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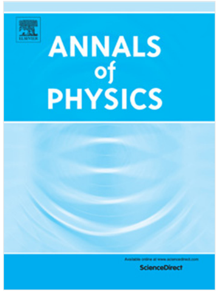

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Exotic looped trajectories via quantum marking

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Abstract

We provide an analytical theoretical study of exotic looped trajectories (ELTs) in a double-slit interferometer with quantum marking. We propose using an excited Rydberg-like atom and superconducting cavities as which-way detectors, just as in the Scully-Englert-Walther interferometer. We show that the resonant interaction between the atom and the field in the cavities can be used to eliminate the effect of non-exotic trajectories and exhibit only the effect of ELTs in the interference pattern. We quantitatively describe our results for Rubidium atoms and suggest this framework as a scheme to measure exotic looped paths and deviations from the standard superposition principle.

Keywords: Double-slit experiment, Matter waves, Path-integral methods, Atom interferometry, Gouy phase
PACS: 41.85.-p, 03.65.Ta, 42.50.Tx, 31.15.xk

1. Introduction

Exotic looped trajectories (ELT) in multi-slit interferometry has emerged as an interesting arena to test foundations of quantum mechanics both theoretically and experimentally. More specifically, one may exploit the validity of the superposition principle and the Born rule [1] to compute probabilities from wave functions which connects quantum theory with experiment. Born rule implies

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