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Title:Persistent oscillatory currents in a 1D ring with Rashba and Dresselhaus spin-orbit interactions excited by a terahertz pulse
Authors:Nita, Marian (1); Marinescu, D.C. (2); Manolescu, Andrei (3); Ostahie, Bogdan (1); Gudmundsson, Vidar (4)
Author affiliation:(1) National Institute of Materials Physics, P.O. Box MG-7, Bucharest-Magurele, Romania; (2) Department of Physics and Astronomy, Clemson University, Clemson, SC 29634, United States; (3) School of Science and Engineering, Reykjavik University, Menntavegur 1, IS-101 Reykjavik, Iceland; (4) Science Institute, University of Iceland, Dunhaga 3, IS-107 Reykjavik, Iceland
Corresponding author:Marinescu, D.C.(dcm@clemson.edu)
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Abstract:Persistent, oscillatory charge and spin currents are shown to be driven by a two-component terahertz laser pulse in a one-dimensional mesoscopic ring with Rashba and Dresselhaus spin-orbit interactions (SOI) linear in the electron momentum. The characteristic interference effects result from the opposite precession directions imposed on the electron spin by the two SOI couplings. The time dependence of the currents is obtained by solving numerically the equation of motion for the density operator, which is later employed in calculating statistical averages of quantum operators on few electron eigenstates. The parameterization of the problem is done in terms of the SOI coupling constants and of the phase difference between the two laser components. Our results indicate that the amplitude of the oscillations is controlled by the relative strength of the two SOI's, while their frequency is determined by the difference between the excitation energies of the electron states. Furthermore, the oscillations of the spin current acquire a beating pattern of higher frequency that we associate with the nutation of the electron spin between the quantization axes of the two SOI couplings. This phenomenon disappears at equal SOI strengths, whereby the opposite precessions occur with the same probability. © 2012 Elsevier B.V.
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Uncontrolled terms:Coupling constants - Density operators - Electron eigenstates - Electron momentum - Electron spins - Equation of motion - Higher frequencies - Interference effects -

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