality, among others, arose in the context of developing varieties of selective realism. On the other hand, scientific ontology is, conceptually speaking, a central part of the metaphysics of science, which has as a central task the assessment of the ontological commitments that it is rational to assume in light of our best science. This is, of course, not the only task of the metaphysics of science, but most of what the discipline does is directly related to scientific ontology. One possible exception is reflection on the fundamental ontological category one should adopt according to our best scientific theories. Perhaps debates over how reality is structured with regard to the notion of fundamentality could exceed in part the limits of scientific ontology. But even if that is the case, they are for obvious reasons indirectly related to scientific ontology (e.g., debates on *fundamentalism* are, after all, about the existence of a fundamental level of reality), and the questions pursued in these debates are discussed by authors largely devoted to issues in scientific ontology. So, both in conceptual and disciplinary terms, scientific ontology is a major part of the metaphysics of science.

The thematic agenda of this field is traversed by various disagreements that, according to the characterization presented in the preceding section, we will characterize as deep disagreements. Among them stands out a radical disagreement about the necessity and viability of metaphysical reflection about science—a disagreement that puts the very project of a metaphysics of science in check. This is the dispute between scientific realists and empiricists.

Chakravartty (2017) reconstructs this dispute as a disagreement between *epistemic stances* about scientific ontology, a notion previously advanced in the works of van Fraassen (2002). According to Chakravartty, “a stance is an orientation, a set of attitudes, commitments and strategies relevant to the production of supposedly factual beliefs” (2017, p. 47). Stances play a central role in determining the resulting doxastic attitude toward a proposition, since “it is the stance that is adopted that determines where the line between belief and suspension of judgment is to be drawn” (2017, p. 218).

In Chakravartty’s reconstruction of the dispute, the *empiricist stance* (characteristic of van Fraassen’s anti-realist view of science) has among its founding epistemic principles the rejection of the demand for explanation of observable phenomena, especially explanations in terms of unobservable entities. Parsimony is one of its central values; thus, the epistemic policies of this position tend to be conservative and imply rejecting with the same rigor explanations that involve electrons, fields, or dementia as those that appeal to *de re* modality or possible worlds. The main goal is empirical

adequacy—truth about what is observable (or isomorphism between the relevant models).

On the contrary, the *metaphysical stance* (corresponding to realist approaches to scientific ontology) has explanatory power as one of its central epistemic values. Those who adopt this stance are usually willing to take more epistemic risks to believe the truth, which results in more liberal epistemic policies. The central epistemic principle of the metaphysical stance prescribes pursuing explanations of observable phenomena in terms of unobservable entities, and their ontological commitments can get as far as involving commitments to de re modality or possible worlds.

Several related notions in the literature capture similar ideas about these fundamental epistemic orientations. Goldman (2010) developed the notion of epistemic system (E-system), while we have previously introduced the notion of epistemic perspective (Borge & Lo Guercio, 2021; Borge, 2021). For the purposes of this paper, we treat epistemic stances and epistemic perspectives as functionally equivalent, though we retain the terminology of ‘perspectives’ because our framework offers a more detailed account of how epistemic principles, values, and goals interact—theoretical machinery that will prove essential when analyzing degrees of depth in Section 4.

An epistemic perspective is a norm that determines the maximally rational doxastic attitudes toward a proposition based on a given body of evidence, a certain hierarchy of theoretical virtues, and a set of epistemic goals. These perspectives consist of epistemic policies oriented toward achieving the fundamental goals of *believing what is true* and *not believing what is false*. Following William James, these twin epistemic goals do not determine a unique policy. The differential weighting of these goals is closely connected to an agent’s hierarchy of epistemic values: those who prioritize values like certainty and error-avoidance naturally emphasize *not believing what is false*, while those who value explanatory power and theoretical comprehensiveness tend to prioritize *believing what is true*. These different hierarchies of values, in turn, generate different epistemic policies—conservative perspectives favor suspension of judgment until conclusive evidence appears, while liberal perspectives are more willing to form beliefs based on available evidence. Importantly, there is no privileged ordering of these goals or values in terms of rationality—both approaches can be maximally rational.

Epistemic perspectives exhibit three key features. First, they determine rational doxastic attitudes as a function of evidence, values, and goals. Second, they are *fundamental* in Lewis’s (1971) sense: it is impossible to justify or fully epistemically evaluate a fundamental perspective without presupposing that very perspective. This makes them *immodest*—they

self-evaluate as at least equal to any incompatible perspective. Third, they are empirically indefeasible, as agents can not recognize empirical evidence against their perspective's reliability. This framework illuminates how epistemic peers can rationally disagree: when agents adopt different perspectives or apply them differently, they may reach opposing conclusions without error.

