Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Mesoscopic spin Hall effect in two- and four-probe ballistic semiconductor nanostructures with Rashba spin-orbit coupling SATOFUMI SOUMA, LIVIU P. ZÂRBO, BRANISLAV K. NIKOLIĆ, Department of Physics and Astronomy, University of Delaware — Recent efforts in spintronics have ignited a quest for fundamental physical phenomena that make it possible to generate and manipulate spin currents in semiconductors by employing spin-orbit couplings. In particular, spin Hall effects, where pure transverse spin current is induced as a response to longitudinal charge current, have been the focus of intense theoretical and experimental investigation. While theoretical scrutiny finds that the intrinsic spin Hall current vanishes in the bulk of infinite homogeneous two-dimensional electron gases (2DEG) with Rashba spin-orbit coupling, we demonstrate that in inhomogeneous nanostructures consisting of a ballistic finite-size 2DEG attached to four leads pure spin Hall current will flow out of the sample through the transverse voltage probes where the magnitude of the spin current can be tuned by changing the Rashba coupling. In the two-probe structures such mesoscopic spin Hall effect leads to spin accumulation whose properties display the same phenomenology as recently observed in experiments. Thus, we establish the fundamental connection between the spin Hall accumulation in two-probe and spin Hall currents in the four-probe semiconductor nanostructures. REFERECES: B. K. Nikolic, L. P. Zarbo, and S. Souma, cond-mat/0408693. S. Souma and B. K. Nikolic, cond-mat/0410716.

Satofumi Souma
Department of Physics and Astronomy, University of Delaware

Date submitted: 04 Jan 2005 Electronic form version 1.4