

## WEAK DISCERNIBILITY, AGAIN

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In this paper I argue that the focus of much contemporary discussion concerning the proper role and philosophical significance of weak discernibility in the context of quantum mechanics (and other physical theories) is misplaced. In particular, I claim that metaphysicians' criticism of weak discernibility on the basis of its alleged inability to *ground* objects' numerical distinctness is orthogonal to Saunders's (2003a) main concern in his original paper, which is to use the notion of weak discernibility as part of a broader "logical aid" for *interpreting* physical theories. How exactly this "methodological" (as opposed to "metaphysical") construal of weak discernibility is supposed to work, however, is not immediately transparent. This paper therefore serves both as an attempt to gain a better understanding of Saunders's interpretational program, and also seeks to encourage a renewed emphasis on the set of issues and questions that such a program—at least on my understanding of it—would appear to raise.

### 1. Introduction

Do quantum particles violate the Principle of the Identity of Indiscernibles (PII)? The answer, of course, depends on how the PII is to be understood. According to one recent influential construal of the principle proposed by Simon Saunders (2003a; 2006, drawing on the work of Quine 1976), elementary bosons do violate the PII, but fermions (and composite bosons with fermionic constituents) do not: for the latter, but not the former, are always at least *weakly discernible*—they invariably satisfy some two-place irreflexive physical relation. The conclusion drawn by Saunders is that fermions' weak discernibility in turn guarantees their status as "objects" in some appropriate sense, whereas elementary bosons' failure to stand in such irreflexive relations reveals that they are not to be construed as "objects", but rather merely as "mode[s] of the corresponding quantum field" (2006: 60).

As an illustrative example, consider the spherically-symmetric singlet state

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of two intrinsically identical fermions. Despite this state's very high degree of symmetry, the fermions in question nevertheless still stand in the irreflexive relation "has opposite direction of each component of spin to" (Saunders 2003a: 294). It is the fact that fermions *always* stand in at least *some* such irreflexive relation to others that is said to ensure their status as objects. The same cannot be said, however, of the elementary bosons: it is possible for them all to exist in exactly the same quantum state such that none of them stands in even an irreflexive physical relation to any other. This, according to Saunders, should lead us to question their status as genuine objects.

We might summarise the general argument as follows:

- (P1) Being invariably at least weakly discernible is a necessary and sufficient condition for objecthood.
- (P2) Fermions are invariably at least weakly discernible; the elementary bosons are not.
- (C) Fermions are objects; the elementary bosons are not.

Let us grant the second premise: fermions, but not the elementary bosons, are always at least weakly discernible.<sup>1</sup> But what about the first premise? Why think that weak discernibility is a necessary and sufficient condition for objecthood?

The precise content of this question, unfortunately, is somewhat obscured by the fact that there is no real consensus among philosophers as to what the appropriate criteria for objecthood are: indeed, one might be tempted to read (P1) as having the status of a mere *definition* of the word 'object' (i.e., as being, in some minimal sense, an 'entity' which is always at least weakly discernible). Most theorists,<sup>2</sup> however, take (P1) to have an implied content which is much more substantive: more specifically, they view Saunders as claiming that fermions' weak discernibility *grounds*, or 'metaphysically explains', their status as numerically distinct entities, and, hence, as 'objects'. (In this context theorists usually implicitly assume that numerical distinctness is a necessary and sufficient condition for objecthood.) Moreover, many of these theorists have criticised this proposal for its implicitly involving a dubious circularity: weak discernibility, they claim, rather than grounding the numerical distinctness of the relevant relata, illicitly presupposes it.

Steven French has recently put this worry as follows:

A circularity threatens: in order to appeal to such [irreflexive] relations, one has had to already individuate the particles which are so related and the numerical diversity of the particles has been presupposed by the relation which hence cannot account for it. (French 2014: 40)

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1. But see Muller and Seevinck (2009), who argue that the elementary bosons are invariably at least weakly discernible as well.

2. See, in particular, those cited in footnote 4 below (with the exceptions noted therein).

As French notes, this worry basically reprises a dispute which is very old—centuries, if not more—in the history of philosophy, namely, that of whether relations *in general* are capable of accounting for the numerical diversity of their relata.<sup>3</sup> Many philosophers who take a position on this issue today are liable to claim that those who disagree are in thrall to mere metaphysical prejudice; indeed, some philosophers have even gone as far as to call into question the very intelligibility of the debate itself.<sup>4</sup> At best, then, it is a dispute—and hardly a novel one at that—which is unlikely to be resolved any time soon.

What many of these contemporary philosophers seem to have missed—or, perhaps, ignored—is that the notion of weak discernibility was never originally intended to have any specific impact on this debate. As I shall argue, Saunders’s main motivation in (re-)introducing the term to philosophy was *methodological*, rather than metaphysical. In other words, weak discernibility’s intended role was to serve as an essential aspect of a broader “logical aid” (Saunders 2003: 291) for *interpreting* physical theories; it was not intended to have any particular bearing on the more robustly metaphysical question of whether relations, irreflexive or otherwise, are capable of grounding numerical diversity.

The remainder of this paper thus serves a dual purpose: first, as an attempt to rehabilitate discussion of this methodological construal of weak discernibility; and second, as an attempt to make some tentative inroads into assessing this construal’s overall tenability.

