Upgrading the Liverpool Atom Interferometer

Jack Ringwood

On behalf of the Liverpool Atom Interferometry team

Physics Case

Atom Interferometers use laser cooled atomic samples to make measurements of:

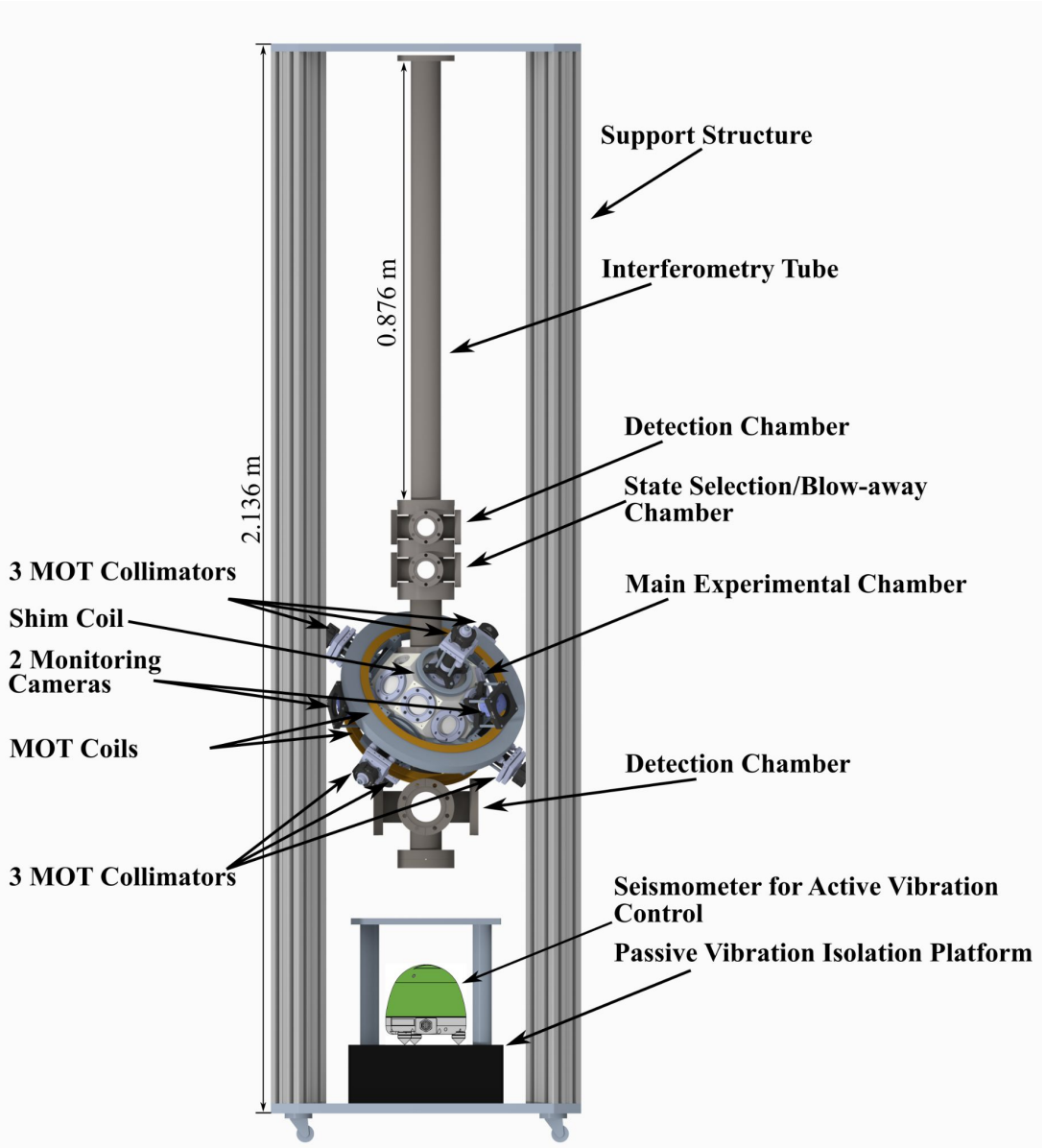
- Local Gravity
- Fine Structure Constant
- Lorentz Invariance Violation

