

CubeSat Mass Spectrometer

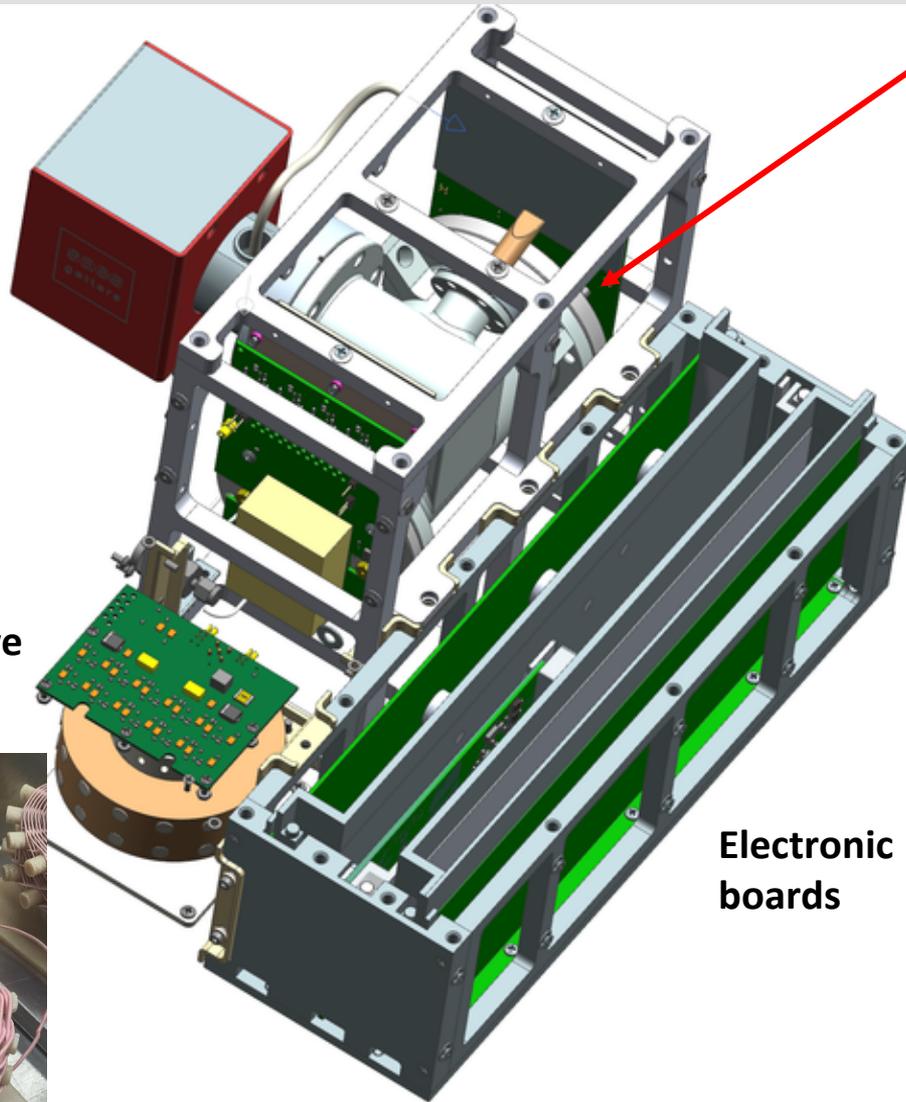
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Kelsey L Reichenbach, Viktor Hristov, Wesley Faistenhammer, Bret
Bronner, Jason Feldman, Declan Winship



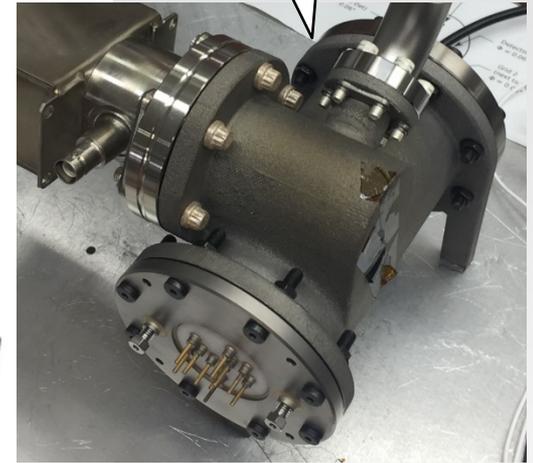
National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

CubeSat MS Concept

Ion & Getter pump

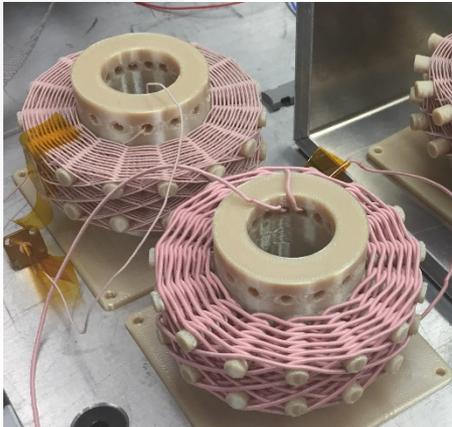


QIT Sensor

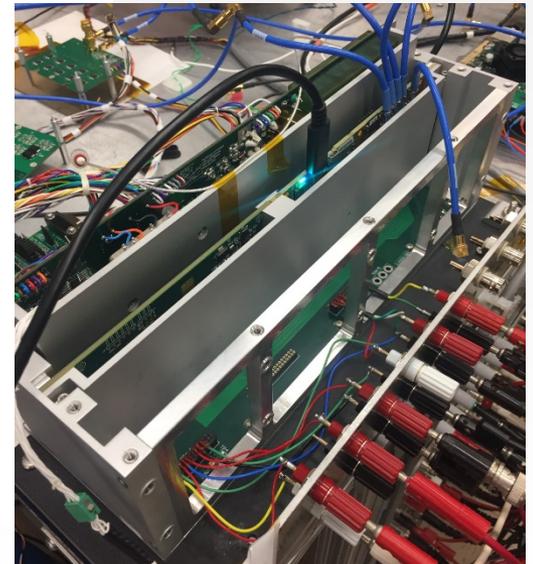


