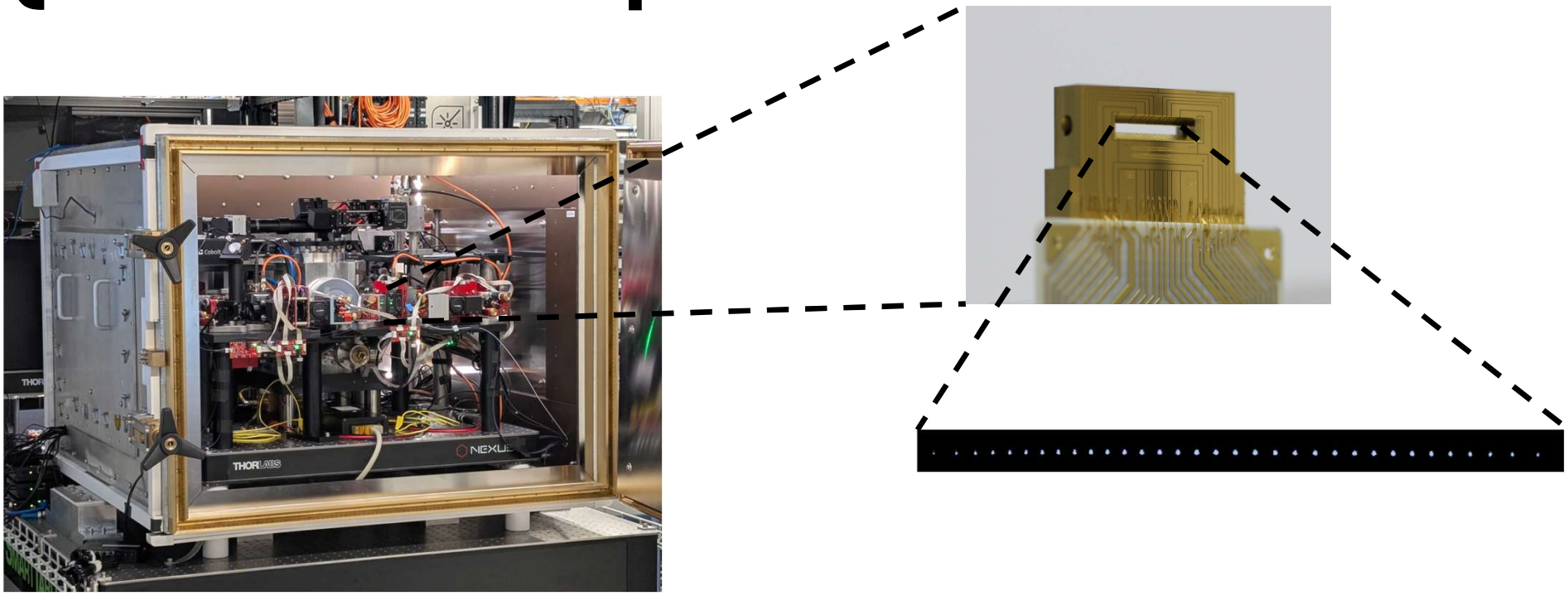
QCHub: RT setup



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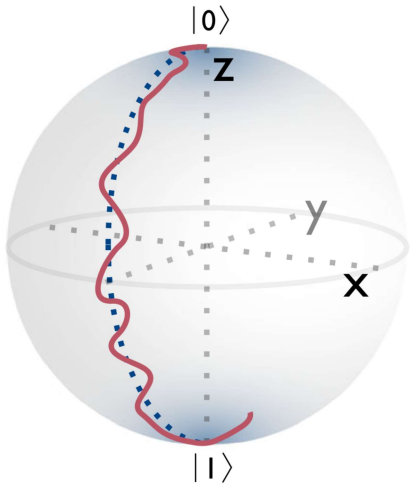
PSI

1. AWG for optimal control

Master's thesis → RF electronics + simulation

contact: mluka@ethz.ch



Goal

- Develop simulation framework for optimal control of trapped-ion systems
- Integrate AWG capabilities into existing control system

Project

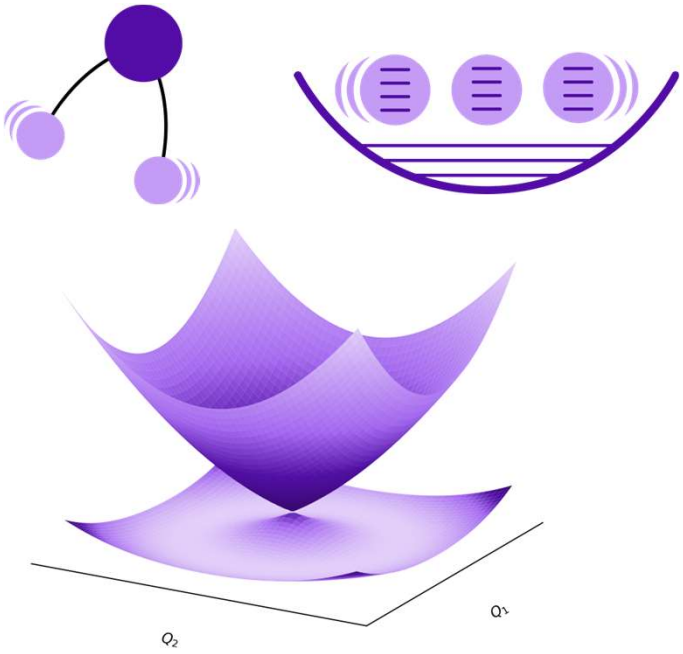
- Characterise the ZI HDAWG (waveform sequencing, triggering, …)
- Implement interface with control system
- Simulate and design optimal control pulse sequences
- Evaluate performance of hardware for selected tasks

PSI

2. Using Qudits for Quantum Simulations

Master's thesis → theory + simulation

contact: paul.venetz@psi.ch

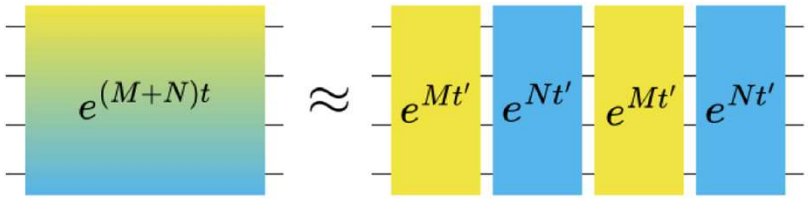


Goal

- Scale up analog simulation of quantum chemistry.
- Decompose Hamiltonian terms in gate sequences for qudits in $^{40}Ca^{+}$.
- Analyse error introduced by trotterisation.

Project

- First model using qutrits.
- Generalisation to qudits.
- Qutip simulations of simple models.



PSI

3. Relay and Tickling on DC electrodes

Semester project → PCB design + testing

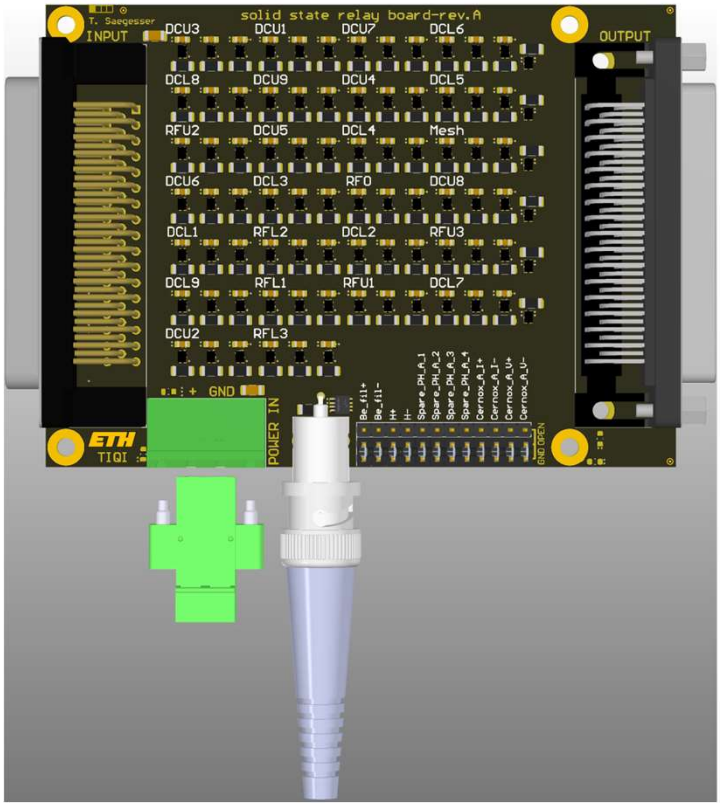
contact: paul.venetz@psi.ch

Goal

- Improve our motional coherence by adding relays on our DC electrodes.
- Enable DC tickling.

