Radical Ontic Structural Realism as a Structuralist Existence Monism

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Abstract: Radical ontic structural realism (ROSR) argues that structure is all that there is and that objects are metaphysically eliminable. By making such claims, ROSR is widely considered metaphysically obscure. To address this, I propose a novel characterisation of ROSR, drawing on two metaphysical concepts: existence monism, attributed to Spinoza by Bennett (1984) and Spinoza's concept of modes. These concepts are adaptable to ROSR, which becomes a structuralist existence monism, where putative objects are reconceptualised as modes of the world's structure. This proposal directly contributes to solving two problems ROSR faces: (A) the need for a metaphysical framework clarifying ROSR's key claims and (B) ROSR's need to account for the apparent plurality of objects we experience. Drawing on Wallace and Timpson's (2010) spacetime state realism, I suggest a solution to a third problem, (problem C), McKenzie's (2024) challenge to ROSR's status as a substantive metaphysical doctrine. My reformulation of ROSR is a natural interpretation of this solution. I also compare my proposal to French's (2014) ROSR, and Esfeld and Lam's (2011) moderate structural realism, highlighting my proposal's advantages.

1. Introduction

Ontic structural realism (OSR) is a family of metaphysical positions emphasising the ontological significance of relations and structure. Two notable variants of OSR are *radical ontic structural realism (ROSR)* (also known as eliminative OSR) and *moderate ontic structural realism (MOSR).* According to MOSR, fundamental objects exist but lack any non-relational identity (Esfeld and Lam 2008). According to ROSR, by contrast, (1) structure is all there is, and (2) objects are eliminated (French 2014). By making these radical claims, ROSR is widely considered

metaphysically obscure. To address this, I propose a novel characterisation of ROSR. This draws on two metaphysical concepts: *existence monism*, attributed to Spinoza by Bennett (1984) and Spinoza's concept of *modes*. In Bennett's (1984) existence monist view, objects are modes of one fundamental substance, which is all that exists. These concepts can be adapted to ROSR. ROSR then becomes a *structuralist existence monism* where putative objects are reconceptualised as modes of reality's structure.

The goal of this paper is to first outline and then defend structuralist existence monism as an interpretation of ROSR. In §2, I introduce ROSR. In §3, I outline three problems for ROSR. Briefly put, these are: (A) the need for a metaphysical framework clarifying ROSR's key claims, (B) ROSR's need to explain the apparent plurality of objects we experience, and (C) McKenzie's (2024) objection to OSR's status as a substantive metaphysical doctrine. In §4, I adapt existence monism and Spinoza's concept of modes to ROSR. I then turn to the task of arguing for this structuralist existence monist interpretation of ROSR and argue, in §5, that adopting this interpretation directly contributes to resolving two of the problems introduced in §3 and is a natural interpretation of my proposed solution to the third, thereby making a case for the view. In §6, I strengthen the case for this interpretation of ROSR by comparing it to other related views, including Schaffer's (2007, 2009, 2010a, 2010b, 2010c) approaches to monism, French's (2014, 2019a) approach to ROSR, and Esfeld and Lam's (2011) MOSR (which employs the concept of modes in a different manner to my view), highlighting my proposal's advantages.

2.1 ROSR and Its Motivations

ROSR is a relational ontology where "objects...qua substantive metaphysical entities are reconceptualized as and eliminated in favour of…nodes or metaphorical 'crossing points' in a network of relations" (Cei and French 2010:37). There are two primary motivations for ROSR. The first comes from the debate around theory change and the pessimistic induction (Ladyman and Ross 2007, Ladyman 2023, see French 2014 for a detailed case for ROSR in this context). I will not focus on this motivation here. The second motivation for ROSR is that it provides a useful metaphysical framework for interpreting various physical theories. These include non-relativistic quantum mechanics, quantum field theory (QFT), and general relativity (GR) (French

2014, 2019a, Ladyman and Ross 2007).[1] ROSR, as a metaphysical thesis, is my primary concern. In this context, structure is typically given an ostensive definition via a series of examples, instead of via a list of necessary and sufficient conditions. Thus, McKenzie (2024) notes that while the boundaries of the category of structure are vague, we can identify *paradigmatic examples* of structure. Such paradigmatic examples include laws, symmetry groups, extrinsic properties, spacetime structure/relations and entanglement relations. Particles and spacetime points (particularly if their identities are secured non-relationally) are paradigmatic examples of objects (Ladyman and Ross 2007, French 2014, McKenzie 2024).

2.2 Structure in ROSR

I will now move on to briefly discuss structure in the contexts most significant to this article: QFT and relativistic spacetime physics. This is relevant as McKenzie's challenge to OSR (discussed in §3) centres on the ontology of QFT, and spacetime structure plays a key role in my response.

The ontology of QFT takes centre stage in the recent debate regarding OSR and its radical form (See French 2014, 2019a, Muller 2014, Glick 2016, McKenzie 2020, 2024). A paradigmatic example of structure in this context is symmetry group structure. This, alongside a structuralist understanding of laws, underpins French's (2014, 2019a) formulation of ROSR. Quantum fields are also given a structuralist interpretation by Ladyman and Ross (2007) and Muller (2014). According to Muller (2014:14-15):

> "there are no particles at the fundamental level…there are only structures and object-like features of structures….the fundamental substance of physical reality are quantum fields….fields are structures. They have object-like features: the field quanta"

However, French (2014) presents the symmetry-centric approach as an alternative to a field-based ontology, as McKenzie (2024) notes. We will return to this ambiguity regarding the status of fields, as this is central to McKenzie's (2024) challenge to OSR discussed in §3.3.

[1] When discussing QFT, I primarily refer to conventional/Lagrangian QFT. Algebraic QFT is referred to as AQFT. See Wallace (2006).

Secondly, OSR also provides an account of the ontology of spacetime. A radical structuralist version is possible (French and Rickles 2006, Ladyman and Ross 2007, Greaves 2011, Bain 2013), although this receives less attention than its MOSR rivals. The debate regarding Spacetime OSR typically focuses on general relativity (GR). Notably, the hole argument is often invoked as grounds for rejecting the attribution of primitive identity to spacetime points (Ladyman and Ross 2007, Esfeld and Lam 2008). Muller (2011) provides the most well-developed defense of spacetime OSR. This utilises the notion of weak discernability (discernability via symmetric and irreflexive relations) to argue for the relational individuation of spacetime points in GR, such that all there is to the identity of these are their relations. A weak discernably-based relational individuation is also available in special relativity (Dieks 2010). As Morganti (2020:79) summarises, when considering:

> "the properties and relations identified as invariants under automorphisms of the four-dimensional space-time manifold…space-time points are differentiated (merely) by spatiotemporal irreflexive and symmetric relations…[Here]…Muller employs the light-cone relation…the relation that relates two points if and only if there is some point inside a light-cone of one of them but outside a light-cone of the other."

