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A possible approach to quantum computation by using classical optical fields modulated with pseudorandom phase sequence

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The history to simulate quantum states using classical optical fields is long. Many researchers utilized classical optical fields to simulate quantum states and quantum computations. However, it is quickly found that the simulation is not efficient and scalable. This is because the classical optical field only supports the product structure but does not support tensor product structure. We proposed a possible scheme to solve the problem that optical fields modulated with pseudorandom phase sequences simulate any state of multiple quantum particles. By using the scheme, we demonstrated optical analogies to many quantum states such as Bell states, GHZ states and W states, and some quantum algorithms such as Shor's algorithm, Grove's algorithm and quantum Fourier Transformation. Firstly, we introduced a theoretical framework, a phase ensemble based on pseudorandom phase sequence referring from the concept of quantum ensemble. Then, we represented various quantum states of n particles by using classical fields modulated with n pseudorandom phase sequences and we also demonstrated nonlocal properties of quantum entanglement in the phase ensemble theoretical framework. Finally, we demonstrated some optical implementations to realize some quantum algorithms. We believe these optical implementations are not difficult to implement. After careful analysis and numerical simulation, we can conclude that our scheme provides an efficient approach to quantum computation without exponential classical resources.

Biography

Jian Fu has completed his PhD at Zhejiang University. He is working as Associate Professor at Zhejiang University. He has published more than 45 papers in reputed journals.

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