

Quantum theory is the primary mainstay of our understanding and formal description of Nature. Moreover, it constitutes a perfectly empirically confirmed formal construction. Even long years of continual progress in experiments and constantinous falsification failed to pinpoint a phenomenon that would not fall in accord with its predictions. The fact that these predictions have been constantly accurate, led to the extraordinary alterations within the last eighty years in the existence of both people as individuals, and humanity as a whole. Despite many years of continuous attempts, a commonly accepted interpretation of mathematical formalism of Quantum Mechanics has not been found. The phenomenon of quantum correlations, especially entanglement, is believed to be most amazing and eluding the schemes of classical thinking. That fact was noticed directly after the mathematical principles of non relativistic quantum mechanics had been formulated. Long term conceptual efforts to grapple the 'spooky actions for separated distance systems' began with the fundamental work of Einsten, Podolski and Rosen and continue until this day. Yet, today we possess the knowledge that quantum correlations-still remaining a great mystery- allow experimental realization. Additionally, they can be controlled and implemented in nontrivial tasks. Let us mention here secure quantum communication, quantum computing, quantum cloning as well as quantum teleportation. Such promising perspectives to practically use quantum correlations as a resource, clearly demonstrate the importance of undertaken efforts to improve the theoretical comprehension of this phenomenon.

In this project we plan to focus mainly on quantum teleportation phenomenon. Speaking more clearly, our goal will be to deliver **new quantum teleportation protocols**, which do not demand correction process on receiver's side and investigating their potential applications in the field. It turns out, that mentioned lack of correction process leads to many interesting and non-trivial applications such as new cryptographic attacks or gives new research paths for investigations relations between complexity theory and nonlocality. Research will be devoted to full description of the performance of proposed protocols as well as description of their internal mathematical structure suggested by the representation theory of finite groups and algebras. Secondly, we plan to make of delivered tools to an **alternative description of quantum channel capacity**, which is one of the biggest challenge of modern quantum information theory. Third research objective is dedicated to investigation effects of **parallel use of teleportation protocols** in the context of super-additivity phenomenon. Parallel research on **new mathematical tools** necessary to achieve mentioned above goals will be taken, which in the author's opinion will be of independent interest.

Summarizing we hope that our researches would have influence on better understanding phenomenon of quantum teleportation, also from the point of view of practical applications, and would develop science discipline of quantum information theory.