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Detecting the Macroscopic Quantumness in Atomic Systems[1]
CHANG-HAU KUO, YAO-CHUN YU, Dept. of Physics, National Tsing Hua University, GUANG-YIN CHEN, Dept. of Physics, National Chung Hsing University, YUEH-NAN CHEN, Dept. of Physics, National Cheng-Kung University, CHE-MING LI, Dept. of Engineering Science, National Cheng-Kung University, JUNG-JUNG SU, Dept. of Electrophysics, National Chiao Tung University, CHIH-SUNG CHUU, Dept. of Physics, National Tsing Hua University — Atomic ensemble interacting with nonclassical light provides an interesting platform for exploring the quantum nature of macroscopic systems. In this paper we study the quantum dynamics of the timed Dicke state in a two-level atomic ensemble induced by the absorption of a single photon. Using the extended Leggett-Garg inequality and quantum coherence witness, we explore the possibilities to identify the macroscopic quantumness in the timed Dicke state with a large number of atoms. As another example, we study the quantum dynamics of three-level atomic system, a popular candidate for storing quantum states in atoms. Our work shows that the extended Leggett-Garg inequality and quantum coherence witness may be exploited to probe the quantumness preserved in atomic quantum memory.

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