# Cover letter

Since the assumption based on theory is that quantum computer can outperform the classical one by many orders of magnitude for the specific classes of algorithms, I am very happy to be a part of the research community, trying to develop the basic unit and coupling mechanisms for the basic unit of such a computer, called qubit.

Coherence vs manipulation time ratio is the main qubit parameter that needs to be boosted. There are several different approaches to a qubit realization. Approach in our group is based on hole spin in semiconductor material called silicon germanium. Because of low hyperfine field and high spin-orbit coupling for heavy holes in germanium, coherence vs manipulation time ratio should be high, according to the theoretical proposals.

Another big barrier for realizing quantum computer is scalability – qubit number need to be scaled up to the array of a large number of qubits for performing a quantum algorithms. Nanofabrication compatibility of a silicon germanium with the CMOS industry helps to lift this barrier. Using already predefined gates for sensing a state of a qubit lifts the second barrier towards scalability solving the state readout in non-invasive way which is not the case for the conventional charge sensor readout technique. Previously listed advantages of the spin qubit realization approach used in my scientific group, makes me motivated to pursue the goal to prove this theoretical predictions also experimentally.

Working on the gate reflectometry as a spin qubit readout system will involve gaining knowledge in high frequency signal components (amplifiers, filters, attenuators, coaxial cables), high frequency circuit design and COMSOL simulations maybe. Current trend of scaling up qubits puts a big emphasis on the “scale up friendly” readout system of individual qubits. With a knowledge gained from design of the gate reflectometry readout system I hope I can be a good candidate to continue my work in this emerging area of quantum computation.

If the gate reflectometry proves to be very sensitive as we expect, this would enable my group and me to do a good experiment with the silicon germanium nanowire based double quantum dot qubit. Good experiments mean to achieve high values for qubit quality criteria in respect to the other proposed spin qubits. Namely, those criteria are the spin relaxation time T1, the spin dephasing time T2\*, the spin echo T2ECHO  time and the CPMG T2CPMG time.

Since February I am the PhD student at Institute of Science and Technology (IST) in Austria. It is very international institution with very high and ambitious goals and it makes me happy to be a part of it. Senior scientists here are very good which helps me in a development of the scientific skills and knowledge by learning from them. It is also very well equipped which gives mine, as well as the other scientific groups, all the necessary equipment for doing a top class research.