

When IR Theories Fails to Grasp the world: Can Quantum Physics Offer a Paradigm shift?



Chahrazed KHIER

Mohamed Lamine Debaghine University – Setif 2, Algeria, c.khair@univ-setif2.dz

Elhamdi AIDOUN

Mohamed Lamine Debaghine University – Setif 2, Algeria, e.aidoun@univ-setif2.dz

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Abstract:

The field of international relations is witnessing profound structural transformations that confound classical explanatory models especially amidst the erosion of sovereignty concepts and the disintegration of the firm boundaries of political agency. Faced with this complex reality this paper poses a central question: can quantum physics offer an alternative theoretical paradigm for understanding the transformations of the contemporary international system?

The study draws on central quantum concepts such as superposition, uncertainty and nonlinearity, in an attempt to translate them into analytical tools for understanding international relations that no longer adhere to traditional dichotomies like local/global or political/economic

Critiquing positivist and materialist models in international theory this paper proposes a new conceptual reading inspired by theorists like Alexander Wendt and James Der Derian who connected theoretical physics with political theory It hypothesizes that quantum theory offers not just a metaphor but an ontological and epistemological shift prompting a re-evaluation of core concepts like agency identity and sovereignty.

The paper aims to develop a new international relations approach that transcends classical reductionism by questioning its foundational assumptions It also seeks to bridge natural and social sciences using flexible conceptual tools suited for today's complex networked reality where the digital revolution has intertwined and fragmented power sovereignty and political identities.

.Keywords: International Relations; Quantum Theory; Sovereignty; Political Agency; Superposition; Networked Reality.

* Corresponding author: Full name, e-mail: c.khair@univ-setif2.dz

Introduction:

Imagine a physicist standing inside a darkened laboratory, peering through the lens of his apparatus at an oscillating quantum particle; This particle does not clearly reveal its nature, it sometimes appears as a wave, and sometimes as a particle, as if its very existence refuses to conform to a single ontological mold. This particle only acquires its shape at the moment of measurement, where observation is not merely a passive act, but an event that changes reality itself casting it from the realm of probabilities, into a moment of determination .Thus ,quantum physics reshapes the relationship between the observer and the observed, between subject and object, and demolishes classical assumptions about fixed independence, and objective reality.

Now, let us transport this scientist outside the laboratory; Let us imagine him directing his gaze towards the landscape of international relations: heads of state making contradictory decisions, alliances forming then collapsing , political statements changing, sharply and security stances suddenly escalating only to subside without warning. The scientist would pause for a moment, then stare intently, only to discover, that the behavior of this international political system closely resembles what he previously observed in the laboratory decisions that cannot be precisely predicted policies that do not stabilize into a single pattern and positions, that are only revealed at the moment of observation or intervention. At this moment the boundaries between the physical and the political between the laboratory and the field dissolve.

To bring this idea closer to the readers mind, imagine a melting clock reminiscent of Salvador Dalís famous painting *The Persistence of Memory*, where the clock loses its capacity for precise measurement ,dissolving between different dimensions of time. Just as the clock loses its fixed time, the state and political sovereignty lose their stability in the international scene, and political decision making becomes analogous, to the moment of measuring a quantum particle, where probabilities intertwine and cease at an unexpected moment of determination.

The similarity between the behavior of quantum particles, and the behavior of contemporary political actors, is not merely a metaphor, but reflects a deep crisis in our traditional explanatory models; The models that have long assumed the state to be an independent actor, with clear boundaries ,capable of making stable, and decisive decisions , today face serious challenges amidst the complexities of the contemporary international reality . Indeed the state often appears as a fragile entity , where local, regional and international influences , intertwine and where the actor is entangled with accelerating technological, and cultural variables.