3D printed titanium vacuum chamber

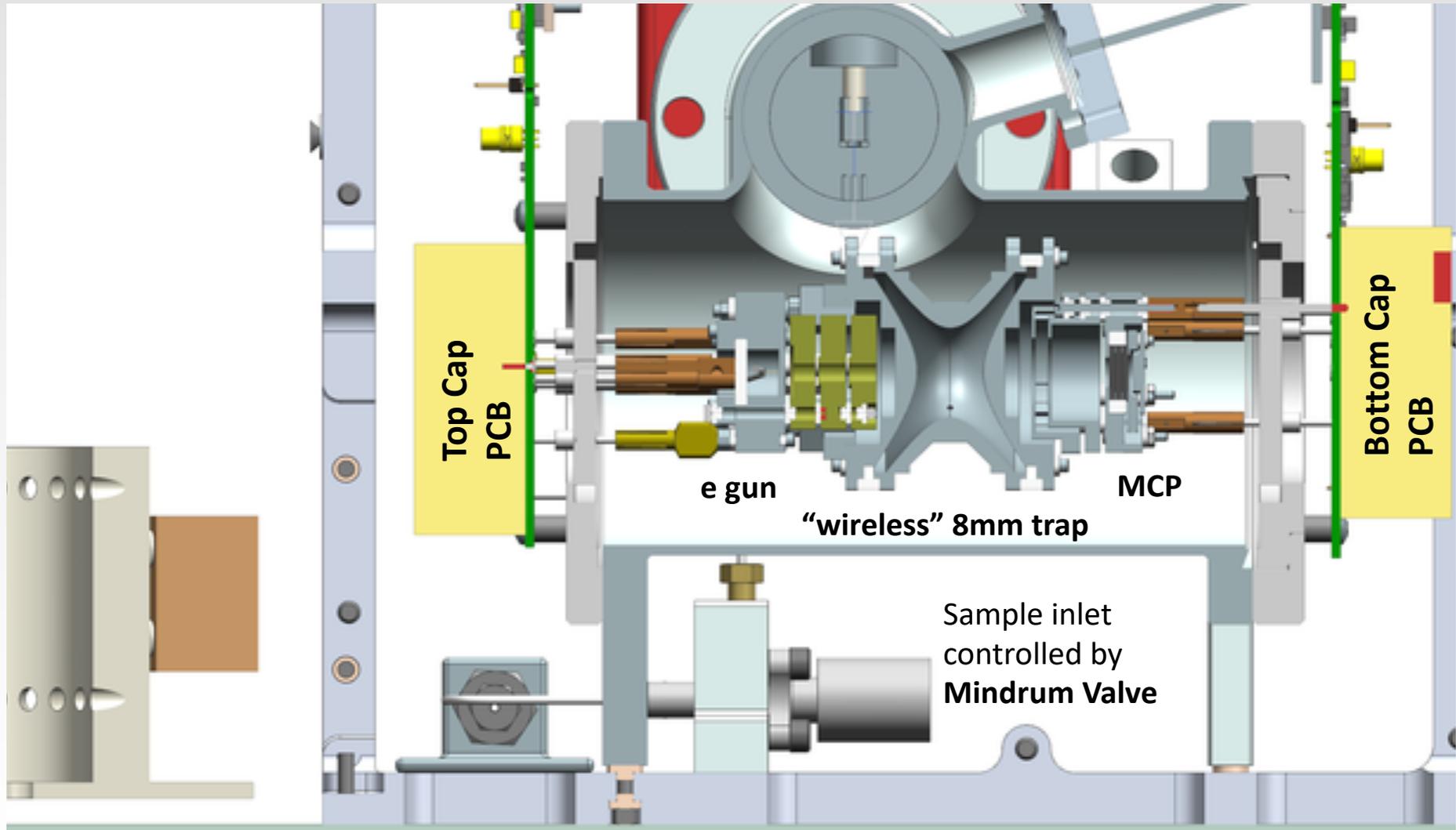
High Q diamond weave
Litz wire coil



