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QUANTUM THEORY AND GENERAL PARTICLE DYNAMICS

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ABSTRACT

It is assumed that the position of a point particle need only have meaning at the moment of measurement. On this basis the most general particle dynamics possible is developed which is consistent with an average description which yield Newton's law ofinteria. It results that there are three simple approaches which satisfy the requirements: customary quantum mechanics, a dynamics which is neither quantum nor classical, and classical mechanics. An additional assumption rules out the second possibility here. Finally, the well-known quantum-velocity (i.e. the probability current density) plays a key role in this development and is here shown to have a much more fundamental interpretation than is customarily recognized.

INTRODUCTION

Quantum theory is, and has been since its inception, a profound description of the world that is fraught with apparent inconsistencies and still gives its practitioners the strong feeling that it is far from being well understood. It is therefore worthwhile to attempt to view and formulate this theory from as many perspectives as possible. There are already several well-known ways of doing this, which include the "rules of passage" from the classical canonical to the quantum operator formalism as suggested by Dirac [1] and von Neumann [2], and the more physical prescription of the Feynman [3] bath integral formulation. Except for the Feynman description,these approaches consist of mere recipes for transcribing the classical description of a system into its quantized version. The path integral approach is much more significant, however, as its basis depends almost entirely on the characteristic quantum mechanical interference propetry of probability amplitudes. But here, too, there is an essential incompleteness in that the weighting function associated with each path has to be postulated. It is accurate to say that all these approaches actually consist in somewhat adhoc algorithms for providing the transition from the classical to quantized description. There does not, then, seem to exist a development of particle dynamics based solely on the properties of measurements as we actually find them. It is with this problem that the present work is concerned.

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