This crisis is not limited to analytical tools, but extends to the foundational concepts themselves. what is a political actor? How is a decision made?; And what does it mean for a state to be sovereign in an era where concepts of perception and knowledge are being redefined through digital media, and communication technologies, that surpass the capacity of the traditional human actor?. This new cognitive framework compels us to reconsider our understanding of political agency, and highlights the importance of concepts such as :interaction, entanglement and uncertainty, which quantum physics offers as an analytical model. In this understanding, the use of quantum concepts comes not as a metaphor, but as a new cognitive perspective that reshapes analytical tools, and gives us a language to understand the fragmentation uncertainty, and entangled agency, that characterize the contemporary world.

Here, this study is presented as an attempt to understand the crises of identity, and political agency in the contemporary international system, drawing on concepts from quantum physics to reshape political analysis tools, and open new paradigm for research in international relations, particularly in the context of Arab politics, which is characterized by its specific complexities and unique challenges.

In this context ambitious, intellectual attempts have emerged calling for a reconsideration of the very structure of political theory, not only in terms of tools, and concepts, but also in terms of the logic of thinking that underlies it. Among these attempts , Alexander Wendts paper Quantum Mind and International Relations stands out as one of the boldest theoretical interventions proposing the use of quantum physics concepts, not as a metaphor but as an alternative ontological and analytical paradigm.

This paper argues that, prevailing explanations in the field of international relations based on Newtonian conceptions of time, agency, and causality, are no longer adequate for understanding a political reality, that is shaped moment by moment, and within a space of overlapping probabilities, rather than fixed decisions. Accordingly, the paper seeks to interrogate this quantum proposal through two interconnected axes: first by offering a critical review of Alexander Wendts attempt, and other literature in this field ; and second , by examining the political possibilities that quantum concepts offer for understanding issues such as, sovereignty, security power, and the positioning of the state in a fragmented world.

1. Rethinking International Relations :The Limits of Traditional Explanatory Models:

Dominant theory in international relations whether realist, or liberal , still rests on assumptions derived from classical physics, the existence of actors ,with defined identities ,and interests states interacting according to linear causal logic, within an international system of defined structure. In realism ,the state is an analytical unit of complete sovereignty, and permanent security interest acting

rationally to protect its survival (Waltz 1979). In liberalism agency remains distributed among states institutions, and individuals, but it is understood through the logic of cooperation and shared interests.

However, these explanatory models face challenges in their ability to accommodate the complexities of contemporary political phenomena. In this context ,it is noted that analytical eclecticism seeks to overcome this limitation, by offering complex causal propositions capable of highlighting interactions between different types of causal mechanisms ,that are usually analyzed in isolation from each other. It also emphasizes the need to move beyond linear analysis, in favor of a multilevel vision that prioritizes context, and its interactions ,considering that complex international phenomena can only be understood through a participatory analysis, that deals with nonlinear interactions, and decentralized causal patterns. This shift does not aim to produce a comprehensive theory, but rather to provide more flexible cognitive tools capable of understanding the rapid transformations in the international system especially, those resulting from the entanglement of the local and the global, the technological and the political ,and the material and the symbolic. Traditional analysis, often isolates the phenomenon under study, and breaks it down into narrow elements; while complex analysis calls for comprehending it in its interactive totality, as a product of an open system ;whose characteristics change with the changing relationships of its components (Hamshi 2021 pp 33–39 61–65).

Many researchers in international relations theory, agree with this critical assessment as Buzan and Little (2000), assert that grand explanatory models despite their historical importance have failed to address overlapping levels of analysis and complex interactions between substate systems, making them of limited validity in an era where governmental and nongovernmental actors , intertwine and transnational crises multiply. Rosenau (2005) also notes that thinking about world politics as a coherent process centered on the state is no longer sufficient, to understand the dynamics of governance without government ,that now characterize many contemporary international interactions.

In the same vein, some theorists have called for adopting socalled network models and complex systems as more capable explanatory alternatives for capturing the nonlinear superpositional, and interactive nature of international phenomena. Albert and Buzan suggest that international society has become more like an open network system where power and knowledge are distributed among multiple nodes, requiring a reconsideration of the fields, basic concepts including sovereignty, borders, and agency. Jervis and Axelrod & Cohen, argue that models based on complexity are capable of generating explanatory insights, that transcend rigid dichotomies, and highlight emergent changes resulting,from subtle interactions between system units, without needing to impose prior ontological stability on these units.

