Object Oriented Ontology and Its Critics

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Living and Nonliving Occasionalism

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Abstract: Graham Harman’s Object-Oriented Ontology has employed a variant of occasionalist causation since 2002, with sensual objects acting as the mediators of causation between real objects. While the mechanism for living beings creating sensual objects is clear, how nonliving objects generate sensual objects is not. This essay sets out an interpretation of occasionalism where the mediating agency of nonliving contact is the virtual particles of nominally empty space. Since living, conscious, real objects need to hold sensual objects as sub-components, but nonliving objects do not, this leads to an explanation of why consciousness, in Object-Oriented Ontology, might be described as doubly withdrawn: a sensual sub-component of a withdrawn real object.

Keywords: Graham Harman, ontology, objects, Timothy Morton, vicarious, screening, virtual particle, consciousness

1 Introduction

When approaching Graham Harman’s fourfold ontology, it is relatively easy to understand the first steps if you begin from an anthropocentric position of naive realism: there are real objects that have their real qualities. Then apart from real objects are the objects of our perception, which Harman calls sensual objects, which are reduced distortions or caricatures of the real objects we perceive; and these sensual objects have their own sensual qualities. It is common sense that when we perceive a steaming espresso, for example, that we, as the perceivers, create the image of that espresso in our minds – this image being what Harman calls a sensual object – and that we supply the energy to produce this sensual object.

This simple model becomes more challenging when we move on to two points upon which Harman insists: first, that real objects never touch and real objects never exert causal forces on each other directly, but only come into contact via sensual objects; and second, that nonliving and even fictional entities, when they come into causal contact, also produce images or sensual objects. It is easy to understand that when humans look at objects, they create images in their mind, but when this idea is extended to nonliving entities enacting basic forces on each other, like when a ceramic octopus is hit by a meteor, the puzzling question is who, or what, is producing the sensual object of their contact? Neither the meteor nor the ceramic octopus seems capable of producing an image. If they do not interact directly, what enables their causal effects on each other?

The principle contention of this essay is that an answer to this question is, in quantum physics, already partly known: virtual particles enact causal contact, drawing their energy from the vacuum of empty space. To assess the plausibility of virtual particles being sensual objects, this essay will look at some of their qualities and the conditions around their production. By exploring the origins of virtual particles in the quantum vacuum, we find the need to counter the anthropocentrism of the measurement problem, and the colossal problem of space–time; and by exploring virtual particles’ role as the carriers of forces in nonliving causal interactions, we encounter the obscure problem of the emergence of consciousness.
Since virtual particles are readily categorisable as real objects, while being interpreted here as candidates for sensual objects, they are therefore offered as examples of objects that exhibit contradictory and mutually exclusive conditions simultaneously, which Timothy Morton refers to as dialetheism. Bringing these threads together, it is speculated that the quantum vacuum and space–time are perhaps two aspects or two states of the same object, and finally a conclusion is proposed that consciousness, from the perspective of Object-Oriented Ontology (OOO), is doubly withdrawn: a sensual sub-component of a withdrawn real object.

2 On the necessity of asymmetrical causation

The nutritive and viscous phenomena of OOO emerged with a startling force by arguing for ontological realism in an intellectual climate where idealism, whether to not openly declare, and anthropocentric anti-realisms permeated the humanities. Harman’s stance was always against the anti-realist position: “the true danger to thought is not relativism but Idealism.” Harman’s variant of OOO began to take special prominence when he founded his ontology on objects. This offered an approach that solved a series of philosophical problems beyond the scope of this essay, but as Ray Brassier said at the 2007 Goldsmiths workshop, “the really significant challenge is explaining their relations.”

So Harman separated objects into two distinct classes, real and sensual, whose difference is principally determined by their interactions. To recall, Harman insists:

Real objects do not encounter each other directly, but only encounter sensual objects, or images of real objects. All contact between real objects is indirect, mediated by sensual reality, and this holds for raindrops and stones no less than for humans.

The non-anthropocentric final clause of this statement led to his theory of causation which Harman refers to as indirect, vicarious or secular occasionalist. Yet, responding to this, Brassier asked a question at the 2007 Goldsmiths workshop that has not hitherto been sufficiently answered: how do the sensual particles know anything about the real objects they interact with? Clearly sensual objects need some epistemological access to reliably map or translate the qualities of the withdrawn real object. Although OOO’s presentation of occasionalism has been the subject of criticism, I will continue from this model of causation but with transformative questions about the causal mechanism and the philosophical and ontographic consequences.