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3. Compare, for instance, French’s remark with Bertrand Russell’s, made in a similar context: “[T]wo terms cannot be distinguished in the first instance by difference of relation to other terms; for difference of relation presupposes two distinct terms, and cannot therefore be the ground of their distinctness” (Russell 1903: 458).

4. Those who endorse or at least appear to express some sympathy with this “circularity objection” to Saunders’s (alleged) proposal include French and Rickles (2003: 228), French and Krause (2006: 170–171), Wüthrich (2009: 1048), Hawley (2009: 109–111), Esfeld and Lam (2011: 148), Caulton and Butterfield (2012: 50, Footnote 29), Arenhart (2013: 471), Dorato and Morganti (2013: 596), and French (2014: 40). Those apparently somewhat less sympathetic include Ladyman and Ross (2007: 137–138), Dieks and Versteegh (2008: 927), Frigg and Votsis (2011: 248), French and Ladyman (2011: 29), and Muller (2015: Section 3). For expressions of suspicion at the very intelligibility of the debate, see Ladyman, Linnebo, Pettigrew (2012: 164) and Pooley (2015: 100). To my knowledge, Pniower (2005: Section 2.4), Pooley (2015: 98) and Ladyman (2016: 201) are the *only* explicit exceptions to the current interpretative orthodoxy, according to which Saunders is understood as claiming that weak discernibility serves to ground objects’ numerical diversity. Neither Pniower nor Pooley nor Ladyman, however, provide significant exegetical support for their preferred reading of Saunders; nor do they subject Saunders’s methodological project to anything like the scrutiny it receives here.

## 2. Methodology, Not Metaphysics

That Saunders sees weak discernibility as primarily serving a methodological as opposed to metaphysical function, and that he does not construe objects' weak discernibility as being that which serves to ground their numerical diversity, is, I take it, reasonably clear from what he writes in his original paper:

I do not suppose there is anything wrong with identity, taken in an irreducible sense.... The proposal, rather, is that in a situation in which we *do not know* what physical objects there are, but only, in the first instance, predicates and terms, and connections between them, then we should tailor our ontology to fit; we should admit no more as entities than are required that can be made out by their means. (Saunders 2003a: 292)

Similarly, elsewhere in the paper Saunders explicitly states that ("in the first instance") he takes his version of the PII to be a "*methodological principle*" (2003a: 289); a few pages later, he refers to his "*method of interpreting* [physical theory] in terms of objects" (2003a: 293); and, perhaps most decisively, in the conclusion to the paper he claims to have "*spoken throughout of the interpretation of theories in terms of objects*" (2003a: 304). (My emphasis in each case.)

How, then, should we understand this proposal? As I read it, weak discernibility's primary function for Saunders is to serve as part of a general method of "extracting" or "reading off" objects—and, in particular, *talk* of objects, using declarative sentences and standard first-order predicate logic (2003a: 290)—from physical theory. The obtaining of the relevant irreflexive physical relations is therefore meant to serve as the minimum (and sufficient) condition for when one may permissibly speak of there *being* objects in the appropriate sense; moreover, one should refrain from granting objecthood to those (putative) entities whose (alleged) numerical distinctness cannot be specified using the predicates and terms drawn from physical theory alone.

The interpretative recipe that Saunders seems to be suggesting might therefore be usefully summarised as follows:

1. Begin with an 'initially interpreted' **physical theory** *T*. This will include various interpreted physical predicates, terms, and *putative* objects.
2. See which putative objects are at least **weakly discernible** according to the various physical predicates that appear in *T* (stripped of identity).<sup>5</sup>
3. Take the putative objects that can be suitably discerned in this way to constitute (what we might call) *T*'s **genuine ontology**; putative objects which

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5. Strictly speaking, for Saunders the relevant predicates must also satisfy the requirement of being *invariant under the symmetries* of the theory at hand (2006: 53). I will slide over this (not insignificant) subtlety here.

cannot be so discerned are thus not part of *T*'s genuine ontology.

I think it is not too difficult to see, on reflection, that the methodological and metaphysical construals of weak discernibility are orthogonal to one another. For accepting—or rejecting—this interpretative package simply *does not bear* on the separate metaphysical question of what, precisely, grounds facts about numerical diversity. On Saunders's scheme, one begins with a collection of putative objects in the initially interpreted theory: "theories are born interpreted", as he writes, hence "we have a rough and ready idea of the objects they are predicates of" (2003a: 290–291). The goal of Saunders's interpretative project is precisely to sharpen this "rough and ready" objectual interpretation to yield what is for him the theory's "genuine" physical ontology (2003a: 295). But it is a *further* question, separate from the interpretative scheme that I take Saunders to be proposing, *how it is* that the numerical diversity of these objects, putative or otherwise, is ultimately grounded—if indeed it is so grounded.

This point is critical to the argument of this paper; and, because it is so apt to be misunderstood, it is worth repeating. On Saunders's interpretative scheme, one starts with the (plausible) assumption that from their very inception physical theories are construed as quantifying over a putative ontology. The central purpose of Saunders's methodology is to distil from this initial or 'naïve' ontological interpretation the objects that the theory in question should be taken 'genuinely' to quantify over. But—and this is the crucial point to note—the viability of Saunders's scheme is strictly compatible *both* with relations' being able to ground the numerical diversity of their relata, *and* with their not being so able. This is because, however the numerical diversity of a theory's putative or genuine ontology is established or grounded metaphysically, the fact remains that physical theories are invariably *initially interpreted* in terms of a putative ontology—which is all that needs to be the case in order for Saunders's methodological project to get up and running.