The fact that we use the framework of epistemic perspectives as equivalent to epistemic stances requires an important clarification. In the original formulation, dealing with peer disagreement (Borge & Lo Guercio, 2021; Borge, 2021), the perspective framework entertained the possibility that two agents could rationally form and maintain steadfast doxastic attitudes even when one believes P and another believes $\sim P$. As Chakravartty (2024) correctly points out, this could drive the framework dangerously close to epistemic relativism. While it is possible to argue against this charge, we here adopt a restricted account of perspectives that avoids this concern entirely. Under this restriction, epistemic perspectives license only two doxastic attitudes: (1) acceptance in terms of belief, and (2) rejection in terms of suspension of judgment. This eliminates scenarios where contrary beliefs about the same proposition are both deemed rational. Instead, disagreements between rival perspectives manifest as cases where one perspective accepts a proposition as belief-apt while another rejects it as unsuitable for belief.

Epistemic perspectives can be understood as comprehensive epistemic frameworks that include multiple epistemic principles working together. Each perspective has a characteristic epistemic principle at its core: the metaphysical perspective accepts explanations of observable phenomena in terms of unobservable items, while the empiricist perspective rejects demands for explanation of observable phenomena in terms of unobservable items. However, as we saw in Section 2, epistemic principles guide but do not fully determine our epistemic actions—they interact with other elements in an agent's perspective. These principles are embedded within epistemic perspectives that include a set of hierarchically ordered values oriented towards the achievement of preferred epistemic goals.

The empiricist perspective prioritizes avoiding allegedly unnecessary ontological commitments, focusing on not believing what is false, while the metaphysical perspective prioritizes explanatory power, bringing it closer to the goal of believing what is true. These different hierarchies of values, combined with their characteristic epistemic principles, result in radically different approaches to scientific ontology.

3.1 The disagreement as deep disagreement

A disagreement of this type, foundational with respect to various subsidiary disputes in metaphysics of science, brings together the features of a deep disagreement. Let us trace each characteristic identified in Section 2:

Genuine disagreement: The parties adopt incompatible doxastic attitudes toward a broad set of propositions that demarcate different boundaries of ontological commitment. While a realist would unhesitatingly subscribe to various existential statements about the unobservable entities postulated by our best theories, an empiricist would lean toward suspension of judgment regarding the same propositions. It is, therefore, a genuine disagreement about factual matters.

Reason-sensitivity: The very history of the debate originated by this disagreement shows that the parties are sensitive to reasons. The formulation of new and better arguments within each of the stances has led both empiricism and realism to rethink several of their fundamental notions and even to formulate refined versions of their original positions. On the flank of the metaphysical stance, for example, the reception of arguments in favor of empiricism led to the formulation of selective variants of scientific realism capable of successfully accommodating anti-realist objections.

Systematicity: The disagreement between realists and empiricists does not put isolated propositions into play, but rather a set of interrelated propositions that form a perspective on the field of scientific research and its rational reconstruction by philosophy. The dispute encompasses not just specific ontological commitments but entire frameworks for understanding the aims and methods of science, which include normative claims about the right way to achieve this understanding and to evaluate the debate itself.

Persistence: Various authors have pointed out that the dispute is persistent, and have even shown concern about it. Cases of disagreement generated by the adoption of conflicting stances seem to be clear examples of the type of disagreement that is not produced either by the epistemic superiority of one of the participants or by differences in the evidence considered or its evaluation. Furthermore, they represent the type of circumstance in which disagreement can not be attributed to the adoption, by one of the participants, of a doxastic attitude that is not maximally rational. Given the characteristics of this type of disagreement, controversies about the existence of the most basic entities postulated by science (e.g., electrons or electromagnetic forces) seem doomed to remain unresolved from a trans-stance perspective. As Chakravartty (2017, p. 203) highlights:

“the resulting impasse between different conceptions of scientific ontology is philosophically insurmountable.”