They are being developed to investigate

- Dark Matter
- Gravitational Waves

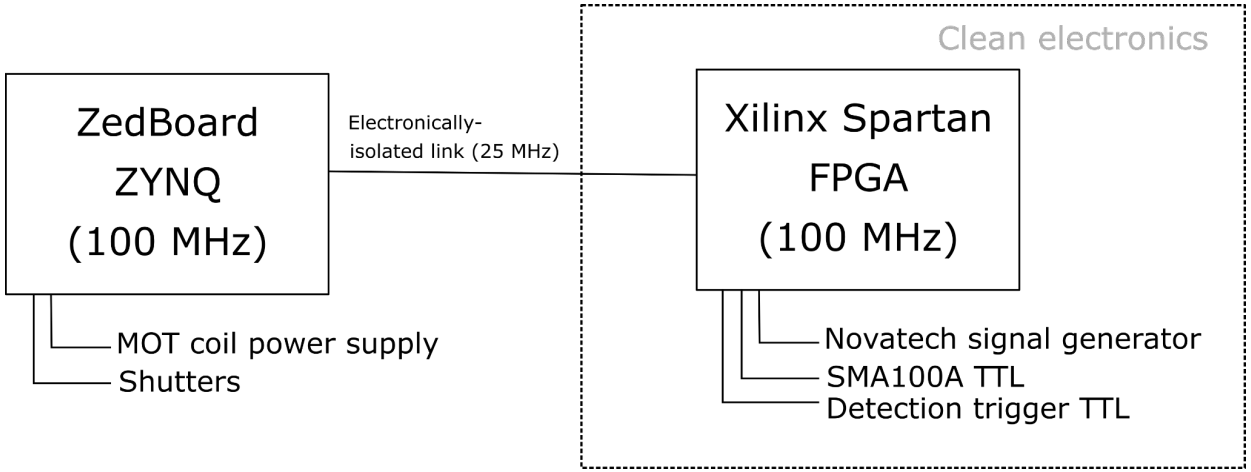
The Upgraded interferometer

- Atomic fountain configuration
- Improved trapping laser power
- Custom built chamber
- Vibration isolation platform for retroreflective mirror
- Novel cold atom source to reduce trap loading times
- Upgraded Raman system
- New control electronics



Overhaul of control system

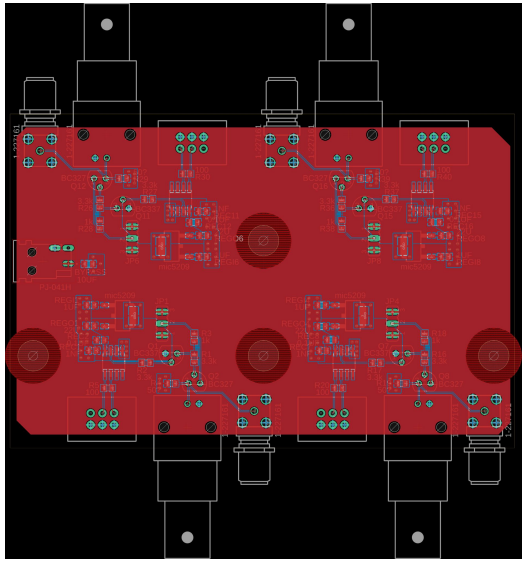
- Existing control system developed organically
- Is reaching limits of what can be achieved with it
- New system implemented with future expandability in mind
- New system consists of central computer with addressable universal outputs
- Each device will need adapting to these universal outputs