Let me illustrate this point with a simple example. Consider, again, the spherically-symmetric singlet state of two intrinsically identical fermions. As previously noted, the fermions in this state stand in the irreflexive relation "has opposite direction of each component of spin to" (Saunders 2003a: 294). They are thus weakly discernible; hence, according to Saunders's proposed methodology, they are numerically distinct objects. Now, let us assume for the sake of argument that relations—and, as a corollary, merely weakly discerning relations—are incapable of grounding numerical diversity. Does this in any way impugn Saunders's suggestion that this state consists of two numerically distinct objects?

No. Granted, it follows from Saunders's proposed methodology *that* the fermions in the singlet state should be regarded as numerically distinct objects. But *what* exactly metaphysically explains, or grounds, such objects' numerical diversity is a question on which Saunders's interpretative scheme is entirely

neutral. Attempting to ground the fermions' numerical diversity by appealing to their weakly discerning relations is just *one* way in which such distinctness might be established. For instance, one could—in principle—attempt to ground such objects' numerical diversity by appealing to each object's possession of some intrinsic, empirically transcendent property (e.g., a 'primitive thisness' or 'haecceity')—though this option would of course be anathema to the many theorists suspicious of the existence of such properties.<sup>6</sup> But there is another, arguably much more attractive, option available. This option would simply be to take the fermions' numerical distinctness as *ungrounded*, that is, as metaphysically *primitive*, and not standing in need of any further metaphysical explanation. The fermions in the singlet state may, in full accordance with Saunders's methodological program, simply be taken to be brutally distinct.<sup>7</sup>

In summary, then, the interpretative program that Saunders is plausibly advocating is logically distinct from the debate which appears to have consumed many philosophers when it comes to discussions of weak discernibility.<sup>8</sup> The viability of Saunders's interpretative scheme does not stand or fall with the thesis that relations may legitimately be taken to ground the numerical diversity of their relata—on the contrary, it stands quite apart from it.

Before moving on to assess the general viability of Saunders's interpretative program, I wish to make two important clarifications about the claims made thus far. Then I would like briefly to respond to some exegetical criticism.

First clarification: in claiming that weak discernibility should not be construed 'metaphysically', *all* I mean is that weak discernibility should not be construed as being that which serves to ground objects' numerical diversity. The claim is not in any way intended to be understood as 'anti-metaphysical', or as being in some sense directed 'against' mainstream analytic metaphysics. Nor is the claim intended to be directed against the coherence of the grounding idiom in general. (For what it's worth, I have no gripe with either analytic metaphysics or the grounding idiom.) The point is simply that weak discernibility is not correctly construed as being in any way *related* to issues about ground, and in particular to issues about what grounds objects' numerical diversity: weak discernibility, I claim, is not to be understood 'metaphysically' solely and precisely

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6. Cf. French and Rickles (2003: 223). Ladyman also notes that it is not, in fact, entirely obvious why appealing to intrinsic properties to ground objects' numerical diversity is any less problematic than appealing to relations, "since one might just as well insist that in order for a property to be instantiated there must be a metaphysically prior individual, or there would be nothing to bear the property" (Ladyman 2016: 201).

7. This is the option that I take Saunders himself to endorse: "I do not suppose there is anything wrong with identity, taken in an irreducible sense" (Saunders 2003a: 292). For further defence of the legitimacy of taking objects' numerical diversity as primitive, see Pooley (2006).

8. Without wanting to be unpleasantly accusatory, I take *all* of the authors cited in footnote 4 (apart from the exceptions noted therein) to be guilty of this misinterpretation of Saunders.

in *this* sense.

Second clarification: I similarly do not wish to be understood as claiming that, by construing weak discernibility methodologically as opposed to metaphysically, Saunders's interpretative project is thereby in some sense metaphysically 'sanitised', or 'metaphysics-free'. Indeed, as I shall argue in the sequel, Saunders's own methodological construal of weak discernibility very plausibly relies upon his having antecedently adopted certain quite substantive metaphysical assumptions. In other words, it is plausibly the case that weak discernibility, construed methodologically, is dependent upon a significantly non-trivial—and by no means straightforwardly obvious, or ineluctable—metaphysical conception of what the world is like, and in particular objectual structure's place within it. None of this, however, should be taken to contradict the central claim made above, namely that the 'methodological' and 'metaphysical' construals of weak discernibility are orthogonal to one another. For as I emphasised in the previous paragraph, *all* I mean by the 'metaphysical' construal of weak discernibility in this context is the construal according to which weak discernibility is understood as being that which serves to ground, or metaphysically explain, objects' numerical diversity. *These* two construals of weak discernibility *are* orthogonal to one another, in the sense that adopting either such construal has no straightforward logical bearing on one's ability to adopt the other. But this claim of orthogonality is clearly very different from the claim that, methodologically construed, weak discernibility is orthogonal to metaphysics *tout court*.

