Elementary Process Theory: axiomatic introduction and applications

Marcoen J.T.F. Cabbolet

Abstract

In this PhD project, the research question was which fundamental laws of nature would govern the physical universe assuming that antimatter (such as positrons, antiprotons, and antineutrons) will be *repulsed* by the gravitational field of ordinary matter. Thus far, gravitational repulsion has never been observed; however, several experimental projects are currently being carried out in order to establish the coupling of antimatter with the earth's gravitational field.

During the course of research, which was carried out in the form of a Hegelian dialectical process, it became immediately clear that an observation of gravitational repulsion would pose a problem that the existing language and assumptions of contemporary physics would not be able to handle: gravitation is then not what is laid down in general relativity, and antimatter is then not what is laid down in the standard model of particles and interactions. The main research activity was therefore focussed on identifying what kinds of entities then exist in the universe and on developing new first principles about the nature of physical reality. As such, the research activity falls under what Whitehead called "speculative philosophy", but the end result transcends the borders of pure philosophy for two reasons: first, because the resulting theory is testable by the scientific method of Lakatos, and further because it is formalized in *mathematical* language – as Cobb put it, "the dominant form of philosophy in the English-language world … assumes that meaningful communication can occur only in *ordinary* language."

The main result of this PhD research is a physically complete ontology of Kant's noumenal universe, that is, the universe as it is in itself, apart from how it is observed – the Kantian view that this is cognitively inaccessible is thus rejected. This ontology then consists of a set of ultimate constituents of the noumenal universe that are referred to by mathematically abstract symbols, and of a set of first principles – the Elementary Process Theory (EPT) – that are formulated mathematically by means of these symbols and that entail the view that physical reality is best understood as a process. It turned out that the usual language of mathematics, that of Zermelo-Fraenkel set theory (ZF), was not appropriate for the definition of the formalism: this led to philosophical problems that were both unavoidable and unsolvable. Therefore, a generalization of ZF, called set matrix theory (SMT), was developed: while ZF uses only sets as terms of the language, SMT uses matrices with set-valued entries – that enabled a formulation of the EPT in mathematical language without any problems. For the physical interpretation of the formalism, which is defined by a number of interpretation rules, some new primitive concepts were introduced, in particular the concepts 'phase quantum' and 'monad'; the latter differs from Leibniz' notion of a monad. The additional concept 'binad' provides a link to existing language: electronic/protonic/neutronic binads are, in existing language, states of being of electrons/protons/neutrons; the EPT contains an axiom about the composition of these binads in terms of phase quanta. The remaining six axioms concern the events that take place in the individual processes: during the course of research it was understood which discrete transitions had to take place for gravitational repulsion to exist. The EPT is then physically complete: the axioms give a generalized description of *all* individual processes in the universe – not just those concerning gravitation – and with that the creation of *all* its ultimate building blocks. Constituents such as electrons, protons, neutrons and their antimatter counterparts all exhibit stepwise motion in the universe of the EPT.

The EPT has been critically confronted with the contemporary foundations of physics, that is, with quantum mechanics (QM) and general relativity (GR): a formal proof in the language of the EPT is given that both QM and GR are incompatible with the axioms of the EPT. In addition, the EPT has been compared with Process Physics (PP) and Whitehead's Process Philosophy (WPP): while the EPT and PP have virtually nothing in common, some aspects of WPP agree with the EPT – although, all in all, WPP and the EPT differ fundamentally with respect to their views on what constitutes an individual process. Furthermore, several applications of the EPT have been developed: a variety of observed processes has been formalized in the framework of the EPT, a theory of the Planck era of the universe has been formulated using the language and axioms of the EPT, and a mechanism for mental causation has been defined that fits seamlessly in the ontology given by the EPT. These applications demonstrate that the EPT, despite its differences with existing theories, applies to real world problems.

The main conclusion is that the original research question has been answered and that the results form an entirely new disciplinary matrix. It remains a challenge, however, to demonstrate that the laws of physics, known to have merit in some area of application, emerge from the EPT. A research program with that aim has been mapped out: further work in this direction is thus needed to establish whether or not the EPT constitutes an advancement in the understanding of the fundamental workings of the universe.