Muller does not definitively specify the OSR type best supported by this argument, nor does Dieks when considering spacetime structuralism in special relativity. However, radical spacetime structuralists could argue that as spacetime points plausibly "have no intrinsic features whatsoever" (Morganti 2020:79), they can be reduced to merely "points of intersection of relations, or nodes in a structure" (French 2014:97), as per ROSR.[2] Moreover, such a view benefits from not positing an extra unneeded category (objects).[3]

Thus, the basic idea in these, and other theories where ROSR (as a metaphysical framework), is applied, is that if putative objects are reducible to (or reconceptualised as) features/aspects of (or

[2] Lam and Esfeld (2012) discuss spacetime points' lack of intrinsic properties in GR, albeit from an MOSR perspective. For Bain (2013), spacetime ROSR is also motivated via appeals to the Einstein algebra formation of GR and category theory.

[3] Greaves (2011) and Knox (2014) critique spacetime OSR. A central objection is not its falsity, but its indistinctness from existing views, primarily sophisticated substantivalism. Spacetime ROSR overcomes this, as an objectless ontology is no orthodox substantivalism.

nodes in) the relevant structure, then structure is what we should be ontologically committed to.[4] The metaphysical category of objects is then viewed as superfluous and eliminable. French (2014, 2019b) combines this with an eliminativism regarding ordinary objects, dispensing with objects entirely.[5]

3.1 Clarifying ROSR's Key Claims: Problem A

My goal is not to argue that ROSR is true (in any specific theory). Instead, it is to provide a metaphysical reformulation of ROSR that helps clarify its general ontological claims and addresses three specific challenges to ROSR's coherence as a metaphysics. As such, having introduced ROSR, I will now discuss three problems (A, B and C below) it faces, two of which my proposal directly helps solve, and the third where it is a natural interpretation of my proposed solution.[6]

French (2014:vi) argues that a structural realist cannot "simply wave one's hands at the relevant theoretical posits or equations and declaim 'that is what I'm a realist about'! One needs to provide some sort of 'clear picture'…that….must be metaphysically informed". French (2014) dubs the requirement for a clear metaphysics of physics Chakravartty's challenge, as for Chakravartty (2007:26):

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[4] ROSR's purported avoidance of metaphysical underdetermination is another argument for the view, particularly in non-relativistic quantum mechanics (see French 2014). An argument for ROSR emphasising a metaphysical underdetermination between spacetime substantivalist and relationalist views is possible (French and Rickles 2006) Bain (2013) alternatively highlights an underdetermination of objects' status in different formulations of GR as supporting ROSR.

[5] See French (2019b) for rebuttals of common defences of ordinary object ontology.

[6] Two of these problems are distinct from the three standard objections to ROSR, identified by Esfeld and Lam (2011:147-148) as a *metaphysical objection* asserting that relations require relata to instantiate relations, an *empirical objection* claiming the physics ROSR discusses does not demand objects' elimination, and a *mathematical objection* challenging ROSR's mathematical coherence due to a purported "ineliminable reference to objects and relata" (Lam and Wüthrich 2015:607) in the mathematics employed in physics. I will address the metaphysical objection, which is intertwined with the need for a metaphysically clear articulation of ROSR's key claims (a key concern of this article called problem (A)). The empirical objection is set aside as I do not argue for ROSR's truth. However, §2's briefly outlined case for spacetime ROSR and §5.4-5.5's discussion of QFT may strengthen ROSR's plausibility in these contexts. I will not address the mathematical objection in detail. Much ink has been spilled on this, and I have little to add beyond suggesting Eva's (2016) category theoretic response, building on Bain's (2013) earlier work, as a plausible solution. This article assumes that freestanding relations are not mathematically incoherent in a manner refuting ROSR. French (2014) (via his 'Poincare manoeuvre') and Dewar (2019) provide alternate responses to the mathematical objection.

> "[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."

To overcome Chakravartty's challenge, a clear, metaphysical articulation of ROSR is needed. I claim that this should include expressing its key claims: (1) that structure is all there is and (2) the elimination of objects via an appropriate metaphysical framework, as without this, we can hardly say that we have a clear, metaphysically informed understanding of the view. The metaphysical framework adopted to explicate ROSR's ontology should also explain how relations are not necessarily relations between relata/objects. This is needed, as it is commonly argued that "relations require some sort of relata as that what stands in the relations", which Esfeld and Lam (2011:147-148) dub *the metaphysical objection to ROSR*. Thus, we need a response to this objection, such that ROSR's claim (1) (that relations/structure is all there is) can be made metaphysically coherent without invoking objects to stand in relations.

Additionally, claim (1) itself, and the ubiquitous talk of *the* structure of the world by radical structuralists (the title of French (2014) is an iconic example) plausibly imply existence monism. Morganti (2020:76) recognises this by attributing to French (2014) the view that one world-structure with no proper parts, identical to the whole universe, exists. However, French's stated position on this is somewhat ambiguous. French (2014:183) suggests existence monism as an option for understanding ROSR, but does not decisively endorse it. French (2016:195-196) rejects understanding ROSR as a traditional existence monism, treating reality as a bloblike object akin to Horgan and Potrč's (2008) view, as this fails to do justice to ROSR's status as a relational/structural ontology. So, the precise nature of ROSR's monist implications requires clarification.

French (2014) often discusses the idea that the metaphysical elimination of objects involves reconceptualising putative objects as aspects of (or nodes in) the relevant structure. This helps to clarify (2), the idea that objects are eliminated somewhat. Yet, based on what has been said so far, it is unclear exactly how this reconceptualisation process works, and how to do this in a sufficiently metaphysically clear manner. Thus, we need a metaphysical framework that can be employed to clarify what is meant by the idea of reconceptualising putative objects in structural terms, such that claim (2) can be clearly understood. I call the general problem of providing a

metaphysical framework for ROSR that clarifies (1) and (2) and addresses Chakravartty's challenge *problem (A)*.[7]

3.2 Problem B: The Plurality Problem

In addition to this, two recently posed problems for ROSR remain largely unaddressed. The first is emphasised by Morganti (2020), who argues that if the structure is all there is, ROSR requires an explanation of the apparent plurality of objects (both microscopic and macroscopic/ordinary) and the properties of such objects we experience. Additionally, Cornell (2016) notes that some critics of existence monism even dismiss it solely based on its violation of existence pluralist intuitions. This objection logically extends to existence monist ROSR. However, any metaphysical view positing only structure, even a plurality of structures, still must metaphysically account for the appearance of a plurality of objects and their properties, both in physics, and regarding ordinary and special science objects. I call this the plurality problem, or *problem (B)*.

3.3 Problem C: McKenzie's Challenge

McKenzie (2024) questions whether OSR (including ROSR) can be understood as a *substantive metaphysical doctrine* at all. QFT is currently our best framework for the physics of matter. McKenzie (2024) argues that for OSR to be considered plausible in current physics, it should be plausible in QFT. McKenzie accepts that paradigmatic examples of objects and structure exist (see §2.1-2.2 for examples). However, there are also contested *edge cases* between the structure and object paradigms, such as quantum fields, resulting in a continuum between what isn't and is structure, such that the categories of structure and object are *vague concepts*. For McKenzie (2024:7):

> "[T]he more elastic the term "structure" is, the less falsifiable the thesis, and the more it risks losing the status of a substantive doctrine...[yet]…The status of structuralism…hinges on the treatment of entities intermediate between the [structure and object] paradigms…[So, can]…the intermediate status of these entities…be exploited to turn a refutation into a confirmation, thereby undermining the "substantive" nature of the

[7] §6.2. discuss French's determinate/determinable-based solution and argues for my alternative.

