

## **Summary of Dissertation: Speculative Physics: the Ontology of Theory and Experiment in High Energy Particle Physics and Science Fiction**

My dissertation presents an argument for a philosophy of speculation in the physical sciences through critical analyses of a recent event in the history of modern physics, the process leading to the confirmation of Higgs boson of the Standard Model of particle physics (a model representing hierarchical relations, and interactions, among elementary entities) in conjunction with selected works of ‘hard’ science fiction. In both cases, historical, sociological, and philosophical frameworks are employed. However the speculative philosophy presented here is completely unrelated to speculative realism.

That said, the dissertation represents two distinct strands of thought:

- 1) How ‘novel’ or ‘new’ knowledge in particle physics, and its closely allied subfields, together with their implication, are considered in the science fiction of the 1970s and 1990s;
- 2) A qualitative assessment of the epistemology of quantum physics through a case study of the prediction, discovery, and confirmation of the Standard Model Higgs boson in particle physics.

Both cases converge to elucidate the (speculative) ontological problems in the physical sciences while arguing for the need of a transdisciplinary framework that can push for a deeper exploration into philosophical questions in physics. The findings suggest that:

- a) Ambivalence, instability, and the speculative characterize the relationship of ontology to epistemology because subjective gaps are always present in any formal representations of a physics object. Moreover, scientific models, such as the Standard Model in this case, are contingent frameworks for operationalizing experiments. Therefore, the models could be disrupted as a result of too many anomalies or new revelations. The epistemologies deriving from that process of scientific knowledge production could only approximate the ontological.
- b) Fiction provides a creative-epistemic platform for arbitrating the subjective elements of scientific production by elucidating the political nature of techno-science without conflating their difference. The ethics underlying the scientific concepts, and accompanying technological issues, in ‘hard’ science fiction are presented as arguments for the social embeddedness of epistemology through the various scenarios provided in fiction, such as in the privileging and advancement of certain forms of knowledge, or theoretical domains.

The first chapter advances the rationale of the dissertation: why a philosophy of speculation (conceived as speculative physics here) is a worthy project; while justifying the motivation behind the dissertation’s thematic organization. The second chapter sets out the theoretical framework of the entire dissertation as informed by physics and science fiction. While borrowing the concept of speculative physics from Schelling’s work, I had completely reworked his original intention to produce an updated conception of speculative physics more suited to modern physics. I explain that speculative physics is more epistemically flexible and expansive than the conventional representation of hypothesis and (underdetermined) theory.

From chapters three to six, the dissertation alternates between a discussion of physics and science fiction by pairing them by sub-themes: speculative theory (chapters three and four) and speculative experiment (chapters five and six). Chapters three and five take on a more specific discussion of the role of speculative theory and experiment in demarcating the prediction, search, and confirmation of the Higgs boson. In chapter three, speculative physics is used for bridging inquiries in the foundations of physics, with questions arising in particle

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physics, and the double-slit (interference) experiment is deployed to argue for ontological and empirical connections between quantum foundations and particle physics.

Chapter five charts the experimental searches for the Higgs boson through case studies of the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid). Both these chapters, and the framework of speculative philosophy, will converge in chapter seven for a discussion on the role of data analytics, speculative computing, and speculative code, all which reference the prehistory of stochastic modeling in digital computing that also comprise a critical explication of the Monte Carlo method as integral to the analysis and interpretation of data. Chapter seven also attempts a discussion on the mediation of physics data from the context of media technology, to argue that the mediation of physics interactions at the particle collider is a cinematic articulation of media technique and event.

Chapters four and six, on the other hand are focused on science fiction. Chapter four takes on the conceptual arguments developed in chapter three, but with minimal technical dressing, to position a discussion of science fiction in relation to the social values of science. The chapter expands on the question of quantum physical interpretation, and brings that into merger with a discourse on capitalism; speaking to issues of scientific labor, knowledge gatekeeping, and ethics governing knowledge production. The reasons are two-fold: to draw parallels between quantum interpretations and cultural critique, and to address values that effect the dominance of a particular scientific interpretation, such as in quantum physics.

Chapter six aims to demonstrate the suitability of science fiction for charting the social-history of science through works of science fiction authored by practicing physicists to chart the field of particle/quantum physics, with arguments reconnecting to issues first raised in chapter four. This chapter uses science fiction to bring into discussion, the speculative aspects surrounding inquiry at the foundation of modern physics while performing the role of a thought experiment for bridging the epistemic and the social. The thought experiments bring together, different motivations underlying the different scales of interpretation in physics.

Chapter eight provides a philosophical perspective to the entire enterprise while attending to how all of these revert to the question originally raised about critical science studies, therefore bringing back the framework first conceived through speculative physics to other areas of science studies, including a science studies of science fiction.

The dissertation is supplemented with an appendix meant to provide a historical and more technical background of the Standard Model of particle physics central to the dissertation's thesis, so that a motivated but non-technically inclined reader can follow the arguments more seamlessly, while the more technically adept reader will not be burdened by technical details obvious to them. Yet, the appendix offers its own critical perspective by cobbling together arguments based on long durée scientific-historiographical narratives to present the Higgs boson as an embodiment of a series of epistemic choices. The choice of relegating the critical-historical representation of the Standard Model to the appendix is aimed at minimizing disruption to the primary arguments advanced in the main chapters.

In conclusion, dissertation intends to broaden conversations on scientific epistemology by demonstrating how an interdisciplinary intervention serves as a starting point for a more concerted effort at transdisciplinary action in science and technology studies. To get there, we need to break down the contentious (hostile) relations between analytic philosophy of science and continental philosophy, as well as that of history of science and cultural/critical theories.