With these two points of clarification out of the way, let me now discharge one important worry. In particular, I would like to pre-empt the criticism that my quotations drawn from Saunders's (2003a) paper were selective by briefly examining other passages in the paper which, at least *prima facie*, appear to lend themselves to a more thoroughly metaphysical construal of the role weak discernibility is supposed to play in Saunders's system. (Those uninterested in such exegetical concerns should feel free to skip to the next section.)

There are two such passages:

- (i) What is wrong with identity taken as primitive? In the most general context, I see nothing wrong with identity. But in physics—specifically identity as it figures in physical *theory*—there are special reasons to view it as derivative. (2003a: 290)
- (ii) Consider Black's two iron spheres, one mile apart, in an otherwise empty space (Black 1952). The irreflexive relation *A* is '... one mile apart from...'. It is *because* this relationship holds that we may say that there are two—that it is intuitively evident that there are two. (2003a: 294)

The arguably quite natural thought is that by "derivative" in (i) Saunders means

*metaphysically* derivative, that he is saying that in physics we have “special reasons” to think that facts about objects’ identity and numerical diversity cannot be taken as metaphysically primitive, but must instead be grounded in weak (or stronger) forms of discernibility. Similarly, the thought is that Saunders’s use, and emphasis of, the word “because” in (ii) suggests the metaphysical construal of weak discernibility: that he is saying that it is the spheres’ weak discernibility which *metaphysically* explains, or grounds, their numerical diversity.

I think, however, that such a reading of both passages can be legitimately resisted. With regard to (i), there is no compelling reason, I think, to take “derivative” here to mean metaphysically as opposed to methodologically derivative (in a sense to be explained presently). For if one looks at the actual context in which this quote occurs, one sees that Saunders is making two claims about the identity relation in physics: first, that as it features in physical theory the identity relation is not a straightforwardly measurable physical quantity (in the same way that, e.g., mass and charge are); and second, that the identity relation as it features in physical theory invariably only represents the equality of *mathematical expressions*—not of objects. Saunders is thus plausibly construed in this passage as claiming that the identity relations which hold between a given physical theory’s ‘genuine’ objects are ‘derivative’ merely in the sense that *they are not part of the theory’s initial interpretation*; that such identity claims must be (metaphorically-speaking) teased out, extracted—*derived*—using the *interpretative* method that he is proposing.<sup>9</sup>

What about (ii)? Admittedly, this passage does not lend itself as naturally to a methodological (re-)construal: the issue of how to correctly interpret physical theories in terms of objects would appear to be orthogonal to the question of whether, and in virtue of what, Black’s two spheres are genuinely numerically distinct. Nevertheless, it is implausible to think that the *only* way of reading this passage is by understanding it as making a metaphysically robust claim about how the numerical diversity of Black’s two spheres is ultimately grounded. For a much more deflationary reading of this passage is also possible: on this deflationary reading, Saunders is simply making the rather more mundane claim that the two spheres’ satisfying the relevant irreflexive relation *makes it plausible to say* (“intuitively evident”) that there are two. In other words, Saunders may be plausibly read as claiming that, at least in Black’s case, the interpretative scheme he is proposing *lines up with our intuitions* about how many objects there are. (Conversely, were such spheres *not* even weakly discernible—but were instead, e.g.,

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9. Moreover, that a mere two sentences after passage (i) Saunders explicitly claims that his desideratum is for a “*clear interpretation of...theories and experiments in terms of physical objects*” (2003a: 294, my emphasis) further suggests to my mind a reading according to which Saunders intends “derivative” here to be construed only in a methodological, not metaphysical, sense.

spatially co-located for all eternity—then presumably it would be “intuitively evident” that the scenario is most accurately described as containing only *one* such sphere.) Saunders may therefore be construed in this passage as arguing more straightforwardly for the intuitive plausibility of weak discernibility *qua* criterion in adjudicating, and perhaps also in explaining our intuitions, about how many objects there are in a given situation; he need not be understood as claiming that weak discernibility is itself metaphysically explanatory of numerical diversity.

Now, I should perhaps say that I do not take the comments made in the previous two paragraphs to be fully conclusive, or irrefutable. (Irrefutability is, after all, an impossible standard to achieve in any work of exegesis.) Certainly, there is a *possible* reading of Saunders which views him as being committed *both* to regarding weak discernibility as an aid in interpreting the ontology of physical theories *and* as being that which serves to ground objects’ numerical distinctness; indeed, I strongly suspect that the majority of theorists (including those referenced in footnote 4 above) who read Saunders as attempting to ground objects’ numerical diversity do so precisely because passages (i) and (ii) above are, at least superficially, quite suggestive of such a reading. My point is simply that such a reading is not at all *compellingly* supported by anything he writes—at the very least, it is one that is far from ineluctable.<sup>10</sup>

In any case, my central contention remains the same: the *clearly intended* methodological construal of weak discernibility has thus far been neglected in the philosophical literature. Moreover, given both the proposal’s patent philosophical novelty, as well as its orthogonality to the much more widely discussed (and historically jaded) metaphysical construal, it is one which, in my view, finally deserves our scrutiny.

### 3. Three Questions

Several questions naturally arise in considering this interpretative account. To keep our discussion manageable, I shall mention only what I consider to be three of the more interesting ones here:

**The Naïve Question.** What, exactly, is wrong with the ‘naïve’ approach to reading off ontology from one’s theory? That is, why not simply take the *putative* objects—e.g., fermions *and* bosons—of one’s theory as representative of the world’s actual ontology?

