Possible Consequences of the Application of Cellular Automates With Strong Antisipation in Quantum Physics

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Geometry, beginning with the development of modern science, and especially since the time of Newton enters theoretical physics in one way or another. One of the key questions is the choice of spaces, in terms of which they formulate the corresponding equations and sets of values that can take physical quantities and variables. Up to now, usually the basic equations are partial differential equations. It is important to emphasize that with this description it is assumed that the independent variables vary continuously (spatial, temporal). Further, unknown functions, as a rule, were applied continuous or smooth. This made it possible to use the whole arsenal of mathematical analysis, the theory of differential equations, including their symmetry analysis. The standard reference can be considered the book of V. Tirring.

However, especially recently, changes in the methods of describing the corresponding mathematical objects began to appear. Among all the various generalizations, one should note a direction that combines approaches that take into account both continual and discrete aspects. As is well known, discreteness in quantum mechanics has various aspects, beginning with the fact that there exists a minimal (Planck) length (10-35 m). Relatively recently (approximately from 80-90s) a new direction appeared in the theoretical physics of micro and macro world, connected with the so-called cellular automata. The space is divided into many identical cells in the case of a plane, cubes in three-dimensional space, and so on. Each of the elements has a finite set of states. In the simplest case, each cell has 2 states. State may change over time with discrete steps, while they themselves state changes occur according to the rules, which are based on knowledge of the state of the cell and cells in a neighborhood (e.g., for plane: Neumann neighborhood - 4 cell or cells 8 near Moore). One of the main examples is the game "life". Quite recently interest in such concepts was initiated by different authors. The basic idea was the use of discreteness at the quantum level (Planck length). Then quantum machines are written in such a way that for limiting transitions with decreasing cell size, the equations of quantum mechanics are obtained in the limit. The formulations of models of cellular automata for problems of quantum physics have different forms depending on the initial axioms, the technique used and the purpose of the research. In various papers these and other variants are considered cellular automata and limit transitions, leading to equations related to quantum mechanics. Undoubtedly, such research will continue in the future. However, taking into account additional properties in cellular automata and posing new mathematical problems can lead to new results and interpretations that may be of interest, among other things, for quantum mechanics. The first of such properties is strong anticipation.

There are many variants of the description of anticipation. Perhaps for intuitive understanding most closely follows: "Anticipation (. Lat anticipatio - anticipating) - Introduction of a result of a process occurring before it actually achieve and feedback means serving in the construction of action.". This concept was met, however, without formalization and measurement, many times in the context of philosophy, economics, psychology, medicine. Relatively recently (probably in the last 30-40 years), both experimental studies and new theoretical concepts have appeared in the study of anticipation. It should be noted that in physics itself have long pointed to the possibility of manifestation antisipatsii in one form or another, since Feynman and even earlier (eg Tetrode in the 20s of the 20th century), for example, when considering the retarded and advanced waves in classical electrodynamics . On the need to take account of non-locality, both in time and in space indicate the results of experiments to test Bell's inequalities, and others. In quantum mechanics, there is even a transactional interpretation

of quantum mechanics J. Kramers, based on the microscopic processes with delay and advance. In the theoretical plan in the field of biology and modeling, systems and models with anticipation were explicitly described by R. Rosen. Then a significant development and formalization of the concept of anti-invasion was introduced in the works of D. Dubois. Beginning in the early 1990's D.Dubois, the idea of a strong anticipation was introduced: "The definition of a discrete system with a strong anticipation: it is a system that calculates the current state at a time t as a function of states in the past $,...,t-3,t-2,t-1$, present t, in future moments of time. "

The key idea of this work is the introduction of a strong antiparticle in the construction of spacecraft for quantum mechanics. Of course, there are many ways to implement this idea. First of all, we describe one of the simplest. For this purpose, we assume that the states of the SC cells can depend on the future (virtual) states of the cells. The basis for the singularity of the solutions of cellular automata with strong anticipation is the possible many-valued solutions and the existence of many branches of solutions. This also implies the existence of many configurations of spacecraft at a given time. We note that this leads to the existence of new features of solutions and interpretations in old problems and the possibilities of posing research problems in the field of quantum mechanics. The main new feature revealed in the simulation of such a system with strong anticipation is the emergence of a multi-valued state of such a system (or hyperincursion in the terminology introduced by D. Dubois, who first pointed out such features of equations and solutions). This new behavior allows us to re-examine classical questions, including uncertainty. All this (and much more) indicates the advisability of further consideration of physical models (and, probably, systems) with strong antipathy. One of the obvious and relatively easy to implement options is to take into account the strong anticipation in the analogues of classical models of spacecraft in quantum mechanics and to study the possible consequences and interpretations.

The proposed models of spacecraft are completely new objects and represent a broad field for research. But it should be noted that they are a fairly complex object for research (even by approximate methods). The main difficulties bring possible branching and multivalued solutions. On the other hand, it is these features that seem most promising in terms of interpretations. Therefore, the paper briefly summarizes the considerations for the direction of further research and possible results. Some puzzling questions are first described. First, the visualization of solutions in models with a strong anticipation surprisingly resembles the illustrations to Everett's interpretation of quantum mechanics. Perhaps a strong anti-invasion can provide a branching mechanism and a multiplicity of worlds in the Everett scheme. Also, the multiplicity of possible transitions can be considered as a candidate for considering the appearance of probability schemes. The next circle of questions arises in connection with the properties of solutions of such models and their limits, generalizing the classical spacecraft equations. It is also appropriate to consider the measurement process on the basis of the same models. In addition, when strong anticipation is taken into account, new questions arise about the very structure of cell-automaton models, primarily about the structure of the cellular space at the micro level.

Conclusions. Thus, in this paper we consider the use of models of cellular automata with strong anticipation in quantum mechanics and possible ways of developing such representations. One of the most promising opportunities is the emergence of polysemy in solutions. New statements of problems and possibilities of interpretations of similar singularities of solutions for quantum mechanics are carried out.