Fringe visibility of exotic trajectories and Sorkin parameter in the Fresnel regime

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The first theoretical study of the effects of exotic trajectories in two-slit interferometry dates back to 1986 in the work by H. Yabuki [1]. The Feynman path integral approach [2] was used there to include all possible paths of the interfering object from the source to the screen passing through the double-slit. Some of such paths are the looped trajectories along the slits, i.e., exotic looped trajectories. However, the probability associated with such trajectories is much smaller than the probability associated with the non-exotic trajectories which are considered in the usual setup for the double-slit experiment. The first observation of these effects was obtained by Sinha et al [3]. Recently, we build an analytical treatment was given for exotic looped trajectories in the triple-slit experiment for matter waves [4].

We theoretically study the fringe visibility of exotic looped trajectories in double-slit experiments with matter waves. We define a fringe visibility associated to the contribution to the interference pattern given by exotic looped trajectories. We demonstrate that the Sorkin parameter is given in terms of this visibility and of the axial phases which include the Gouy phase. Thus, the effect of exotic looped trajectories can be attested by measuring deviations from unity for the fringe visibility. We show that the effect of exotic looped trajectories can be significantly increased by adjusting the parameters of the double-slit apparatus in the Fresnel regime.

These results have now been submitted in Physica Scripta. The number is PHYSSCR-107194.

4. References


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