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10. For what it’s worth, Saunders (personal communication) has confirmed to me that it was always his intention for weak discernibility to be construed methodologically, rather than metaphysically—though, of course, this does nothing by itself to alleviate the (alleged) textual difficulties which arise in interpreting his (2003a) paper as suggesting such a purely methodological construal (i.e., passages (i) and (ii) above).

**The Epistemological Question.** On what legitimate basis do we decide that Saunders’s interpretative proposal is in fact the correct, or best, way of interpreting physical theories in terms of objects?

**The Metaphysical Question.** What kind of metaphysics—of objecthood, and the world more generally—motivates the interpretational proposal Saunders is suggesting? And how plausible is this metaphysics?

In the following three sections we shall consider each of these questions in turn. We begin with the Naïve Question.

#### 4. The Naïve Question

What is wrong with the ‘naïve’ approach to theory interpretation? To take the specific case of quantum theory once again, why not ‘naïvely’ read off the ontology of this theory as one comprised of both fermions *and* bosons?

Saunders does not provide any extensive criticism of interpretative naïvety in his original paper (nor, to my knowledge, elsewhere). He merely states that there would be “nothing systematic” to such an interpretative approach, and that it is therefore “plausible” that we should look for a way (namely, his own) of reading off a theory’s ontology which does have some such claim to systematicity (2003a: 291).

This criticism is, I take it, far from compelling. Indeed, the claim itself doesn’t even appear to be correct: plausibly, interpretative naïvety *is* systematic—it is systematically naïve! However, to criticise Saunders on the basis of his failure to discredit interpretative naïvety would, I think, be unfair. For he is in my view best read not as attempting to offer a detailed *criticism* of interpretative naïvety. Rather, I think he is best read as simply proposing an interpretative method which purports to offer an *improvement* over—is, in some sense, ‘better’ than—interpretative naïvety. The relevant question then becomes: Why, systematicity aside, should we think his method is better?

For Saunders, it would seem that the primary reason for thinking that his method is better is straightforward: namely, that it rules *out* the elementary bosons *qua* genuine objects, but nevertheless rules *in* all fermions (and particles with fermionic constituents). As he writes:

The stable constituents of ordinary matter are all fermions. Apart from the Higgs particle...all elementary bosons are gauge quanta; they all mediate forces between fermions.... The PII treats fermions quite differently. Given the contrast between [bosons and fermions], as gauge fields and sources respectively, *it is a merit of the principle that it does*. (Saunders 2003a: 295, my emphasis)

This claim of merit, however, can be legitimately questioned. To be sure, the elementary bosons are generally fermionic force-mediators. But why should this fact give us any reason to question their status as genuine objects? Indeed, unless adequate justification is provided in support of the claim that Saunders's interpretative scheme (rather than some other) is *in fact* the correct, or best, way of interpreting physical theories in terms of objects, *neutrality* on the issue of whether the elementary bosons are genuine objects would seem to be the stance that is most naturally called for. Absent any such justification, however, Saunders's claim of merit seems, at best, premature.

This, of course, naturally brings us to our second question.

## 5. The Epistemological Question

This is precisely the question (just alluded to) of what the relevant criteria for a successful objectual interpretation of a theory are supposed to be. More precisely, it is the question of how we are to legitimately decide when and whether any such proffered interpretation is actually *correct*.

I think we can gain some insight into how Saunders is thinking about this question by examining a particularly revealing footnote:

If I am concerned with metaphysics at all, it is *descriptive* metaphysics, in Strawson's sense, as an aid to the interpretation of physics, and to that end I aim to preserve a good part of established practice. Ordinary objects had better turn out to be objects, on any account, and so they do on mine; it is as an extension from this that their stable constituents had better turn out to be objects as well. With the rest there is more latitude. (Saunders 2003a: 295, Footnote 7)

Recall that, for Strawson, "Descriptive metaphysics is content to describe the actual structure of our thought about the world" (Strawson: 1959: 9). I thus take Saunders's claim here to be that *what ultimately justifies the use of his methodological scheme is the fact that "ordinary" objects, such as tables, chairs, etc., are invariably at least weakly discernible*. In other words, I take his suggestion to be that the proposed minimum and sufficient objectual criterion of weak discernibility is sufficient to *describe* our ordinary ontological scheme (in that every object of our ordinary ontological scheme is invariably at least weakly discernible by some physically salient predicate); moreover, it is *because* the objects of our everyday ontological scheme are invariably at least weakly discernible that ultimately justifies our taking weak discernibility as a minimum and sufficient criterion for objecthood, and which in particular justifies our using weak discernibility as part of a broader logical aid for determining what objects there are according to a given physical theory.

Arguably, Saunders's claim to be engaging in descriptive metaphysics has some initial plausibility, for tables, chairs, and many other ordinary objects besides, very plausibly *are* invariably (at least) weakly discernible by some physically salient relation—for instance, by some spatiotemporal relation—from all other such objects.<sup>11</sup> Nevertheless, the claim is not without its problems. I shall mention two such problems here, one of which I think is defeasible, the other less so.

