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SEÇÃO EPISTEMOLOGIA & FILOSOFIA DA LINGUAGEM

# The spectrum of metametaphysics: mapping the state of art in scientific metaphysics[1]

*O espectro da metametafísica: mapeando o estado da arte na metafísica científica*

*El espectro de la metametafísica: mapeo del estado del arte en metafísica científica*

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**Abstract:** Scientific realism is typically associated with metaphysics. One current incarnation of such an association concerns the requirement of a metaphysical characterization of the entities one is being a realist about. This is sometimes called "Chakravartty's Challenge", and codifies the claim that without a metaphysical characterization, one does not have a clear picture of the realistic commitments one is engaged with. The required connection between metaphysics and science naturally raises the question of whether such a demand is appropriately fulfilled, and how metaphysics engages with science in order to produce what is called "scientific metaphysics". Here, we map some of the options available in the literature, generating a conceptual spectrum according to how each view approximates science and metaphysics. This is done with the purpose of enlightening the current debate on the possibility of epistemic warrant that science could grant to such a metaphysics, and how different positions differently address the thorny issue concerning such a warrant.

**Keywords:** Metametaphysics. Metaphysics. Methodology of metaphysics. Naturalism. Scientific metaphysics.

**Resumo:** O realismo científico é comumente associado à metafísica. Uma encarnação atual de tal associação diz respeito à exigência de uma caracterização metafísica das entidades sobre as quais alguém está sendo realista. Isso, às vezes, é chamado de "Desafio de Chakravartty" e codifica a afirmação de que, sem uma caracterização metafísica, não se tem uma imagem clara dos compromissos com os quais o realismo está engajado. A conexão necessária entre a metafísica e a ciência naturalmente levanta a questão de saber se tal demanda é adequadamente satisfeita e como a metafísica se relaciona com a ciência a fim de produzir o que é chamado de "metafísica científica". Aqui, mapeamos algumas das opções disponíveis na literatura, gerando um espectro conceitual de acordo com como cada visão aproxima a ciência da metafísica. Isso é feito com o propósito de esclarecer o debate atual sobre a possibilidade de garantia epistêmica que a ciência poderia conceder à metafísica, e como diferentes posições abordam de forma diferente a espinhosa questão relativa à tal garantia.

**Palavras-chave:** Metametafísica. Metafísica. Metafísica científica. Metodologia da metafísica. Naturalismo.

**Resumen:** El realismo científico se asocia comúnmente con la metafísica. Una encarnación actual de tal asociación se refiere al requisito de una caracterización metafísica de las entidades sobre las que uno está siendo realista. A esto a veces se le llama "El desafío de Chakravartty" y codifica la afirmación de que sin una caracterización metafísica uno no tiene una imagen clara de los compromisos



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con los que está comprometido el realismo. La conexión necesaria entre la metafísica y la ciencia plantea naturalmente la cuestión de si tal demanda se satisface adecuadamente y cómo se relaciona la metafísica con la ciencia para producir lo que se llama "metafísica científica". Aquí, mapeamos algunas de las opciones disponibles en la literatura, generando un espectro conceptual de acuerdo a cómo cada mirada se acerca a la ciencia de la metafísica. Esto se hace con el propósito de aclarar el debate actual sobre la posibilidad de una garantía epistémica que la ciencia podría otorgar a la metafísica, y cómo diferentes posiciones abordan la espinosa cuestión de tal garantía de manera diferente.

**Palabras clave:** Metametafísica. Metafísica. Metafísica científica. Metodología metafísica. Naturalismo.

## 1 Relating metaphysics with science

Metaphysics, as a philosophical discipline, is now more than two thousand years old. Over the years, a constant set of problems has solidified as part of it (universals, causality, and the nature of substance, for instance), while some new problems have been added as time passed by (free will, the nature of possible worlds, personal identity, to mention but a few). The resilient nature of metaphysical problems had recently to face, once again in the history of the subject, comparisons with empirical science, with the latter's ever-growing progress and success rate in problem-solving used as a ruler with which to measure the achievements of metaphysics.

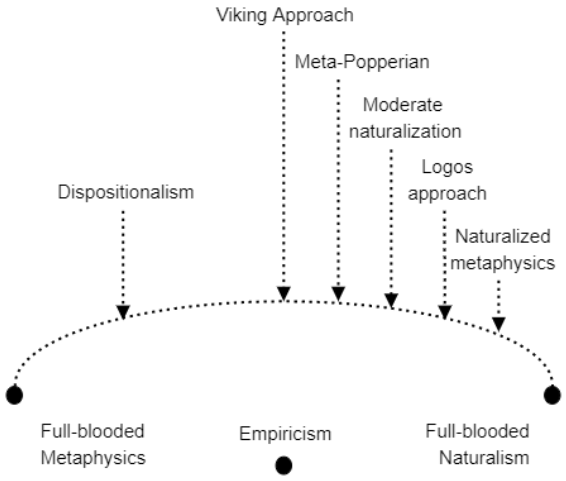
The recent revival of this kind of debate coincides with a growing self-awareness of metaphysicians that discussion is required as to the methods and epistemology of the discipline; that is, it coincides with the rise of *metametaphysics*, the philosophical discipline concerned with the foundations, methodology, and epistemology of metaphysics. As Tahko (2015, p. 151, original emphasis) puts it, the epistemological question — which causes so much worry when comparisons to science appear — is so important that in many cases "[...] it is simply impossible to distinguish between metametaphysics 'proper' and epistemology. Hence, we cannot avoid delving into epistemic issues when we pursue questions in metametaphysics; they are a central part of the *methodology* of metaphysics".

As one can now imagine, the confluence of these two worries, the epistemology of metaphysics, and the comparison of the achievements of the discipline with the progressive nature of science, suggests to more than one metaphysician, and philosopher of science alike, that perhaps science has something to teach to metaphysics. Science and metaphysics are different, for sure, but some have thought that metaphysics could somehow benefit from science; perhaps, there is some way to *transfer* epistemic warrant from science to metaphysics, by making metaphysics *constrained* by science in some way. Doing so, of course, requires that the precise relation of metaphysics and science be completely explicit, and that the way such an epistemic warrant is obtained should be also readily available, and work as intended.

In this paper, following the suggestion by Tahko, we take the problem of framing such a relation in clear terms as a central concern for metametaphysics. The current state of the debate concerning the appropriate relationship between science and metaphysics is so diverse and plural, that it is quite helpful to imagine the current situation as consisting of a spectrum of positions, each advancing a kind of relation between metaphysics and science. It is our aim to bring some order in the field by providing the first steps in that direction. Chakravartty (2007a, chap. 1-2) has already proposed a similar analogy to map the literature concerning the debate about scientific realism, and also used the spectrum analogy to deal with the degrees of metaphysical commitment of scientific inferences.[4] Our proposal, unlike the aforementioned, aims to map attitudes about the methodological relationship between science and metaphysics. We can use Figure 1 as a graphic resource to map some of the positions in recent literature on the subject. We hope that, by bringing some of the available options to the fore, it will be easier to sort out what is really expected from such a relationship and whether there are any views with prospects of success.

[4] In fact, the framework proposed here fits well with Chakravartty's (2017) suggestions about metaphysical inferences: the greater its epistemic risk and the more open to empirical vicissitudes, the more naturalistic a proposal would appear; the lower its epistemic risk and the less open to empirical confrontation, the more detached from scientific evidence as a source of warrant a proposal becomes.

**Figure 1 –** The spectrum of metametaphysics.




**Source:** Prepared by the authors (2021).

Given that it is a relation between science and metaphysics that we are looking for, it is very natural that the standard way of posing the problem is to attempt to relate scientific realism to metaphysics. As this will be our starting point, we will follow the tradition and will not question this for now. The plan seems clear: it is the role of both metaphysics and science to provide a description of the world, delivering a complete picture of reality. Although we shall not go into the details, it must be recorded that "scientific realism" has a standard characterization, the essence of which can be summed up in the claim that *science provides an approximately true description of the world, even in its non-observational aspects*. According to this thesis, the empirical success of mature and well-confirmed scientific theories can only be explained by their being at least *approximately true*. This, in its turn, requires that the posits of such theories exist (non-observable ones included), populating the world as described by the theory.

