No-cloning and No-deletion Theorems

Why is no-go theorems of strong interest? With the great advances of quantum information processing, understanding the limits of the manipulations we can perform on quantum information becomes more and more important. These limits tell us what we can do with the information contained in unknown states and what we cannot. The limitation arises mainly due to the linearity and unitarity of quantum mechanics. Therefore, the laws of quantum mechanics impose restrictions on manipulations with quantum information.

Particularly, I am considering here two no-go theorems, namely, No-cloning and No-deletion theorems.

(a) No-cloning theorem tells us that it is not possible to copy an arbitrary quantum state but it does not prohibit us from approximate cloning. An interesting aspect of quantum cloning is that it can be used for broadcasting of entanglement into two identical inseparable states. In this process, the entanglement originally shared by two observers is broadcast into two identical less entangled states by using a local cloning machine. We have investigated the problem of secret broadcasting of three-qubit entangled state between two distant partners with universal quantum cloning machine and then the result is generalized to generate secret entanglement among three parties. This result is interesting in the context of quantum cryptography.

(b) Another fundamental limitation on quantum information is the quantum "no-deleting" principle which states that given two copies of an unknown quantum state we cannot delete a copy against the other using any physical operation. Like quantum cloning machine, we can always construct an approximate quantum deleting machine. We have constructed the first approximate universal deletion machine that delete a copy against the other with fidelity of deletion greater than 1/2. The proposed deletion machine consist of two unitary transformations which we named as a deleter and a transformer. The role of deleter is to delete a copy against the other and the role of transformer is to increase the fidelity of deletion.

Publication under this topic:


