

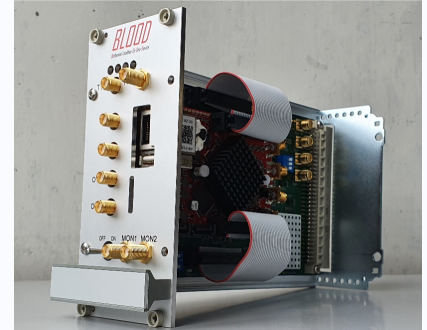
Lab Integration of Multi-Client Digital Laser Lock Box for Trapped Ion Experiments

Semester Thesis

Spring 2024

Background

In 2022, our students developed a novel digital lock box, named **BLOOD (Bichannel Lockbox On One Device)**. This system is planned to be the successor to the **EVIL** lock box, which has been in use for a decade. BLOOD, featuring a Red Pitaya FPGA board and a custom-designed PCB, maintains backward compatibility with existing EVIL setups and our DEVIL client/server software. A major improvement in BLOOD compared to its predecessor is the capability to digitally control analog gain and offset parameters. The first prototype of BLOOD has shown promising results, successfully stabilizing laser frequencies in the lab. Nonetheless, further development is necessary to fully unlock its potential.



Proposal

We propose a semester project focused on improving and extending the capabilities of the BLOOD device. The main goals and expected outcomes are:

- Continued development of BLOOD to ensure its readiness for regular lab use.
- Adding support for the second channel of the device.
- Resolving existing issues to improve reliability and optimize performance.

Achieving these objectives will contribute significantly to our group's research and give you a great learning experience.

Recommended Skills

These skills are recommended for the project, but they are not strict requirements:

- Proficiency in **C/C++** and **Python** for software development.
- Some experience with hardware design, **FPGA** development, and embedded systems.
- Familiarity with version control systems, particularly **git**.
- Understanding of **Linux** operating systems.
- Basic knowledge of digital and analog circuits.
- Interest in laser technology and its applications in quantum experiments.

Learning Opportunities

The project offers many chances to improve your skills in areas like:

- Improving your programming skills, especially in **C/C++** and **Python**.
- Gaining a deeper understanding of hardware design, including **FPGA** development.
- Getting hands-on experience with version control systems, mainly **git**, in team settings.
- Getting familiar with **Linux** operating systems, including command line usage.
- Learning how to find and fix bugs, and make systems work better.
- Exploring how lasers are used in the quantum experiments.