To understand why this constitutes a deep disagreement, we can draw on the framework of Strong Peer Disagreement (SPD) developed in previous work (Borge & Lo Guercio, 2021). This framework distinguishes between strong epistemic peers (who share similar epistemic perspectives) and weak epistemic peers (whose perspectives diverge or who apply similar perspectives differently). Strong epistemic peers are agents who have (approximately) the same epistemic virtues, possess (approximately) the same relevant information, and whose epistemic perspectives are sufficiently similar, applying their epistemic perspectives in approximately the same way. Weak epistemic peers, by contrast, share the first two characteristics but their epistemic perspectives are relevantly divergent, or they apply the norms of their epistemic perspectives differently. Importantly, the SPD framework is particularly well-suited to philosophical disagreements, where it is reasonable to assume that all participants in the debate possess comparable epistemic virtues and have access to the same relevant evidence—making them epistemic peers in the traditional sense, even as they diverge in their epistemic perspectives. The possibility of SPD arising from scenarios in which similar perspectives are applied in sufficiently distinct ways will be central to our characterization of degrees of deep disagreement in the next section (see especially Section 4.2.1 on differential application).

The disagreement between epistemic perspectives within scientific ontology is a paradigmatic case of SPD—a disagreement between weak epistemic peers whose different epistemic perspectives lead them to incompatible conclusions despite shared evidence. The dispute emerges not because of any failure in performance or differences in evidence taken into consideration; rather, both agents prioritize different theoretical virtues and epistemic goals, accept different methods for weighing evidence or divergent explanatory demands. This classification helps us understand why the disagreement persists: as we established in Section 2, when epistemic principles are embedded in different perspectives with different values and goals, they can lead to radically different epistemic actions even when the agents are equally competent and have access to the same evidence.

Recognizing this disagreement as a deep disagreement—specifically as a case of SPD—explains why progress in these debates often seems frustratingly slow despite the sophisticated arguments developed by both sides. Since the disagreement originates at the level of fundamental epistemic values and policies, no amount of first-order evidence or

argumentation can decisively settle the dispute. The underdetermination of epistemic actions by principles alone means that even shared evidence will be interpreted differently through the lens of each stance. Moreover, it illuminates why attempts at “neutral” arbitration between realist and anti-realist positions consistently fail: there is no stance-independent perspective from which to evaluate the competing claims, as any evaluation must itself proceed from some epistemic stance.

Perhaps most importantly for our purposes, this analysis reveals that deep disagreements in metaphysics of science are not monolithic. While the disagreement between stances represents a particularly deep form of disagreement, deep disagreements admit of degrees—a point we will explore further by examining disagreements within stances. The fact that disagreements can occur not only between stances but also within them suggests a more complex landscape of epistemic variation. This observation motivates our examination of degrees of depth in the following section, where we will see how even philosophers sharing the same broad stance can find themselves in deep disagreement about specific metaphysical issues. The persistence and systematic nature of the stance disagreement, combined with its satisfaction of all the criteria for deep disagreement, establishes it as a paradigmatic case in the metaphysics of science. However, as we will see, this is just the beginning of a more nuanced story about the varieties and degrees of deep disagreement in this field.

4. Degrees of Depth in Disagreements about Scientific Ontology

The disagreement between proponents of the metaphysical perspective and the empiricist perspective, exhibits, as we saw in the preceding section, the characteristics of a deep disagreement. Within the framework of epistemic perspectives, this set of characteristics can be explained by the adoption of divergent perspectives—that is, perspectives that include conflicting epistemic principles associated with hierarchies of epistemic values that either include different values or assign differential weight to the epistemic values in play.

More precisely, the notion of SPD allows us to account for scenarios in which a steadfast attitude is rationally permissible for both parties to the disagreement. This explains the persistence of such disagreements even in contexts where both parties are committed to rational discourse and engage in careful examination of reasons and evidence—the disagreement persists not because of any epistemic failure, but because both positions remain rationally tenable given their underlying epistemic perspectives.

However, as we have seen, such disagreements arise not only when parties adopt divergent epistemic perspectives, but also when agents who share the same epistemic perspective apply it differently to specific domains. This possibility suggests that degrees of deep disagreement exist. It is reasonable to think that a disagreement resulting from the differential application of a shared epistemic perspective represents a lesser degree of depth than one arising from fundamentally opposed perspectives. In other words, if two agents who disagree due to different applications of their shared perspective were to adopt genuinely rival perspectives, their disagreement would become even deeper. This graduated conception of depth aligns with the case discussed in the previous section and will be formalized through our analysis below (Section 4.2.2).

In light of these considerations, this section examines a concrete case study of central importance in the metaphysics of science: the debate over objective modality in scientific ontology. This case allows us to illustrate the distinction between deep disagreements arising from rival epistemic stances and those resulting from differential applications of shared perspectives. We will then analyze this case through the lens of Serebrinsky's (2025) framework to demonstrate how deep disagreements in the metaphysics of science exhibit degrees of depth.