One apparent drawback of such a starting point concerns the following: if we accept that science populates the world with its posits and attempts a description of it in practically every level of complexity, what role is left for metaphysics? There seems to be no work left for metaphysicians! But not all is lost. Some have found a place for integrating metaphysics in the efforts of producing a description of reality by suggesting that metaphysics helps us having a *clear picture* of the entities posited by scientific theories, in the precise sense that science populates the world with entities, observable and non-observable alike, and metaphysics comes on the top of that, complementing the description of reality somehow. This kind of view of the complementary relation between metaphysics and science is what lies behind what Steven French called "Chakravartty's Challenge". According to Chakravartty (2007a, p. 20), "[o]ne cannot fully appreciate what it might mean to be a realist until one has a clear picture of what one is being invited to be a realist about".

Providing this "clear picture", according to the challenge, is a necessary condition for us to coherently believe in the realistic content of scientific theories. The role of metaphysics would be to *add* to the picture already provided by science and help us achieve the required clarity on the image provided. Explaining *how* to do that would amount to providing the required link between metaphysics and science, and also to explaining how metaphysical theories could benefit from science, after all. We shall employ this setting of the problem as a methodological guide in our attempt to map the distinct ways in which science can be related to metaphysics. Certainly, other starting points could be used as well, but we see this one as providing quite a useful common ground, mainly because it takes the required science for granted. The core of our proposal here is to classify the tone of the approaches and responses to the challenge, direct or indirect, obtained in the literature, under a metametaphysical spectrum.

Figure 1 is a graphic resource for such a mapping, and it should be interpreted as follows: the proposals positioned in the spectrum with one of the triangular ends are the proposals that accept Chakravartty's Challenge as a demand for complementary work of metaphysics and science. Proposals mapped with a circle, both at the ends of the spectrum and outside it, are the

proposals that refuse the Challenge.[5] Notice that, in the context of this paper, refusing the Challenge indicates that one somehow denies that metaphysics should receive any kind of warrant from science, with no hopes that epistemic credibility may flow from science to metaphysics. Both full-blooded positions present "easy" answers for the integration of science and metaphysics, e.g., integration is not welcomed, not required, or must be even rejected. We'll start from there. As we shall see, radical positions, lying in the extremes of the spectrum, have not a problem of integration of metaphysics and science due to the rejection of the need for integration. That counts in favor or against them, depending on one's view on the legitimacy of the claim behind Chakravartty's Challenge.

## 2 The extreme cases

### *2.1 Full-blooded Naturalism*

A first answer to the challenge would consist in denying that obtaining a clear picture requires that one goes beyond the resources of science. The claim, according to this line of thought, is that metaphysics (understood as a purely aprioristic discipline) is not required for the development of objective knowledge about reality. We will call this position "full-blooded naturalism", which somehow avoids introducing properly metaphysical concepts in the workings of science. Full-blooded naturalists, like Quine and his current followers, would deny the challenge if the idea of a clear picture is to be achieved by *adding* metaphysics to science.[6] The reason is the impression that metaphysics fails to contribute to the general economy of science, or that some additional layer is needed.

Roughly speaking, it is claimed that metaphysics does not contribute to scientific functioning and scientific explanations. Therefore, full-blooded naturalists do not need this extra layer of theory over science. In a slogan form, they would say: *we shouldn't care about metaphysics; only scientific questions matter, and these are answered at the level of the scientific theory itself; we are left at the level of the posits of the theory*. In current terminology, when the focus is on ontology, this is also called a 'shallow' version of realism, a realism that does not go beyond what science itself says. Realism with metaphysics is called 'deep realism' (see also our discussion of the Viking approach). The shallow realist view is summarized by Burgess:

> For many professed 'realists', realism amounts to little more than a willingness to repeat in one's philosophical moments what one says in one's scientific moments, not taking it back, explaining it away, or otherwise apologizing for it: what we say in our scientific moments is *all right*, though no claim is made that it is *uniquely* right, or that other intelligent beings who conceptualized the world differently from us would necessarily be getting something wrong. For many professed 'anti-realists', realism seems rather to amount to a claim that what one says to oneself in scientific moments when one tries to understand the universe corresponds to Ultimate Metaphysical Reality, that it is, so to speak, a repetition of just what God was saying to Himself when He was creating the universe (BURGESS, 2004, p. 19, original emphasis).

So, the idea is that the shallow realist, or full-blooded naturalist, has no other access to reality except the one provided by science. Nothing in addition to that is needed or required. Perhaps, the kind of approach to metaphysics that the full-blooded naturalist would adopt follows very closely the strategy suggested by Maddy (2005) in her discussion about positing mathematics along with the sciences, and not positing corresponding entities for astrology. Just as it happens to astrology, it could be argued, metaphysics contributes nothing to the objective description of the world (according to such naturalists), it even sometimes contradicts science. Then, as a result, one may (if ever) approach metaphysics only sociologically, or psychologically; just as one does not need to take the posits of astrology into account when dealing with science, one does not need to take

[5] Or, at least, they refuse in terms that we are understanding the Challenge itself (BUENO, 2019).

[6] Quine's philosophical position is not easy to locate: on one hand, one may identify him as an empiricist; on the other hand, one may argue that he thinks that metaphysics and science are continuous, meaning that he is not an 'enemy' of metaphysics in a strong sense. It is, however, precisely this sense of continuity with science in Quine's view of 'metaphysics' that aligns him with the full-blooded naturalist end of the spectrum, as it implies that metaphysics, as a discipline, has no autonomy whatsoever. Any specifically metaphysical pursuit that does not concern science, such as the nature of properties (universals or tropes?), is of no concern for a Quinean naturalist.

into account metaphysics when accounting for the working of science and the emerging picture of reality. Maddy says:

> My answer to this question, suggested above, has been that mathematics is used in science, so the naturalist's scientific study of science must include an account of how its methods work and how the theories so generated manage to contribute as they do to scientific knowledge. Astrology and theology are not used in science — indeed, in some versions they contradict science — so the naturalist needs only to approach them sociologically or psychologically. (MADDY, 2005, p. 449).

Questions not answered by science, or even without any prospect of being investigated scientifically, would be questions that full-blooded naturalists would not be interested in (Maddy 2005). This does not mean that they would be considered *pseudoquestions*, but only that the interest of naturalists in such metaphysical issues would be so limited that they simply do not enter the debate, adopting, as pointed out by Wolff (2019), a form of "quietism" concerning metaphysics.

In this sense, then, to a Quinean naturalist, metaphysics, as the specifically philosophical discipline, fails to contribute with the general *economy* of science (i.e., its operation of providing for predictions and explanations). So they don't need this extra theoretical layer over science in order to somehow 'complete' the picture of reality advanced by science. As remarked by Lewis (2016, p. xiii), with a touch of reductionism, a full-blooded naturalist could remorselessly claim that "[…] metaphysics is just physics, perhaps expressed in more philosopher-friendly terms". Also along these lines, as Lowe (1998, p. 4-5) summarized, a full-blooded naturalist would say that the only possible metaphysics is physics itself.

> […] to the extent that there is a legitimate province of metaphysical inquiry, it is one entirely catered for by the empirical sciences. On this view, it is these sciences, if anything, that can tell us about the fundamental structure of reality. This being so, there can be no scope for a distinctly "philosophical" approach to the questions of metaphysics, conceived as an approach different in its methods or objects from those already embraced by the empirical sciences. For instance, if there are fundamental questions to be raised about the existence and nature of space and time, it seems to follow that these can only be answered by such sciences as cosmology and quantum physics. There can be no room for "armchair" philosophical speculation or "conceptual analysis" as routes to addressing such questions. To the extent that metaphysical questions are genuinely answerable, it will be said that they are being answered by people working in departments of physics, not by people working in departments of philosophy (LOWE, 1998, p. 4-5).