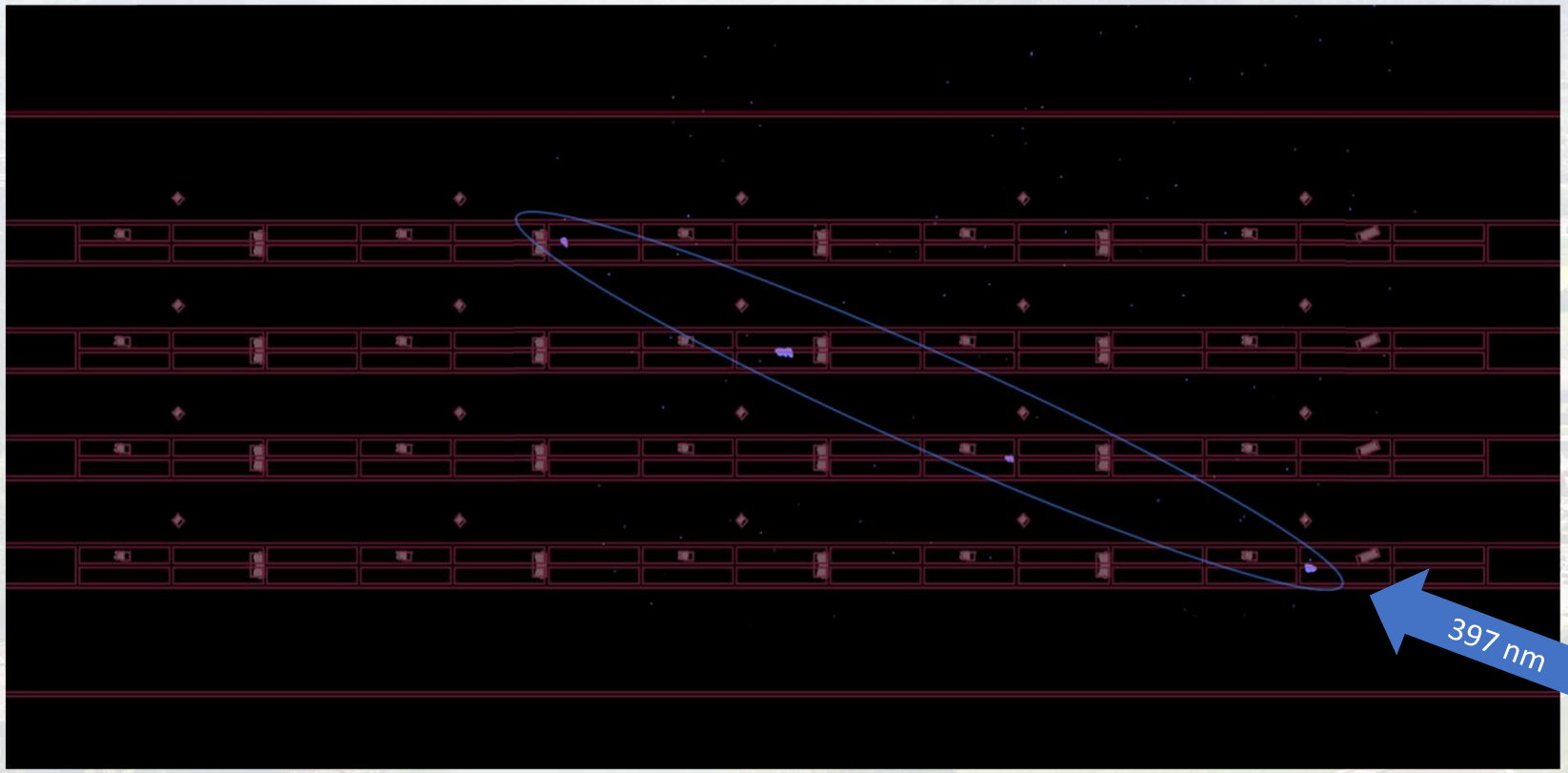
Project

- Adapt existing PCB design to our setup.
- Measure noise isolation.
- Measure motional coherence before / after.