> core thesis of structuralist metaphysics? It seems...that it could…[as]…the truth value of…structuralism based on current physics is sensitive to the way…we choose to classify quantum fields—entities which…only some, structuralists classify as "structure."[8]

McKenzie is not arguing that the fact that the categories 'structure' and 'object' have vague boundaries rules out OSR's status as a substantive metaphysical doctrine. This is so, as McKenzie (2024:7) accepts that some "vagueness may be simply a fact of scientific life, and one might reasonably think that this might extend to scientific metaphysics". McKenzie also cites Van Frassen's (1980:16) claim that "[a] vague predicate is usable provided it has clear cases and clear counter-cases", and accepts that this is so regarding structure in OSR. Additionally, McKenzie notes Van Fraasen's argument that some vagueness is ubiquitous in ordinary and scientific language.

In light of this, McKenzie instead argues that it makes little sense to think of OSR as a substantive metaphysical doctrine that makes strong truth claims about reality's metaphysical nature if the truth of OSR relies on quantum fields (a contested edge case) being categorised as structures. Crucially, McKenzie (2024) notes that structuralists typically take a laissez-faire attitude to the structural status of quantum fields, as they neither identify the ambiguous status of quantum fields as a problem nor take steps to fix it. If structuralism is a substantive doctrine, this shouldn't be so.

McKenzie (2024:1) then offers an alternate explanation of the nature of the structuralist project: structuralism is a *stance*, as Van Frassen (2002:47–48) understands these, namely, an "attitude, commitment" or "approach", not a metaphysical doctrine. For McKenzie (2024:2), structuralism is a methodological stance centring on "the injunction to foreground when doing metaphysics, that the language of physics is mathematics". McKenzie's (2024:1) argument for this resembles Van Fraassen's case for why materialism is "a stance; namely, that by thinking of it as such, we have a better explanation of the behaviour of the putative doctrine's adherents…[as]…thinking

[8] For McKenzie (2024:9), fields' status as structures is crucial to structuralism's truth because symmetries alone cannot underpin OSR in QFT, as symmetry structure fails to determine the specific magnitudes of key properties defining particle kinds (such as the mass and spin of fermions) and how many particles kinds exist in nature, and we would reasonably expect symmetries to determine these in a symmetry structure-based ontology. These properties can be accommodated as properties of structurally interpreted fields and particles treated as ontologically reducible (or dependent) features of fields.

of structuralism as a stance best explains the toleration of disagreement within the structuralist community with respect to whether quantum fields ought to be classified…'structure'".

I do not seek to rule out the idea of a structuralist methodological stance, as McKenzie describes it. Instead, as this article focuses on ROSR as a metaphysical doctrine, I will (in §5.4-5.5) argue that a substantive structuralist doctrine also remains possible. This argument is needed because if understanding structuralism as a metaphysical doctrine is implausible, this undermines my proposed interpretation of ROSR's status as a substantive metaphysical doctrine. I call McKenzie's challenge to OSR's status as a metaphysical doctrine problem (C).

In sum, we have three problems:

(A) The need for a metaphysical framework clarifying ROSR's key claims (1) and (2).
(B) The plurality problem.
(C) McKenzie's (2024) challenge to OSR's status as a substantive metaphysical doctrine.

I will now introduce my proposal for interpreting ROSR before moving on to argue that it provides the metaphysical tools to solve these problems in later sections, thereby making a preliminary case for the view.

4.1 Modes and Existence Monism

My proposal is that ROSR is best understood as a structuralist form of existence monism, where putative objects are reconceptualised as modes of reality's structure, drawing on concepts attributed to Spinoza by Bennett (1984, 1996, 2001). For this proposal to be comprehensible, my key conceptual tools, namely modes and existence monism, first require an introduction.

Existence monism is the view that all that exists is one concrete object, substance or entity, with no proper parts. If we take C to represent "the property of being a concrete object", Schaffer (2018:2) formalises existence monism as follows:

$$\text{Existence monism: } \exists x(Cx \& \forall y(Cy \rightarrow x=y))$$

We could understand C in more general terms as the property of being a concrete physical entity, where 'physical entity' is a general term referring to any physical concreta (be it a structure or object). I adopt this more general approach. Existence monism contrasts with *existence*

pluralism, the assumption that a plurality of concrete entities exists.[9] This Schaffer (2018:2) characterises as follows:

$$\text{Existence pluralism: } \exists x \exists y(Cx \& Cy \& x \neq y).$$

Existence monism is sometimes attributed to Spinoza, where only one object, known as God or substance, exists. Schaffer (2018) identifies Bennett (1984, 1996) as accepting such an existence monist interpretation of Spinoza. On Bennett's interpretation, Spinoza accepts that all that exists is one substance, and all physical and mental objects are properties of this.[10]

A common objection to existence monism is the seemingly obvious existence of a plurality of objects. In response, existence monists can draw on the properties of substance, called modes, as the apparent plurality of objects can be considered merely properties (modes) of the one substance, not concrete entities or objects in their own right, as existence pluralism requires.[11] Cornell (2016), without mentioning Spinoza directly, adopts a similar attitude to plurality. Cornell claims that what we commonly consider a plurality of objects can be understood as the distributional properties of one object in existence monism. A distributional property of an object attributes a quality (like redness or blueness) to the object, and specifies how that quality is distributed across its extension, such as "being red and blue striped" (Cornell 2016:2405). Cornell's (2016:2409) approach allows us to translate facts expressed "in pluralist terms into monist-friendly facts".

Spinozist modes are properties in the sense that they are particular states or features of substance, such that substance exists in a specific way (Bennett 1996). Modes inhere in substance, and are not concrete entities (substances, objects or physical structures) that are the subject of

[9] Schaffer (2018, 2009) also contrasts existence monism with priority monism. Both existence monism and priority monism accept that there is one fundamental concrete entity, but priority monism admits a plurality of non-fundamental objects into its ontology, whereas existence monism does not. Priority monism is not the primary focus of this article, but Schaffer's specific views and their relation to my proposal are discussed in more detail in §6.1.

[10] Characterising Spinoza as an existence monist is contentious. Some consider Spinoza a priority monist (Schaffer 2018). Others consider the existence/priority monism distinction insufficiently fine-grained to capture Spinoza's view (Melamed 2013). I set these interpretive concerns aside, as my focus is on applying these concepts to the metaphysics of physics.

