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Linear optical quantum circuits construction algorithm based on directed graphs or transform matrices

Today great interest in quantum information is observed throughout the world. Quantum computing schemes based on quantum algorithms will allow for effectively solving many complicated mathematical problems. There are two different approaches to implementing the experimental schemes for quantum algorithms: based on linear optical quantum computation (LOQC) or quantum circuits with nonlinear elements. The LOQC schemes are easier to implement, but their mayor disadvantage lies in probabilistic nature of their functioning. The probabilistic nature of obtaining results in the LOQC supports the relevance of the search of the most effective variants of optical circuit designs for specific quantum operations: their composition and arrangement of the basic quantum computing elements. In this report we propose an algorithm for automatically constructing LOQCs from several basic elements. The program uses the transformation matrix, relating the input and output parameters of the quantum system, or a directed graph that describes the composition of the desired circuit. The algorithm is based on the method of dual-rail encoding. In our implementation, beam splitters and wave plates are used as the basic elements. These basic elements are required for optical realization of any one- or two-qubit gates. As a result of this work, we developed an algorithm that allows implementing LOQC using the transformation matrix between the input and output states, or a directed graph. Additionally, the programs allow analyzing the circuit relative error probability, and choose the best possible realization.

Biography

Anton Kozubov has received his Bachelor's degree at the ITMO University in 2015 and is at present in his first year of Master's program. He works as an engineer in quantum information laboratory at ITMO University. His scientific areas of interest include quantum computing and communications.

kozubov.anton@gmail.com