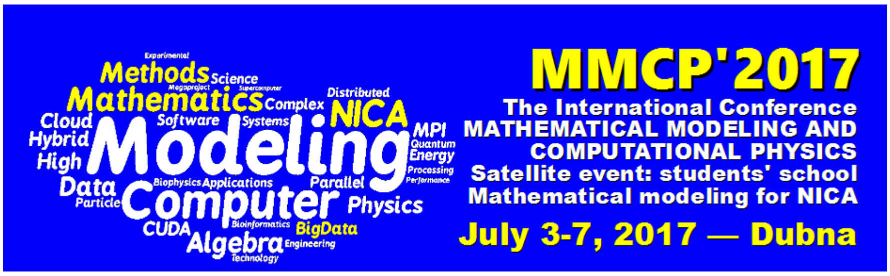


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# The dipolar relaxation of multiple quantum coherences as a model for an investigation of decoherence processes in many-qubit clusters in multiple-quantum NMR

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Quantum decoherence is one of the most important problems for creation of quantum devices which outperform their classical counterparts [1]. The performed investigations demonstrate [2] that the decoherence time decreases when the number of qubits in the coherent cluster increases.
We used methods of multiple-quantum (MQ) NMR [3] for the investigation of the decoherence processes in many-qubit clusters forming in the course of the MQ NMR experiment. One-dimensional systems are very suitable for the considered problem because the consistent quantum-mechanical theory for MQ NMR dynamics was developed [4] only for one-dimensional systems. It was shown [4] that only MQ coherences of zeroth and plus/minus second orders emerge in a one-dimensional chain, initially prepared in the thermodynamic equilibrium state, on the preparation period of the MQ NMR experiment in the approximation of the nearest neighbor interactions [5]. We developed a theory describing the dipolar relaxation of the MQ coherences of zeroth and second orders in the finite spin chain on the evolution period of the experiment which follows immediately after the preparation period [6]. The dependencies of the intensities of the MQ NMR coherences of the zeroth and second orders on the evolution period are obtained for various numbers of spins in the chain. It is shown that the MQ NMR coherence of the zeroth order does not decay completely in the relaxation process.
The size of the coherent clusters forming on the preparation period is expressed via the duration of this period and the space dimension. The dependence of the relaxation time on the number of spins in the formed cluster is obtained. Considering the dipolar relaxation of the MQ NMR coherence of the second order as a simple model of the decoherence process in the many-qubit system, we found that the decoherence time slowly decreases with the increase of the number of spins in the correlated cluster.

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## Short biography note

G.A.Bochkin graduated from Moscow State University (Department of Mathematics and Mechanics) in 2014. He now works at the Institute for Problems of Chemical Physics, in the laboratory of spin dynamics and spin computing. Research interests: magnetic resonance and quantum information theory.

**Primary author:** Mr BOCHKIN, Georgii (Institute of Problems of Chemical Physics of RAS)

**Co-authors:** Prof. FEL'DMAN, Edward (A Head of the Theoretical Department of the Institute of Problems of Chemical Physics of RAS); Mr VASIL'EV, Sergei (Institute of Problems of Chemical Physics of RAS)

**Presenter:** Mr BOCHKIN, Georgii (Institute of Problems of Chemical Physics of RAS)

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