PSI

2D Array setup

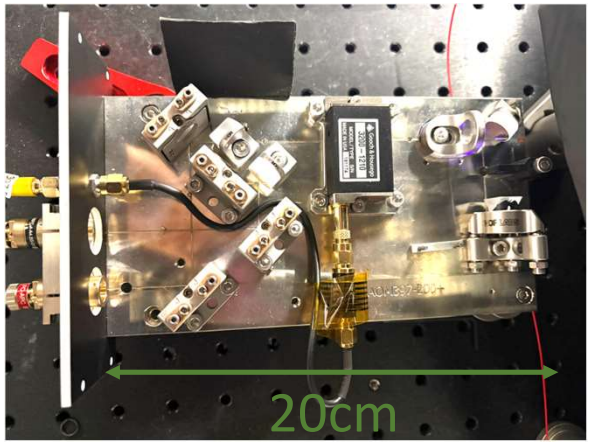


Twenty zone ion trap with integrated photonics

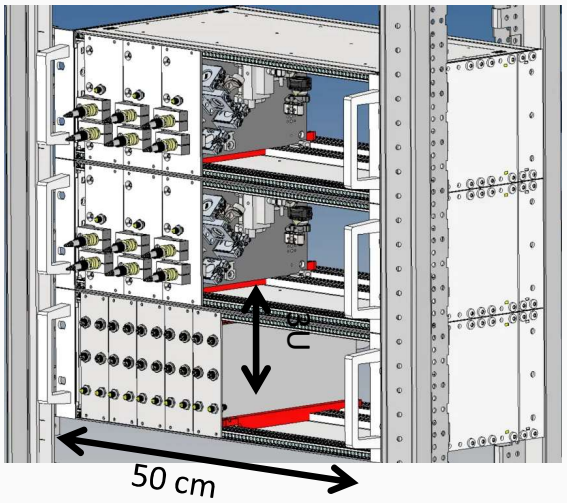
Semester project:

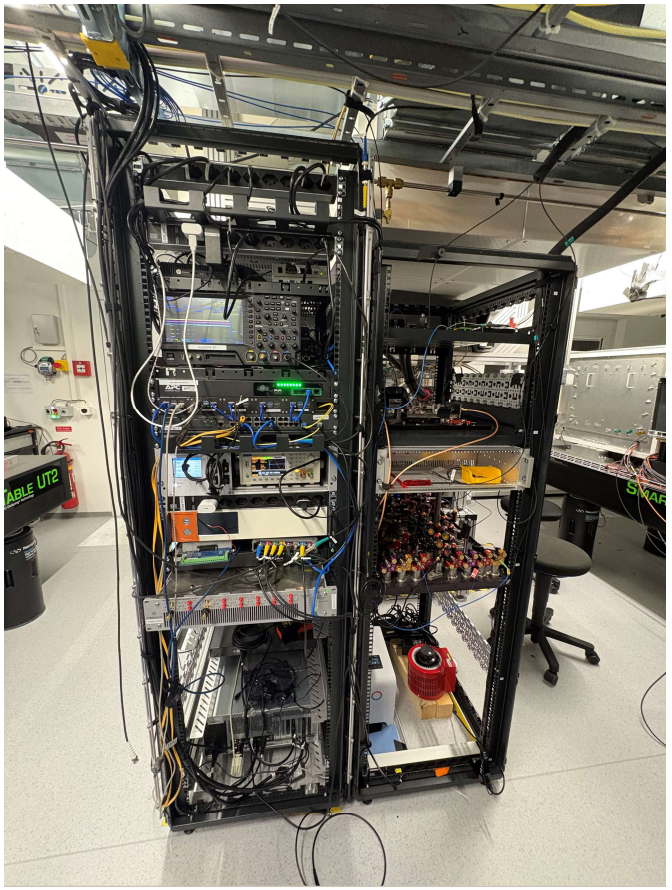
- Fiber Noise Cancellation (FNC)
- Extending modular optical setup
- Design polarization controller

- Characterisation of trap



10 outputs / rack unit
(1/2" optics, modular)





Twenty zone ion trap with integrated photonics

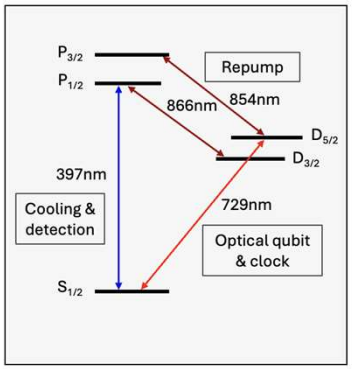
Conntact: tviskova@ethz.ch or zehndedo@ethz.ch

Project 1: Characterization of a Trapped Ion Optical Atomic clock

- Trapped ions can also be clocks
- Help us characterise the clock of the RT setup and understand if we have the most precise clock in Switzerland