Harman first published on occasionalist causation in his 2002 book, Tool-Being: Heidegger and the Metaphysics of Objects, refining the ideas in 2004’s Guerrilla metaphysics: phenomenology and the carpentry of things, 2007’s “On Vicarious Causation,” then expanding them in 2009’s Prince of Networks: Bruno Latour and Metaphysics, but his use of occasionalism in OOO was developed into its current form in two essays published at the beginning of 2010, “Time, Space, Essence, and Eidos: a New Theory of Causation” and “Asymmetrical Causation: Influence Without Recompense,” so it is on these two texts that this essay will initially focus.
Occasionalism originated in the work of Islamic philosophers of the tenth century around Abu al-Hasan al-Ash’ari and then reemerged in the seventeenth-century French philosophers, Géraud de Cordemoy and Nicolas Malebranche, where Allah or God is the mediating force that enables causation to occur. The origin of Harman’s interest, however, seems to have been Latour:

Latour is probably the first thinker in history to invent a local option for occasional cause – one not passing through God (as in al-Ash’ari, Malebranche, and even [Alfred North] Whitehead) or the human mind (as when [David] Hume and [Emmanuel] Kant turn human habit or categories into the seat of all relations).10

Harman reached out towards Latour’s occasionalism for several reasons proceeding from his ontology which stands in bright contrast to the whirlpool of correlationism, for which Harman cites the term’s originator, Quentin Meillassoux:

the central notion of modern philosophy since Kant seems to be that of correlation. By “correlation” we mean the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other. We will henceforth call correlationism any current of thought [that] maintains the unsurpassable character of the correlation so defined.11

Harman frequently begins his explanations of occasionalist causation and OOO by moving from his de-anthropocentrised reading of Martin Heidegger, so I will briefly summarise these positions before recounting the tensions between the fourfold ontology’s elements and then arguing how virtual particles described in physics might act as sensual objects.

For Harman, Heidegger’s spectacularly famous tool analysis draws our attention to the difference between a hammer that we confidently use, with almost all of the hammer’s ready-to-hand qualities withdrawn from us, and the disruptive phenomena of the broken hammer, whereby the previously withdrawn qualities are now foregrounded and made present-at-hand. Harman’s unusual reading of these concepts makes a subtle but important shift:

the ready-to-hand is the reality of the hammer itself apart from any distortion by human access, and the present-at-hand is whatever exists only in relation to such access[...]. Heidegger’s link with the abandoned occasionalist tradition[...] [is that] objects withdraw into inscrutable depths[...] [yet] we know that they somehow relate, or nothing would happen and presence-at-hand would not exist.12

The important limitation of Heidegger’s opposition is the lack of account of the ready-to-hand without recourse to human perception, and thereby how inanimate objects interact without human involvement, as Harman writes, “there is no discussion in Heidegger of causal relations between nonhuman things, and in this respect Heidegger remains a child of the correlationist era.”13 When a comet that has sailed around the solar system for a billion years falls towards Jupiter and smashes through Europa’s ice sheets into its subsurface ocean, it is of supreme importance to know what this means for us – after all, humans find each other extremely fascinating – but ontologically, differentiating between human perception and nonhuman relations is an essential aspect of realism, akin to knowing the difference between this cosmic event’s astrological significance and empathising with Europa’s traumatised aquatic denizens.

The difference between human and nonhuman relations is part of what led Harman towards occasionalism. Causation, as we colloquially understand the term today, is symmetrical, as Harman explained:

[Isaac] Newton taught us that even a paper clip or grain of dust exerts gravitational pull on the sun, and not just the mighty sun on these trivial entities. If a brick smashes a window and not the reverse, we still know that the brick loses

10 Harman, *Prince of Networks: Bruno Latour and Metaphysics*, 82.
11 Meillassoux, *After Finitude: Essay on the Necessity of Contingency*, 5; as quoted in: Harman, “Fear of Reality: On Realism and Infra-Realism,” 129.
12 Harman, “Time, Space, Essence, and Eidos: a New Theory of causation,” 4–5.
13 Harman, “Asymmetrical Causation: Influence Without Recompense,” 100.
speed and gains small cuts and divots while passing through the glass. The physical realm seems entirely symmetrical in this respect.14

