Abstract

Charge transport of electrons in mesoscopic systems display a variety of interesting quan- tum effects. Universal Conductance Fluctuations (UCF) is one such effect where sweeping a magnetic field when measuring the resistance of a sub-micron metallic wire, noise like uctuations are seen. But the uctuations are reproducible when the field is swept back and forth. This unique magnetic finger-print is due to scattering from impurities when phase coherence of electrons are comparable to device sizes. Spintronics is an emerging field where the spin of the electron is used to process or transmit data like the charge in conventional electronics. A pure spin current without charge transport is central to not only spintronics but also to realize novel effects related to spin in nano-scale devices. In this proposal we do some experimental ground work to make metallic nano-structures. The classic Johnson-Silsbee non-local geometry will be used to generate and detect spin currents. The main motive is to look for effects similar to UCF but in spin currents. Separating charge UCF from spins will be one major challenge. The main work involves perfecting the lithography to make metallic devices on sapphire. Sapphire was chosen due to its high thermal conductivity at low temperatures which is needed to cool the devices efficiently. A host of other work needed to start the measurements like cryogenic filters for noise cold fingers and sample holders are being designed in this work. This dissertation opens with a brief introduction on the physical concepts governing the experiment, extensively explains the device fabrication procedure in the second chapter and the proposed setup in the third. The dissertation closes with a brief description of the major equipments in the appendix.