[11] Here, as Schaffer (2007) notes, monism is understood as a claim about the number of concrete entities/objects/property-bearers, not the number of properties. I adopt this approach.

predication. Instead, modes are predicated on substance, and substance is the one property-bearer of which modes are properties. Bennett (1996:67) gives an illustrative example:

> "A mode was often thought of not as a universal property, but rather as a particular property instance. A blush is a mode: For a face to have a blush on it is just for the face to be red in a certain way; we do not have two things, a face and a blush, standing in a certain relation; rather, we have a single thing, a face, and it is blushing…. So even if you and I are blushing in exactly the same way, your blush is one item and mine is another: They are quality-like items [properties], except that they are particular rather than universal."

As Bennett shows, modes are particular property instances (like a blush) that are predicated of a substance/property-bearer (the face) and are ways the face exists (its distributional qualities or features or states), not concrete entities (and objects) in their own right. As there is only one object (substance) and property-bearer, other seemingly objectlike entities, like cats and particles, are understood as particular properties of substance in Bennetts's interpretation of Spinoza. This makes sense, as to say that an electron, or a cat, is a mode is to say that this specific particle or animal is really a particular feature/state of substance, and thus a particular way substance exists. Bennett (1984) did not originally treat modes as particular properties, but Bennett (1996, 2001) eventually accepted this.

4.2 Quasi-Spinozist ROSR

The central insight of ROSR is that the ontologies of our best physical theories need not necessarily be understood in object-oriented terms. Nonetheless, this leaves open how we should understand the ontology of these theories. If we recall our general definition of existence monism, this states that one concrete entity exists. If we understand the one fundamental concrete entity as a physical structure, we have a *structuralist existence* monism. This view claims that all that exists is the one structure of the universe: the *world-structure*. We have one concrete entity (the world-structure), understood as having an essentially structural nature. The structural status of the one concrete entity is its metaphysically primitive essential nature, or way of being.

To put my claim another way, the view involves modifying Spinoza's basic idea that there is one substance (with an essentially objectlike nature), which is all there is, by rethinking the notion of substance in relational/structuralist terms, such that the universe is one relational system. By not positing objects as bearers of relations and properties, this ontology is distinct from MOSR and from orthodox object-based existence monist views, such as Bennett's and Horgan and Potrč's (2008) views. By eliminating fundamental and non-fundamental objects, it is distinct from *priority-based OSR*, which emphasises the ontological priority of structure over objects but retains non-fundamental objects (McKenzie 2020).

Spinozist modes can also be incorporated into this position.[12] This allows ROSR to claim that the plurality of putative objects physics describes (e.g. particles) and whose properties we detect experimentally are really modes (particular distributional properties, in the sense of features or states) of the world-structure. As modes are distributional qualities/properties of the world-structure (not concrete entities or objects in their own right), we can eliminate objects as distinct concrete entities. For want of a better name, I call this explicitly structuralist existence monist ROSR, which treats putative objects as modes, *Quasi-Spinozist ROSR*. However, no particular faithfulness to Spinoza's views is intended. Instead, the goal is to provide a useful metaphysical framework for clarifying ROSR's claims and for solving several problems ROSR faces.

I have only briefly stated my proposed view so far. To fully understand it, we must work through the challenges to ROSR that it helps solve. What Quasi-Spinozist ROSR is and entails will become clearer when I show what it does, and give examples (in §5.4-5.5) of existence monist ROSR and modes in contemporary physics. Discussing the challenges to ROSR and my view's usefulness in this context also allows us to distinguish Quasi-Spinozist ROSR from French's (2014, 2019a) approach to ROSR, which is less clear about its monist commitments, and which focuses on the determinate/determinable relation as a preferred metaphysical framework. I will highlight the advantages of my approach in §6.2.

5.1 Addressing the Challenges to ROSR: Problem (A)

[12] Here, I grant the common ROSRist assumption that structure is concrete and physical, not mathematical. See French (2014) for defenses of this.

Regarding problem (A), identifying ROSR as a structuralist/relational existence monism provides a clear understanding of its key claim (1): that structure is all that there is, and its implicit monism as all that exists, is the world-structure: the relational system that is reality. Does this undermine ROSR's structural status? (French's (2016) aforementioned concern, and Dorato's (2016))? No, as we can reject the idea that a monistic 'one' is necessarily unstructured or non-structural. This is so, as (for radical structuralists at least), certain physical theories are best interpreted in purely structural/relational terms (i.e. the theories' basic posits are identified as paradigmatic examples of structure). This can then be taken to imply that the universe is essentially structural/relational in nature (in the context of the metaphysics of the theory in question). In some contexts (see §5.5), this may even naturally suggest a specifically monist ROSR. So, the monist radical structuralist would consider it more perspicuous to talk about this 'one' (the universe) as a structure (and so attribute it a structural nature) rather than speak of a bloblike object because the fundamental ontology of the physical theory in question is interpreted in structural terms.[13]

We also need a metaphysical tool/framework that clearly explicates how putative objects are reconceptualised as aspects of the world-structure. Introducing modes provides this. If we recall Bennett's blushing face example, blush is not a concrete entity (or thing) distinct from a face, but a distributional property or feature (or state) of it. In Bennett's view, putative objects other than the one substance (cats, particles, etc.) are reconceptualised as modes (distributional qualities/properties) of one substance. If putative objects are similarly reconceptualised as the world-structure's modes in ROSR, objects are eliminated. This clarifies ROSR's key claim (2) that objects understood as "substantive metaphysical entities" (Cei and French 2010:30) are eliminated: objects, as a metaphysically distinct concrete physical entity-type (or category), are eliminated in favour of understanding putative objects as the world-structures modes.

As a result, ROSR's key claims (1) and (2) can be reformulated as follows:

[13] French's (2014:287) statement that particular forms of structure described in physics like laws, symmetries, and (and even spacetime structure) "can be conceptually distinguished but not ascribed an independent existence" is then interpreted as identifying the status of the various forms of structure that motivate attributing the world-structure its essentially structural nature. In some contexts, certain forms of structure play a more central role in specifying this structural nature (e.g. the role of spacetime structure in SSR discussed in §5.4-5.5, or law and symmetry structure in French's (2014) view).

(i). ROSR is a structuralist existence monism, where all that exists is reality's structure.

(ii). Putative objects are modes of this structure, and objects (as a distinct entity type/category) are eliminated.

This provides the metaphysical framework to clarify key claims (1) and (2) that Chakravartty's challenge (and a viable solution to problem A) requires. The notion of existence monism, and the idea that putative objects are really modes are admittedly unconventional metaphysical ideas. However, as §4.1 shows, they can be clearly stated and can thus underpin the metaphysically informed account of ROSR's ontology demanded by Chakravartty's challenge. Moreover, the underlying metaphysical skeleton on which my framework is built, the property/property-bearer relation, is easily recognisable. This places ROSR within a longstanding tradition where properties are modes of property bearers.

