Quantum Nano-Automata (QNA): Towards Microphysical Measurements with Microphysical QNA 'Instruments'

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Two important concepts for nanoscience and nanotechnology-- the quantum automaton and quantum computation--were introduced in the context of quantum genetics and complex genetic networks with nonlinear dynamics. In previous publications (Baianu,1971a, b) the formal definition of quantum automaton was initially presented in the Schrodinger representation of quantum mechanics, and several possible implications for genetic processes and metabolic activities in living cells and organisms were considered. This was followed by reports on quantum, as well as symbolic, abstract computations based on the theory of categories, functors and natural transformations (Baianu,1971b; 1977; 1987; 2004; Baianu et al, 2004). The notions of quantum topological semigroup, quantum automaton, and/or quantum computer, were then suggested with a view to their potential applications to the analogous simulation of biological systems, and especially genetic activities and nonlinear dynamics in genetic networks. A representation of interacting quantum automata of nanoscale 'sizes', such as devices possibly made of quantum dots, and their quantum state decoherence modalities is here considered in the Heisenberg picture of quantum dynamics. The interesting question of microphysical measurements performed by quantum nano-automata is raised in terms of quantum logics suitable for countable observations with definite probability densities. It is expected that such quantum nano-automata experience decoherence when they become irreversibly entangled with interacting systems in their surrounding environment. Novel experiments with small, nano-clusters of such quantum automata can be now designed for different types of quantized fields, and the results of such experiments for specific molecular force fields are then finitely computable by standard quantum theory in the Heisenberg picture.

Keywords: Automata Theory/ Sequential Machines, Bioinformatics, Complex Biological Systems, Complex Systems Biology, Computer Simulations and Modeling, Dynamical Systems , Quantum Dynamics, Quantum Field Theory, Quantum Groups,Topological Quantum Field Theory (TQFT), Quantum Automata, Quantum Dots, Cognitive Systems, Graph Transformations, Logic, Mathematical Modeling; applications of the Theory of Categories, Functors and Natural Transformations; pushouts, pullbacks, presheaves, sheaves, Categories of sheaves, Topos, n-valued Logic, N-categories/ higher dimensional algebra, Homotopy theory; applications to quantum field theories, quantum gravity, complex systems biology

bioengineering, informatics, Bioinformatics, Computer simulations, Mathematical Biology of complex systems and phenomena in various types of Dynamical Systems; bioengineering, Computing, Neurosciences, Bioinformatics, biological and/or social networks; quantitative ecology and quantitative biology/