Harman sought a model of asymmetrical causation because although material contact is ostensibly symmetrical, perception is clearly asymmetrical. Whoever or whatever is perceived can be completely oblivious to its being sensorially apprehended. Following on from the separation of real and sensual objects where real objects interact only via sensual intermediaries, the act of perception entails only a real object (the perceiver) encountering a sensual object (the image, or other sensual object, of the perceived). As Harman writes:

what I see is an image of my friend, but this image does not see me in return: only the friend herself sees me, or rather an image of me. In both cases the friend-image is merely a passive simulacrum that vanishes from reality as soon as I cease paying attention, while the real friend is a genuine entity to reckon with, helping or conspiring even when I sleep.15

Recognising the implications proceeding from the idea that all real objects encounter only sensual objects, yet knowing that real objects act causally on each other, at the end of “Asymmetrical Causation: Influence Without Recompense,” Harman asks the crucial question:

How does a real object[...] make some sort of contact, however oblique, with another real one? Only the answer to this question will give us a clear understanding of the manner in which influence is a pure gift from elsewhere, without recompense.16

In response to this question, the proposition of this essay is that in some part of this “pure gift” can be located precisely in something we might have habitually called empty space, but which contemporary physicists would more likely call the quantum vacuum. By reviewing this material, this essay will sketch out a mechanism for occasionalist causation between nonliving objects (Figure 1).

![Figure 1: Harman’s fourfold Ontography, adapted from: Harman, The Quadruple Object, 114–115, 126.](image)

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14 Harman, “Asymmetrical Causation: Influence Without Recompense,” 98.
15 Ibid., 102.
16 Ibid., 108, emphasis added.
3 Time, space, essence and eidos

For Harman, time, space, essence and eidos are the “four great tensions” that arise from the fourfold structure of infra-realism comprising real objects, real qualities, sensual objects and sensual qualities. Since this essay will examine space–time as a hyperobject, it will use space and time slightly differently from Harman, so it will be helpful to briefly recount Harman’s fourfold structure as laid out in “Time, Space, Essence, and Eidos: a New Theory of Causation,” “Asymmetrical Causation: Influence Without Recompense” and more completely in The Quadruple Object. Each of these four tensions, time, space, essence and eidos, are subjected to powerful counteracting forces: two are acted upon by joining, which Harman calls, fusion, and two by deliberate breaking called fission.

Eidos is the tension between sensual objects and real qualities. As an example, when we examine, under a broad range of situations, a stegosaurus’ coprolite, photographing it from various angles under different lights, prodding it with analytical tools, we apprehend many different sensual objects corresponding to the withdrawn real object. Through theory, we gather the coprolite’s real qualities. Of all the tensions, the theory that counteracts eidos might have the least bearing on nonliving entities, as it implies some kind of memory and cognition. The translation of this tension into non-anthropocentric or nonliving terms is an open question for OOO.

Essence is the tension between real objects and their real qualities, “essence is produced only once in a while” as an act of fusion is required to bind them. Bringing a real object and its real qualities into “explicit counterpoint” is referred to as “causation.” Causation is the counterpoint to essence because causation completely transforms real objects yet involves only a portion of the real object’s qualities. However, since real objects do not touch and a sensual object must enact the contact, the tension between real objects and their real qualities is perhaps not causation per se, but the defining moment when a real object reveals qualities that the sensual object can translate into its own qualities.

In Harman’s formulation, time is the tension between a sensual object and its sensual qualities, with “confrontation” of its counterpoint. To explain, Harman writes, “what we mean by the experience of time is ‘change[...] produced by degrees, [in which] something changes and something remains’ (Leibniz) although here we are speaking of the purely sensual realm.” Defining time as a purely sensual tension disconnected from the real has been criticised by Peter Gratton, Peter Wolfendale and Arjen Kleinherenbrink, and indeed space and time are the two most challenging aspects of the fourfold. Furthermore, Harman’s most recent essay on occasionalism separates spatial and temporal occasionalism, noting that some variants of occasionalism require some external power, either God or the human mind, to hold objects through time to maintain their apparently consistent identity. This problem of the apparent persistence of objects through time lies somewhat beyond the scope of this essay but will be briefly addressed in Section 3.6.

Finally, in Harman’s fourfold, space is the tension between real objects and sensual qualities, the counterpoint between real objects and sensual qualities is brought about by “allure.” In “Asymmetrical Causation: Influence Without Recompense,” Harman emphasises the non-Cartesian aspect of his definition of space as “neither an empty container where events unfold, nor a system of relations between things, but the tension between relation and non-relation in things.” Comprehending time and space as objects remains
mysteriously counterintuitive, and in pursuit of some understanding about these assertions I will look to science and to some of the references to physics explicit and implicit in OOO. So after exploring the curious presence of virtual particles in the proportion of forces, we will return to the problem of space in the fourfold.