What distinguishes these new approaches, is their abandonment of the unifying ambition of grand theory, and their focus on the plurality of models and contexts in what resembles an epistemological pragmatism, which holds that the validity of any explanatory model, is conditioned by its ability to illuminate, rather than to achieve theoretical dominance. Thus , analytical eclecticism intersects with complexity theories in that it accepts incompleteness as a structural feature of any serious theoretical analysis ,and rejects the construction of closed models that claim to encompass a highly changing and unpredictable reality.

However, despite the epistemological flexibility and pluralistic approach to causality, offered by eclectic and complexity theorybased analytical approaches ,they remain captive to an ontological logic that assumes, relative stability in structures actor identities and decisionmaking paths ;They reconfigure phenomena according to complex relational networks, but do not necessarily transcend the representational view of the world which sees that an actor's behavior can be observed, or modeled based on recurring patterns and measurable contexts .That is, these models despite their efforts to move beyond linear explanation, still keep political actors in a state of identity stability, and assume that decisionmaking is a rational process, amenable to modeling. They also overlook or ignore the moment of observation discourse symbolic interaction, and the non -causal influence of non-material factors in the production of agency.

Even constructivist approaches, which granted identity and social interaction, a fundamental position in the construction of the actor, have in many of their formulations, retained a degree of ontological fixity in their conception of identities .They assume that actors form their identities, through social interaction, but within stable temporal frameworks that allow those identities to be measured and analyzed as modelable patterns. This conception still relies albeit partially on a representational logic of the world, which assumes the existence of structures amenable to continuous observation, and definition rather than understanding them as probabilistic states that crystallize only under specific conditions, or moments of overlap, and entanglement . Critical literature has pointed out, that this approach overlooks the moment of observation and symbolic interaction as factors that produce agency, not merely external determinants of it Consequently prevailing approaches, exclude the potential for non-causal influence of nonmaterial factors such as: collective emotions, or discursive representations in the shaping of international politics. (Wendt 1999 pp 327–340).

In this context, critical contributions from Arab scholars have emerged, offering insights that parallel post-positivist trajectories in international theory. Mohammed Hemchi argues that traditional explanatory models - including constructivism - remain insufficient when confronted with the nonlinear, indeterminate, and probabilistic nature of international behavior. He contends that the persistent assumption that identities, or actors can be fixed within stable causal

frameworks overlooks the deep structural transformations driven by cognitive and symbolic entanglements among actors. Moreover, these models often reproduce a rigid epistemological division between the observing subject and the observed phenomenon, neglecting the constitutive role of observation itself in shaping the realities under analysis. This critique resonates strongly with the "observer effect" in quantum physics where the act of observation alters the state of the observed (Hamchi, 2019, pp. 30–34).

Moreover, the current digital transformation and specifically the rise of artificial intelligence, demonstrate the limits of rational models that assume humans alone are capable of decision making based on preconceived preferences, and calculated data. While algorithms now, participate in assessment and prediction, and even influence public and international policy decisions; there is an increasing need for approaches that do not presuppose determined intent or stable identity. Here some emerging trends including the quantum approach in international relations, propose moving beyond rigid rationality in favor of a conception that allows for understanding indeterminate states, unmeasurable emotions, and interactions that only manifest at the moment of actualization resembling metaphorically or realistically what occurs in quantum systems where properties only manifest at the moment of measurement. (Wendt 2015 pp 62–67); (Fierke & Mackay 2020 pp 454–456).

