Abstract

Using NMR techniques, we simulate the violations of two Bell-type inequalities: Mermin-Ardehali-Belinskii-Klyshko (MABK) inequality and Chen's inequality, for the 3-qubit generalized GHZ states. The experimental results are in good agreement with the quantum predictions and show that Chen's inequality is more efficient than MABK inequality in the case of the generalized GHZ entangled states.

Conclusions

In summary, we have investigated the simulation of the violation of Bell-type inequalities, including MABK inequality and Chen's inequality for the generalized GHZ states in an NMR system. In the range of the generalized GHZ states, Chen's inequality is more efficient than MABK inequality. The experimental results are well in agreement with the expectation of quantum mechanics.

It is necessary to emphasize that, in strict, because NMR qubits are many nuclear spins of atoms bounded together in a single molecule, separated by a few angstroms, the NMR experiment is inherently local. Whereas, the meaning is that, when we experimentally simulate the violation of different Bell-type inequalities for arbitrary generalized three-qubit GHZ states in NMR, the results are excellently in accord with the quantum predictions. It tells us, despite of many existed disputes, NMR may contribute more on some fundamentals of quantum mechanics. As a refined tool and technique for experimentally realizing quantum computation in the last decade, NMR is still contributing to numerous fundamental problems of quantum mechanics now. In the future, we will still pay attention to this area.