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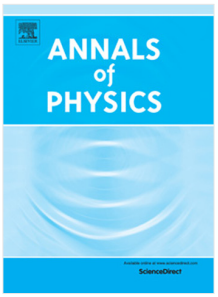

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Probing the noncommutative effects of phase space in the time-dependent Aharonov-Bohm effect

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Abstract

We study the noncommutative corrections on the time-dependent Aharonov-Bohm effect when both the coordinate-coordinate and momentum-momentum noncommutativities are considered. On the noncomutative phase space, while the ordinary gauge symmetry can be kept by the Seiberg-Witten map, but the Lorentz symmetry is broken. Therefore nontrivial noncommutative corrections are expected. We find there are three kinds of noncommutative corrections in general: 1) ξ-dependent correction which comes from the noncommutativity among momentum operators; 2) momentum-dependent correction which is rooted in the nonlocal interactions in the noncommutative extended model; 3) momentum-independent correction which emerges become of the gauge invariant condition on the nonlocal interactions in the noncommutative model. We proposed two dimensionless quantities, which are based on the distributions of the measured phase shift with respect to the external magnetic field and to the cross section enclosed by the particle trajectory, to extract the noncommutative parameters. We find that stronger (weaker) magnetic field strength can give better bounds on the coordinate-coordinate (momentum-momentum) noncommutative parameter, and large parameter space region can be explored by the time-dependent AB effect.

Keywords: Noncommutative geometry, Aharonov-Bohm effect, Atom interference

Contents

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