The first, defeasible, difficulty is that our everyday ontological scheme would *prima facie* appear to contain some examples of objects that are not even weakly discernible by any physically salient predicate. As Hofstadter and Dennett (1981: 6–7) have pointed out, voices, languages, haircuts, symphonies and the game of bridge would all appear to be straightforward examples of “things that are neither mysterious [nor] ghostly” which populate our everyday ontological scheme, but which nevertheless are not obviously identifiable with nor reducible to anything describable in the language of fundamental physics. In particular, it is difficult to see what *physically* salient irreflexive relation any two (e.g.) distinct symphonies will invariably satisfy: after all, which physically salient irreflexive relation weakly discerns, say, Tchaikovsky's 5th and 6th Symphonies? (Not any two particular *performances* of the symphonies, mind—for these could presumably be discerned spatiotemporally—but rather the symphonies *simpliciter*?) Moreover, is it not true that such entities constitute part of our ordinary, everyday ontological scheme, one which any attempted “descriptive metaphysics” should be expected to recover? Of course, Saunders might respond, so much the worse for our ordinary ontological scheme. To which the obvious reply is, so much the worse for Saunders's claim to be doing *purely* “descriptive” metaphysics.

I think, however, that Saunders might well have a plausible response to this objection: in particular, I think he could argue that his claim to be doing “descriptive metaphysics” was always intended to have restricted scope. For given that his manifest interest in his paper is with *physics*, and in particular with interpreting physical theories in terms of objects, I think he might have legitimate grounds for claiming that his descriptive-metaphysical enterprise was solely intended to recover commonsense *physical* ontology, not commonsense ontology *simpliciter*. And, indeed, although it is true that the kinds of objects mentioned above are not naturally thought of as being *purely* abstract objects (on a par with, say, numbers), it is nevertheless similarly natural *not* to think of them as constituting *physical* objects (as Hofstadter and Dennett, 1981: 7, themselves point out). Saunders, then, might justifiably claim that it is no mark against his (physically-oriented) descriptive-metaphysical enterprise that it might fail to recover them.

There is, however, a second—and, I think, less defeasible—problem with

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11. In general, of course, such objects will be ‘absolutely’ discernible, in the sense that they differ with respect to some physically salient intrinsic or relational property.

Saunders's claim to be doing purely descriptive metaphysics, namely, that it would appear to do nothing to justify his claim (noted in the previous section) that his scheme's ruling out the elementary bosons *qua* physical objects constitutes a virtue of it. For while Saunders is plausibly right in saying that the stable constituents of ordinary physical entities such as tables and chairs should count as objects according to any attempted objectual (and descriptive-metaphysical) interpretation of a given physical theory, and while he is also plausibly correct in claiming that there is more "latitude" (2003a: 295, Footnote 7) in determining the elementary bosons' status as genuine objects given the fact that they are generally gauge quanta, it is nevertheless difficult to fathom why the fact that the elementary bosons *aren't* counted as objects according to one such scheme should be seen as beneficial. (Consider: if the elementary bosons *were* granted objectual status according to this or some similar interpretative scheme, would this fact thereby count against it?) Neutrality is what appears to me to be what is most naturally called for; Saunders's claim of merit seems unwarranted.<sup>12</sup>

## 6. The Metaphysical Question

Let us now ask the question concerning what kind of metaphysical framework—and, in particular what kind of metaphysical conception of objecthood—is underwriting the interpretational program that Saunders is plausibly advocating.

There are several different ways of approaching this question. Here is one. Assume, for the sake of argument, that we have a theory which we have good reason to believe is true, or at least approximately true. Assume, further, that the world comes equipped with a mind-independent, conceptual-scheme independent fundamental ontology. (That is, assume that the world fundamentally contains *things*.) And now assume that we're in the process of trying to interpret this theory objectually, to figure out what the ontology of the world actually is. The relevant question is, *does the fundamental ontology of the actual world and the ontology yielded by adopting Saunders's interpretative method line up?* To take quantum theory once again as an illustrative example, does the world fundamentally only contain fermions, but not bosons, as genuine entities; or does it contain both?

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12. Saunders (personal communication) has suggested that his interpretative scheme's ruling out the elementary bosons as genuine objects might plausibly be regarded as a virtue because it demonstrates that the minimal objectual requirement of weak discernibility is not trivially satisfied by every putative physical entity. Perhaps he is right that this is a positive feature of his method. (Though note that, according to Muller and Seevinck, 2009, the minimal objectual requirement of weak discernibility plausibly *is* trivially satisfied by every putative physical entity—for they argue that the elementary bosons can in fact be weakly discerned as well.) Nevertheless, why this apparent non-triviality should be taken to constitute an advantage of Saunders's interpretative scheme *in comparison to other such schemes* (e.g., interpretative naïvety) is entirely opaque.