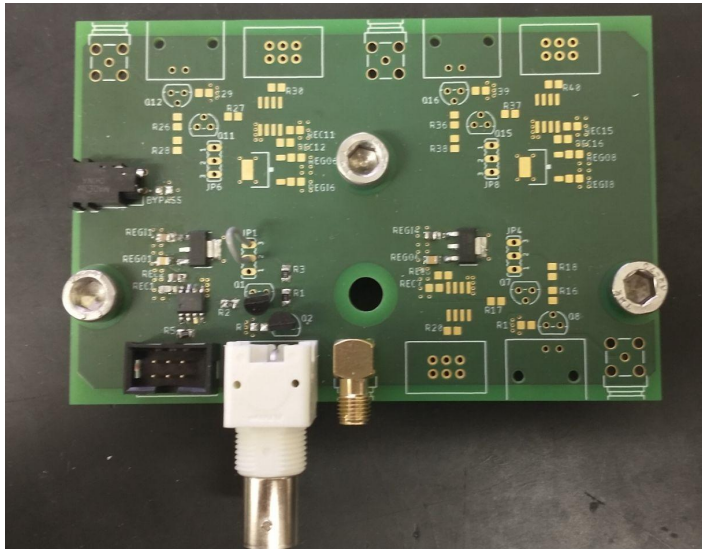
Existing control system

Overhaul of control system

- Designed modular PCB to interface with various devices
- Converts control signal for use with devices
- Easily configurable for range of devices
  - Output voltage, impedance
- Multiple outputs for controlling devices simultaneously



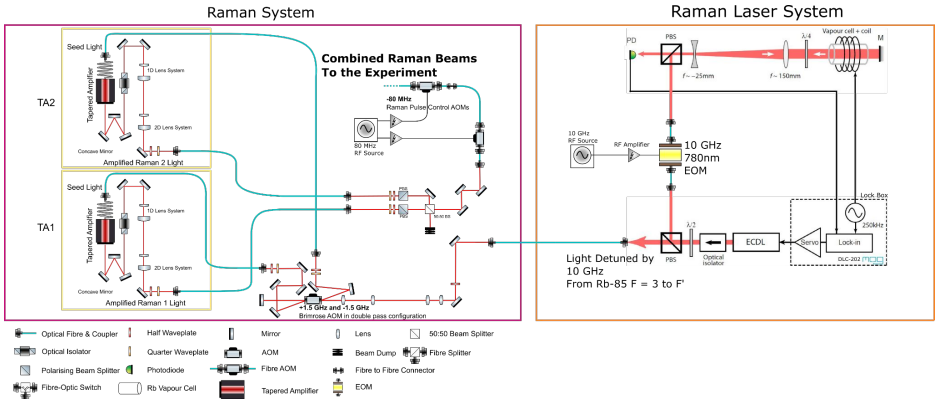
CAD image of interface PCB

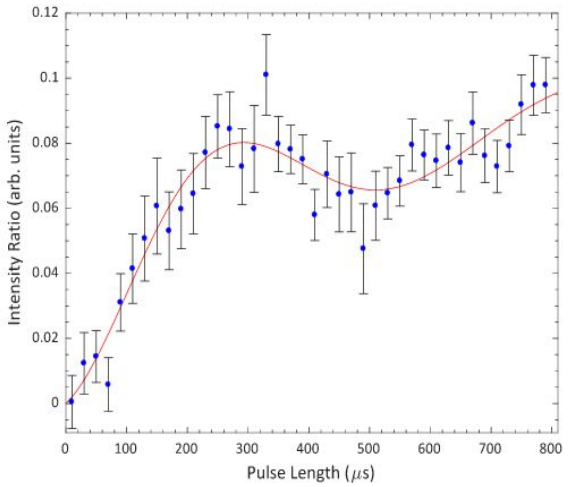


Fabricated PCB with one channel populated

The Upgraded Raman System

- More power
- Better frequency control
- Reduced leaking light
- Working on stabilising power

