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Introduction

Quantum Informatics - 2007 (QI-2007) is the forth international symposium on quantum informatics held in Russia. The symposum was organized by the Faculty of Computational Mathematics and Cybernetics of Moscow State University and the Institute of Physics and Technology of Russian Academy of Sciences, and was sponsored by Russian Fund for Fundamental Research (RFFI, grants 07-01-06114-g, 06-01-00494-a), and NIX Computer Company (grant #F793/8-05).

QI-2007 demonstrated the substantial progress and new trends in quantum informatics that arose in the past two years. At first we saw the continuing development of quantum cryptography in Russia, which made it possible to characterize quantum informatics as a new perspective in IT technologies. The quantum channel, constructed by Sergei Molotkov (MSU, ISSP) began in Moscow. We expect further distribution of his scheme among the top level of business society and state organizations of Russia. Molotkov's recent advantage is the establishing of the eavesdropping strategy, breaking quantum channel security with 11% noise. This strategy can be called the collective attack. It is characterized by the usage of quantum memory in eavesdropping. The former 11% border of admissible noise in quantum channel has been thus proved to be exact.

New investigations in quantum computer technology on solid state quantum dots have been represented by Alexander Tsukanov and Alexander Kokin (FTIAN). An ion trap quantum computer abstract model was investigated by Alexander Burkov (MSU), who applied the universal Akulin-Harel scheme to excited ions in Paul trap.

A significant part of QI-2007 was devoted to the critical analysis of the modern state of quantum theory, especially in the area of many particle ensembles. Andrei Khrennikov and Gulliaume Adenier (Växjö University, Sweden) discussed fair sampling in EPR experiments that is the basis of quantum many-body theory. Detailed investigations of this kind of experiment are necessary because they reveal the stochastic character of quantum physics. It is also important to find new methods of representation of the quantum evolutions, more economical than the matrix algebra methods, because the latter require a huge amount of memory. Yuri Ozhigov (MSU, FTIAN) represented one of such methods: dynamical diffusion, which can serve as the satisfactory approximation for quantum unitary dynamics of the grain if spatial resolution is fixed. The concept of hidden time in quantum theory has been developed by Pavel Kurakin (MFTI). Al Kraklauer (USA) defended the positions of the so called local realism in quantum theory; his viewpoint represents the protest against the standard Hilbert formalism of tensor products that forms the base of the quantum theory of many bodies.

Indeed, Hilbert formalism leads us to and extremely large expenditure in time and memory if we try to simulate quantum evolution. But the excellent explanation of experimentally found entanglement makes us treat this formalism as the element that must be preserved in all possible reconsideration of the foundations of quantum theory.

The desirable reconsideration of the foundations of quantum theory could be heard in several papers presented at the QI-2007. My opinion is that the problem of quantum theory lies in its mathematical apparatus. It must be reorganized on the basis of algorithms instead of standard mathematics. An algorithmic approach in quantum physics is the best alternative to the standard formalism. This can be illustrated in the decoherence problem. The standard viewpoint treats decoherence as a kind of energy dissipation. The algorithmic treatment of decoherence represents it as the result of a severe limitation of classical memory in the simulation of quantum dynamics when the number of involved particles draws rapidly.

The very near future will show us the development of the ideas and methods represented at the QI-2007 symposium. Some video films from QI-2007 and books devoted to the algorithmic approach will soon become available at the site of the Quantum Informatics Chair in MSU: http://qi.cs.msu.su/

Yuri I. Ozhigov