2. The Limits of Explanation in a Fluid, Interconnected, and Transnational World:

Dominant theory in international relations, whether realist, or liberal still rests on assumptions derived from classical physics; the existence of actors with defined identities, and interests states interacting according to linear causal logic within an international system of defined structure. In realism, the state is an analytical unit of complete sovereignty, and permanent security interest acting rationally, to protect its survival (Waltz 1979). In liberalism, agency remains distributed among states institutions and individuals, but it is understood through the logic of cooperation and shared interests.

However, these explanatory models face challenges in their ability to accommodate the complexities of contemporary political phenomena. According to Hamchi's analysis, analytical eclecticism seeks to overcome this limitation, by offering complex causal propositions capable of highlighting interactions between different types of causal mechanisms, that are usually analyzed in isolation from each other; It emphasizes the need to move beyond linear analysis in favor of a multilevel vision that prioritizes context, and its interactions considering that complex international phenomena can only be understood through a participatory analysis that deals with nonlinear interactions and decentralized causal patterns (Hamchi 2021 pp 33–39 61–65).

Researchers at the Arab Center for Research and Policy Studies, assert that grand models despite their historical importance have become incapable of explaining the transforming international scene characterized by the entanglement of governmental and nongovernmental actors, and the increase in transnational crises ; They observe the necessity of employing more flexible approaches that allow for understanding political transformations in light of globalization and modern digital technologies, which impose new interactive patterns exceeding traditional linear models. (Arab Center 2019).

In this context Adel Zeggagh represents a distinct critical voice in the Arab field calling for a reconsideration of the concept of the political actor, and identities which are often understood as fixed and defined. Zeggagh explains that political systems in the age of globalization are no longer independent, and stable entities; but are shaped through complex interactions and cognitive and cultural entanglements that cannot be reduced to traditional rational, or predictive models. This vision, aligns with Hemchi's emphasis on the importance of moving beyond the representational perspective that assumes the possibility of observing and modeling the actor in isolation from the moment of observation and symbolic interaction which calls for thinking about quantum models that deal with uncertainty and superposition in international behavior . (Zeggagh 2018 pp 112-118); (Hemchi 2019 pp 30-34).

These criticisms, intersect with Western analyses pointed out by Buzan and Rosenau, who noted that traditional political thinking remained confined to a vision of the state as the sole center of gravity thereby diminishing the understanding of multilevel governance complexities. James Der Derian also calls for drawing inspiration from concepts of complexity and nonlinearity in world politics in an attempt to overcome simplistic causal models that have failed to keep pace with rapid transformations.

Consequently, the need to develop international relations theory does not stop at merely replacing or modifying grand theories, but extends to creating new frameworks that allow for a deep and more accurate understanding of political phenomena in an interconnected, and unstable world, where the local intertwines with the global the material meets the symbolic , and the boundaries of identity and stability dissolve in moments of interaction and observation.

3.Quantum Turns in International Relations: Rethinking Theory Through Physics:

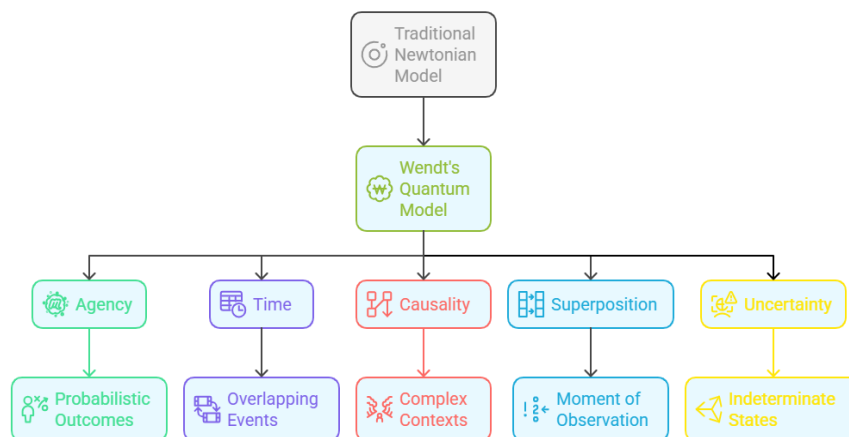
Alexander Wendts paper, proposes a revolutionary model for understanding political agency inspired by principles of quantum physics such as superposition uncertainty, and the moment; a property is measured measurement. Wendt argues that traditional models based on Newtonian physics and a fixed ontology of actors are no longer sufficient to explain the complex and changing dynamics in contemporary international relations .(Wendt 2015).