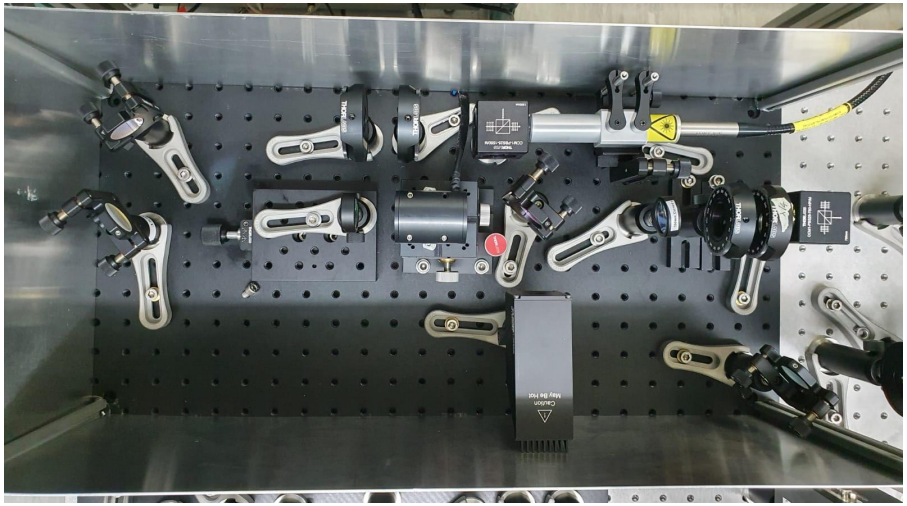




First measurements of Rabi Oscillations with New Laser

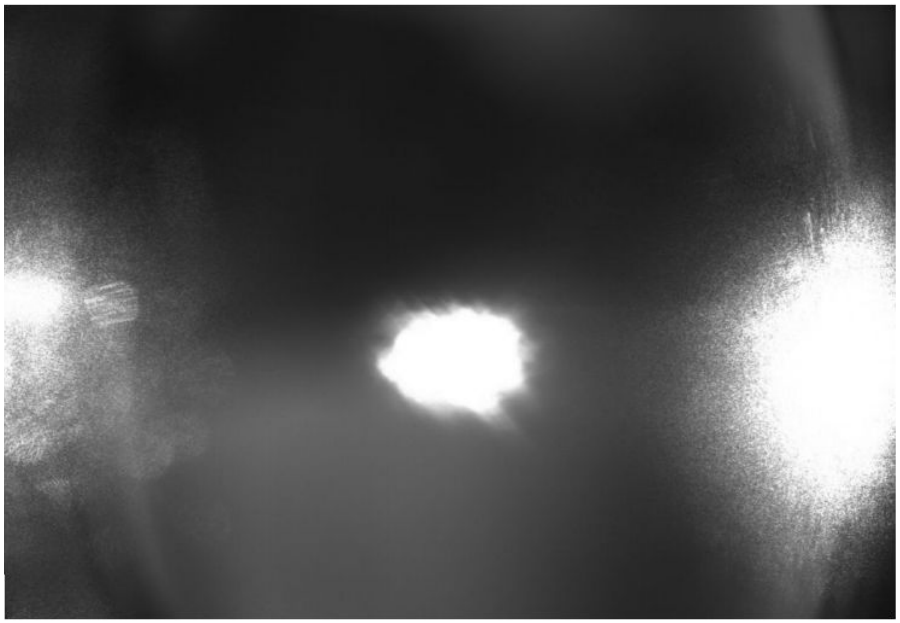
Upgrade Progress

- New trapping laser installed, order of magnitude power increase
- New launch-capable circuits under construction
- Large vapour cells built
- Custom chamber electropolishing complete



