On the replacement of the paradigm in quantum physics.

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The relevance of such a replacement has long been ripe and overripe.

Quantum mechanics has existed for about 100 years. Quantum mechanics is a mathematical model that describes experimental results. Moreover, this is an abstract mathematical model that does not have any clear physical meaning. The search for the physical meaning or physical interpretation of this mathematical model lasts almost as long.

There are a lot of variants of interpretation of quantum mechanics: Copenhagen, many word interpretation (MWI), De Broglie-Bohm, informational interpretation, QBism, objective collapse, relational interpretation, transactional interpretation and many other [1]. “New interpretations appear every year. None ever disappear” [2]. It is already clear from their number that none of the interpretations is satisfactory. It is difficult for a physicist to understand the meaning of some interpretations. The popularity of the many-worlds interpretation has been growing in recent years [3]. From a physical point of view, this is a complete absurdity. But mathematicians and philosophers like it, because it allows them to solve some of their mathematical problems. In our opinion, MWI is a symbol of the dead end in which the problem of physical interpretation of quantum mechanics has been for many years.

In such cases, philosophers say that a paradigm shift is needed. The paradigm in quantum mechanics is the concept of symmetry or unitary transformations. Translated from mathematical to physical language, this means that "all the laws of physics are symmetric in time". Physicists often repeat this statement as a mantra.

At the same time, for quite a few years in optics (nonlinear optics), there have been a number of direct and indirect experimental proofs of the nonequivalence of forward and reversed quantum processes [4, 5]. That is, there is no symmetry in time in quantum physics. Differential cross sections of forward and reversed quantum processes can differ by many orders of magnitude. From this nonequivalence, the necessity of the existence of some kind of memory of a quantum system about its initial state directly follows - without such a memory, it is impossible to distinguish a forward process from a reversed one. Since quantum systems can be very large (for example, experiments with beam splitters - various versions of interferometers, Hong-Ou-Mandel effect), such a memory must be nonlocal.

In other words, we are dealing with the non-invariance of time reversal in quantum physics. This is the alternative paradigm.

From a physical point of view, the most interesting interpretation is De Broglie-Bohm theory [6]. It did not receive proper recognition for two reasons:

1 - the theory assumes the existence of hidden parameters, the physical nature of which is not known,

2 - the theory supposes the existence of some nonlocal quantum potential, the physical nature of which is also unknown.

The alternative paradigm explains this nature. The hidden parameters are differential cross sections of forward, reversed (or partially reversed) quantum processes. The equivalent of a nonlocal quantum potential is the nonlocal memory of quantum systems about their initial state, which determines the difference in differential cross sections.

The experimental study of the differential cross sections of quantum processes in general is not a very difficult technical problem [4]. An experimental study of the properties of nonlocal memory of quantum systems can also be carried out using fairly simple means (for example, in experiments with beam splitters [7, 8]). However, the problem here is that experimenters are afraid to work in these directions without the approval of theorists. But, theorists are hesitant to recognize the need for a paradigm replacement in quantum physics.

As a result, we have a surprising situation: violation of T-invariance has long been recognized in the field of high-energy physics in the case of weak interactions [9, 10]. But. in the field of low-energy physics (nonlinear optics, conventional quantum physics), it has not been possible to achieve a similar recognition for many years, despite the presence of quite obvious experimental evidence. Now this problem looks more like social than physical.

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