Tasks:

- Understand the effects leading to systematic shifts of ionic clocks
- Analyse (and take) the data from a monolithic ion trap ion clock and benchmark its performance



Project 2: Loading and gate operation with Integrated photonic

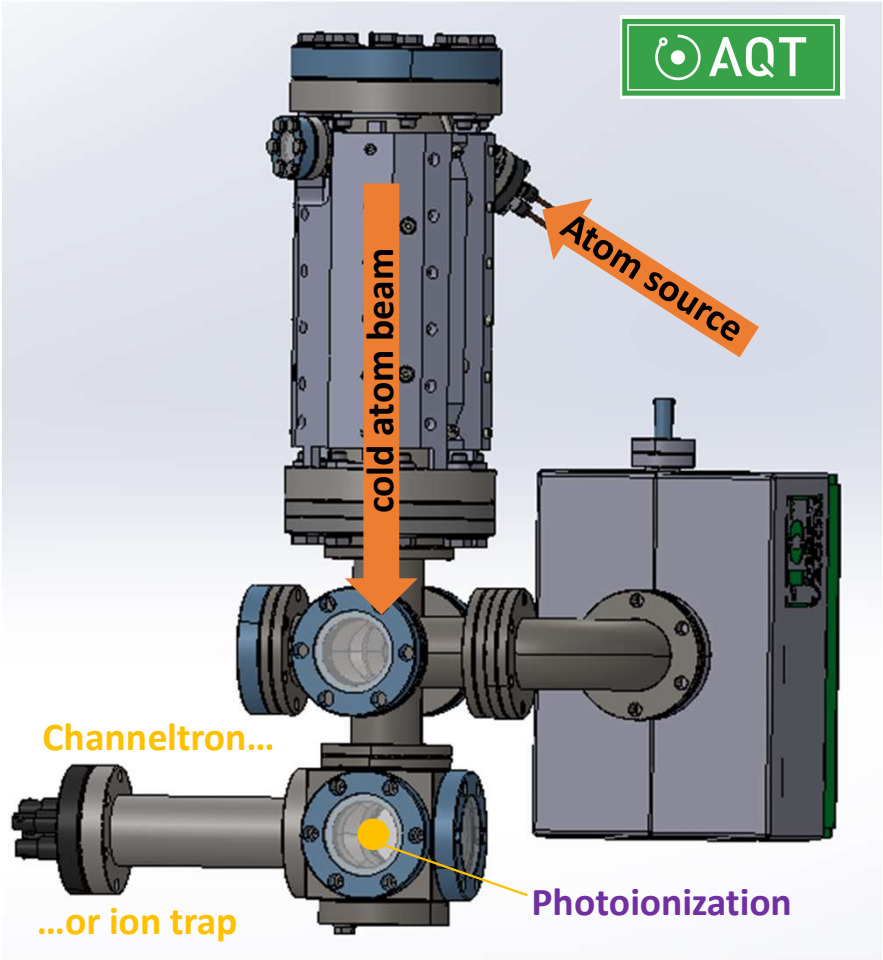
- Help us move operation from free-space optics to integrated delivery
- Optimize loading operation

Tasks:

- Setup the necessary optical systems
- Help extending the control system and implement experiments

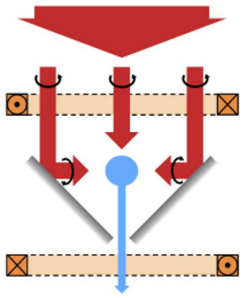
Summary of
- Semester Projects
- Master Thesis

Investigating 2D MOT loading of an ion trap

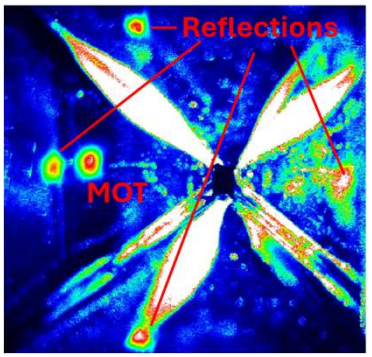


Goal of the thesis: characterize the cold atom beam (atom flux, optimal parameters) built by AQT and use it for enhanced loading of an ion trap.
Contact: jolan.tissier@psi.ch

If time allows, we will also investigate a pyramid MOT as a source of cold atoms, for ion trap loading.



Ravenhall et. al., 2021



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