

TIME-DOMAIN INTERFEROMETRY OF ELECTRON WEAK LOCALIZATION THROUGH TERAHERTZ NONLINEAR RESPONSE

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Yuan wan

Weak localization is the quintessential quantum interference phenomenon that features prominently in disordered conductors. Since its discovery, the canonical diagnostic for electron weak localization has been the magnetoresistance, which works as a space-domain interferometry. In this work, we propose an ultrafast diagnostic for electron weak localization based on the nonlinear optical response in the terahertz regime. Our analytical and numerical calculations reveal that, in orthogonal/symplectic class systems, two consecutive, phase coherent optical pulses generate an electric current echo that appears after the second pulse, and at a time equal to the pulse delay time. The current echo reflects the quantum interference between a self-intersecting electron path and its time reversal partner, and, therefore, provide a time-domain interferometry of weak localization. Our results can be potentially tested on disordered metal films by using terahertz two-dimensional coherent spectroscopy or ultrafast transport measurements.