5.2 Problem (A) and The Status of Relata

Introducing modes also allows us to respond to Esfeld and Lam's (2011) metaphysical objection to ROSR: the objection that relations require fundamental relata/objects to stand in relations. This is needed as this objection threatened the metaphysical coherence of ROSR's key claim (1). The reason it seems like physical relations must be relations between such fundamental relata/objects is because there are seemingly relata-like/object-like modes. Rather than relations being necessarily borne by relata, what we typically think of as relation-bearing relata/objects are really modes (and properties, in the sense of qualities, features or states) of the world-structure, where this purely relational structure locally coalesces into an (only) seemingly objectlike/relata-like state. Suppose putative objects, like spacetime points or particles, are the world-structure's modes. In that case, we have an explanation of their role in our physics (and thus metaphysics of physics) that does not require categorising them as objects or viewing them as bearers of relations in the traditional sense.

My argument is akin to Cornell's general argument defending revisionary metaphysical theories from common-sense-based objections. According to Cornell (2016:2401):

> "If some..[revisionary]..theory, T, entails the negation of some proposition of common sense, p, then in order to overcome the common-sense objection (i.e. the objection that

> states, p therefore ~T), all that is required of T's proponent is a SAE...[sufficient alternate explanation]..that explains why it seems as though p is true when it is in fact false. If such an explanation is forthcoming, one is no longer rationally entitled to object to T solely on the grounds that it conflicts with p. The SAE nullifies the common-sense objection."

Quasi-Spinozist ROSR's use of modes provides this sort of explanation of why it seems like there are fundamental relata/objects. Moreover, the metaphysical objection asserting the conceptual and metaphysical dependence of relations on relata seemingly has the basic form (p, therefore, ~T) that Cornell (2016) mentioned. This objection is easily stated as p (relations are the relations between objects, per ordinary or philosophical/metaphysical common sense), therefore ~T (where our revisionary theory T is ROSR's acceptance of freestanding relations). So, it is reasonable to think my explanation of why it seems like relations are relations between relata (they are really modes) nullifies this objection.[14] This fulfils §3.2's requirement that a good metaphysical formulation of ROSR (and solution to the problem (A)) should contribute to addressing Esfeld and Lam's (2011) metaphysical objection to ROSR.

Other arguments against Esfeld and Lam's (2011) metaphysical objection also gain renewed force in light of my proposal. For example, Ladyman and Ross (2007) argue that the common-sense object and relation-related metaphysical intuitions underpinning this objection are contingent and unreliable artifacts of cultural, linguistic and evolutionary history.[15] This becomes more compelling if understood as explaining how we are mistaken about the fact that what really exists are modes and are misled into object-oriented illusions. Ultimately, Quasi-Spinozist ROSR helps us clarify ROSR's key claims and respond to Chakravartty's challenge, and it provides a means of addressing the metaphysical objection to ROSR. This completes my solution to problem (A).

5.3 Addressing Problem (B): Explaining Plurality

[14] Similarly, for Lam and Wüthrich (2015:610), arguably, "invoking some sort of mutual conceptual and ontological dependence of physical relations and physical relata against ROSR begs the question precisely because ROSR denies such dependence".

[15] For Smith (1998), our conventional (illusory) picture of objects and relations results from our registration of the world via our linguistic and cognitive faculties. See also Schwaninger (2019).

Spinoza's theory of modes straightforwardly accounts for our experience of plurality just as it does for traditional substance/object monism. What we experience as objectlike entities and their properties are really modes of reality's structure. This allows us to metaphysically account for objectlike aspects of physics and even ordinary or special science objects in structural monist-friendly terms as experiences of, and facts regarding modes (properties/states of world-structure), thereby solving problem (B). If we recall Cornell's (2016) defence of revisionary ontologies, in this context, Cornell argues that understanding apparent plurality in terms of the properties of one substance/object explains how it seems like a plurality of objects exists. If we have a properties/modes-based metaphysical explanation of apparent plurality, one cannot rule out existence monism (including existence monist ROSR) solely because it conflicts with pluralist common sense.

While the status of everyday language is not my primary focus, here, I will briefly mention that in Bennett's (1984) Spinozist monism, sentences regarding objects can be paraphrased in terms of modes of substance. This basic strategy extends to Quasi-Spinozist ROSR, where we can paraphrase statements like 'tables exist' or 'particles exist', in terms of the modes of world-structure existing in a tablelike or particle-like state. Schaffer (2007:179) suggests a more formal, complementary approach, namely understanding "the instantiation relation as region-indexed, so we get constructions like: the world [or world-structure] instantiates-at-r1 tablehood, and the world instantiates-at-r2 chairhood".[16] Thus, it is reasonable to think that our linguistic practices can be understood in light of the ontological revisions ROSR requires to our notion of (now only apparent) plurality.[17]

5.4 Addressing Problem (C): Structuralist Spacetime State Realism

As discussed, McKenzie (2024) challenges OSR's status as a substantive metaphysical doctrine because OSR's viability in current physics depends on an ambiguous case: quantum fields' status as structures. If one is in the business of developing a reformulation of the radical structuralist metaphysical doctrine, as I am, then a response to McKenzie's challenge is needed. To do so, I

[16] This best applies in contexts where putative material objects are understood as properties of spacetime structure (see §5.4-5.5). Here, the existence monist resists the reification of regions into distinct substances and building blocks of spacetime due to such existence pluralism's lesser ontological parsimony, and as Bennett (1984:110) argues, because "there is no one right way of dividing space [or spacetime] into discrete regions".

[17] Horgan and Potrč's (2008) contextual semantics is another option for dealing with pluralistic language.

briefly shift focus to the ontology of QFT, and a specific approach to its interpretation: *Spacetime State Realism (SSR)*. I then argue, in §5.5, that Quasi-Spinozist ROSR is naturally supported by this SSR-based response to McKenzie's challenge. Later on, in §6.2, I argue for this view's advantages over French's formulation of ROSR in this context.

To defend OSR as a substantive metaphysical doctrine, ontic structuralists (including radical structuralists) must take a clear position on how the fundamental structure of QFT should be understood. I argue that ambiguity regarding the structural status of fields (if understood as QFT's basic concrete entities and property bearers, as opposed to properties of spacetime) becomes less troublesome if it is not central to OSR's truth. McKenzie accepts that paradigmatic examples of objects and structures exist. Suppose we can find one of these paradigmatic examples to underpin OSR's ontological claims in QFT. In that case, the dilemma regarding the status of fields in QFT can be avoided, as OSR's truth no longer depends on fields (understood as basic concrete entities/property bearers) being categorised as structures. Yet, McKenzie (2024:15) states, "I do not see any obvious candidates" for such a structure.

However, QFT's ontology (and quantum fields themselves) can also be understood in terms of *properties of spacetime*, rather than treating fields as distinct, independent substantial entities (be they structures or objects) and property bearers in their own right, as McKenzie (2024) implicitly does. Wallace and Timpson's (2010) SSR is the most well-developed iteration of this approach and employs resources from algebraic quantum field theory (AQFT) in its construction. The precise details need not concern us here.[18] Baker (2016:13) provides a handy overview of the results, namely that in:

> "[SSR]…there is a fundamental quantity assigned to each region of spacetime, represented by the local state of that region. For example, in the algebraic approach every open region O is associated with a subalgebra A(O) of the algebra of observables A, whose elements stand for the quantities localized in that region. The restriction of the global quantum state ω to O is then a state of A(O), which we call the local state ωO...[R]ather than just codifying the expectation values of physical quantities, the state

[18] Consult Wallace and Timpson (2010). Swanson (2018:933) provides a revised formulation "in terms of a presheaf of local state spaces dual to the net of local observables," addressing at least some objections to Wallace and Timpson's original density operator-based approach.

