

Abstract Submitted  
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**Spin torque contribution to the frequency dependent spin Hall conductivity in spin-orbit coupled systems** A. WONG-LOPEZ, F. MIRELES, J.A. MAYTORENA, C. LOPEZ-BASTIDAS, Centro de Ciencias de la Materia Condensada-UNAM — The spin Hall effect in spin-orbit coupled systems has lately attracted great attention. Since the electron spin is not a conserved quantity in spin-orbit coupled systems, the conventional form for the spin current operator turn out to be ill-defined. A fundamental issue is then a proper definition of spin current in such systems. Recently J. Shi et. al. [1] introduced an unambiguous and proper definition of spin current which adds to the conventional part, a spin source term (spin torque) associated to the spin precessional motion. In this work, using the linear response Kubo formalism, and employing the new definition for the spin current operator, we study the frequency dependent spin Hall conductivity for a two dimensional electron gas in the presence of Rashba and Dresselhaus spin-orbit coupling. We show that the optical spectrum of the charge and spin conductivity changes dramatically when the proper definition is used, as new and strong resonances appear. It is shown that the spin torque contribution to the spin Hall conductivity clearly dominates over the conventional part. These results may encourage experimentalists to measure the spin Hall current and/or spin accumulation in the frequency domain in such systems, as to establish the validity of the new definition of the spin current operator. [1] J. Shi, P Zhang, D. Xiao and Q Niu, Phys Rev. Lett **96**, 076604 (2006)

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