The full-blooded naturalist attitude totally separates metaphysics from science, foreseeing the abandonment of any kind of expectation of forming a worldview based on the completion of science by metaphysics; thus abandoning any form of attempt to endow metaphysics with some epistemic warrant from science.

In short, due to its lack of confidence that metaphysics is required for an overall reasonable picture of reality, the full-blooded naturalist denies that Chakravartty's Challenge must be answered at all — let alone, by adding a metaphysical layer over science. Given that the issues involved far outstrip what science does and can investigate, at least so far, metaphysics, as the philosophical discipline, is better kept out of any attempt of establishing a world view. One may either deny or remain silent about such questions; there is an epistemic gap between the reaches of science and the problems of metaphysics so that it is metaphysics that must go. For this reason, it is epistemically weak, and therefore it is, as Chakravartty (2013, p. 29) says, a "[…] misguided philosophical pursuit".

That said, let us present the other extremity of the spectrum.

### *2.2 Full-blooded Metaphysics*

Full-blooded metaphysicians also seem to have a very straightforward answer about the relation between metaphysics and science: metaphysics is the first science. Empirical science would therefore not have an epistemic priority over metaphysics. Quite the opposite. Think of

Aristotle's view or, more recently, Lowe's (1998, p. 5) view of metaphysics, according to which metaphysics makes investigations into every possible characterization of what the world could be like, and science eventually instantiates (but cannot fail to submit to) such possibilities: "[…] empirical science is dependent upon metaphysics and cannot usurp the latter's proper role". To cite an anti-realist example on the spectrum of full-blooded metaphysics, Benovsky (2016, chap. 5) argues that science should not be demanded to give epistemological credentials to support metaphysics. For him, scientific theories are provisional, whereas metaphysical theories are not susceptible to empirical refutation. In this way, it is metaphysics that should underpin all other areas of knowledge, including science, and that foundation should be immune from empirical revision, or the need for a scientific warrant.

For full-blooded metaphysicians, metaphysics is the condition of possibility and the background on which empirical science operates. No metaphysics, conceived as a priori and universal, should be justified by science. Science should not even address metaphysical issues, since metaphysical problems (a priori and universal) are outside the purview of its field of investigation. As Hofweber (2021, p. 423) puts it, metaphysics is described as a "glorious" discipline by the full-blooded metaphysician, which is somehow considered to be the "queen of sciences" in the following sense.

> Only in metaphysics do we see the larger picture of what reality is like, although smaller parts of this picture are painted in the individual sciences. Metaphysics is a central hub where all the pieces are being put together. The sciences each deliver their results to this hub, and philosophy and metaphysics put them all together into one overall picture of reality, possibly with some additions and augmentations. So understood, metaphysics has a domain and it has its own domain: it concerns certain large-scale facts about how the different domains investigated in the particular sciences come together and relate to each other. Metaphysics thus has a special place in inquiry, it is the central place where the puzzle pieces are being put together (HOFWEBER, 2021, p. 423).

Put in a slogan form, full-blooded metaphysics would say: *we must not ground metaphysics on science, but, rather, ground science on metaphysics*. In other words, we could say that, according to this view, we have the requirement that metaphysics does not derive its epistemic credentials from science; rather, science must always fit into the schemes proposed by metaphysics. In such a view, science has no preference over metaphysics:

> Empirical science at most tells us what is the case, not what *must* or *may be* (but happens not to be) the case. Metaphysics deals in *possibilities*. And only if we can delimit the scope of the *possible* can we hope to determine empirically what is actual. This is why empirical science is dependent upon metaphysics and cannot usurp the latter's proper role (LOWE, 1998, p. 5, original emphasis).

This full-blooded attitude not only separates entirely metaphysics from science, but also provides for the abandonment of the questions and answers posed by empirical science, as an epistemic aid to metaphysics, under the argument of its provisionality; metaphysics should stick only to universal issues — not to transitory ones, as science does. Thus, the epistemological role that science plays in supporting metaphysics is not even a question for full-blooded metaphysicians. To further illustrate a case in point of this kind of attitude towards metaphysics, consider once again Lowe's conception of the discipline.

> Metaphysics, properly conceived, is the study of the most fundamental structure of reality and involves the attempt to determine what categories of things can and do exist, which in turn involves understanding the nature or essence of the things in question and hence their existence and identity conditions (LOWE, 2011, p. 108).

In this case, because of its subject-matter, metaphysics is an autonomous and irreducible discipline:

> […] no empirical science can legitimately have the concerns of metaphysics, since any such science is confined to the study of just one part or aspect of reality as a whole. Nor can the conjunction of all empirical sciences replace metaphysics in its task, for none of these sciences has the authority to adjudicate whether or not its theories and findings are compatible

> with those of the others. Each science pursues truth within a limited domain. […] Only a discipline whose proper subject-matter is the fundamental structure of reality as a whole can have the authority to adjudicate whether the theories and findings of one empirical science are consistent with those of another. And that discipline can only be metaphysics (LOWE, 2011, p. 104).

Metaphysics deals with issues that are relevant for science, but science cannot have a role in establishing epistemic constraints on metaphysics. The metametaphysical question at stake is the methodological priority based on the epistemic priority of each area: the full-blooded metaphysician will say that metaphysics has its own epistemic credentials, while the full-blooded naturalist will say that metaphysics has *no* epistemic credentials at all. It is easy to see that both full-blooded attitudes are straightforwardly against the relationship between their areas: they would remorselessly say that "my field takes the lead". It is easy to see that there is no common ground between the full-blooded parts of the debate since the epistemological role of the foundation of one discipline by the other is mutually exclusive. The way in which both full-blooded alternatives respond to Chakravartty's Challenge is therefore of limited interest here — and perhaps the Challenge is not a legitimate challenge for these extreme positions, if it is understood as requiring collaborative work of science and metaphysics.

### *2.3 Empiricism*

Before we move on to the intermediate cases of the spectrum, let us discuss one more case, given that it is a bit out of the continuum of cases we focus on, and still, is related to the connection (or rather failure thereof) of metaphysics and science. It concerns modern versions of empiricism. In order to classify their situation properly, it is useful to distinguish between two major approaches of naturalism, following the literature on the subject: there are ontological versions of naturalism on the one hand, and there are epistemological and methodological versions of naturalism on the other. Basically, ontological versions of naturalism state that the world is populated by the entities of science observable and non-observable. Methodological and epistemological naturalists suggest, in different ways, that the legitimate methods for knowledge acquisition are the methods of science (for a detailed discussion, see Bryant, 2020a). Modern empiricists, contrary to commonsensical expectations, deviate not only from full-blooded metaphysical stance, but also from full-blooded naturalism, which would incorporate both views on naturalism (that is, that science has the method to provide us the catalogue of reality, and the appropriate means to know them, as a shallow realist would have it too). Let us check.

The first point of conflict with naturalism comes with the empiricist adoption of a 'philosophy first' position from an epistemological side; modern empiricists take quite seriously the claim that experience is the guide for what is real and for how it is. This is because its criterion of evaluation for the existence of unobservable entities, for example, is either *stronger than* or *prior to* what would be indicated by science itself, which complements experience with a wide array of methods and techniques to access reality going beyond experience. In this sense, empiricism is not naturalistic, because there is no *scientific* reason for one to privilege the knowledge of observable entities solely (CHAKRAVARTTY, 2007b, p. 186). The reasons for putting the weight on perceptual evidence are mostly philosophical. It results from this emphasis on experience that empiricists do not accept the epistemic authority of science on what concerns the existence of non-observable entities. Ontological naturalism goes by the board too, then; on what concerns the non-observable posits of science, given that they go beyond what is licensed by experience, the epistemic authority of science is limited by a philosophical view.

