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Fundamental Irreversibility and the Concept of Events

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Dedicated to Res Jost and Arthur Wightman, friends for many years and appreciators of unorthodox thought

Abstract. It is proposed that the transmutation from possibilities to facts should be introduced as an essential element in fundamental theory. This has no bearing on TCP-invariance. If indeterminism is accepted it leads to a picture of an evolving history formed by individual events and causal ties. In the low density regime it can be compared with the treatment of multiple collisions in quantum field theory.

Introduction

It is difficult and perhaps still somewhat controversial to summarize the tenets of quantum physics. Indeterminacy is one aspect which is easily understood and accepted by most. It is the recognition that the "laws of nature" do not allow the prediction of future development with certainty even if optimal knowledge of the past were available. The problem of "reality" touches a deeper level, a central nerve of physics and it has troubled many. Using the standard language and concepts developed during the early discussions by Bohr, Heisenberg, Dirac, von Neumann we must divide the universe into two parts: the "observed system" Σ and the observer with his equipment M. The singling out of a system Σ constitutes a (to some degree arbitrary) mental decision on the side of the observer but it was emphasized by Heisenberg that, while the cut can be shifted to some extent it cannot be avoided. The "system" cannot be the universe as a whole. The two parts, Σ and M have different aspects. On the side of M there is the free will of the observer to plan an experiment and consciousness of results. A reduction of free will and consciousness to physical laws is not attempted. Furthermore, on the side of M, there is the need to describe the instruments and the findings in common language (the language of "classical physics" in the formulation of Bohr). Within this frame the task of the theory is to specify the general properties of possible systems (mass, spin, charges of particles, structure of matter...) and to predict the probability for finding a particular measuring result from the available knowledge about the past.