Wendt bases his argument on several key conceptual premises:

Agency: It does not mean a fixed and independent actor but rather agency that crystallizes at the moment of interaction, and observation where the outcome is probabilistic not deterministic.

- **Time:** Time is not treated as linear and absolute but as a relative and multilevel phenomenon where events can overlap and superpose.
- **Causality:** It shifts from a direct causal model to nonlinear causal relationships, where causes and effects intertwine within complex contexts.
- **Superposition:** It allows for the conception of multiple simultaneous states without one being determined until measurement, or interaction occurs.
- **Uncertainty:** It imposes limits on prior and precise knowledge of an actor's behavior or the outcome.

Quantum Model in International Relations



Wendt criticizes the traditional view, that sees the political actor as a rational fixed entity, and proposes instead a model that reflects the probabilistic and fluid nature of identities and policies. This model, enables an understanding of indeterminate states and interactions that only appear at a specific moment of observation, consistent with the principles of quantum physics .(Wendt 2015 pp 62–67).

Wendt also emphasized, that political agency is not a fixed state but a product of an interactive moment, characterized by uncertainty and superposition, where actors identities are formed and transformed within the same context .(Wendt 2015). This idea, found resonance in the work of James Der Derian ,who argued that international security is no longer confined by state borders or fixed

sovereignty, but has become linked to complex networks of nonlinear interactions that challenge traditional concepts of power and sovereignty.(Der Derian 2009).

Robert Jervis also points out, that uncertainty and multilevel dynamics in international politics, make it difficult to predict actors behavior based on traditional causal models, necessitating consideration of complex decentralized systems.(Jervis 1997). Robert Axelrod and Michael Cohen, add that international politics is a field where cumulative patterns interact to produce new transformations that can only be understood through models allowing for interpretive flexibility and interaction.(Axelrod & Cohen 2000).

Subsequently, Karen Barad presented a philosophical vision that reinforces these approaches through the concept of agential realism, which abolishes the separation between the observer and reality , showing politics and agency as direct products of interaction and the moment of observation which aligns with Wendts approach, in emphasizing the role of observation in shaping political agency.(Barad 2007). In the same framework, Mackenzie Wark asserts that power and sovereignty have expanded to include digital spaces where identities and policies intertwine within complex and changing systems.(Wark 2019).

These overlapping interventions, show how the quantum field in international relations transcends being merely a theoretical metaphor to become a vital cognitive framework for understanding the complexities of power ,sovereignty, and agency in a changing world , especially with the emergence of artificial intelligence, and digital spaces that reshape the contours of international politics.

4. Artificial Intelligence as a Quantum Actor: Redefining Agency and Sovereignty.

In the traditional perspective, artificial intelligence is viewed as an analytical tool or a technology subordinate to human decision making; However, in the quantum perspective, artificial intelligence is rethought as an observer that changes the very nature of political action; It does not merely receive data but contributes to shaping outcomes akin to the observer effect in quantum mechanics where a particle is only quantum when observed.

This perspective suggests that artificial intelligence through its ability to process data in real time analyze behavioral patterns, and predict scenarios does not merely simulate decision making, but participates in its formation, and even changes the conditions of agency itself. The recommendations of artificial intelligence algorithms when adopted by a decision maker become a moment of political wave function collapse, where all possibilities of action are reduced to a single apparent choice. (Wendt & Der Derian 2020).

In their joint article, Wendt and Der Derian go further by proposing the concept of a quantum security assemblage meaning that, what we consider security is no longer produced solely through the interaction of states but through

the superposition of human and nonhuman , sensor systems, artificial intelligence platforms, surveillance networks etc operating as interconnected systems that influence the understanding of the threat itself; the timing of the response and the form of the decision taken In other words security is no longer a product of purely political interaction, but the result of a quantum system of flows and probabilities.

This conception, harks back to Wendts broader theory of the quantum mind, elaborated in his foundational work, where he posits that the human mind - and therefore political perception -does not operate according to a classical computational model, but is subject to quantum properties like superposition, uncertainty, and entanglement .This means that, artificial intelligence built on classical computational models. when it evolves into self-learning and probabilistic prediction models itself approaches a quantum performance not just technically but also cognitively.

The quantum impact of artificial intelligence is measured not only by its ability to analyze reality, but by its ability to constitute; it Just as observation in quantum physics changes the state of a particle the existence of artificial intelligence systems ,changes the meaning of sovereignty, redefines who the actor is and what constitutes a political event in the first place .This is what Wendt links to the idea that social agency, is not limited to humans alone but extends to include informational and cognitive systems, that contribute to the production of action and meaning . (Wendt 2015 pp 222–225).

In this sense sovereignty- which has long been associated with human decision making and control over territory - becomes distributed or at least conditioned by what artificial intelligence systems propose, and conceal ; We are facing a redefinition of sovereignty, not only in terms of who has the right to make decisions but , who has the ability to see reality and reconfigure it . (Barad 2007).

Hence, we can speak of the concept of entangled sovereignty or quantum sovereignty, where state decisions intersect with nonhuman systems that monitor produce and direct, without necessarily being visible, or accountable .This phenomenon, requires international relations theories to reconsider the concept of the actor and, the nature of power, and knowledge in the global political field.

Introducing quantum concepts into the analysis of international phenomena, represents not merely an epistemological expansion, but also entails an ontological revolution against the prevailing classical model in the field of international relations. Quantum theory as Wendt points out, is not limited to being a computational tool for understanding subatomic particles, but represents a comprehensive conception of reality, as interconnected nonlinear and possessing multiple potentialities; In this framework , international politics becomes less like a chessboard with clear boundaries, and more like a dynamic wave field constantly

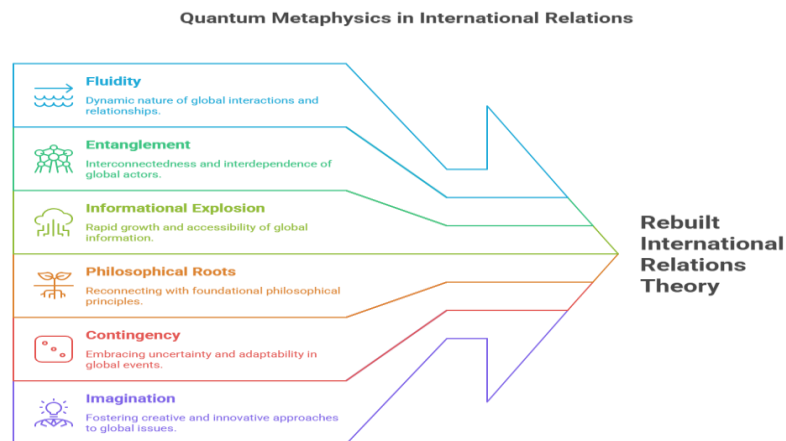
shaped by the superposition of possibilities observer interventions, and complex interactions between subjects and objects.(Wendt 2015 pp 73–76).

This shift challenges the classical assumption of the possibility of separating the observing subject, from the observed reality an assumption, that has remained dominant in international relations literature since its inception ; But in the quantum perspective as Der Derian and Wendt argue the very act of observation changes the nature of the subject and even contributes to creating the phenomenon under analysis. This vision, derived from the measurement problem in physics opens a new horizon for understanding politics as a field constantly shaped through performances interactions and mutual recognitions, not just through objective interests and structures .(Der Derian & Wendt 2020 pp 406–407).

From here, it can be said that the quantum approach belongs to a broader series of theoretical transformations in the field of international relations, such as post-structuralism, radical feminism, and post-humanist theories ;These approaches all share a critique of the classical conception of rationality ,sovereignty, and identity, and seek to affirm the performative networked and interactive nature of international reality; But what distinguishes the quantum perspective is its attempt to move beyond the metaphorical character of some of these approaches, by offering new mathematical and logical models for understanding indeterminacy superposition ,and probabilistic collapse.(Orlando 2020 pp 470–472).

This approach is likely to reshape the relationship between theory and practice; If classical theories arose in the context of a quest for cognitive control over international reality the quantum approach calls for recognizing the limits of knowledge and opening up to multiple models of reality ,where the material intertwines with the symbolic the subjective with the objective and the individual ,with the collective. In this context sovereignty, for example is not understood as a fixed legal concept, but as a super-positional site determined at the moment of recognition translation, or even collapse under the pressure of changing contexts.(Barad 2007 pp 153–159).

However, the quantum approach is not without challenges It does not claim to offer a complete explanatory theory, but presents itself as a horizon for thinking or as its proponents call it an exercise in quantum thinking; This imposes a dual caution on researchers on the one hand caution against superficial projections, or misuse of physical terms, and on the other hand caution against hastily dismissing; the approach on grounds of strangeness or irrationality . Scientific history, shows that the most influential theories were in their beginnings the most bewildering.(Der Derian & Wendt 2020 pp 407–409).



Ultimately, this new metaphysical paradigm offers an opportunity to rebuild international relations theory, on foundations more consistent with the nature of the contemporary world, characterized by fluidity entanglement , and informational explosion; It also allows the field to reconnect with its deep philosophical roots, and liberate itself from the predictive-control tendency, that has dominated it since World War II, to become a field more open to contingency probability and imagination.

Conclusion

The crisis facing traditional explanatory models in international relations, reveals the limits of approaching the international world through intellectual tools, that have settled on concepts of sovereignty, agency, linear causality , and balance as developed by classical physics; These concepts despite their analytical effectiveness in previous periods, have become incapable of encompassing the complexities of a global system characterized by instantaneous entanglement, the interplay between humans and technology, and the rise of non-centralized forms of power. In this context, the quantum approach as developed by James Der Derian and Alexander Wendt , represents a radical call to rethink the ontological, and epistemological assumptions of the field, not as a negative critique, but as an attempt to reactivate a theoretical imagination open to complexity, uncertainty, and entanglement.(Der Derian & Wendt 2020 pp 399–401).

What distinguishes this orientation, is that it does not seek to replace one theory with another, but to expand the scope of consideration to include concepts that may appear strange or unscientific on the surface but carry deep explanatory power in a world moving towards total entanglement between political technological, and symbolic systems, Through concepts such as : entanglement, superposition, and wave function collapse, international relations can be

envisioned not as a closed and separate domain, but as a dynamic multi centered system whose identity is determined by interactions observations, and probabilities , not by national constants and borders alone.(Wendt 2015 pp 84–88).

This does not necessarily mean a break with all, that international relations theories have achieved over the past century, but rather points to the need to transcend their explanatory limits and rethink their conceptual structures; Just as the quantum shift in physics, did not abolish Newton's laws, but reframed them within a broader and more accurate model; introducing quantum approaches to international relations can contribute to developing the field not dismantling it. This requires theoretical courage and an openness, to the interplay between physics philosophy, and critical thinking in order to formulate a theory more consistent with the post-modern and post-human era.(Orlando 2020 pp 477–478).

The future of international relations in light of this perspective, depends on its ability to interact with other sciences, to constantly question itself, and to adopt multiple explanatory models consistent with a world that never stops changing. From this standpoint, quantizing cannot be considered merely a theoretical fad, but an embodiment of what could be the beginning of a long-term epistemological shift in understanding world politics, moving beyond the Newtonian model to more complex pluralistic, and flexible models.

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