Upgrade Progress

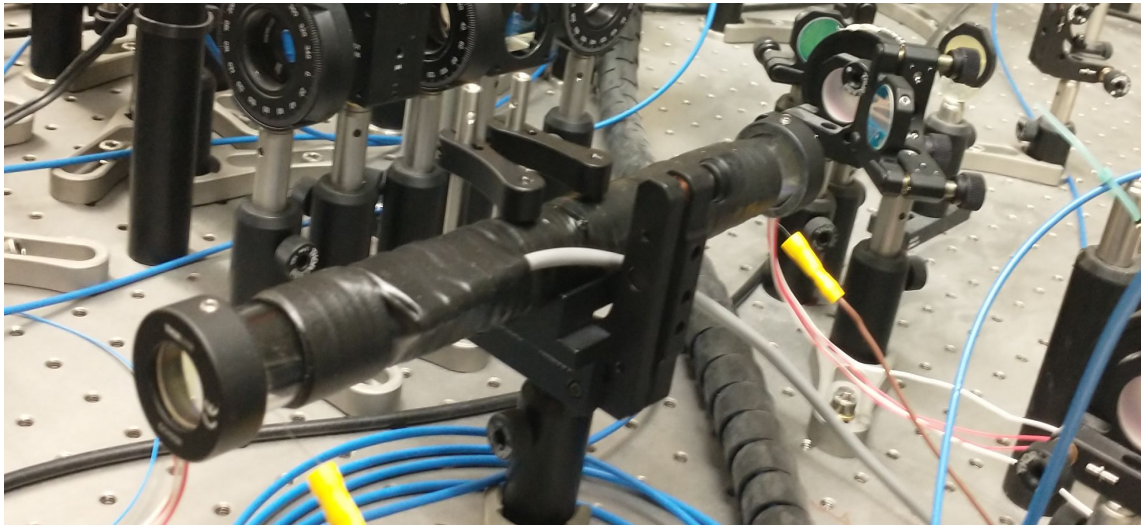
- New trapping laser installed, order of magnitude power increase
- New launch-capable trapping circuits under construction
- Large vapour cells installed in interferometry circuit, absorbs leaked light
- Custom chamber electropolishing complete, returned to us



First trapped atoms using new trapping circuit

Upgrade Progress

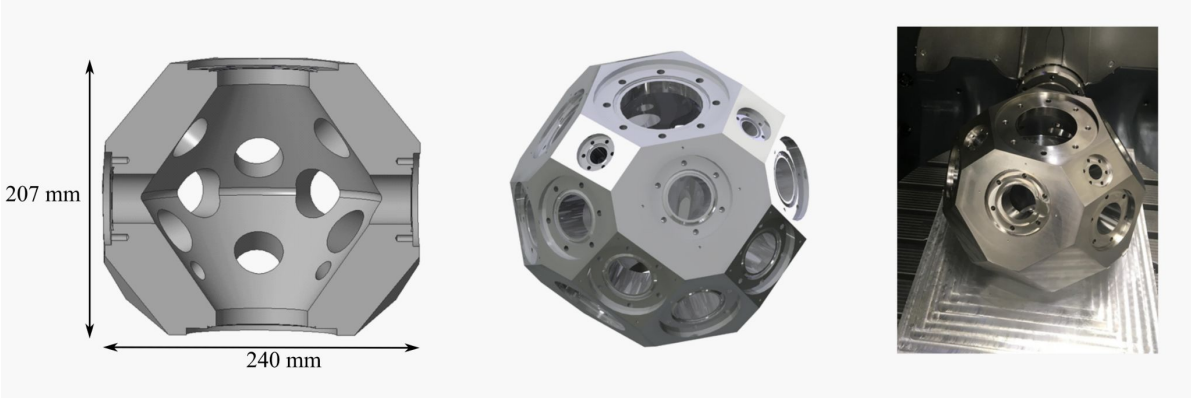
- New trapping laser installed, order of magnitude power increase
- New launch-capable trapping circuits under construction
- Large vapour cells installed in interferometry circuit, absorbs leaked light
- Custom chamber electropolishing complete, returned to us

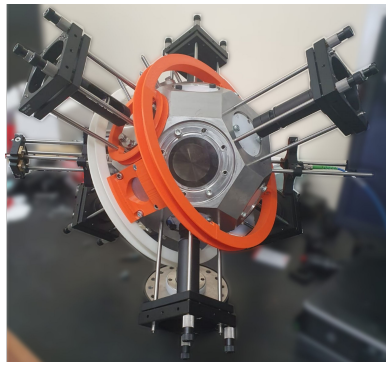


New Rubidium 85 vapour cell installed into circuit

Upgrade Progress

- New trapping laser installed, order of magnitude power increase
- New launch-capable trapping circuits under construction
- Large vapour cells installed in interferometry circuit, absorbs leaked light
- Custom chamber electropolishing complete, returned to us





New chamber, complete and ready for installation

Summary

- Upgrade is underway
- New control system implemented
- New laser installed, increased trapping power
- Assembly of vacuum apparatus will progress shortly