3.1 Space is not empty

Whenever it is stated in magazines or popular books that in quantum physics, empty space is not empty, most people misunderstand immediately: yes, they respond, it’s not empty, there are objects in space. But the statement that space is not empty really should be made affirmatively: space is more than a geometrical substrate. Most people intuitively hold the idea that space is an abstract void in which objects are located, a mathematically and conceptually pure Cartesian grid into which points, lines and objects are situated. But in the first decade of the twentieth century, Hermann Minkowski showed that space and time could be unified mathematically, and soon afterwards his student, Albert Einstein, explained that space–time was a singular object, and more importantly, that the object of space–time was causally effected by other objects. In 1919, Arthur Eddington (who later wrote the two-table analogy developed by Harman into the three-table analogy) proved this experimentally.26

In spite of this revolutionary moment in physics, the way people use the word space is still the abstract void in which objects can be located, maximally neutral, weightless, transparent and frictionless, unmoved and unmovable. So whenever the non-emptiness of space or space–time is mentioned, it is always made directly in opposition to the intuition that space or space–time is an immaterial, empty void. Hearing repeatedly that space is not empty, it is like being asked to not think of a glass of water and we unavoidably think of a shiny glass of water. The negative construal of the explanation occurs in philosophy, for example, Morton’s Realist Magic, “there is no such thing as a space, or time, 'in' which objects float”27 as well as in physics journals, for example, in a recent paper in Nature on the Casimir effect, the authors remind their readers:

One of the most surprising predictions of modern quantum theory is that the vacuum of space is not empty. In fact, quantum theory predicts that it teems with virtual particles flitting in and out of existence. Although initially a curiosity, it was quickly realized that these vacuum fluctuations had measurable consequences.28

The warning furnished already about how we misunderstand the idea of empty space is crucial here. What we are investigating in this essay is the proposition that the statement quoted above is not asserting that empty space has virtual particles in it, but the more radical claim is that emptiness is these virtual particles. Although in the world of ideas we can imagine emptiness as truly empty, in the physical world, teeming with vast quantities of virtual particles is as empty as empty gets. Instead of reaffirming the negative, let us remind ourselves that space–time is an object and explore reality of virtual particles.

3.2 Virtual particles

The idea of virtual particles has been around for a century but is little known outside physics. A brief history of how they were discovered will provide an outline of some of their key properties and the interpretations made about them. In 1924, Niels Bohr’s “Quantum Theory of Radiation” described persistent disturbances in the wave functions of electromagnetic fields as “virtual radiation fields.”29

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26 Harman, “The Third Table,” 4–15.
27 Morton, Realist Magic: Objects, Ontology, Causality, 42.
28 Wilson et al., “Observation of the Dynamical Casimir Effect in a Superconducting Circuit,” 376.
29 Bohr et al., “The quantum theory of radiation,” 165–175.
In 1928, Paul Dirac predicted that the negatively charged electron had a positively charged, anti-matter partner that became known as the positron. Then a few years later, he explained that the disturbances in electromagnetic radiation, the “virtual radiation fields” observed by Bohr, had a symmetrical component that could be explained as “the creation of an electron and a positron from electromagnetic radiation.” This interpretation of the mathematics indicating the creation of a matter and anti-matter pair from electromagnetic radiation arose from the following two highly influential papers: Einstein’s 1905 paper on Special Relativity that proposed energy–mass equivalence (wave–particle duality) and Werner Heisenberg’s 1927 paper on the uncertainty principle which gave a limit to how much certainty there can be regarding a particles’ position and momentum simultaneously. This uncertainty principle can also be stated as a limit to the amount of knowledge about time and energy, hence even in an absolute vacuum, where there is zero energy and zero mass, there is some uncertainty about that zero. The matter and anti-matter pairs that Bohr observed in the virtual radiation fields corresponded to symmetrical energy fluctuations possible within the level of uncertainty about that zero in a zero-energy vacuum. It is in here, in the vacuum energy, that virtual particles reign. Everywhere is filled with every variant of every of quantum particle, collectively their qualities either add to infinity or cancel each other out into zeroes, charmingly referred to as quantum trivialities, leaving the apparent emptiness. For this reason, it can well be said that “the ether of the 21st century is the quantum vacuum.”

3.3 Correlationism of the Copenhagen interpretation

With particles emerging out of nothing, the puzzling wave–particle duality of matter, and the double-split experiment inflated into the infamous metaphor of Schrödinger’s cat, these early years of quantum physics research revealed profoundly counterintuitive, anti-Newtonian insights into the world around us. The ambiguity about what is or is not real, and the need for a different kind of interpretation of the results from the interpretations valid for the everyday objects and interactions of classical mechanics, led Bohr and Heisenberg to assert what became known as the Copenhagen interpretation.

