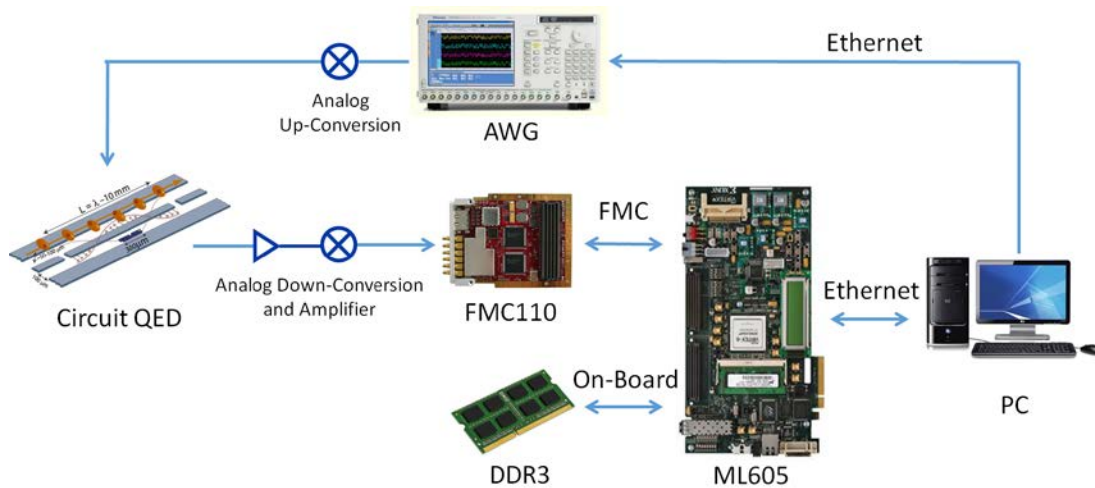# Master-/Semester- project on:

Real-Time Implementation of Quantum State Identification using an FPGA

Short Project Description

The experimental control and analysis of the quantum mechanical states of individual atoms and other quantum systems such as quantum dots or superconducting circuits became possible only at the end of 20th century, but it requires the development of high performance electronic devices. The research on the development of these electronic devices is crucial for quantum computers based on these systems. Quantum computers are machines that may operate much more efficiently than current computer technology for certain tasks. In this project, your goal will be to implement real-time quantum state identification for superconducting circuits by the implementation of optimal linear processing and thresholding of measured signals, followed by signal histogram generation all implemented on FPGAs.

Our current experimental setup is shown in figure above. You will use a Virtex-6 FPGA to perform quantum signal processing operations in real time, and an FMC110 ADC board to sample analog signal outputs of Circuit Quantum Electrodynamics (CQED) at 12-bits and 1 GSPS resolution. You will use an Arbitrary Waveform Generator (AWG) to provide input signals to the superconducting quantum circuits. You will operate a PC to initialize the AWG, to set the FPGA hardware parameters, and to record and display the signal processing results. The interface between the FPGA and ADC board, DDR3 and PC is already implemented.

You will implement optimal linear processing and thresholding of measured signals, and generation of signal histograms. You will use the resulting hardware implementation to extract quantum states of superconducting circuits in real-time. You will implement the FPGA hardware using Verilog or VHDL. You will use Xilinx ISE, Xilinx System Generator, Chipscope, Modelsim, Matlab and Mathamatica as development tools during the project. The engineer working on the project will obtain significant experience with signal processing in the context of quantum computing experiments and FPGA hardware implementations.

Status: Available

Looking for one semester or master project student

Supervisors: Dr. Abdulkadir Akin (Quantum Engineering Center), abdulkadir.akin@phys.ethz.ch

Paul Magnard (Quantum Device Laboratory), paul.magnard@phys.ethz.ch

Prerequisites:

Knowledge in VHDL and Matlab

Character:
 10% Theory
 20% Matlab and Mathematica implementations
 50% HDL implementation using Xilinx ISE and Modelsim
 20% Real-time experiments

Professor:
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