Maxwell Equation for the Coupled Spin-Charge Wave Propagation B. ANDREI BERNEVIG, XIAOWEI YU, SHOU-CHENG ZHANG, Stanford University — We show that the dissipationless spin current in the ground state of the Rashba model gives rise to a reactive coupling between the spin and charge propagation, which is formally identical to the coupling between the electric and the magnetic fields in the $2 + 1$ dimensional Maxwell equation. This analogy leads to a remarkable prediction that a density packet can spontaneously split into two counter propagation packets, each carrying the opposite spins. In a certain parameter regime, the coupled spin and charge wave propagates like a transverse "photon". We propose both optical and purely electronic experiments to detect this effect.

B. Andrei Bernevig
Stanford University

Date submitted: 22 Nov 2004   Electronic form version 1.4