However, just like the more radical versions of naturalism (which are identified with the shallow realism above), empiricists end up also moving away from Full-blooded Metaphysics, since it also does not satisfy their epistemic criteria. As Bueno (2019, p. 8) states, structural empiricism (a form of empiricism) "[…] insists that only those items

for which one has evidence of a particular sort warrant ontological commitment, namely, items that are observable in the broad sense that they satisfy counterfactual dependence conditions analogous to those met by perception". This cuts out of the picture both items in the naturalistic ontology, as well as the need for a clear image of such posits in terms of a metaphysics that exceeds the sources of our knowledge.

As a result, this viewpoint has, according to Bueno (2019, p. 8), "[...] the virtue of avoiding Chakravartty's challenge". This happens precisely because the "structural empiricist resists the temptation to reify what is posited in one's ontology", i.e., resists the demand to answer questions that concern the nature (the "clear picture" required by the Challenge) of the entities that the scientific theories deal with.

Rejecting the stronger theses of both opposites discussed so far, there is nothing for the empiricist to integrate (recall, Chakravartty's Challenge, as a beckon for integration between the two areas, is denied). For these reasons, we consider the current empiricists as outside of the spectrum of the efforts on the integration of metaphysics and science. In one sense, they side with the metaphysicians in not giving to science any epistemic privilege over knowledge, but they also side with the naturalists when they claim that the metaphysicians' standards and aims are far outside what is justified by our human epistemic condition. This may be seen as an advantage, but it also has the problem of being held inadequate by both of the more radical views: the resulting image of reality is just too crude for the full-blooded metaphysician, who wants a richer description, and in its epistemology, it is just too much first-philosophical for the naturalist, who wants unrestricted science to guide us in our epistemology and ontology.

Note that we are not saying that the empiricist shares with metaphysicians the idea of not conceiving science as one of the most important sources of information about the world: empiricists take science — and above all empirical evidence — extremely seriously, which is why they question metaphysics. There are several forms of empiricism, many of which (such as constructive empiricism) recognize that there is always some metaphysical aspect involved in describing the world, and even other versions (such as structural empiricism) do not adopt an attitude that prioritizes philosophy rather than science, as they seek to understand science in its own terms instead of introducing metaphysical categories to do so.

Here, in fact, we are working with a very general idea of current empiricism, and one of the risks of this is to oversimplify this stance. However, we call attention to a characteristic that seemed common to the numerous forms of empiricism: it would not be the case to say that empiricism denies the importance of science as one of the most *important* sources of information about the world. The point is that the empiricist is more demanding than science itself on some issues, such as the justification for the claims concerning existence of unobservable entities. And that demand, in the terms we put it, would be more metaphysical than naturalistic. There is a tension between empiricism and naturalism about ontology and epistemology/methodology. In our classification, the naturalist is the one who takes science seriously on its own terms, and the empiricist introduces epistemological demands from outside science. The empiricist puts the epistemic value of science above metaphysics, but on the terms we are concerned with in this paper, i.e., establishing a relation between science and metaphysics, empiricists seem to impose their own empirical filters on both fronts, which leads to neither adopting one of the mentioned extreme positions and also neither accepting integration; the empiricists' epistemic demands creates then a position that lies outside the spectrum.

The claim that empiricism takes science seriously, and therefore questions metaphysics, is quite common. But it is a claim that assumes that metaphysics is incompatible with science, and that, in turn, is an empiricist — unscientific thesis. A legitimate naturalist simply remains silent about metaphysics, while the empiricist rejects metaphysics. In this sense, empiricism is already an

anti-metaphysical thesis, against the integration between metaphysics and science, and this is a component that we are calling first-philosophical.[7]

To complement this discussion on the curious position of modern empiricism, a mix of respect for science with first-philosophical approaches, notice that it is the more recent versions of empiricism that conflict with naturalism. Although current empiricism is anti-metaphysical, it is also, in some sense, an interpretation of science that does accept it as an epistemic authority. This clearly has generated some tension in the history of empiricism, with anti-metaphysical tendencies not necessarily shocking with the scientific attitude per se. As Psillos puts it:

> There has been an empiricist tradition in the core of Logical Positivism/Empiricism, starting with Moritz Schlick and ending in Herbert Feigl (via Hans Reichenbach) which has taken it to be the case that empiricism need not be characterised by 'phobia of the invisible and the intangible' as Feigl once put it—after all, this phobia would be uncharacteristic of the empiricist spirit precisely because it would take something other than science, say some philosophical prejudices, as a guide to what there is in the world. According to this tradition, the world of empiricism need not be a barren place devoid of all the explanatory entities posited by scientific theories; and yet, empiricism need not compromise its anti-metaphysical attitude (PSILLOS, 2011, p. 303).

Now, this brings some interesting distinctions on versions of empiricism to the fore. Clearly, Logical Empiricists of the tradition mentioned by Psillos are closer to the sort of full-blooded naturalism that we have been describing than the current versions of empiricism. Interesting as it is, we shall leave a discussion of this topic for another occasion.

## 3 Mapping the middle ground

The terrain between the two ends of the spectrum promises the integration of the best of both worlds. On the one hand, it does not yield to full--blooded naturalization, which makes it possible to raise questions about the nature of entities, and, therefore, enables it to address Chakravarty's Challenge as it was originally intended by French. On the other hand, they allegedly import certain epistemic credentials of science and, therefore, have epistemic justification — which does not occur (nor it is desired) by full-blooded metaphysics. In a few words: we may have our science and our metaphysics not only living in peaceful coexistence, but also, the successful empirical science lends epistemic credentials to the metaphysics that gets associated with it.

We will provisionally call this range of the spectrum "scientific metaphysics". Although interesting, as they aim to benefit from the positive parts of each radical position, the cases in the middle of the spectrum are the most problematic, as we shall see.

In what follows, we will offer a mapping of recent positions in the literature that covers the terrain of scientific metaphysics.

### *3.1 Naturalisms*

To mention a recent taxonomy on the subject, what we call here "full-blooded naturalism" broadly corresponds to what Bryant (2020a, p. 49) called "global metaphysical naturalism", while the naturalisms in this section would be variations of what she calls "naturalistic metaphysics" — which is basically a metaphysics that is "approached through a scientific lens". McKenzie (2020, p. 2) mapped two attitudes towards the naturalization of metaphysics: a "negative" and a "positive" claim of naturalistic metaphysics. The negative claim states that *it is not worth doing any kind of metaphysics that is not informed by science*. This group portrays very well the theses firstly proposed by Ladyman and Ross (2007) concerning the methodology of metaphysics. It is important to emphasize that the negative attitude is the common ground of the dispute over the middle ground of the spectrum. That is, directly or indirectly, all the other proposals mapped here

[7] Note that empiricism bears a resemblance to the full-blooded metaphysician: full-blooded metaphysicians value the fact that science fits their scheme, but if it doesn't, it is science that must be reinterpreted. To see this, just consider Benovsky's (2016) claims, for a metaphysician, and consider van Fraassen's (1991) claims, for example, for the empiricist versions of quantum mechanics and empiricist interpretations of probability.

respond to the negative attitude, which we will call "metaphysics naturalized".

The second group mapped by McKenzie (2020, p. 4) is also related to the naturalization project, but it is definitely more liberal than the negative attitude. McKenzie calls this second group "positive claim of naturalized metaphysics", characterized by the statement that *it is worth doing metaphysics, as long as it is informed by science*. Although she considers that both statements are endorsed by naturalistic metaphysicians, we think it is appropriate to distinguish them in two proposals, one of which is more radical than the other. Let's start with the more radical of the two.

### *3.1.1 Metaphysics naturalized*

To this group, the distinction between a "traditional" metaphysics and a "naturalized" one is essential. As pointed out by McLeod and Parsons (2013), a clear distinction between the two ways of doing metaphysics often misses the mark. This problem, however, did not prevent the distinction from being made, thus giving rise to a terminological mess. The first kind of metaphysics has many names: "neo-scholastic" (ROSS; SPURRETT, 2004), "analytic", "armchair", "traditional" (LADYMAN; ROSS, 2007), "fantasy" (FRENCH; MCKENZIE, 2012), "intuition-based" (GUAY; PRADEU, 2020), "free-range" (BRYANT, 2020b) and "a priori" metaphysics (MCKENZIE, 2020).