> ωO itself represents a fundamental property of region O. In effect, QFT describes a "field" of local states in much the same way that electrostatics describes a field of vectors".[19]

SSR implies that spacetime and its regions are the fundamental bearers of properties, and the local quantum states are *properties* of these (Wallace and Timpson 2010:709-710, Ismael and Schaffer 2020). In SSR, putative objects like particles and even macro-objects like cats "are patterns in the state-valued field" and "everything must ultimately be analysed in terms of patterns of fundamental properties of spacetime regions" (Swanson 2018:934-950). Adopting this approach allows us to rethink our approach to OSR in QFT by offering a new candidate for QFT's fundamental structure: *spacetime structure*. Understanding spacetime in structural terms is typical in OSR (See French and Rickles 2006**,** Ladyman and Ross 2007, Esfeld and Lam 2008, Muller 2011, Bain 2013, French 2014, Ladyman 2023) such that spacetime is a paradigmatic example of structure. So, we have a candidate for a fundamental structure that is not a contested edge case.[20] SSR then provides a means of understanding quantum systems as properties of this spatiotemporal structure's regions. Thus, we have an alternative approach to QFT's ontology: a *structuralist SSR*. Consequently, the "status of structuralism" no longer "hinges on the treatment of entities intermediate between the [structure and object] paradigms" (namely fields, if understood as substantial entities) in the manner that worries McKenzie (2024:7). This example gives OSR, in general, a response to problem (C). But how does this relate to Quasi-Spinozist ROSR and the broader proposal of this article?

5.5 Structuralist SSR and Quasi-Spinozist ROSR.

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[19] Despite employing AQFT resources, for Wallace (2012:15), SSR requires no commitment to AQFT "programme[s]" seeking to supplant conventional QFT with a more rigorous alternative. Wallace and Timpson affirm Wallace's (2006) interpretative methodology, where unitarily inequivalent representations are considered "an artefact of the formalism…disappear[ing]…when we properly understand the renormalization process" (Wallace and Tipson 2010:711). Adopting Wallace's (2006) interpretive approach provides a response to the potential challenge inequivalent representations pose to monist structuralism highlighted by Glick (2016).

[20] Arguments for spacetime OSR mostly focus on GR, not the special relativistic background typical in QFT. However, the hole argument or an analogue of it applies in all local spacetime theories, including special relativity (Earman and Norton 1987, Landsman 2023). So, any support spacetime OSR gains from this plausibly extends to special relativity. Spacetime points in special relativity are weakly discernable, and relational individuation of these is possible (Dieks 2010). This could be interpreted via ROSR as implying that they are mere nodes in (and modes of) spacetime's structure, as §2 describes. Ladyman and Ross (2007:140) also claim that as GR is our best spacetime theory, when considering spacetime's ontology, taking GR as our guide to this is plausible, even when the initial motivation to do so begins with the problem of understanding quantum fields as properties of spacetime.

Interpreting SSR via the Quasi-Spinozist ROSR framework allows us to understand local states, which are properties of spacetime (and its regions), as modes of spacetime's structure (with spacetime understood in ROSR terms), giving a *radical structuralist SSR*. This is a natural interpretation in the context of ROSR (particularly if one accepts spacetime ROSR for the reasons discussed in §2). This is because the fact that SSR gives an ontology of quantum properties of spacetime is itself grounds to consider understanding these properties as modes to be perspicuous interpretation.[21] Additionally, for Bennett (1984, 1996), putative material objects are really modes (properties) of space, albeit three-dimensional space, fitting with Spinoza's 17th-century historical context (Esfeld and Lam 2011). Radical structuralist SSR is a natural contemporary update of Bennett's basic idea. If SSR is understood in Quasi-Spinozist ROSR terms, the attitude to quantum fields, field properties (and particle properties and even quantum fields themselves) is a broadly super-substantivalist one (more on this in §6.1), with a structuralist twist.

Treating the local quantum states in SSR as intrinsic properties of spacetime's regions also seems natural.[22] However, Ismael and Schaffer (2020) emphasise that the local states need not be treated as fundamental intrinsic properties, as the global quantum state associated with all of spacetime (i.e. the spacetime structure of the universe) uniquely specifies "all the physical information contained in the local states" (Baker 2016:13). This implies that the global quantum state is the sole fundamental property/mode of the spatiotemporal structure of the universe (Ismael and Schaffer 2020). This gives further grounds to treat this global spacetime structure as the fundamental entity/property-bearer in QFT and understand it in monist terms. Which, if one is a radical structuralist about spacetime, pushes one towards the monist interpretation of ROSR

[21] Structuralist SSR's implication would differ if one has a different spacetime structuralist view, such as MOSR. As this article focuses on ROSR, I save the development of MOSR-based (or priority-based OSR-based) perspectives on structuralist SSR elsewhere.

[22] Doing provides a different approach to the status of intrinsic properties in QFT and OSR's difficulties accounting for them. See Esfeld and Lam (2011), McKenzie (2020), and Berghofer (2018) for discussion of this debate, which is typically conducted assuming these are properties of fields, understood as structures (and thus concrete entities/substances in their own right). SSR provides a new way to think about QFT's fundamental properties. In structuralist SSR, the fundamental properties of QFT are the local quantum states, which are properties of spacetime regions. If our ontological commitment fundamentally rests with spacetime's structure, that QFT's basic properties can be intrinsic to this structure (and its regions), is a natural consequence of the view. This does not compromise the structural status of the theory's fundamental concrete entity and property-bearer, space-time structure, which is the locus of our ontological commitments.

under consideration in this article. If retained in the ontology, local states can then be considered non-fundamental modes/properties of the world-structure. That SSR provides a response to McKenzie's challenge provides grounds for structuralists to adopt SSR. If SSR implies a monist structuralism, then this means of overcoming McKenzie's challenge (via adopting SSR) lends further support to the monist aspect of my proposal. Which, in light of §5.1's solution to problem (A), should be an existence monism.

Another reason for radical structuralists to favour SSR, which, by extension, bolsters the case for monist ROSR, is that the status of the quantum state is often unclear in the ROSR literature.[23] By understanding the quantum state in terms of spacetime's properties, radical structuralist SSR clarifies its status in ROSR. In sum, SSR provides a response to problem (C). Suppose we adopt this response and also accept ROSR. If so, this naturally leads to my view, both due to the monist implications of SSR identified by Ismael and Schaffer (2020) and because identifying the quantum properties (the global and local quantum states) of spacetime as modes is a natural and perspicuous interpretation. That Quasi-Spinozist ROSR directly contributes to solving problems (A) and (B) and is a natural interpretation of my solution to problem (C) gives a prima facie case for the view.