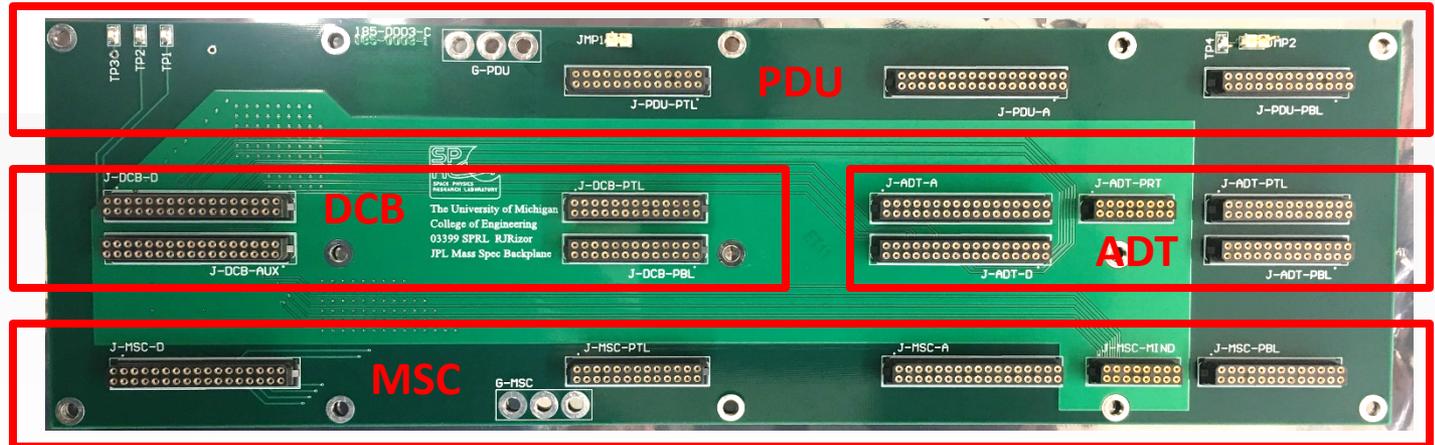
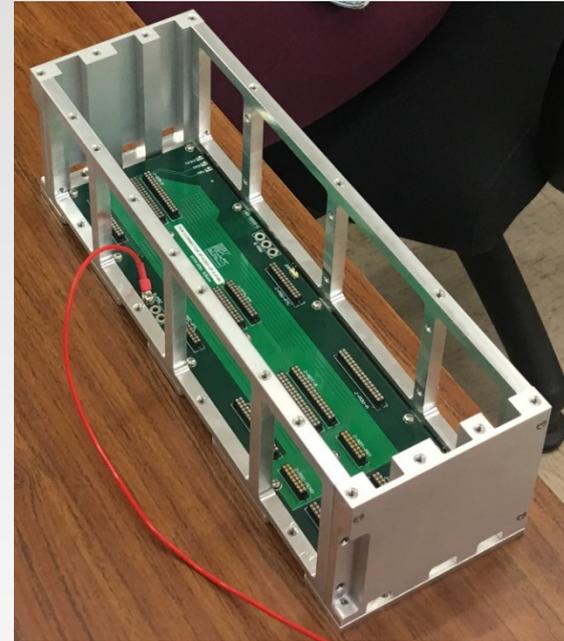
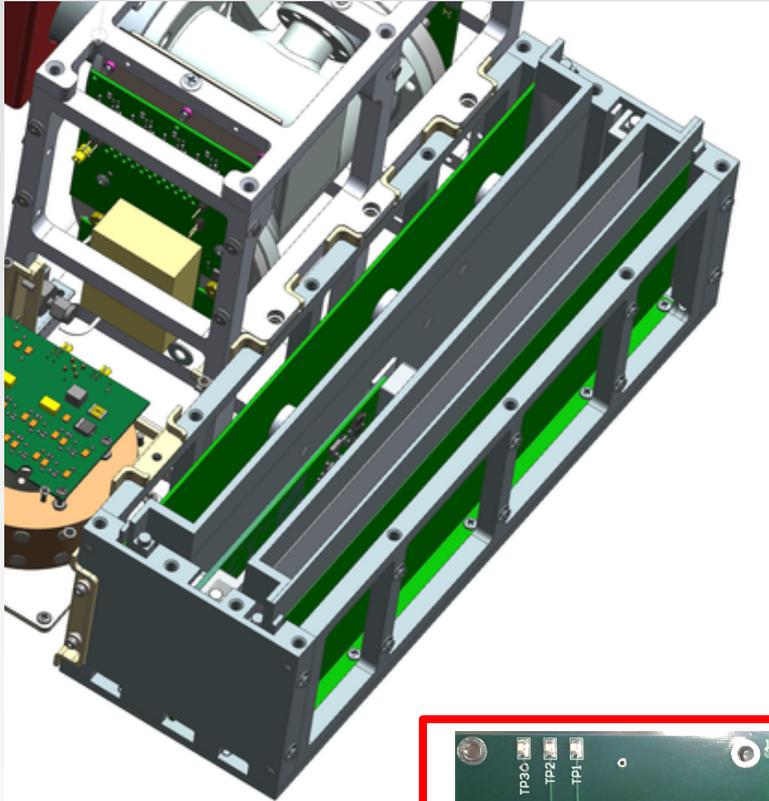
Electronic boards