The Copenhagen interpretation, and its fatal flaw, can be best explained by focusing on what is known as the measurement problem. The measurement problem arises because quantum physics uses two discreet and incompatible sets of equations. On one side is Ernst Schrödinger’s wave function which describes the quantum states prior to measurement, and on the other side is the Born rule which yields a measurement probability. As Adam Becker has explained:

When you look at something that has a wave function associated with it, or when you take a measurement of something that has a wave function associated with it, which is supposed to be everything in quantum mechanics, that wave function collapses. It goes to zero everywhere, except in one spot or in one spot[...]. And the problem is that these two rules for how wave functions work contradict each other[...]. And so there’s the question, When do you use one and when do you use the other one[...]. And the traditional answer, the Copenhagen answer, is to say, “Oh, you use the Born rule, this collapse rule, when you’re looking at things, when you’re making a measurement, and use the Schrödinger equation for when you’re not looking.” What do we mean by looking? What’s a measurement?[...] [what the Copenhagen Interpretation] proposed was it’s not right, it’s not good scientific practice, to talk about what’s going on when you’re not looking.

By adding this distinctly perceptual criteria, “when you’re looking,” the Copenhagen interpretation brought anthropocentrism into the heart of otherwise mathematically driven research. Humans alone

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30 Dirac, “The quantum theory of the electron,” 610–624.
31 Dirac, Theory of electrons and positrons, Nobel Lecture, 324.
32 Other differences between real and virtual particles are explained in Schmitz, “Propagators and Virtual Particles,” 127.
33 Volovik, “From semiconductors to quantum gravity: to centenary of Matvei Bronstein,” 1, 2.
34 Becker, “Episode 59: Adam Becker on the Curious History of Quantum Mechanics.”
became the sole agent capable of causing the collapse of the wave function. The OOO position might incline us immediately to assume that all objects are capable of some kind of observation and hence some kind of measurement, but this is strictly forbidden by the Copenhagen interpretation. Quantum objects must be unobserved in order to change, hence objects must be unobserved most of the time. Hence, in the Copenhagen interpretation, only conscious human observation, including all its mechanical proxies, collapses the wave function. This privileging of the human as the sole agent in the Copenhagen interpretation is the anthropocentrism we now call correlationism and reopened the door to mystical speculation about human’s special place in the universe inherited from the pre-scientific worldview. OOO reasserts a non-anthropocentric view of objects, and this anti-anthropocentrism is necessary to resist the Copenhagen interpretation. Bohr and Heisenberg were bullishy adamant that they were correct and mocked researchers who questioned their orthodoxy; Heisenberg asserted: “I avow that the term ‘Copenhagen interpretation’ is not happy since it could suggest that there are other interpretations, like Bohm assumes. We agree, of course, that the other interpretations are nonsense.”

The Copenhagen interpretation’s forced marriage between physics and correlationism did not convince everyone. Bohr, the charismatic leader of the Copenhagen interpretation, acquired a reputation for confusing mathematically inclined scientists with sophistry. As David Albert has recently said:

[a] long string of brilliant people who would spend an hour with Bohr, their entire lives would be changed. And one of the ways in which their lives were changed is that they were spouting gibberish that was completely beneath them about the foundations of quantum mechanics for the rest of their lives.36

One such example of this anthropocentrism is Eugene P. Wigner’s 1970 essay “Physics and the Explanation of Life.” Wigner was by all accounts a brilliant physicist, winning the Nobel Prize in 1963, but he was troubled by the Copenhagen interpretation being so different from classical mechanics, especially “the necessity of the formulation in terms of perceptions, and hence the reference to consciousness.”37 Wigner referenced Rene Descartes and Malebranche arguing that nonhuman animals were non-conscious automatons and concluded that there must be different laws of nature for animate and inanimate matter, which meant different laws for humans than for everything else.38 Apparently, even Wigner was himself not convinced by his own rationale that all animals were automatons, as Albert related, “as a graduate student I witnessed Wigner at a conference[…] speculating to the effect that he thought dogs could likely collapse wave functions, but mice probably not.”39 With such groundless, correlationist speculations about consciousness emanating from respectable members of the physics community, younger and emerging physicists had to remain strategically ambivalent. Richard Feynman explained the necessity of keeping a distance from theoretical speculation, arguing for an epistemologically instrumentalist approach:

every theoretical physicist that is any good know six or seven different theoretical representations for exactly the same physics, and knows that they are all equivalent, and that nobody is ever going to be able to decide which one is right at that level, but he keeps them in his head hoping that they will give him different ideas.40

