The Development of a Compressively Strained Ge Hole Spin Qubit with RF Readout

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A measurement system has been designed and developed to characterize lateral double quantum dot devices formed in the undoped two-dimensional hole gas of a compressively strained germanium on silicon (cs-GoS). Hole based systems are of increased interest due to their reduced hyperfine interaction with nuclear spins which leads to better spin coherence and large and tunable spin-orbit interaction that is very valuable for better readout of spin-based qubits, controllable light-heavy hole interaction for the engineering of the hole energy bands and the hole effective g-factor. One of the goals of this project is to study the performance of an RF-QPC and to use it as a quantum spin-readout. A fast and sensitive readout is crucial for quantum technologies in order to perform a single shot readout, fast Bayesian feedback, and to perform fast quantum protocols to process information encoded in hole spin qubits. We will present observations in our experiment, phenomena such as fractional quantization of conduction, coulomb blockade, and spin blockade. Current challenges lie in device stability, inhomogeneities, in conductance throughout the device and reliable formation of quantum dots. These issues can be linked to charge trapping and non-optimized geometry of the device. A description of the cryogenic configuration which includes the dilution unit and a 9T magnet will be presented.