4.1 Case study: Modality in scientific ontology

4.1.1 Modality within the metaphysical perspective

The question of modality's ontological status is central to articulating coherent positions in the metaphysics of science. Modal features of the natural world—what is possible, necessary, or contingent—underpin crucial scientific practices including inference, modeling, and extrapolation. This question is particularly important for one of the most active areas of debate in the metaphysics of science: determining the metaphysical status of laws of nature (cf. our earlier discussion of the Humean-governing debate in Section 2.2).

This debate extends naturally from disputes about scientific realism. If our best scientific theories provide approximately true descriptions of both observable and unobservable aspects of reality, what specifically do laws tell us about the world's structure? More crucially, how can we distinguish genuine laws of nature from mere accidentally true generalizations?

The intuitive distinction rests on explanatory and inferential power: unlike correlations that capture spurious coincidences between phenomena, authentic laws identify stable features of reality that, under

appropriate conditions, reliably support inferences, modeling practices, and explanations.

Within the metaphysical perspective, accounting for science's epistemic success requires accepting explanations that invoke unobservable entities. This commitment reflects the high priority this perspective assigns to explanatory power within its hierarchy of epistemic values. These unobservable entities include familiar theoretical posits like electrons, mitochondria, and forces—that is, entities that are immediate objects of scientific discourse. The crucial question for modality within the metaphysical perspective is whether this commitment suffices or accounting for the nomological stability of laws requires additional ontological commitments—crucially, a commitment to objective modality in the form of necessary connections in nature. While the metaphysical perspective permits—and even encourages—robust ontological commitments that could extend to embracing objective natural necessity, Humeans contend that such commitments are philosophically unnecessary.

The Humean conception of reality presents the universe as a vast mosaic of particular instances of categorical properties—in David Lewis's memorable phrase, *one little thing and then another*. Within this framework, the truthmakers for natural laws are nothing more than stable patterns of regularity within the mosaic itself. These regularities provide whatever nomological stability laws possess, without requiring any appeal to necessary connections in nature. Despite this ontological austerity, Humean positions maintain that we can still draw a meaningful distinction between genuine laws and mere accidentally true generalizations. The most sophisticated articulation of this view appears in the Best Systems Account (BSA).

The BSA offers precise criteria for lawhood: a regularity counts as a genuine law only if it appears as an axiom or theorem in the deductive system that best systematizes all truths about the world. “Best” here means achieving an optimal balance between two competing theoretical virtues—explanatory strength and systematic simplicity. Not every true generalization qualifies as a law under this account; only those embedded within the most theoretically virtuous systematization of all facts earn this status. While the BSA has generated considerable debate and faces various objections (see Loewer, 1996), our focus here is on how this Humean approach addresses the challenge of modality within the broader metaphysical perspective.

From the Humean perspective, modality presents primarily a semantic rather than an ontological challenge. Scientific theories and laws routinely employ modal vocabulary, and possible worlds semantics

provides the tools needed to interpret these statements, assign them truth conditions, and understand the practices they enable. What Humeans reject is any ontological commitment to objective necessity in nature, particularly the postulation of laws as mind-independent entities. This semantic approach does not abandon the explanatory power of laws and modal discourse. Rather, by treating modality as a linguistic phenomenon, Humeans can characterize laws as a distinguished class of statements that earn their special status precisely through their role in the optimal systematization of worldly facts—combining maximal explanatory power with theoretical simplicity. Genuine laws retain their explanatory efficacy under this treatment. Unlike accidental generalizations, they remain suitable for explanations, inferences, predictions, and modeling practices. The crucial Humean insight is that we can preserve all these epistemic benefits without postulating necessary connections in nature. This places Humeanism in direct opposition to necessitarianism, the doctrine that objective necessity exists in the natural world.

Necessitarian positions share a commitment to de re modality but face the Placement Problem: where exactly does modality reside in our ontology? As Vetter (2009, p. 6) notes, anyone who thinks modal statements are true in virtue of features of the actual world must somehow include unrealized possibilities in actuality. This generates the central challenge of identifying what ontological machinery can bear this modal burden.

Governing theories offer one prominent solution to the Placement Problem by locating modality in laws conceived as genuine ontological entities. On this view, natural regularities require explanation through the postulation of laws as mind-independent features of reality. In the DTA theory laws are complex entities consisting of second-order universals (relations of nomic necessitation) that hold between first-order universals (natural properties), which are themselves instantiated in particular states of affairs.