The Copenhagen interpretation’s dominance in theoretical physics lasted until its founders, Bohr and Heisenberg, retired. Feynman’s public comments about epistemological instrumentalism were a deliberate nudge for scientists and philosophers to look again at what had been broadly understood as a frozen element of research, and more recently, many alternate interpretations of quantum mechanics have been
proposed, though no single proposition stands above the others. One common objection to a realist interpretation is that the quantum wave function and its collapse are not real objects but epistemic objects. This indeed seems highly plausible and effectively discharges the criticism of correlationism. So I will continue a speculative realist interpretation focused on the causally active, the waves, particles and fields.

3.4 Casimir effect

Whether or not virtual particles are real in a physical sense, they are real by OOO’s criteria for objects, and they are certainly materially effective. A key example that connects space with virtual particles is the Casimir effect mentioned by Morton in *Realist Magic* and *Hyperobjects*. In *Realist Magic*, Morton is arguing two ideas simultaneously, first is that contrary to the mechanistic causation of cogwheels and colliding spheres germane to Newtonian physics, causation is an aesthetic phenomenon. Second is that all objects are assemblages, and that merely by proximity, two objects can be unified into one:

if you make really tiny nanoscale cogwheels, when you place them together you may find that they don’t spin, because to all intents and purposes they have become an item. Casimir forces have glued them together even though they haven’t properly touched.

The paper that Morton’s *Realist Magic* citation directs us to, published in *Nature*, explained that in “1948 [Hendrik] Casimir calculated an extraordinary property that two uncharged metallic plates would have an attractive force in vacuum.” A more recent *Nature* paper explains that when the space between the metallic plates is less than 1 μm, small virtual particles fit between the plates, but larger virtual particles do not. With more virtual particles outside than inside, the “vacuum radiation pressure between the plates is then less than the pressure outside, generating the force,” effectively “gluing” the plates together.

In a dynamic variation in the Casimir force, where one of the two objects is accelerating, virtual particles are transubstantiated into real particles. This process is what causes the evaporation of black holes via Hawking radiation. As virtual particle–antiparticle pairs are generated near a black hole and transubstantiated into real particles using the energy of the acceleration of the black hole, one particle is captured by the black hole and the other flies off in the opposite direction, escaping the black hole, and in a minuscule way, draining the black hole of its energy.

3.5 Virtual particles as force carriers

In the Casimir force, virtual particles press onto objects en masse; however, individual virtual particles can also enact forces. Five years after Dirac speculated that the virtual radiation fields contained electron–positron pairs, Edwin A. Uehling demonstrated that these virtual particles had measurable effects on real particles. By the 1950s, Feynman had comprehensively explained that virtual photons

41 Leifer, “Is the Quantum State Real? An Extended Review of ψ-Ontology Theorems.”
42 Morton, *Realist Magic: Objects, Ontology, Causality*, 72, 106, 118–119, citing: Anon., “Focus: The Force of Empty Space,” reporting about the article: Mohideen & Roy, “Precision Measurement of the Casimir Force from 0.1 to 0.9 μm;” and Morton, *Hyperobjects: Philosophy and Ecology after the End of the World*, 41.
43 Morton, *Realist Magic: Objects, Ontology, Causality*, 118.
44 Mohideen & Roy, “Precision Measurement of the Casimir Force from 0.1 to 0.9 μm,” 4549.
45 Wilson, “Observation of the Dynamical Casimir Effect in a Superconducting Circuit,” 376.
46 Ibid.
were the mediators of causal interactions between photons, electrons, positrons and quarks. By the 1960s, such ideas were routinely taught in universities; Feynman’s California Institute of Technology lecture notes, *Quantum Electrodynamics*, published in 1961, detailed the many causal processes of “virtual pairs” and “virtual photons.” Over the following decades, virtual particle pairs were more generally described as the carriers of forces and the mediators of causal contact. As Paul Davies wrote in 2007, physicists view “the action of the forces [...] as an exchange of virtual particles.” In terms of the uncertainty principle’s momentum and position uncertainty, Davies explained:

> the range of a force is directly related to the mass of the virtual particle that is exchanged: the bigger the mass, the shorter the range. The photon is massless, so electromagnetism has unlimited range. The fact that the weak nuclear force has such a short range implies that it exchanges virtual particles of very high mass.