However, we should be careful to distinguish radical structuralist SSR from the broader Quasi-Spinozist ROSR metaphysical framework as such. The former is an example of how the latter is applied to a physical theory in a perspicuous manner, but it is not this framework's only application. This is important as sometimes privileging spacetime structure is inappropriate. For example, in quantum gravity, spacetime's non-fundamentality is often considered a generic feature of such theories (Wüthrich 2019). However, ROSR may be viable in at least one quantum gravity approach, as Dawid (2013) advocates an interpretation of string theory rejecting object-based ontology entirely that understands the theory in terms of non-spatiotemporal structure, which could plausibly be interpreted as ROSR. It is a natural step to identify the emergent, seemingly objectlike features of reality we observe as modes of the underlying string-theoretic structure. Much more could be said on this, but this at least establishes prima facie plausibility for my proposal in a fundamentally non-spatiotemporal context.

[23] An exception is French (2013). However, French's (2013) symmetry group structure-centric structuralism faces the problems McKenzie (2024) highlighted in §3.3 in QFT.

6.1 Super-substantivalism and Schaffer's Monist Views

So far, I have introduced Quasi-Spinozist ROSR and its relevance to solving three metaphysical problems that ROSR faces. This provides initial grounds to think that my interpretation of ROSR strengthens and clarifies the radical structuralist position. This subsection then examines my approach's relationship to views similar to radical structuralist SSR, such as Schaffer's super-substantivalism, Le Bihan's super-relationalism, and Schaffer's monist views more generally. Then, I compare my broader Quasi-Spinozist ROSR proposal to other relevant approaches to OSR in §6.2-6.3. In both cases, I highlight my approach's advantages.

Firstly, Schaffer (2009) suggests but does not endorse, *eliminativist super-substantivalism*. However, he says essentially nothing about it beyond its purported identification of physical objects with spacetime regions and elimination of the former in favour of the latter. Instead, this is hastily dismissed as overly revisionary. While this resembles §5.5's proposal, radical structuralist SSR still differs from this eliminativist super-substantivalism to the extent Schaffer accepts spatiotemporal objects (in the form of spacetime points), as is typical of orthodox substantivalism. Whether this retention of objects is good or bad depends on one's stance on spacetime ROSR, for which §2 outlines a basic case. Schaffer discusses super-substantivalism from a priority monist perspective. Priority monism is the view that there is only one fundamental concrete entity (in Schaffer's case, an object: the universe), but unlike existence monism, a plurality of non-fundamental concrete entities exist. Schaffers' (2009) preferred identity super-substantivalism thus retains objects (identified with spacetime regions). Schaffer offers no hint that eliminativist super-substantivalism implies a shift to existence monism, further distinguishing our approaches.[24]

There are also a few other notable differences between Quasi-Spinozist ROSR as a general metaphysical framework and Schaffer's monist approach. Schaffer (2009, 2010a, 2020b, 2010c) accepts non-fundamental objects into his ontology, and understands the relationship between these and the monistic one in mereological terms, as a relation between the parts (of the

[24] Existence monism also has a prima facia quantitative parsimony advantage over priority monism, as Schaffer (2018) notes. Schaffer's preferred counterargument invokes Occam's laser, which excludes the non-fundamental from the parsimony count. However, Baron and Tallant (2018) make a strong case against this. While I will not explore this in detail, such parsimony is an advantage of my existence monist approach.

universe) and the whole (the universe itself). Whereas Quasi-Spinozist ROSR, as an existence monism, understands the relationship between the monistic one (here understood as the world-structure) and the apparent plurality of putative objects in terms of modes (properties in the sense of features or states) of the world-structure, instead of employing conventional mereology to understand this relationship.[25]

On a related note, Schaffer's (2010a, 2010b, 2010c) notion of the priority of the whole is key to his priority monist position, and can be understood as the claim that the whole universe (the one fundamental object) is ontologically prior to the plurality of non-fundamental objects that are its proper parts. Traditional existence monism denies that one concrete entity (here understood as having an essentially object-like nature) has ontologically robust parts, in the sense that such putative parts of the universe, such as particles, are considered metaphysically robust objects, not modes/properties. Therefore, it is incompatible with Schaffer's claim of the priority of the whole universe over its parts (the non-fundamental objects), as Schaffer (2010a:67) notes. This incompatibility holds in quasi-Spinozist ROSR, too, with the caveat that Quasi-Spinozist ROSR also rejects the idea that the one concrete entity (the universe) is best understood as an object, as in Quasi-Spinozist ROSR the universe has an essentially structural nature. So, this article's proposal and Schaffer's view also differ in this regard.[26]

Schaffer (2010a:56) also states that monism (minimally understood in the priority monist sense that there is one fundamental concrete entity), if true, "is true with metaphysical necessity". In contrast, radical structuralists like French (2014) and Bain (2013) prefer to keep their

[25] Schaffer (2020a, 2010b, 2010c, 2009) also argues for priority monism for several reasons that are independent of super-substantivalism. These include other physics-based arguments, including one drawing on the holism implied by quantum entanglement (Schaffer 2010a), a move that Schaffer (2007) also considers available to existence monism. Schaffer (2013) develops a nomic integration argument. However, Schaffer (2013:80-81) notes that this argument is compatible with a Spinozan monism that treats the plurality of putative objects as modes (although Schaffer does not endorse this view). Schaffer (2020a, 2010b, 2010c) offers several more metaphysically focused arguments for priority monism. These include including arguments drawing on the metaphysical possibility of gunk (Schaffer 2010a, an analog of which highlighting the possibility of infinite descent is given Schaffer (2007) on behalf of existence monism), truthmakers for negative existentials (Schaffer 2010c), and the internal relatedness (and ontological interdependence) of all things (Schaffer 2010b).

[26] Schaffer (2010a) notes some further differences between existence monism and priority monism, such as existence monism being both incompatible with the idea of the monistic one as an organic unity composed of various objects that are its proper parts, and as an integrated system of a plurality of (derivative) objects. In contrast, priority monism is not incompatible with these claims. Such differences plausibly extend to quasi–Spinozist ROSR.

metaphysical claims more closely tied to the relevant physical theories and primarily rely on physics-related arguments when presenting their views, such as those discussed in §2 (§5.4-5.5's discussion could be considered another example of this approach). Thus, such radical structuralists would only claim that their views are contingently true, based on these physics-related concerns. As I am focusing on ROSR and its approach to the metaphysics of physics here, I have no commitment to the general metaphysical necessity of monism. However, if it turns out that monism is a metaphysically necessary truth, then this further motivates the adoption of a monist OSR, and when considering ROSR, Quasi-Spinozist ROSR.[27]

Finally, Schaffer (2007, 2010c:324) notes that "[e]xistence monism is a crazy view", with the apparent Moorean truth of some form of pluralism, at least regarding non-fundamental objects, noted as a potential motivation for this. However, Schaffer (2007), as discussed in §5.3, acknowledges the possibility of various strategies to respond to this objection (such as paraphrasing pluralistic statements such that these are expressible in existence monist-friendly terms). Schaffer (2007) even suggests a further physics-related argument (the explanatory exclusion argument, which limited space precludes detailed discussion of here, see also Schaffer 2018:2), as a means for the existence monist to motivate their view.

