Gravitational Interaction and the Aristotelian Act–Potency Distinction

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Abstract

This article examines the hypothesis that gravitational interaction, unlike electromagnetic or nuclear forces, does not involve a transition from potency (BEING IN POTENCY) to act (BEING IN ACT) and back. Drawing on Aristotelian ontology, this work argues that gravitational influence may be exerted by matter that remains, at least partially, in potency - without undergoing actualization or change of form. This ontological feature may explain why gravitational interaction eludes particle detection and why no mediating particle, such as the graviton, has been observed.

1 Introduction

In an article *Quantum potentiality: An Aristotelian Interpretation of Modern Physics* [Sova, 2025a], I propose an extension of the ontology of contemporary physics to include genuinely existing beings in the state of potency (BEING IN POTENCY), such as free quantum systems that, at a given moment, are not in an actually realized state (BEING IN ACT), but instead exist, for example, prior to the act of measurement. Within Aristotelian ontology [Aristotle, 1933], [Aristotle, 1957], this article attributes these beings to a full and independent ontological status. BEING IN POTENCY is thus understood as an autonomous mode of being, not as a deficiency or merely an epistemic concept.

In the follow-up article *Quantum Gravity: Extending the Stress-Energy Tensor* [Sova, 2025b], I proposed an extension of Einstein's gravitational field equation [Einstein, 1920], [Carroll, 2004] by introducing an additional tensor $P_{\mu\nu}$, which accounts for the gravitational influence of matter existing in the mode of potency, that is, matter that is not in an actualized state.

In quantum field theory, forces are mediated through discrete exchanges: for instance, an electron emits or absorbs a photon, transitioning between energy states. This dynamic presupposes a clear shift from BEING IN POTENCY (possible excitation) to BEING IN ACT (actual emission), followed by reversion to potency (new stable configuration). However, gravitational interaction neither follows nor can follow this scheme. Unlike other forces, it does not involve discrete actualizations or transformations of form. Instead, it emerges from the continuous ontological presence of matter in spacetime, including matter that exists only in the mode of potency.

In this paper, I argue that gravity is not mediated through a transition of form but rather emerges from the very persistence of matter in spacetime, regardless of whether it is actualized in the sense of classical observation. **This idea provides an ontological basis for the fundamental undetectability of the graviton and points to a fundamentally different metaphysical status for gravity**. Unlike other forces, which are manifested through discrete transitions from potency to act and back, gravitational interaction appears as a continuous structural effect rooted in the enduring presence of being, even in its potential mode.

So, unlike other fundamental forces, which manifest through transitions between BEING IN POTENCY and BEING IN ACT, such as the emission or absorption of particles, gravity appears to be a structural effect of the very presence of matter, even when it exists in the potency mode.

2 Gravitational Interaction Without Form Change

Consider the emission of a photon during an electronic transition [Kulhanek, 2024]. When an electron moves from a higher to a lower orbital, a discrete amount of energy is released as a photon. This quantum event is not merely a formal change of state in the quantum mechanical sense but can be ontologically interpreted as the actualization of a potentiality: the electron was in potency to occupy a lower-energy state, and this possibility was realized in act. In this Aristotelian

sense, the transition exemplifies the passage from potential being (dynamis) to actual being (energeia). Similarly, processes governed by weak and strong nuclear interactions, such as beta decay or hadron transformations, can also be described as actualizations of specific potentialities within matter.

From an Aristotelian perspective, actualization is never a terminal state in an absolute sense but part of an ongoing ontological dynamic in which actuality continuously gives rise to new potentialities. When an electron transitions to a lower energy state, its previous potentiality is fulfilled: its dynamism to be in that state becomes energeia. However, this new actuality is itself embedded within a larger field of potency: the electron now has the potential to be re-excited, to participate in another transition, or to interact with external fields or particles. In this sense, every realized act is also the ground for new unrealized possibilities. This recursive structure—where being-in-act opens new dimensions of being-in-potency—expresses a fundamental ontological rhythm, one that parallels the behavior of quantum systems as they evolve through state transitions and interactions. The Aristotelian distinction thus offers not only a metaphysical description of physical change, but also a coherent framework for understanding how the world remains both stable and open to novelty.

The gravitational interaction, by contrast, does not seem to involve any such event. A massive body curves spacetime regardless of whether its internal structure or configuration changes. The gravitational field persists even in the absence of any local transformation or interaction event.

In general relativity, the gravitational field is described as the curvature of spacetime sourced by the energy-momentum tensor, regardless of whether the matter configuration changes in time. This aligns with the idea of persistent ontological presence. This suggests that gravity arises not from act but from the ontological consistency of presence, the persistence of being, even in potency. In the next section, we shall return to this ontological feature when discussing the absence of a mediating particle.

3 Why Gravity Defies the Act–Potency–Act Pattern

If gravity were mediated in the same way as other fundamental interactions, we would expect it to involve an exchange particle: the graviton. However, no such particle has been observed. This persistent absence challenges not only standard

quantum field theory but also advanced frameworks such as string theory and loop quantum gravity, both of which aim to describe gravity as a quantized interaction [Rovelli, 2004, Zwiebach, 2009]. Despite decades of theoretical development, no empirical evidence for the graviton has been found.

This persistent absence may not simply reflect an experimental limitation but could instead indicate a deeper ontological distinction. Unlike other fundamental interactions, which operate through discrete transitions between potentiality (BEING IN POTENCY) and actuality (BEING IN ACT), gravity may arise from the continuous presence of matter in spacetime, even when that presence is merely potential. In this view, gravity is not an interaction in the usual sense, but rather a structural consequence of the law-governed potency of matter.

From an Aristotelian perspective, the concept of a graviton may be metaphysically misplaced. If gravitational influence arises not from discrete actualizations but from the continuous presence of matter, including its structured potency, then no mediating particle is required. Instead, gravity reflects a geometric response to the ontological reality of being in potency, without necessitating transitions between ontological states.

Thus, gravitational interaction can stand apart from all other fundamental forces by not following the act–potency–act schema. Electromagnetic, weak, and strong interactions involve discrete transitions—events in which potentialities become actualized and are often associated with particle exchange. In contrast, gravity appears to arise from the continuous ontological presence of matter, including its potential mode of being (BEING IN POTENCY). This renders gravitational influence fundamentally non-local in the Aristotelian sense and potentially undetectable by approaches that rely on observing actualized transitions or particle events.

4 Conclusion

This article has proposed a metaphysical reinterpretation of gravitational interaction through the lens of Aristotelian ontology. Unlike electromagnetic, weak, and strong forces—which operate through discrete transitions from potency to act and back—gravity appears not to involve any such transformation. Instead, it emerges as a structural consequence of the continuous presence of matter in spacetime, including matter that exists only in the mode of potency.

Drawing on the distinction between BEING IN POTENCY and BEING IN ACT, we have argued that gravitational influence may proceed from structured potentialities without the need for actualization. This idea challenges the conventional expectation of a mediating particle such as the graviton and provides an ontological explanation for its persistent non-detection. It also invites a re-evaluation of approaches that attempt to quantize gravity by assimilating it to the same interaction schema as the other forces.

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