Let us assume, for now, that they all refer to the same thing, say, the caricatured case that we call here "full-blooded metaphysics" — and let us call it "analytic metaphysics", so that we do not introduce yet another name in the literature. As pointed out by McKenzie (2020, p. 1-2), the literature engaged with naturalization considers that analytic metaphysics is: "irrelevant" and "pseudoscientific" (LADYMAN; ROSS, p. 17), "frivolous" (FRENCH; MCKENZIE, 2015, p. 28), "sterile" and "empty" (CALLENDER, 2001, p. 34), and "epistemically inadequate" (BRYANT, 2020b, p. 1867).

Perhaps the fiercest criticism of the so-called "analytical" way of producing metaphysics was advanced in the now-classic *Every Thing Must Go* by Ladyman and Ross (2007), whose work is, without exaggeration, a milestone in this metametaphysical discussion about the nature of analytic metaphysics, and all later literature can be seen as a response and reaction to them — after all, they introduce *polarization* into the debate. The essence of their criticism is already distilled in the introduction: "[…] contemporary analytical metaphysics is a professional activity engaged in by some extremely intelligent and morally serious people, fails to qualify as part of the enlightened pursuit of objective truth, and should be discontinued" (LADYMAN; ROSS, 2007, p. vii).

This kind of naturalist expectation is to *extract* metaphysics from science somehow. Metaphysical investigations, instead of being treated as pseudo-problems, would have answers extracted from the scientific theories themselves. In this sense, science would not only inform metaphysics but, also, it would help us answer metaphysical questions. Thus, naturalists of this type claim that "science, especially physics, has shown us that the universe is very strange to our inherited conception of what it is like" (LADYMAN; ROSS, 2007, p. 10). In other words, to this metametaphysical conception, metaphysics should be "[…] a unified world-view *derived* from the details of scientific research" (LADYMAN; ROSS, 2007, p. 65, emphasis added).

Only these questions would be worthy of intellectual respect, so that all other questions that cannot be asked or answered by science — that is, questions proper to analytical metaphysics — must be abandoned. To sum up, Wallace (2012, p. 3-4) nicely characterizes it, this kind of naturalism is "[…] the thesis that we have no better guide to metaphysics than the successful practice of science".

Chakravartty's Challenge is then answered as follows by naturalized metaphysics: the clear image is filled with the metaphysical content extracted from the scientific theories themselves. From a methodological perspective, although a scientific-realistic view may be challenged by arguments involving underdetermination (FRENCH; KRAUSE, 2006; SKLAR, 2010), what counts for the naturalist is that the metaphysical content is *extracted* from scientific theories.

The idea that metaphysical content can be

endowed with scientific justification when it is somehow extracted from the theoretical content of science is, as we are mentioning, the most radical attempt at establishing one such relation between metaphysics and science. In this sense, as Robus (2015) stressed, the proponents of this kind of metaphysical naturalism would say that science "licenses" metaphysics. The plan, it seems, is that the *theoretical* context of science may also come with some metaphysical content, in order to give us a picture of reality. French and Krause (2006, p. 244) have put the issue very clearly on what concerns issues of identity and individuality for quantum particles. Thus, the particles, as posited by quantum mechanics, should somehow also provide an answer as to the issue of their individuality or non-individuality (the 'metaphysical component' of the theoretical content of the theory). If that cannot be done in this particular case (concerning individuality) due to the lack of information provided by quantum mechanics (generating metaphysical underdetermination), then, rather than abandoning the project of somehow deriving a metaphysics from physics, it is suggested that the metaphysical basis must be changed (so that, ideally, scientific support for metaphysics may still be successfully sought under the same kind of 'extracting' procedure):

> […] if that theoretical content is taken to have a metaphysical component, in the sense that the realist's commitment to a particular ontology needs to be articulated in metaphysical terms, and in particular with regard to the individuality or non-individuality of the particles, then the realist appears to face a situation in which there are two, metaphysically inequivalent, approaches between which no choice can be made based on the physics itself. […] The choice for the realist is stark: either fall into some form of antirealism or drop the aforementioned metaphysical component and adopt an ontologically less problematic position (FRENCH; KRAUSE, 2006, p. 244).

Physics should somehow be responsible for indicating the metaphysical profile of its entities (e.g., are they individuals or non-individuals?) because only then this attribution of a metaphysical profile will be justified.[8] However, as French and Krause are quick to point out, physics fails in doing that, because it is compatible with both profiles, individuals and non-individuals. As a result, we have metaphysical underdetermination, and the metaphysics of individuality somehow floats free from the theoretical content, being it the case that we can understand the relevant physics with each of the two available options and still have a consistent picture. The same kind of demand or expectation that physics should answer this kind of question (again, about the individuality of particles) was frame by Ladyman, in the following terms (where it is also recognized that physics can't do that):

> We need to recognize the failure of our best theories to determine even the most fundamental ontological characteristic of the purported entities they feature. It is an *ersatz* form of realism that recommends belief in the existence of entities that have such ambiguous metaphysical status. What is required is a shift to a different ontological basis altogether, one for which questions of individuality simply do not arise (LADYMAN, 1998, p. 419-420, original emphasis).

That is: realism and the metaphysical profile are one of a piece. If our form of realism cannot answer the metaphysical question, then, it is an ersatz realism (in other words: a legitimate form of realism must answer Chakravartty's Challenge and, moreover, extract the metaphysical picture from the realistic content of the theory). Ladyman then recommends that we change the ontological basis i.e. that we forget about particular objects, so that problems of individuality do not arise, and shift to an ontology of structures (as the above-mentioned quote of French and Krause also recommended). What is important for us is the hope, underlying this kind of claim, that science gives us an answer to metaphysical questions too. We must somehow extract the answer for a metaphysical problem from the theoretical content of science. If that cannot be done for the metaphysics of objects, then, let us try to do that for a metaphysics of structures.

It is important to notice how this differs from the

[8] Here we generalize the notion put forth by Branding and Skiles (2012) of "individuality profile" to a 'metaphysical profile', which is not restricted to the debate concerning (non-)individuals (see French, 2014).

full-blooded naturalist attitude seen before. While the full-blooded naturalist denied any need to answer Chakravartty's Challenge in the intended sense of integrating the two fields, the naturalist we are discussing now accepts that metaphysics does play a role in a complete description of reality. However, the thought now is that this will only go as far as the metaphysics is somehow authorized by science, where 'authorized' is a neutral word for the idea that epistemic warrant must be conferred to the metaphysical content of the view directly by the scientific theory (*extracted* from science, as we have put before, in the sense that it follows from the theoretical content of the scientific theory itself).

### *3.1.2 Logos approach*

According to the 'logos approach' to quantum mechanics, mainly developed by de Ronde (2019; see also de Ronde and Massri, 2021; de Ronde and Massri, 2019a; de Ronde and Massri, 2019b), we should take metaphysical lessons from quantum mechanics; the theory should be understood "[…] in close analogy to the Aristotelian hylomorphic metaphysical scheme". Specifically, the reformulation of the concepts of "potential realm" and "power". This is so because these are the subject matter of quantum mechanics: immanent powers: "[a]ccording to the logos approach, QM does not talk about 'small particles', it talks about a potential realm — independent of actuality — represented in terms of immanent powers with definite potentia" (DE RONDE; MASSRI, 2019b, p. 16).

It is argued that previous attempts to apply Aristotelian metaphysics of potentialities to current physics (HEISENBERG, 1958), as well as dispositionalist interpretations (MARGENAU, 1958), would have well-defined metaphysical starting points or presuppositions, and it would be these starting points that created problems in the foundations of quantum physics; they bring in assumptions that are at odds with the description of reality provided by quantum mechanics, or so de Ronde claims.

