Two in one: Work with high-performance computing and quantum computing

Background
Building a quantum computer is an extremely challenging task and classical simulations on high-performance computing (HPC) solutions play a significant part in this endeavor. A good and performant simulator cannot only help to explore quantum algorithms, but it can also serve as a steppingstone for building a higher-level infrastructure for a cloud-based quantum computing stack. One such simulator is Qiskit Aer from IBM. It belongs to a class of generic array-based simulators and its main strength is a support for noise models and GPU acceleration. This simulator is currently used on personal laptops and we would like to have it deployed on HPC as a cloud-based service. To this end, a suitable higher-level infrastructure already partially exists in our lab, however, it primarily targets our physical experiments.

Problem description
The goal of this project is to extend an existing cloud-based quantum computing stack at QTL with a new backend: the Qiskit Aer simulator. The simulator is available in source code and needs to be compiled and deployed on a computer cluster which features GPU accelerators. Making the simulator available through QTL’s SW ecosystem will then require designing and implementing suitable higher-level control layers.

Workflow
Key milestones of the project:
1) Deployment of multiple instances of Qiskit Aer on the Alvis cluster at Chalmers
2) Design & implementation of a control layer as a part of the software at QTL
3) Test over-the-cloud functionality against quantum circuits generated by Qiskit Terra

Team size
3-6 students

Student background
E, F, TM, D, IT

Literature
https://github.com/Qiskit/qiskit-aer

Supervisors
Miroslav Dobsicek, dobsicek@chalmers.se