The governing metaphor is central: these law-entities literally govern the natural world by producing the regularities we observe. Unlike the Humean picture where regularities are ontologically basic, governing theories reverse the explanatory priority. Laws are the fundamental entities that generate regular patterns through their governing relation to particular instances. This makes laws, rather than regularities, the primary source of natural necessity. The modal facts about what must happen, what can happen, and what can not happen all derive from the governing activity of these higher-order entities.

Dispositionalism offers a competing necessitarian solution. Mumford (2004) argues that governing theories face a fatal dilemma: laws

can not effectively govern their instances whether conceived as external or internal to them¹. This leads dispositionalists to relocate modality from laws to properties themselves. On this view, fundamental properties are intrinsically dispositional—they are essentially characterized by their causal powers and dispositions to behave in certain ways under specified conditions. These “powerful properties” are self-governing in the sense that their modal character is built into their very nature, eliminating the need for external governing entities. Dispositions can thus ground nomological stability and support law-like generalizations without requiring either Humean regularities or governing universals.

While Mumford’s detailed arguments for each horn of the dilemma extend beyond our scope here, the core insight drives dispositionalism’s appeal within the metaphysical perspective. If governing theories fail to deliver genuine explanation—the central value of this perspective—then they become ontologically dispensable. Properties with intrinsic causal powers offer a more economical and theoretically satisfying account of the modal structure that science reveals.

Debates surrounding modality, and specifically those associated with the metaphysical discussion of laws, exhibit the characteristic features of deep disagreements. They constitute genuine disagreements about factual matters (whether objective modality exists and where it resides), they are reason-sensitive (with extensive philosophical argumentation on all sides), they are systematic (encompassing broader questions about explanation, causation, and scientific ontology), and they are notably persistent despite decades of sophisticated debate.

Crucially, all participants in these debates operate within the shared framework of the metaphysical perspective. They are scientific realists committed to accounting for science’s epistemic achievements through robust ontological commitments. Yet they disagree fundamentally about how to understand modality within this shared framework.

For Humeans, modality presents essentially a semantic rather than ontological challenge, requiring no commitment to necessitarianism. They argue that we can fully account for modal discourse, scientific practices, and the predictive power of laws without postulating necessary connections in nature. Importantly, this position does not reflect greater ontological parsimony—a characteristic more typical of empiricism. Indeed, some

¹ The core of the argument is that if laws exist as entities external to their instances, they lack the efficacy needed to govern those instances—how can something wholly separate from a particular event control its behavior? Conversely, if laws are internal to their instances, they can not govern in any meaningful sense, if they collapse in their instances, instances are thus governing themselves, and laws play no role.

Humeans like Lewis embrace extravagant ontological commitments to infinite concrete possible worlds and complex property classifications. The driving consideration is not parsimony but explanatory adequacy.

From the Humean perspective, supervenience provides the most explanatorily powerful account of modal phenomena and scientific practice. Laws retain their explanatory force not through governing relations but through their role in the optimal systematization of facts—the best system that balances simplicity and explanatory power. This preserves laws' epistemic utility while avoiding metaphysically problematic commitments.

Necessitarians, equally committed to scientific realism, reject Humean regularism as explanatorily inadequate for capturing scientific practice. However, they differ among themselves about where to locate the source of modality's explanatory power. Governing theories place it in complex ontological structures—universals that govern natural regularities through necessitation relations. Dispositionalists reject such structures as explanatorily irrelevant, proposing instead that modality resides in the intrinsic causal powers of properties themselves.

This pattern reveals something crucial about the nature of this disagreement. The dispute does not stem from adopting divergent epistemic principles or assigning different weights to fundamental epistemic values. Rather, it emerges from differential applications of shared principles and values to the specific domain of modality. All parties prioritize explanatory power and accept robust ontological commitments when warranted, but they disagree about what explanatory adequacy requires in this particular case.

4.1.2 Modality in the empiricist perspective

Empiricism in the philosophy of science emerged as an attempt to recover central insights from Hume's modern empiricism, particularly its anti-metaphysical orientation and the foundational principle that all legitimate knowledge must originate in experience. These ideas found systematic expression in the Vienna Circle's logical empiricism and later in van Fraassen's constructive empiricism, though with important modifications.