As de Ronde (2019, p. 138) argues, in the first case, Heisenberg would have been committed from the start with an "actualist account of reality". In a closely related sense, Margenau's dispositionalism would define the existence of potentialities in *actual* terms, that is, "[…] only in relation to the process of actualization and the observability of 'clicks' and detectors" (DE RONDE, 2019, p. 143). According to de Ronde (2019), there is an orthodoxy in the philosophy of physics that starts from metaphysical assumptions both a posteriori and common sense, both based on an (unproblematized) notion of 'observation'. One of the main problems with such a metaphysical assumption being to treat observation as given and unproblematized — as if physicists were supposed to investigate clicks in measurement apparatuses rather than study fundamental aspects of what gives the discipline its name in the first place: *physis* (the Greek term for 'reality' or 'nature'). In particular, these assumptions would encapsulate unwarranted categorizations of reality in terms of notions that simply do not apply in the quantum realm, notions such as 'objects' and 'actuality'. Given the inappropriateness of this strategy, de Ronde recommends that we simply turn it around: "[…] our approach stresses the need to provide a conceptual representation of the mathematical formalism, one which need not be constrained or reduced to our 'common sense' observability of tables and chairs" (DE RONDE, 2019, p. 143).

So, thinking about the taxonomy adopted here, the logos approach is a proposal that orbits between the "traditional" and "metaphysics of science" regions of the content axis. It is *traditional* because it is inspired by the Aristotelian concept of "potentiality" (or "*dynamis*"), but it is also a "metaphysics of science" in as much as it relates with science in its goal. It is a *revisionary* project, to the extent that it reformulates concepts of traditional metaphysics for the purposes of science, and a priori in the sense that it goes from metaphysics to physics. So, as de Ronde (2019, p. 144) argues, instead of presupposing from the start "[…] the controversial idea that actual observations are perfectly well defined", it is more fruitful to "[…] concentrate on the formal-conceptual level". To sum up his proposal in methodological terms, de Ronde (2019, p. 145) says: "[w]e believe that an

important help could be provided by philosophers of physics who should be in charge of trying to develop a conceptual representation of quantum superpositions that would allow us to think in a truly quantum mechanical manner".

In methodological terms, de Ronde proposes that the development of an appropriate metaphysics can lead to a better understanding of current physics, so it is tempting to locate his proposal within the '*metaphysics first!*' region of the spectrum insofar as it seems to attribute primacy to metaphysics over physics:

> According to our viewpoint, there is no physical observation without the aid of a network of adequate concepts. It is important to stress at this point that we use the term 'metaphysics' to refer to the systematic definition of conceptual schemes. A metaphysical scheme is a conceptual net of interrelated concepts. It provides the very preconditions of observability itself (DE RONDE, 2019, p. 126).

But, on closer examination, it turns that this metaphysics is extracted from quantum mechanics itself, i.e., immanent powers represents the most appropriate conceptual (metaphysical) scheme for quantum mechanics because it captures what the theory is *really* talking about:[9] "the representation and understanding of reality can be only achieved through the analysis of metaphysical conceptual schemes which are provided by physical theories themselves" (DE RONDE, 2019, p. 126). Based on this, we think it is the appropriate place for the logos approach to quantum mechanics in the spectrum of Figure 1 is among the proposals for naturalization of metaphysics presented in the previous subsections — since it is in a position of tension between *developing a metaphysics for* and *extracting a metaphysics from* quantum mechanics.

### *3.1.3 Moderate naturalization*

The above approach to the relation between metaphysics and science may be deemed by many as too radical, and as putting high hopes in the wrong place. Science, it could be claimed, due to metaphysical underdetermination, does not bring with it its own metaphysics in such a direct fashion. A more moderate approach is then recommended for those with such inclinations. This project is, as Morganti (2015, p. 58) states, "[…] metaphysics-friendly, yet naturalistic-inclined viewpoint". Morganti and Tahko (2017) are the original proponents of the so-called "moderately naturalistic metaphysics", arguing that both science and metaphysics share one key feature: a subject matter.

According to Bennett (2016), defining a subject matter to metaphysics is not an easy task. As summarized by Paul (2012, p. 4-5), there is a standard interpretation that considers that the subject matter of metaphysics concerns "systematic, general truths concerning fundamental facts", in order to describe "features of the world that are metaphysically prior to those of the scientific account".[10] Bennett (2016, p. 33, emphasis added) argues that metaphysics is better understood as "[…] the study of what there is, and what *what there is* is like, for a restricted value of 'what'". Hofweber (2016) further distinguishes the *task* and the *domain* of metaphysics, arguing that metaphysics, if it is to be considered an *ambitious* program, should have its *own domain* — thus heading back to the "standard" view.

These difficult debates notwithstanding, to the proponents of this kind of naturalism, the subject matter of both science and metaphysics is that of "examining and explaining reality" (MORGANTI; TAHKO, 2017, p. 2559). What the two disciplines do not share are the procedures for such an examination. While metaphysics is considered to be a purely a priori operation, science is considered an entirely a posteriori discipline. Although there are counterexamples to this statement,[11] what we consider worthy of mention is the connection with the reality that metaphysics inherits from

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[9] Of course, one could maintain a skeptical attitude that this is the best option for understanding quantum mechanics, given so many other options in the interpretive role of the theory. Arguing for this view, however, is not our purpose here, which is to offer an inventory of the main proposals that relate metaphysics to science.

[10] To a criticism towards this standard attitude, see Bennett (2016).

[11] For the claim that metaphysics can (and does) operate also with an a posteriori methodology, see Guay and Pradeu (2020); for an argument in which science also operates at the a priori level, see Chakravartty (2013). This is the 'dilemma' addressed by Robus (2015).

science, when in connection with it. In this sense, Morganti and Tahko (2017, p. 2559) state that: "[...] metaphysics ought to seek an at least *indirect* connection with reality through the empirical methods of science".

The epistemic priority of science, which somehow transfers epistemic warrant to metaphysics in intersectional cases, justifies the "naturalist" part of the nomenclature of the project in question. The "moderate" part comes from the value of metaphysics in positively contributing to a complete description of reality. According to the authors, science does not build a worldview alone. Part of this is the role of metaphysics. So metaphysics cannot be extracted from scientific theories.

This type of naturalist, then, would respond to Chakravartty's Challenge like this: a clear picture is obtained through *mutual and complementary* work between metaphysics and science. A detailed way in which this mutual work should take place is not specified by the authors (and, as far as we know, by almost anyone else). Still, they propose that metaphysics should be *restricted* by science — it would provide both the space of possibilities for the development of metaphysical theories in the service of science and criteria for choosing to decide the most suitable metaphysics:

> [...] some elements of science are prior to metaphysics in that science not only contributes to the definition of the basic possibility space itself, but also gathers the indications coming from the actual world that are necessary for fleshing out the various metaphysical hypotheses and selecting the most appropriate [...] it is a perfectly legitimate endeavour for metaphysics to engage in an abstract analysis of (metaphysical) possibilities without seeking explicit confirmation from science, but this does not mean that such an analysis can be *completely* independent of science (MORGANTI; TAHKO, 2017, p. 2578, emphasis added).

This is a recurring attitude in the literature on metametaphysics; a recent example is Bryant's (2020b) proposal, according to which metaphysics would have epistemic guarantees if it is somehow restricted by science — but see also Arenhart (2012) for further developments on the view that science can constrain metaphysics. As we will argue later, specifying the conditions of restriction is essential for the promise of 'having the best of both worlds' to be fulfilled.

In giving importance (albeit restricted) to metaphysics, we think that the appropriate place for this type of naturalism on our spectrum would be alongside the project of naturalized metaphysics, but with relatively greater proximity to full-blooded metaphysics in relation to that: as we have discussed, metaphysics is autonomous from science in this proposal, although it must connect to reality through science, gathering, thus, epistemic warrant.