Absent any antecedently justified reason for thinking that Saunders's proposed methodological scheme is in fact the correct way of interpreting physical theories in terms of objects, it is (to say the least) extremely difficult to see how one might attempt to answer this question. Fortunately for Saunders, however, it would seem that he need not respond to it—for his conception of objecthood and, more generally, his metaphysics, allows him to avoid it. As he has written in a recent paper:

It may even be that the world is at bottom a mathematical structure, or 'has' a mathematical structure; but in trying to be more precise as to what that involves, I see no safer way than to put questions of ontology into words, using simple declarative sentences and the standard apparatus of first-order quantifiers.... *Objectual structure...I see as a coarse-graining of the mathematical structure of the world: the pegs and poles that gather its materials and most reliably tie them together.*<sup>13</sup> (Saunders 2016: 166, my emphasis)

For Saunders, then, what his interpretative scheme is supposed to yield is not the true ontology of the world in any metaphysically robust sense: strictly speaking, there is no such thing. Rather, what it yields is a description of the world *in terms of* objects and their properties; it is an approximate or 'blurry' description of a world whose structure is by nature mathematical, or more precisely of a world whose structure is most perspicuously described in the language of mathematical physics, rather than in objectual terms (i.e., in terms of objects and their properties). Crudely put, then, the job of the theoretical physicist is to delineate this mathematical structure as perspicuously as she can, using physical equations; the job of the (descriptive) metaphysician is to break this structure down, as perspicuously as *she* can, into objectual terms.

There are many interesting issues and questions that arise in considering this metaphysical proposal. Again, to keep our discussion manageable, I shall only mention three of what I take to be the most compelling ones here.

First, one might wonder whether there are alternative objectual interpretative proposals, distinct from Saunders's own, that are similarly capable of offering a decent enough (or better) coarse-grained description of fundamental reality.

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13. Compare also:

The world is a structure, and it is thought of as such in exact physical, interpreted mathematical terms, but how it is to be broken down into parts, to be spoken of predicatively, can be a more rough and ready affair, sufficient only in the sense of FAPP, to use Bell's acronym; sufficient linguistically, but only for all practical purposes. (Saunders 2003b: 132)

My reading of this and the above passage—according to which Saunders does not believe that the world has any fundamental ontology—has also been confirmed to me privately by Saunders. (Thanks to an anonymous referee for pressing me on this point.)

That is, granting the fact that the world is most perspicuously described in the language of mathematics and that it can only be described in a more-or-less coarse-grained fashion in terms of objects and their properties, one might ask what reason we might have for thinking that describing the world in terms of objects that are at a minimum weakly discernible will offer a better, or more faithful description of this underlying reality than a description of the world in terms of objects (or ‘objects’) that aren’t. Thus, to take the specific case of quantum mechanics again, why think that describing the world as presented by quantum theory in terms of fermions, but not bosons, *qua* genuine objects offers us a more faithful coarse-grained description of the world than a (‘naïve’) objectual description in terms of both?

The answer is not, I think, immediately obvious. One might initially be inclined to think that Daniel Dennett’s (1991) influential criterion of what a suitably ‘coarse-grained’ description of fundamental reality should be—one which has since been eloquently elaborated and defended by David Wallace (2012: Chapter 2)—might be of help here. On Dennett and Wallace’s view, an emergent ontology should be regarded as ‘real’, or constitutes a ‘real pattern’, to the extent that it in some way contributes to the explanatory or predictive power of various scientific theories which admit such entities as part of their ontology. So, for instance (to use Wallace’s example), tigers are real, albeit emergent, objects in virtue of the fact that by positing them as genuine entities we greatly increase the explanatory and predictive success of a number of theories across the biological sciences. And it is for this reason that, according to Dennett and Wallace, a coarse-grained description of the world which construes tigers as genuine objects should be taken to provide us with a more faithful coarse-grained description of fundamental physical reality than one which does not.

Unfortunately, however, Dennett’s criterion would appear to fail to have any substantive application in our primary case of interest (i.e., quantum mechanics). For here, recall, we have two candidate coarse-grained ontologies, one of which includes both fermions and bosons, the other of which includes only fermions. Now, is there any extant theory, either in the special sciences or elsewhere, which admits only fermions as elements of its ontology, but not bosons? Or is there any such extant theory in which *removing* any commitment to bosons, but not fermions, as objects would nevertheless allow the theory to retain all of its explanatory or predictive power? As far as I can tell, the answer to both questions is *no*. Rather, it would seem, scientific theories either fail to quantify over *both* fermions and bosons in the first place (as in, for instance, theories in the biological sciences), *or* they indispensably quantify over both, to an essentially equal extent (as in, for instance, the Standard Model of particle physics).<sup>14</sup> Thus, I

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14. As an anonymous referee has helpfully pointed out to me, quantum field theory in general makes no distinction between fermions and bosons with respect to their being

submit, Dennett's criterion plausibly fails to provide any support for the view that an ontology composed exclusively of fermions offers a better coarse-grained description of the structure of the world than an ontology composed of both.<sup>15</sup>

Second (and relatedly), given that on Saunders's proposal the world is most perspicuously described in the language of mathematics, it is at the very least not immediately obvious what the 'robust' metaphysical significance is of his denial of the status of objecthood to the elementary bosons. Would we really be flat-out "wrong"—as Saunders (2006: 60) suggests we would be—if we thought of bosons as genuine objects, rather than merely as modes of the corresponding quantum field? And, if so, what exactly would be wrong about it? Presumably, the answer to this question is that thinking of bosons in objectual terms would lead to a *worse* coarse-grained description of the world than it would were we not thinking of bosons objectually. But, again, it is at best unclear why we should think this is true. Indeed, absent an adequate—and presumably non-Dennettian—account of what a satisfactory 'coarse-grained' objectual interpretation of the world is meant to be, the worry inevitably arises as to whether *anything* of genuine significance hinges on Saunders's claim that fermions, but not the elementary bosons, are 'genuine' objects (other than, perhaps, our refrainment from *calling* the latter 'objects').