Two modifications prove particularly relevant here. First, van Fraassen adopted a common-sense realism that, as he acknowledges, departed from traditional empiricist commitments (see van Fraassen, 2003, p. 479). Second, and more fundamentally, empiricism was reconceptualized not as a doctrine but as an epistemic stance whose constitutive principle is the rejection of explanations of observable phenomena in terms of

unobservable entities. This principle preserves the Humean heritage by granting epistemic legitimacy only to knowledge derived from sensory experience.

Consistent with this Humean foundation, logical empiricism and constructive empiricism reject objective necessity in nature. Van Fraassen argues that genuine necessity is purely logical—the apparent distinction between physical laws and accidental facts reflects not objective features of reality but distinctions made relative to theoretical contexts. By treating statements of physical necessity as indexical expressions, he provides a framework where they can be understood as forms of conditional logical necessity, dissolving the need for “real necessities” in the world (van Fraassen, 1977). Given this traditional empiricist hostility to objective modality, one might expect metaphysical discussions of modality to be entirely absent from this perspective.

However, contemporary developments within empiricism challenge this expectation. A particularly striking case emerges in the work of Otávio Bueno and Scott Shalkowski (2015, 2023), who defend what they call “modalism”—the view that modality is a primitive, irreducible feature of reality. According to modalism, modal facts are basic features of the world that can be known through experience, requiring no reduction to non-modal facts.

Modalism offers an elegant solution to the Placement Problem that has troubled necessitarian approaches. Rather than locating modality in subsidiary categories like dispositions, laws, or universals, modalism treats modality as attached directly to fundamental ontological categories like objects or facts themselves. This eliminates the complex metaphysical machinery that other approaches require, though at the cost of declaring modality primitive.

The crucial question for empiricists is epistemological: can primitive modality be captured directly through experience, or must it be established through metaphysical inference? Bueno and Shalkowski argue for the former, claiming that modal properties are “nothing but features of objects; perfectly ordinary, observable features at that” (2023, p. 99). On their view, “Modal knowledge is an extension of knowledge of actual properties that objects have and how these properties change under changing circumstances. Knowledge of possibility arises from knowledge of actuality. Testing limits is testing the possible. Knowledge of the necessary results from what is precluded from such variations” (2023, pp. 99).

This empiricist modalism faces significant challenges. While some modal knowledge seems experientially grounded—experiencing someone’s presence in a room provides knowledge that her presence there

is *possible*—other cases prove more problematic. We know it's possible for someone to run 100 meters in 9.57 seconds even without witnessing such a performance. Similarly, the necessity that ice melts when heated seems difficult to derive from direct experience in any non-inferential way.

Bueno and Shalkowski respond that knowledge of necessity can emerge from identifying modal features that remain invariant across empirical testing. Yet this conflicts with a long empiricist tradition, exemplified by Hume and van Fraassen, that rejects direct perception of possibility and necessity. Even van Fraassen's common-sense realism explicitly excludes commitment to objective de re modality.

Importantly, the disagreement between Bueno's empiricist modalism and traditional empiricist approaches does not concern fundamental epistemic principles. Both accept empiricism's core commitment to rejecting explanations of observable phenomena through unobservable posits. Both endorse ontological parsimony as a guiding value and resist elevating explanatory power within their epistemic hierarchy. The dispute centers instead on how these shared principles apply to the specific domains of modality and experience.

While both approaches agree that metaphysical or nomological modality lacks epistemic warrant, they diverge regarding physical modality. Bueno argues that physical modality can be directly captured in experience as an ordinary, observable feature of objects. When one experiences a table, one apprehends not only its shape, color, and rigidity, but also its modal properties—its breakability bears the same observational status as its blueness or coldness.

This reveals the disagreement's true character: it concerns not the adoption of rival epistemic principles or different weightings of epistemic values, but rather the differential application of shared principles to specific domains. The debate between van Fraassen and Bueno exemplifies disagreement within a shared epistemic perspective about how that perspective's commitments extend to particular cases—in this instance, determining what counts as observable or knowable through sensory experience.

4.2 *Analyzing degrees of depth*

4.2.1 *From fundamental to domain-specific principles*

Both the metaphysical and empiricist perspectives in scientific ontology share certain epistemic principles that underpin all scientific inquiry. These include commitments to logical consistency, respect for

empirical evidence, and the general reliability of observation under appropriate conditions. Even the most ardent scientific realist and the most cautious empiricist agree that our scientific theories must be logically coherent and that observational evidence plays a crucial role in theory evaluation. Still, as we have highlighted, within debates on scientific ontology, they adopt opposing principles. This suggests that for epistemic principles, fundamentality is domain-relative. Both perspectives share common principles in the wider domain of scientific inquiry but incompatible principles in the restricted domain of scientific ontology.

