

**PROCESS PHYSICS :  
BOOTSTRAPPING REALITY FROM THE  
LIMITATIONS OF LOGIC**

by

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*To my children,  
Kelsey Adela Jean and Perry Lawrence*

*℘*

*In memory of my father, who lifted me up,  
and of Don, my uncle,  
who sparked a life-long state of wonder*

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# Abstract

For all the successes of the two edifices of modern physics, quantum theory and Einstein's relativity, a fundamental description of the Universe as a whole – a theory that informs as to the true nature of reality – has continued to elude science. This thesis describes the development and evolution of a new paradigm called *Process Physics*, a radical information-theoretic modelling of reality. It is argued that the failure of the extant approaches in physics is the direct consequence of limitations stemming from the mathematization, language and methodology of theoretical physics: the limitations of the postulated background spatial concepts and geometric modelling of time, the limitations of quantum theory in its failure to account for the measurement process and classicality; and the limitations of formal systems. In contrast, *Process Physics* utilizes the limitations of logic first identified by Gödel and asserts the priority of process and relational endophysics, realized via a stochastic, autopoietic bootstrap system whose properties emerge *a posteriori* rather than being assumed *a priori*.

The work is arranged in two parts. Part I discusses the historical, philosophical, and metaphysical foundations of physics to consider how the prevailing views in modern physics arose and what this revealed and contributed to the development of *Process Physics*. Part II describes the fundamentals of the new theory and its implementation, and demonstrates the viability of looking outside the current paradigms by showing that *Process Physics* yields unified emergent phenomena that permit an understanding of fundamental processes and penultimately motivate both quantum theory and relativity as relevant higher-level descriptors within their respective domains.

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## Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

---

Signature of Author

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# Introduction

For all the undeniably great successes of the two edifices of modern physics, quantum theory and Einstein's relativity, a fundamental description of the Universe as a whole – a theory that informs as to the true nature of reality – continues to elude science. As Geoffrey Chew wrote, “Despite the glorious achievements of 20<sup>th</sup> century physics, obscurities persist. Each successive triumph has sharpened awareness of unresolved mysteries” [1]. For decades, researchers have sought that fundamental description in the domain of *quantum cosmology*, endeavouring to unify quantum theory and gravity, yet to no avail. The research reported here was motivated principally by dissatisfaction with that state of affairs, the desire to understand why it should be so, and the hope that the insights so gained could lead to a fresh and more optimistic approach to the resolution of the many deep problems.

This work describes the evolution of a new paradigm from the early investigations through to the development of the foundations of what is now called *Process Physics*, a radical information-theoretic modelling of reality. It is the contention of this thesis that:

1. the failure of the extant approaches in physics is the direct consequence of limitations inherent in the language and methodology of theoretical physics, leading to a construct of assumptions and rigid mathematization that have

blocked further efforts to attain a full understanding of Nature at its deepest levels;

2. close examination of the historical developments of the mathematization of physics reveals its circumscription, principally: the limitations of the *a priori* background spatial concepts and geometric modelling of time in the physics of Galileo, Newton, and Einstein; the limitations of quantum theory in its failure to account for the measurement process and classicality; and the limitations of formal systems discovered by Gödel, Turing, and Chaitin;
3. insights gained by the analysis of those limitations and leading to the alternative approach of *Process Physics* demonstrate the viability of looking outside the current paradigms; and
4. *Process Physics* yields emergent phenomena that are unified, permitting an understanding and linking of fundamental processes that penultimately motivate both quantum theory and relativity as relevant higher-level descriptors within their respective domains.

To elucidate and support this contention, the present work is arranged in two parts: the first addresses points 1. and 2., above, by considering the historic, philosophic and metaphysical foundations of the prevailing views in modern physics; the second part addresses points 3. and 4. by describing the fundamentals of the theory of *Process Physics* and its implementation in the development of modelling constructs to examine, test, and develop various aspects of the theory and thereby demonstrate the viability of *Process Physics* as “an ultimate theory that can be formulated as a

finite number of principles” [2] – a goal formerly held by Stephen Hawking. In a striking reversal, Hawking changed his position on the attainability of such a pre-eminent theory. Citing Gödel’s theorem, he said (*ibid.*)

In the standard positivist approach to the philosophy of science, physical theories live rent free in a Platonic heaven of ideal mathematical models. That is, a model can be arbitrarily detailed, and can contain an arbitrary amount of information, without affecting the universes they describe. But we are not angels, who view the universe from the outside. Instead, we and our models, are both part of the universe we are describing. Thus a physical theory, is self referencing, like in Gödel’s theorem. One might therefore expect it to be either inconsistent, or incomplete. The theories we have so far, are both inconsistent, and incomplete.

Rather than accept Gödelian arguments as an impediment to progress, with an infinite regress of ever deeper principles in the manner suggested by Hawking, *Process Physics* instead embraces them to reveal that Gödel’s theorems provide the opportunity to re-evaluate the status of conventional modern physics. The vital insight is that the limitations of logic imposed by Gödel (and those who followed) furnish the key to achieving a profound, if not ultimate, understanding of Nature at its most fundamental level.