Third and finally, one might ask how Saunders's proposed methodology fits into the broader philosophical context in which it is frequently discussed, namely ontic structural realism (OSR).<sup>16</sup> So, what is the connection between Saunders's method and OSR? The answer, somewhat unsurprisingly, depends on how exactly we construe OSR. Here are three versions of the view:

**Eliminativist OSR:** There are no objects, fundamental or otherwise.<sup>17</sup>

**Emergentist OSR:** There are no fundamental objects; however, objects do exist emergently, at a suitably coarse-grained level of description.<sup>18</sup>

**Grounding OSR:** Whatever objects there are, their numerical diversity is grounded in the relations they bear to one another.<sup>19</sup>

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"excitation number[s] of a certain mode of a quantum field" (Saunders 2003a: 295).

15. Of course, it is perhaps conceivable that an objectual description of the world in terms of fermions just *is*, in some metaphysically brute and unknowable sense, a much more faithful coarse-grained description of reality than an objectual description in terms of both fermions and bosons. The pertinent question is, what reason do we have to think that such a possibility—even if conceivable—is actually true?

16. See, e.g., Ladyman and Ross (2007: 137–138), Rickles (2008: Section 5.3.3), and French (2014: Section 2.8). (Thanks to an anonymous referee for pressing me on this question.)

17. This is the view that I take, e.g., French (2014: see esp. Chapter 7) to endorse.

18. This is the view that I take, e.g., Ladyman and Ross (2007: see esp. 131) to endorse.

19. For further discussion of this and other versions of OSR, as well as further references to the relevant literature, see Ladyman (2014: Section 4)

It is easy to see that Saunders's proposed methodology is essentially incompatible with Eliminativist OSR: namely, for the reason that (e.g.) fermions turn out to be genuine objects according to his method. Moreover—and as previously discussed—Saunders's method is entirely neutral on the question of whether relations in fact ground objects' numerical diversity, that is, it is neutral on the issue of whether Grounding OSR is true.

Saunders's method, however, arguably finds a quite natural home in Emergentist OSR: indeed, we have seen that Saunders himself appears to subscribe to precisely this version of OSR. Thus, for the Emergentist OSR-ist, Saunders's scheme could be said to yield precisely those objects which exist only at a suitably emergent level of description. Nevertheless, it should be noted that the Emergentist OSR-ist is—at the very least—by no means logically *compelled* to adopt Saunders's proposed methodology for yielding such an emergent objectual description of the world, for there are other *prima facie* plausible (e.g., Dennettian) ways of cashing out what the relevant criteria are for such an emergent objectual description. Emergentist OSR thus does not necessarily stand or fall with the success or otherwise of Saunders's interpretative method.

There is, then, no straightforward answer to the question of whether Saunders's methodology ultimately speaks for, or against, OSR: the answer depends too heavily on precisely which version of OSR one is considering. Nevertheless, two things can be said with confidence: first, not every version of OSR has its fate inextricably tied to that of Saunders's interpretative method; and second, not every version of OSR has its fate inextricably tied to that of every other version of OSR. In particular—and to note a point of particular relevance to the arguments of this paper—the (alleged) failure of Grounding OSR does nothing to impugn Saunders's methodological project; nor does it in any way call into question those versions of OSR which are happy to accept the numerical diversity of objects, fundamental or otherwise, as primitive.<sup>20</sup>

## 7. Conclusion

In summary, I have done two things in this paper.

First, I have argued that the originally intended philosophical significance of weak discernibility has, thus far, been seriously misunderstood in the literature. Moreover, I have argued that, construed as originally intended, the notion of weak discernibility avoids—indeed, is orthogonal to—a common ('circularity') objection often levelled against it. Thus, I have argued weak discernibility is properly understood only 'methodologically': that is, as playing an essential role

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20. For an example of just such a version of (what the authors label) "moderate" OSR, see Esfeld and Lam (2008: esp. 33–4).

in a broader scheme of *interpreting* physical theories in terms of objects; it is not correctly (i.e., ‘metaphysically’) construed as being that which serves to ground objects’ numerical distinctness.

Second, I have tried to make some tentative inroads into assessing this methodological proposal’s overall tenability. More specifically, I have argued that (i) Saunders has yet to provide any genuinely compelling grounds for thinking that his proposal offers a significant improvement over ‘interpretative naïvety’, according to which one regards a given physical theory’s *putative* ontology (i.e., the ontology as conceived in the theory’s initial or ‘naïve’ interpretation) as its true or ‘genuine’ ontology; and (ii) that his proposal plausibly relies upon his having adopted several highly non-trivial or non-transparent assumptions about what the world is like, and in particular about objectual structure’s place within it.

As should be clear from the preceding discussion, I do not claim that any of my questions or criticisms are unanswerable. But what I do claim is that such questions and criticisms—rather than common concerns about the ability of relations to ground the numerical diversity of their relata—are at least *genuinely relevant* to the notion of weak discernibility, at least as originally construed by Saunders. Moreover, they are in my opinion much more worthy of examination than the questions which usually revolve around discussions of weak discernibility in the contemporary literature—questions which, arguably, were already discussed to death in the metaphysics literature over a century or so ago.

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