Having identified that virtual particles are the agents that transfer forces between real objects, we have a contender for the sensual objects theorised by Harman’s fourfold. In their favour, it can be noted that, aside from gravity, virtual particles are necessary to enact causal interaction between any two real particles.

### 3.6 Backwards time

Feynman added another important consideration to the description of vacuum polarisation when he explained that an electron–positron pair could be explained as two electrons, one travelling forward in time and the other travelling backwards in time, and that “electrons travelling backwards in time are recognized as positrons.” Extending this specific observation, Yōichirō Nambu wrote that virtual particles:

> flow down as well as up the stream of time; the eventual creation and annihilation of pairs that may occur now and then, is no creation nor annihilation, but only a change of directions of moving particles, from past to future, or from future to past; a virtual pair, which, according to the ordinary view, is foredoomed to exist only for a limited interval of time, may also be regarded as a single particle that is circulating round a closed orbit in the four-dimensional theatre.

This dismantling of space and time at the quantum level continued more ferociously with the development of entanglement. The common explanation of entanglement is that two particles can causally interact without being physically connected, and another explanation is that these causal connections occur non-locally, that is, without engaging with space and time. Entanglement thereby does not imply anything about the nature of locality but merely asserts that not all objects are always obliged to interact with space–time. Given the phenomenon of non-locality, it appears that space emanates from objects as Morton asserts, but not that objects *always* emanate space and time.

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47 Uehling, “Polarization Effects in the Positron Theory,” 55–63.
48 Feynman, *Quantum Electrodynamics*, 74, 167, 171, 173, 178. These lecture notes only once use “virtual particles” (193), where Feynman quotes his own 1949 paper, “Space-Time Approach to Quantum Electrodynamics.” This 1949 paper is the earliest use of the term “virtual particle” I have yet found. It is used there in a footnote without explanation, clearly implying that the reader was already perfectly familiar with the idea, probably because it directly extended the more common uses of “virtual pair,” “virtual disintegration” and “virtual field.” The first paper explicitly dealing with virtual particles, Barut’s 1962, “Virtual Particles,” is a narrow specialisation on an already well-explored topic.
49 More specifically the virtual particles of gauge bosons.
50 Davies, *Cosmic Jackpot: Why Our Universe Is Just Right for Life*, 98. For a deeper explanation, see: Schmitz, “Propagators and Virtual Particles,” 113–143.
51 Davies, *Cosmic Jackpot: Why Our Universe Is Just Right for Life*, 98.
52 Feynman, “The Theory of Positrons,” 752.
53 Nambu, “The Use of the Proper Time in Quantum Electrodynamics I,” 82.
54 Morton, *Realist Magic: Objects, Ontology, Causality*, 30, 42, 48, similarly: Morton, *Hyperobjects: Philosophy and Ecology after the End of the World*, 61, 64. Furthermore, it suggests that the “temporal Occasionalism” explored in Harman’s most
Backwards causation as a form of atemporality and non-locality allows virtual particles a full range of causal powers other than gravity. However, virtual particles ostensibly violate one necessary condition of sensual objects, that they do not interact with each other, since virtual particles are themselves subject to the influence of other virtual particles through the process of screening.

3.7 Screening

To understand screening in the quantum vacuum, it is necessary to conceive of objects less like Heideggerian hammers and more like clouds. Clouds are dense concentrations of water vapour, and there is water vapour everywhere in the atmosphere, so proceeding from this excessively broad definition there is only one cloud and it is more or less visible in different places. Clouds are more meaningfully described phenomenologically as locations where water vapour’s blocking visible light is conspicuously reduced, but even in the most crisply formed cloud’s edge is blurry when viewed up close. So the idea that needs to be taken forward from a cloud conception of objects is that the boundary between an object and the surrounding depends on how, and from where, one perceives it, or what qualities are interacted with.

Beginning with the picture of space filled with virtual particles of all sizes, consider their motion. In accordance with the uncertainty principle, larger virtual particles exist for a very short period of time and very small virtual particles exist for longer. This means that larger virtual particles are formed in environments filled with innumerable smaller virtual particles that exist for the entire duration of these larger virtual particles’ brief lives. Consequently, Wilczek writes:

due to the behaviour of virtual particles a (real) positive charge is partially screened. That is, the positive charge ends to be surrounded by a cloud of compensating negative charges that find it attractive. From far away we do not feel then full strength of the positive charge, because that strength is partially cancelled by the negative cloud.