Yet, not all proponents of a perspective apply its core principles in the same way. The case study examined in the previous section suggests that these principles can be applied differently in subdomains, among other reasons, based on differing value assessments.

In other words, these fundamental principles significantly underdetermine the specific epistemic actions agents perform in particular domains. The key insight is that agents derive domain-specific principles from fundamental ones through a process of differential application. This can be clearly seen in the case study on modality.

Within the metaphysical perspective, for example, all proponents share the central principle of accepting explanations in terms of unobservable entities to account for the success of science. However, they apply this principle in very different ways when confronting the problem of modality. Proponents of governing theories apply the principle by positing that laws of nature are complex, unobservable universal entities that “govern” phenomena. Meanwhile, dispositionalists, judging such governing laws to lack real explanatory power, apply the same principle but locate modality in the dispositions or “powerful properties” intrinsic to objects—another type of unobservable. Humeans, in turn, apply the principle differently still: they argue that the best explanation does not require positing unobservable modal entities, but is rather found in the simplicity and strength of the “best system” describing the mosaic of observable events, thereby avoiding a commitment to de re necessity.

Similarly, within the empiricist perspective, the fundamental principle of rejecting explanations of observable phenomena in terms of unobservable entities is applied differently in the discussion about modality. Classical empiricists like van Fraassen apply this principle strictly, arguing that physical necessity is not an observable feature of the world, and therefore we should suspend judgment about its existence. In contrast, empiricist modalists like Otávio Bueno apply the same core principle but argue for an expanded scope of the “observable,” claiming that modal properties like an object’s fragility can be known through experience.

Thus, for them, accepting modality does not violate the empiricist tenet, as it is not an unobservable posit to explain the observable, but an observable feature in its own right.

Our framework illuminates how this differential application operates. As we have shown elsewhere (Serebrinsky, 2025), two agents A and B that adopt an epistemic principle P0 for a domain D can derive, from that principle, different epistemic principles P1 and P2 for a subdomain d. A and B will then disagree about propositions about d, although they adopt the same principle P0 for the broader domain D. This is because epistemic principles guide but not fully determine epistemic action. While P0 interacts with other states of A and, by doing so, justifies the derivation of P1, the same principle P0 interacts with other states of B (some of which are different from the relevant states of A) and, by doing so, justifies the derivation of P2.

4.2.2 Mapping degrees of depth in the modality debate

The modality debate in scientific ontology perfectly illustrates our thesis about degrees of depth. We can map three distinct levels of disagreement, each exhibiting different degrees of depth based on the generality of the principles in conflict within the domain of scientific ontology.

First level (deepest): The disagreement between metaphysical and empiricist stances represents the deepest form of disagreement. Here, the conflict involves fundamental epistemic principles about the legitimacy of explanations invoking unobservables and incompatible hierarchies of epistemic values. The metaphysical stance's principle of pursuing explanations of observable phenomena through unobservable entities directly conflicts with the empiricist stance's principle of rejecting such explanatory demands. This results in radically different epistemic actions: where one stance sees a domain suitable for belief formation, the other prescribes suspension of judgment. The disagreement encompasses the broadest possible domain—the entire scope of scientific ontology.

Second level (intermediate): Within each stance, disagreements about modality exhibit an intermediate degree of depth. These disputants share fundamental principles and core epistemic values but differ in their application to the specific domain of modal properties.

Within the metaphysical stance, Humeans and necessitarians agree that explanatory power justifies robust ontological commitments, but they disagree about what explanatory adequacy requires regarding modality. Both accept that “we should believe in those entities that best explain scientific success,” but Humeans judge that regularities suffice for

explanation while necessitarians insist that genuine explanation requires necessary connections. Similarly, within the empiricist stance, traditional empiricists and modalists like Bueno share the principle of restricting belief to what can be known through experience, but they disagree about whether modal properties fall within experience's scope.

These disagreements are less deep than stance-level disagreements because they involve smaller domains—not all of scientific ontology, but specifically the ontological status of modality. The shared fundamental principles provide some common ground that is absent in trans-stance disagreements.

Third level (shallowest): The most localized disagreements occur within sub-positions, such as the dispute between Armstrong and Tooley about universals within the governing theory framework. Both accept not only the metaphysical stance's fundamental principles but also the domain-specific principle that laws are best understood as relations between universals. Their disagreement concerns an even more restricted domain: whether these universals can exist uninstantiated. While philosophically significant, this represents a shallow disagreement relative to the broader framework of scientific ontology—it touches neither fundamental epistemic principles nor their application to modality generally, but only a specific question within an already accepted approach to laws.

