

The Ghostly Quantum Worlds

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ABSTRACT

We present the foundations of a new emerging interpretation of quantum theory bearing wide-range implications. Physical basis of the interpretation is non-questionable yet relatively new – it relies on the different structures (decompositions into parts, subsystems) of the quantum Universe. We compare the mutually irreducible structures of the Universe and recognize them as the different facets of the one and the same quantum Universe. Physical picture is interesting and non-reducible to the existing interpretations. As a particularly interesting topic in this context appears the 'free will' topic of current interest in the interpretation of quantum theory. To this end, we arrive at the following interesting observation. The freely chosen actions (*e.g.*, quantum measurements) performed by a (conscious) agent that are still locally observable in the alternate Worlds could seem physically unexplainable ('non-physical', 'ghostly').

Key Words: interpretation of quantum mechanics, quantum structures, free will, Everett's parallel worlds, multiverse

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1. Introduction

There is a hot ongoing debate about the interpretation of quantum mechanical formalism; for some recent issues see *e.g.*, (Saunders *et al.*, 2010; Pussey *et al.*, 2012; Ma *et al.*, 2012; Vedral, 2010; Mermin, 1998; 't Hooft, 2007).

Based on some fresh looks into the quantum mechanical formalism, here we point out a new interpretational discourse of wide-range implications that include both consciousness as well as the issue of free will (Conway and Kochen, 2008; Gisin, 2010).

Our starting point is the recently re-discovered importance of the "structure", *i.e.*, of the decomposition into parts, subsystems, of a composite quantum system (Dugić and Jeknić, 2006; Dugić and Jeknić-Dugić, 2008; Dugić and Jeknić-Dugić, 2012; Jeknić-Dugić *et al.*, 2011; Dugić *et al.*, 2012; Jeknić-Dugić *et al.*, 2012). When applied to the quantum Universe, this opens the new avenues not only for interpretation but also a wide-range of implications for describing the quantum Universe. The emerging picture is physically interesting and mind provoking. Physical existence of the simultaneously existing dynamical *Quantum Worlds* is unquestionable. For the Universe as isolated whole, a World does not seem more realistic than any other world. Bearing only the common time axis and being subject to the Schrödinger law, these worlds represent the parallel worlds of the completely new kind.

Our aim here is properly to describe the quantum mechanical foundations of such, new kind of the parallel quantum worlds, and

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