Thus, Wilczek explains that real particles and larger virtual particles experience either screening or anti-screening. Anti-screening describes the process whereby the colour charge of the attracted quarks amplifies, rather than attenuates, the effective charge. So due to cloud-like effects of screening or anti-screening, where exactly the boundary around a large virtual particle is drawn, its effective charge and therefore its causal power are radically changed. This means that if we chose to describe the virtual particles that enact causal forces – the electromagnetic force and the strong and weak nuclear forces – as material evidence of sensual objects, then they would appear to violate the principle that sensual objects do not directly interact. The validating interpretation, however, might be Morton’s dialetheism that objects may be both real and sensual.

All of these theoretical associations can be effortlessly undone, of course, merely by saying that virtual particles are in all circumstances only real objects, and some other sensual objects, as yet unknown, intervene to afford causal contact. However, since the generation of sensual objects is so easy to conceive in the case of a living being’s perception, and the microphysical nonliving version as yet unexplainable without a physical explanation that can scale upwards towards the emergence of consciousness, the details of Harman’s occasionalist causation still slightly privilege the human observer, despite its admirable ambitions to the contrary. It is in response to this problem that some solution is sought. In their favour, virtual particles are available locally in all locations at all times to enact causation between nonliving real objects, and they can never be accessed by anything other than the real objects they act upon (and by other virtual particles).

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recent essay on the subject may be similarly explained as secondary objects, or as effects, of real objects: Harman, “A New Occasionalism?” 132.
55 Wilczek, The Lightness of Being, 241.
56 Ibid., 47.
57 Wilczek, The Lightness of Being, 47–49, 222, 238; Wilczek, Asymptotic Freedom: From Paradox to Paradigm, 104–107.
58 Morton, Realist Magic: Objects, Ontology, Causality, 31, 162, 192.
4 Occasionalism and consciousness

Let us run through an example of conscious observation in OOO terms to examine the available options before translating them to the nonliving. When a hummingbird looks at two sweet flowers, the hummingbird forms an image (a sensual object) of each flower.\(^{59}\) When it recalls one of those images, three things might have occurred. First, the hummingbird might have stored that sensual object within itself, and the hummingbird must be capable of holding sensual objects as sub-components; or second, the sensual object of the flower was transubstantiated into a real object and then translated anew into a sensual object when recalled (if sensual objects are dialetheic, this transubstantiation might be a nominal event); or third, the sensual object of the flower was used as a template to create a new real object (a real memory object) and then translated into a new sensual object when recalled. None of these options are inconsistent with the fourfold, and the primary difference concerns the mechanism of memory: do perceivers store sensual objects or make real objects that can more or less reliably regenerate those sensual objects? In all cases, it appears that real objects contain, or merge with, or possessively process, multiple sensual objects. So we arrive at the easy assumption that real objects have sensual objects as sub-components and that consciousness depends, at least in part, on the accumulation of sensual objects. Consciousness in ourselves, as Descartes recognised, is immediately and irreducibly apparent. The sensual objects we hold within our real selves are closer to us, more available to us, than any real object, but consciousness in others can only ever be imagined, as it is evident only in the assemblages of sensual objects held within real objects, thereby consciousness in others is doubly withdrawn.

How then do nonliving objects hold sensual objects? The Casimir effect gives us an example of how through form and proximity, real objects can leverage the difference in available virtual particles to enact force on themselves. Such objects do not need to store sensual objects, or virtual particles, in the manner assumed with conscious observers, but merely have a form that captures or utilises the available forces that the virtual particles will provide. Similar formal arrangements like the molecular machinery of DNA leverage very similar effects. In narrowly construed examples like this, virtual particle occasionalism seems like a plausible option.

In the cases of larger nonliving interactions, like a meteor hitting a ceramic octopus, virtual particle occasionalism operates on the smallest scale, but as an object made of objects, there must be sensual objects for each pair of causally interacting real objects. So although virtual particles act as a plausible description for the sensual objects bridging causal contact between the electrons of the meteor’s and the octopus’ real silica atoms, it might still be the case that the sensual objects linking the elegant form of the octopus’ tentacle to the complex form of the meteor’s corroded skin arise only in the mind of the perceiver. That both octopus and meteor are themselves an “endless regress of objects wrapped in objects” necessitates a similarly endless regress of sensual objects.\(^{60}\) Different sources therefore inevitably account for different sensual objects.

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\(^{59}\) Harman originally referred to this as the connection, called a “sincerity,” between the real object and sensual object becoming a real object: Harman, “On Vicarious Causation,” 192.

\(^{60}\) Harman, Guerrilla Metaphysics: phenomenology and the carpentry of things, 161.
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