This mapping validates some theoretical considerations advanced in previous work (Serebrinsky, 2025): the depth of a disagreement correlates with the generality of the principles in conflict. As we have argued, “the domains in which they apply some epistemic principle differently” can vary in size, and “when some of those domains will be larger... then, disagreements will be deeper” (2025, p. 10).

The formal structure is clear: disagreements about more fundamental principles—those with broader domains of application—generate deeper disagreements. The metaphysical/empiricist divide involves principles that apply across all of the domain of scientific ontology. The Humean/necessitarian divide involves principles specific to modal properties. The Armstrong/Tooley divide involves principles specific to the nature of universals within one particular approach to modality.

This gradability thesis explains our intuitive judgments about relative depths. The disagreement between Humean supervenience and governing theories feels deeper than that between Armstrong and Tooley precisely because it involves more general principles with broader domains of application. It's not merely that more propositions are at stake, but that the principles generating these disagreements operate at different levels of generality within agents' epistemic perspectives.

This approach represents a significant advance over earlier accounts that treated deep disagreements as an all-or-nothing phenomenon. As we noted in Section 2, both Fogelin's (1985) framework of "normal" versus deep disagreements and Lynch's (2010) account of fundamental epistemic principles fail to accommodate the intuitive gradability of depth. Our framework, by contrast, shows how the same mechanisms that generate deep disagreements—the differential application of epistemic principles across domains—also explain their varying degrees.

Recognizing degrees of depth transforms our understanding of debates in metaphysics of science. First, it explains differential progress across debates. Shallower disagreements, involving more localized principles, may achieve resolution through focused argumentation within a shared framework. Deeper disagreements, involving more fundamental principles, resist resolution precisely because they lack the shared epistemic resources that would enable adjudication.

Second, our framework clarifies why trans-perspective disagreements face qualitatively different challenges than intra-perspective ones. When disputants share an epistemic perspective, they can at least agree on what would count as progress—even if they disagree about whether it has been achieved. Trans-perspective disagreements lack even this minimal common ground, explaining their remarkable persistence.

This connects to broader issues in the epistemology of disagreement. As Kinzel and Kusch (2018) argue, epistemic judgments are inherently situated and context-sensitive. Our framework builds on this insight by showing how context-sensitivity operates through the differential application of epistemic principles across domains. The situated nature of epistemic actions means that even agents who share fundamental principles may reasonably reach different conclusions about specific domains.

Finally, understanding degrees of depth suggests a more nuanced view of rational discourse in metaphysics of science. Rather than viewing all disagreements as equally intractable or equally resolvable, we can calibrate our expectations to the depth of the disagreement. The shallowest disagreements may yield to standard philosophical argumentation. Intermediate disagreements might progress through careful attention to how shared principles apply to specific domains. The deepest disagreements, however, may persist as long as the underlying epistemic perspectives themselves remain rationally defensible options—a sobering but realistic assessment of the limits of philosophical progress in these domains.

This analysis reveals that deep disagreements in metaphysics of science are not monolithic but exhibit a rich structure of varying depths. Understanding this structure is crucial for practitioners seeking to advance

debates in productive directions and for philosophers of science reflecting on the nature and limits of their discipline.

5. Conclusion

We have argued that disagreements in metaphysics of science can be fruitfully understood through the lens of deep disagreement theory, particularly when enriched by a framework that accommodates degrees of depth. By examining the disagreement between empiricist and metaphysical stances in scientific ontology, we have shown how these disputes satisfy all the criteria for deep disagreement while revealing a more complex structure than traditional accounts suggest.

Our analysis of modality debates within and across epistemic perspectives reveals that deep disagreements vary in depth according to the generality of the principles in conflict. The deepest disagreements involve fundamental epistemic principles with broad domains of application, while shallower disagreements concern more localized principles within shared frameworks. This gradability thesis not only explains intuitive judgments about the relative intractability of different debates but also provides practical guidance for understanding which disagreements might admit of resolution and which are likely to persist.

By bridging the epistemology of disagreement with metaphysics of science, we have illuminated both fields: metaphysics of science gains a sophisticated framework for understanding its persistent debates, while the epistemology of disagreement benefits from concrete cases that test and refine its theoretical categories. This mutual enrichment suggests that continued dialogue between these disciplines will prove valuable for understanding the nature, limits, and prospects of philosophical inquiry in science.

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