Returning to the topic of Radical structuralist SSR, this also differs from Le Bihan's (2016) *super-relationalism*, an ontology of spatiotemporal relations that eliminates fundamental objects, as Le Bihan (2016) accepts that relations are *between* relata (namely natural properties), contra ROSR. When considering the broader Quasi-Spinozist ROSR framework (rather than §5.4-5.5's SSR example), this framework potentially extends to non-spatiotemporal quantum gravity. Given the centrality of spatiotemporal relations to Le Bihan's account, this does not seem to be so regarding his view. So, this view has a narrower range of applicability than mine.

6.2 French's ROSR: Modes, Determinates and Determinables

Quasi-Spinozist ROSR is not ROSR's only metaphysical framework. French (2014, 2017, 2019a) primarily employs the *determinate/determinable relation* for this purpose.[28] For example,

[27] I would like to thank an anonymous reviewer for highlighting the need to outline the relationship between Schaffer's monist views and Quasi-Spinozist ROSR in more detail in this section.

[28] French (2014, 2017) also considers the bundle theory of objects (but considers it a less-than-ideal fit with the relevant physics) and favours his determinable/determinate-based approach, so I focus on that.

the structure of the "Poincaré group…can be regarded as a determinable which also yields spin as a property-determinable, which in turn yields the property spin ½, associated with the electron…as a determinate" (French 2017:237). French's framework provides a clear picture of the status of property values (like spin 1/2) of putative objects. Exactly how putative objects (i.e. electrons) themselves are reconceptualised in structural terms is less clear. This is evident as French (2019a:175) insists that ROSR in QFT does not require "anti-realism about 'particles' such as electrons, pions, quarks, whatever".[29] A metaphysical tool clarifying how this can be so, is needed. Additionally, it is reasonable to think that if we rely on Muller's (2011) weak discernability-based argument to underpin spacetime ROSR (as §2.2 discusses), a metaphysically informed account of the structuralist reconceptualisation of spatiotemporal putative objects (namely spacetime points) is also needed.

Quasi-Spinozist ROSR's use of modes provides the right metaphysical tool for the job, letting us reconceptualise putative objects as structure's properties (modes). This allows us to regard putative objects (like particles or spacetime points) as properties (in the form of modes) themselves, something not explicitly stated in French's account. As a result, Quasi-Spinozist ROSR accounts for the experienced plurality of putative objects (by understanding these as modes), as problem (B) requires. It is unclear how this is done in French's account, to the extent that it does not fully explain the structural reconceptualisation of putative objects. If the determinable/determinate relation remains useful in some contexts, Quasi-Spinozist ROSR could accept that determinable symmetry structure can, in some theoretical contexts, be (partially) characteristic of the world-structure's structural nature (in the manner §5.1 describes). This structure then yields determinate property instances/modes like spin ½. So, we can potentially subsume French's symmetry example and others like it into this broader framework.

Thus far, in this section, we have primarily framed our discussion in terms of French's (2017) symmetry structure example. Yet, we can also understand QFT in terms of SSR. Here, the relationship between spacetime's structure and the quantum properties/states is explicitly a

[29] Here, French (2019a:175) states that putative objects (as opposed to determinate property instances like spin 1/2) should be reconceptualised as "aspects of the structure of the world", but does not elaborate on the metaphysical nature of this reconceptualisation. Yet, Chakravarty's challenge demands "an appropriately metaphysically informed interpretation" (French 2014:60). The concept of modes describes this reconceptualisation in a manner that, by drawing on Spinoza, is clearly metaphysically informed, or at least more so (and more precise), than the more generic notion of an aspect of structure.

property/property-bearer relationship. Modes-based ROSR is ideally suited for understanding the relationship between properties and their bearers. It is not immediately apparent that SSR can be recast in terms of the determinate/determinable relation, as the structure of spacetime could possibly be interpreted as a determinate concrete entity/structure (as understood in the block universe view) instead of as the determinable structure that French's framework seemingly requires. At the very least, as SSR already requires us to talk about matter as particular properties (and by implication modes) of spacetime, and §5.4-5.5 shows that this language suffices for a good account of its ontology, applying the determinate/determinable relation in this context doesn't provide much additional benefit beyond what modes provide. Given that §5.4 shows that structuralist SSR allows us to resolve problem (C), providing ROSR with a conceptual tool (modes) well-suited to this context is clearly useful.

Finally, an explicit structuralist existence monism enhances ROSR's metaphysical clarity, by contributing to the solution to problems (A-B) and is a natural implication of my solution to problem (C). So, advocates of French's approach should welcome this aspect of my proposal. Ultimately, there are several reasons to think that Quasi-Spinozist ROSR provides metaphysical tools that strengthen ROSR, in addition to those that French offers.

6.3 Moderate and Radical Modes-based OSR

Esfeld and Lam (2011) endorse a MOSR also utilising Spinozist modes. This is the inverse of my proposal. Rather than putative objects being modes of one world-structure (existence monism), Esfeld and Lam view relations as modes of a plurality of objects (existence pluralism). While distinct from mine and as an existence pluralism, less quantitatively parsimonious, this view has much to recommend it. However, there is one problem with this, to the extent that it is intended as a form of OSR, namely that it may not fit the standard definition of OSR. According to Esfeld and Lam (2011:150-151), a conceptual differentiation between objects and relations/modes exists, but this distinction does not apply ontologically; instead, there is only one entity type, objects, which can exist in specific ways (modes). This seemingly implies that relations are demoted from being fundamental to simply being ways that objects exist, where it is the objects that are fundamental. Esfeld and Lam's use of modes also implies this, as for Spinoza (2002:218), "substance is prior in nature to its affections[modes]". So, if relations are modes of objects, they are ontologically derivative features/properties. This calls Esfeld and Lam's view

into question as a form of OSR, since OSR is typically considered a view that "inflates the ontological priority of structure and relations" (Ladyman 2023:4). Esfeld and Lam's (2011) view does not appear to uphold this definition. In contrast, my application of modes to ROSR faces no such problem.

7. Conclusion

Taking stock: understanding ROSR as a structuralist existence monism clarifies claim (1) that structure is all that there is. Spinozist modes provide a metaphysical framework for explaining claim (2), the reconceptualisation of reality's seemingly objectlike features as modes of structure and the elimination of objects. Our experienced plurality of seemingly objectlike entities is explained as the experience of modes. Thus, problems (A) and (B) have viable solutions. A different approach to QFT's structure, structuralist SSR, resolves problem (C), and this solution, in a ROSR context at least, is best understood via Quasi-Spinozist ROSR. Quasi-Spinozist ROSR also provides metaphysical tools that strengthen and clarify ROSR as a metaphysical position, in addition to those French (2014) offers. Ultimately, I have provided a much-needed clarification of ROSR's metaphysical claims, such that ROSR can be regarded as a strong competitor to its rivals in the metaphysics of physics.

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