High order duality: Theory and Experimental

Shi-Yao ZHU

Beijing Computational Science Research Center

Abstract

The duality for a single particle state has been extended to the states composed of multi-particles. The first and second order duality relations for the two-photon states are investigated theoretically and experimentally. The sum of the wave-like information and particle-like information is equal to one for a group of two-photon pure states, or smaller than one for other two-photon pure states and two-photon mixed states. By feeding the Mach-Zehnder interferometer with photon pairs created by spontaneous parametric down-conversion, we experimentally verified the first and second duality relation. The optical fields exhibiting the same first-order particle-like and wave-like behaviors may carry entirely different second-order duality information. In principle, the high order duality experiment can be implemented by a coherent state.