### *3.2 The Viking Approach*

The terminology of Chakravartty's Challenge was originally advanced by French (2014), for whom the challenge would not consist only in the attribution of a metaphysics (or a 'clear picture') on the top of what we adopt a realistic attitude about. It is also necessary to balance this search for metaphysics with epistemic humility, which is in itself also a dilemma: on the one hand, if metaphysicians adopt an excessively humble attitude, they end up staying where they feel epistemically safe, repeating the relevant physics, and not arriving in metaphysics itself (these would be 'ersatz 'or 'shallow' realists, see also French, 2018a); on the other hand, if they venture beyond science, into a genuinely '*beyond-physics*' kind of metaphysics, then science could not even restrict the philosophical quest — in this case, the 'floats free' from science metaphysics — and that is why metaphysical underdetermination is something that can be taken for granted (this becomes explicit in French, 2018b). After all, if metaphysics is not determined by physics, it can always go deeper, even, say, the ultimate foundations of reality. The problem with this is that we have no epistemic guarantee since nothing but intuition serves as a guide.

The perfect balance of epistemic humility, says French (2014), is his "Viking Approach to metaphysics": the middle ground between science and metaphysics. This approach has this name because the metaphysicians of science would

not be responsible for producing metaphysical content, but for adapting the metaphysical content produced by analytical metaphysicians for the purposes of science, that is: to respond to Chakravartty's challenge with extant metaphysics. So it's a process based on plundering rather than developing. Later on, in a more subtle analogy, the Viking approach was re-named as the "Toolbox" approach (FRENCH; MCKENZIE, 2012; 2015), but the goal is the same:

> [...] realists should not be content with adopting a 'shallow' form of their stance, as represented by expressing a belief in the existence of electrons, say, and leaving it at that. Motivated by 'Chakravartty's Challenge' [...] I suggest they should go 'deep', metaphysically speaking, and draw on the various devices that metaphysics makes available in order to offer a clearer picture of what that belief in electrons consists in (FRENCH, 2019, p. 22).

This metametaphysical view responds to Chakravartty's Challenge using concepts available in the history of philosophy (i.e., in the *traditional* metaphysics) to provide reasoning or clarification of the relevant characteristics of a given scientific theory. Thus, it bridges science and metaphysics, by attributing epistemic value to metaphysical concepts that can be plundered and applied to the development of a clear picture for the posits of scientific theories. That is, the proposal operates by applying existing metaphysical concepts to scientific theories.

> [...] modern metaphysics has, for whatever reasons, set off along a different path from much of the philosophy of science, which has taken it further and further away from what are generally understood to be the fundamental features of science, particularly physics. As a result, current discussions about gunk and simples, or even 'core' notions such as intrinsicality and fundamentality, seem to bear little relation to how scientists conceive of the world. However, we nevertheless think that metaphysics offers an array of moves and manoeuvres, devices and techniques, etc., that can be profitably deployed to elaborate an understanding of the world that does mesh with what science tells us, where we take that understanding to, minimally, go beyond a straightforward recitation of the scientific details. [...] the toolbox approach is conditionalised twice over: first, of course, upon naturalistically inclined metaphysicians taking tools from the toolbox, instead of making them 'to order' as it were, and thereby completely sidelining traditional, analytic, non-naturalised metaphysics; and secondly, upon those tools actually being useful to the interpretation of science as it develops (FRENCH, 2020, p. 190).

The Viking Approach argues for an *unrestricted* development of metaphysics. The justification for this total freedom lies in the possibility of the use of these "traditional" metaphysical theories by science. Thus, a Viking-style metaphysician would not be concerned with the development of metaphysical theories for science: on the contrary, science and metaphysics would operate at completely independent methodological levels, but philosophers of science interested in metaphysical aspects of scientific posits could use (or "plunder"), when convenient, the results obtained through the development of traditional metaphysics.

In this sense, we consider that the Viking Approach is at the exact center of the spectrum, between the full-blooded metametaphysical stances.

### *3.3 Meta-Popperian*

Another metametaphysical approach that considers metaphysics to be an extra layer over science is the meta-Popperian, as developed by Arenhart (2012) and expanded by Arroyo and Arenhart (2019; see also Arroyo, 2020; Arenhart and Arroyo, 2021a). The method consists of a negative approach towards the metaphysics of science, specifically towards the metaphysical profiles one may add to scientific theories in order to address Chakravartty's Challenge.

On the one hand, such a method works with the Viking/Toolbox approach, but provides us the elements according to which we can decide between metaphysical theories associated with scientific theories; by doing so, on the other hand, it shows precisely what a productive interaction between science and metaphysics should be, and exactly how science can restrict the range of application of metaphysics in scientific theories, thus being a moderately naturalistic metaphysics.

This approach bears on a distinction between "ontology" and "metaphysics" which has become fairly common in the literature (ARENHART, 2012; TAHKO, 2015; HOFWEBER, 2016; THOMSON-JO-

NES, 2017; ARENHART; ARROYO, 2021b). Very briefly, both disciplines are individuated by their task, assuming that ontology deals with existence-questions and metaphysics deals with nature-questions, The latter building on the former. From an ontological point of view, if one uses a Quinean metaontology of ontological commitment, scientific theories give us a catalog of what exists — it can be *naturalized* so to speak Quine (1951, p. 65). However, the nature of the items in such a catalog remains unaddressed by science: that would be a task for metaphysics. Chakravartty's Challenge then puts the debate in the following terms: metaphysics can be used to clarify science.

So one might say that there are electrons in the ontology of quantum mechanics, for instance, and refuse to go further than that. Shallow realism goes here. Recall that for naturalists, what matters is that at least ontology is offered by science (and not, say, one's intuitions). Here, it can be claimed that the choice is voluntary (CHAKRAVARTTY, 2017) or based on other non-objective criteria, such as aesthetic beauty (BENOVSKY, 2016). As for the metaphysical layer, using the Viking/Toolbox approach we can give metaphysical flesh to the ontological bones of each of the interpretations. As there is no anchoring in physics, it is to be expected that there is metaphysical underdetermination (ARROYO; ARENHART, 2021).

Enter the meta-Popperian to objectively evaluate which metaphysical profiles are not really options (ARENHART, 2012; ARENHART; ARROYO, 2021a). This method can be appreciated in three steps, as presented explicitly in Arenhart and Arroyo (2021a). In the first step, the ontological commitments of a scientific theory in question are identified; in the second step, Viking/Toolbox metametaphysics is adopted, and the metaphysical literature is examined for ways in which the nature-questions of the entities obtained in the first step can be metaphysically conceived; in the third step, the options obtained in the previous step are evaluated, that is, the philosopher of science checks whether there are incompatibilities between the metaphysical ways in which the entities may be understood and the obtained ontological demands of such entities, i.e. it is evaluated whether there are ontological or scientific restrictions to dress these entities metaphysically in a certain way. This is where the negative aspect of the method happens, nodding towards a moderately naturalized attitude: in the clash between science and metaphysics, it is the metaphysics that should be modified.

The Viking approach makes a requirement to have a metaphysical layer through the Chakravartty's Challenge. The meta-Popperian, on the other hand, does not make this requirement. All that is required is that if there is a metaphysical layer, it must be consistent with science.[12] In this way, meta-Popperian metametaphysics is compatible with an attitude that additional metaphysics is otiose, while Viking sees a positive role for metaphysics. Of course, someone can add these requirements and adhere to the meta-Popperian, but as it stands, the proposal is neutral in that regard.

We situate the meta-Popperian in the spectrum outlined in Figure 1 as a middle ground between the Viking Approach and the moderate naturalization, as it sides with science (and not with metaphysics) in the eventual clash between the two disciplines.

### *3.4 Dispositionalism*

Much of what is at stake in disputes about the relation of science and metaphysics concerns the subject matter of metaphysics as a discipline. The common view in the literature is to treat metaphysics as a discourse on the fundamentals of reality.

> Where scientists and philosophers of science, for example, are interested in specific objects, events, processes, properties, the various types or kinds of these things, laws of nature, causes and effects, and so on, metaphysics apart from science concerns more general or fundamental things and kinds of things, of which scientific subjects of interest are exemplifications (CHAKRAVARTTY, 2017, p. 61).

[12] And its corresponding "naturalized ontology", as Arenhart and Arroyo (2021a, 2021b) suggest.

In this sense, the subject of metaphysics would be different from that of physics, and the question of epistemic priority ends up being dispelled by the autonomy of the two areas. Chakravartty's (2017, p. 70) proposal consists in deliberately avoiding this debate while remaining focused on the portion of metaphysics that relates to science in some way.

What makes such a proposal to be placed in this intermediate range of the spectrum is the statement that a complete worldview cannot be built only with science, nor only with metaphysics, so that its positive proposal in the debate consists of offering a "unified picture of the metaphysics of scientific realism" (CHAKRAVARTTY, 2007a, p. xiv). Such a "unified picture" is how Chakravartty responds to the "challenge" that bears his name: understanding science as an analysis of dispositional and categorical properties. Take physics as an example: roughly speaking, it is a science that talks about putative things with certain properties such as mass, charge, and spin; according to Chakravartty (2019, p. 12), "[d]ispositionalism is simply one among other theories of the nature of such properties." In other words, the metaphysical content that deals with the nature of these things, which are defined in terms of their properties, is provided by dispositionalism — which, in turn, allows, together with science, a unitary understanding of reality.

Notably, Chakravartty (2007a; 2017) chooses to guide his exposition with the debate about scientific realism as a background; in it, the guiding thread would be certain epistemic virtues of adopting a dispositional metaphysics for science. Among them, Chakravartty (2017, p. 108, original emphasis) highlights the union between two types of scientific realism, realism about entities, and realism about structures; a metaphysics of dispositions would have as content the entities, but its object would be the structures: "dispositions are dispositions *for* relations".

Our thread is, however, different. We are not willing to enter the debate here about scientific realism *per se*, but what interests us are the perspectives of the relations between science and metaphysics. Under this view, dispositionalist metaphysics about properties is (probably in a revisionist sense) a resumption of Aristotelian metaphysics about causal powers.[13] Chakravartty then defines the dispositional and categorical properties as follows:

> Dispositions are generally described in contrast to 'categorical' properties: dispositional properties are usually characterized in terms of what happens to things having these properties under certain conditions, and categorical properties are usually characterized in terms of the static features of things, without reference to any further happenings or conditions (CHAKRAVARTTY, 2017, p. 102-103).

This sets up an *actualist* account of dispositions, as is even clearer in the following example:

> Everyday examples of dispositions are properties like fragility and solubility, which are described in terms of what typically happens to things having these properties when they are treated roughly (they break) and placed in solvents (they dissolve), respectively. Everyday examples of categorical properties are dimensions (e.g., length, area, volume), shapes (e.g., square, cylindrical, tetrahedral), and configurations or arrangements (e.g., a given molecular structure). The intended difference here is that between properties whose natures are properly described in terms of the powers they confer on the things having them to behave in particular ways in particular circumstances, and properties whose natures involve no such empowerment (CHAKRAVARTTY, 2017, p. 103).

Thus, thinking of the graphic representation of Figure 1 we can highlight dispositionalism as a metaphysical attitude close to the Viking Approach, but with a greater angular incidence to full-blooded metaphysics as it considers dispositionalism (whether revisionist or traditional) as an answer to the interaction between science and metaphysics. That is, this response to the Challenge is certainly more focused on metaphysics than on science.

## 4 Discussion: the spectrum as a compass

The middle range of the spectrum looks really attractive, promising to deliver the best of both worlds: the depth of metaphysics and the trust

[13] See, for instance, Chakravartty (2008, p. 152).

of science. The question that remains is: does it? An appropriate relationship between metaphysics and science has yet to be very well justified or even specified. Let's recap some central points discussed so far.

The naturalization of metaphysics contributed more to a manifesto (whose highest flag was raised by Ladyman and Ross, 2007) in favor of reforming the way of thinking and doing metaphysics than as a positive proposal. That is, if we admit that science must really be taken into account in order to do metaphysics, we still do not know how this should be done. Moreover, if metaphysics can only go as far as science goes, then there is no room at all for metaphysics — this kind of proposal stays, employing French's (2018a) in the 'shallow' waters, without assigning any metaphysical profile to the entities posited by science.

A similar criticism can be directed to the other, more modest proposals for naturalizing metaphysics. The proposal for scientifically-oriented metaphysics really acts as an epistemic jury of metaphysical theories seems really promising. But a proposal is not yet a clearly articulated view as long as it remains at the level of a declaration of intent — and that is precisely what the literature proposing the naturalization of metaphysics appears to be: a *letter of intent*. And as much as we can agree with the intentions, we still don't know how to apply them. So it's not much use without it.

The same cannot be said of de Ronde's logos approach. The problem with this approach is the tension between autonomy and continuity of metaphysics in relation to science, since it is not clear how one could, at the same time, develop and extract a metaphysics from quantum mechanics — unless some terminological distinction about what is actually extracted and what is actually developed is done, what is not done by the logos approach methodology. We hope that future work can untie these knots.

Perhaps the only one that stands out is the Viking Approach. In fact, it is plausible to understand Chakravartty's approach of Chakravartty within the metametaphysics of the Viking/Toolbox Approaches, e.g., as an *application* of metaphysical profiles to science. As Chakravartty (2019, p. 12) acknowledges, dispositionalism is just a way of understanding, in metaphysical terms, the scientific endeavor. In this way, one can understand these proposals as a "Vikings' pillage" (even though there seem to be some "tailor-made" elements, see French, 2019). On this interpretation, Chakravartty's proposal would be better characterized as a metaphysical proposal, unlike the other proposals considered here, which are metametaphysical.

That said, we believe that, although it stands out from the rest, considering that it is in fact a proposal and not a manifesto, the Viking Approach does not come out unscathed. Without going into the merits of the functionality of French's (2014) proposal, what seems to be justified is the very motivation of the Viking Approach. Why should we justify the practice of metaphysics in this way? Or, still, simply: why should we look to science for justifications for metaphysics? Is a "scientific" metaphysics better than a non-scientific metaphysics because it is… scientific *simpliciter*? And even if we leave it at that, we still have the problem of metaphysical underdetermination: if metaphysics floats free from science, then metaphysical underdetermination must be taken for granted from the start! So we will still not know which metaphysical profile is the correct profile for the entities postulated by the science in question, e.g., there is no *scientific* support to evaluate this question.

To end this paper in a more positive tone, it seems that the "meta-Popperian method" (ARENHART, 2012; ARROYO; ARENHART, 2019; ARENHART; ARROYO, 2021a) captures the best of the worlds of the metametaphysical proposals available in the literature concerning the relations between metaphysics and science. On the one hand, with the distinction between 'ontology' and 'metaphysics', it shows the gains of naturalization: ontology, which is concerned about what exists, can be naturalized if understood as a catalog of what exists in the world *according to* scientific theories. Metaphysics does not have this naturalization prospect, i.e., it is not obtained from

science. But instead of promoting its unrestricted development, the method finds in science (and the corresponding ontology obtained from it) the guidelines for restrictions of metaphysical compatibility. The meta-Popperian method, in other words, shows in practice how science can give an epistemological *assessment* (not *justification*) of metaphysics. This is the naturalistic guise of the method: in the case of conflict between a scientific theory and a metaphysical theory, it is the metaphysics that must go (e.g., not the science that must be modified). In agreement with Chakravartty (2017) and Vetter (2018), we maintain that the epistemic value of metaphysics as a discipline should not be hierarchical in relation to science and that it should not inherit epistemic value from science; nevertheless, in the case of clash between metaphysics and science, it seems that there are pragmatic reasons in stake to find it more fruitful to modify the metaphysical theory than the physical theory.

A definitive proposal for an appropriate relationship between science and metaphysics is, nevertheless, still a work in progress. And, as such, it is more 'work' than 'progress': much has been said about this, but little has been advanced in the discussion. The spectrum offered here can act as a metaphysical compass to guide those who wish to venture into the still unexplored, though mapped, the territory of scientific metaphysics. Having mapped the terrain, we know where we have already stepped. And it is undoubtedly easier to take the next step when knowing the direction one wants to go.

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