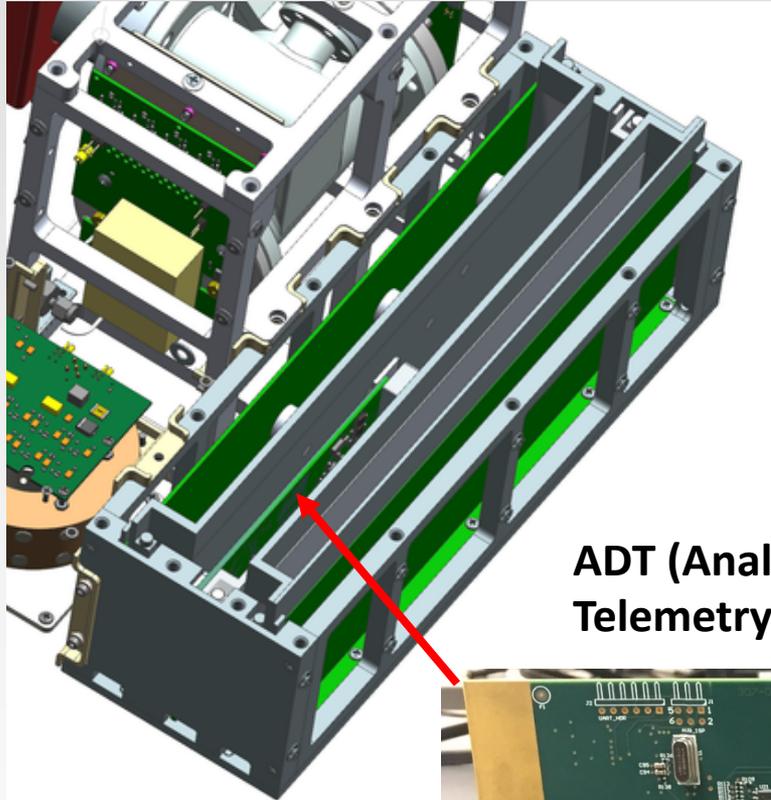
CubeSat MS Concept – QIT Sensor



Backplane



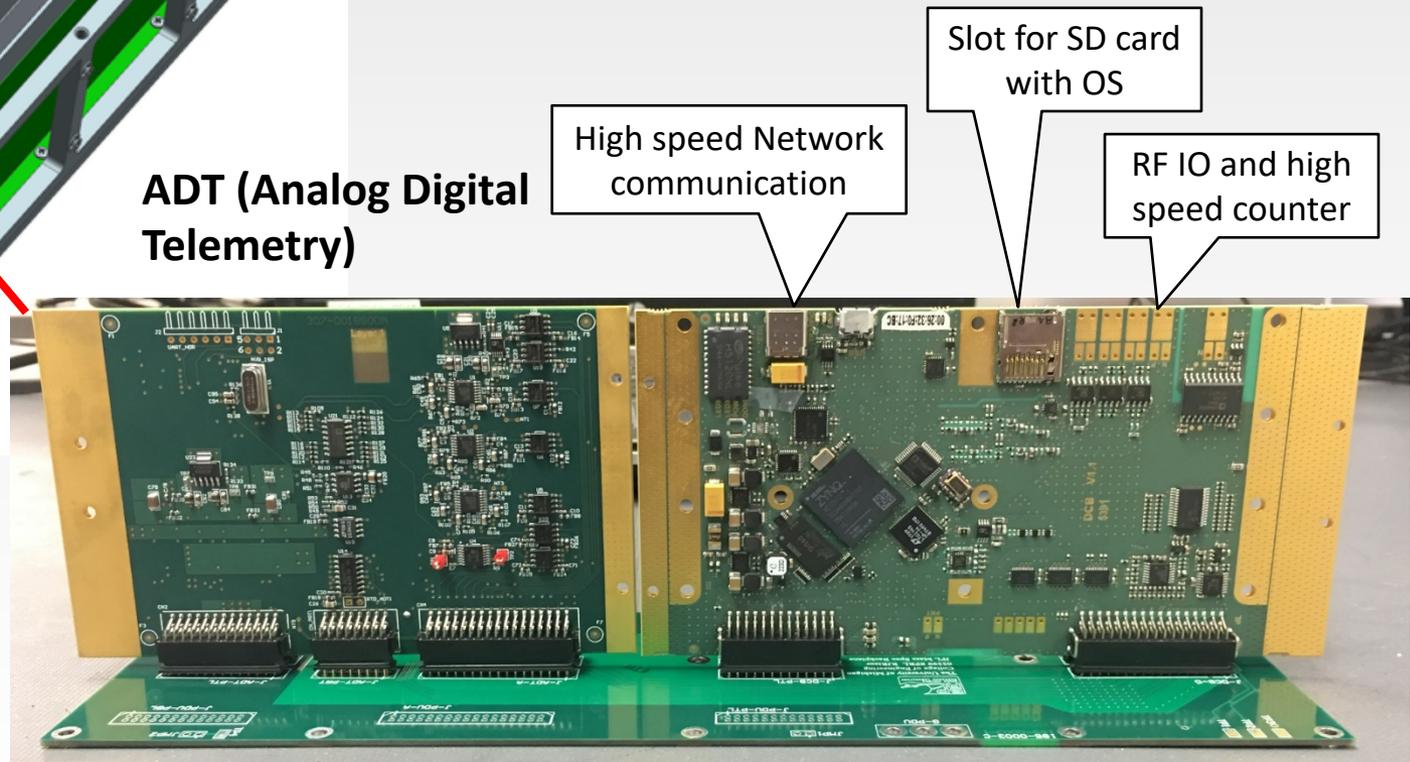
Digital Control Board (DCB) and Analog Digital Telemetry (ADT) boards



ADT (Analog Digital Telemetry)

DCB (Digital Control Board)

- Dual ARM Cortex-A9 System
- On Chip FPGA
- Data acquisition
- RF generation
- Electronics control

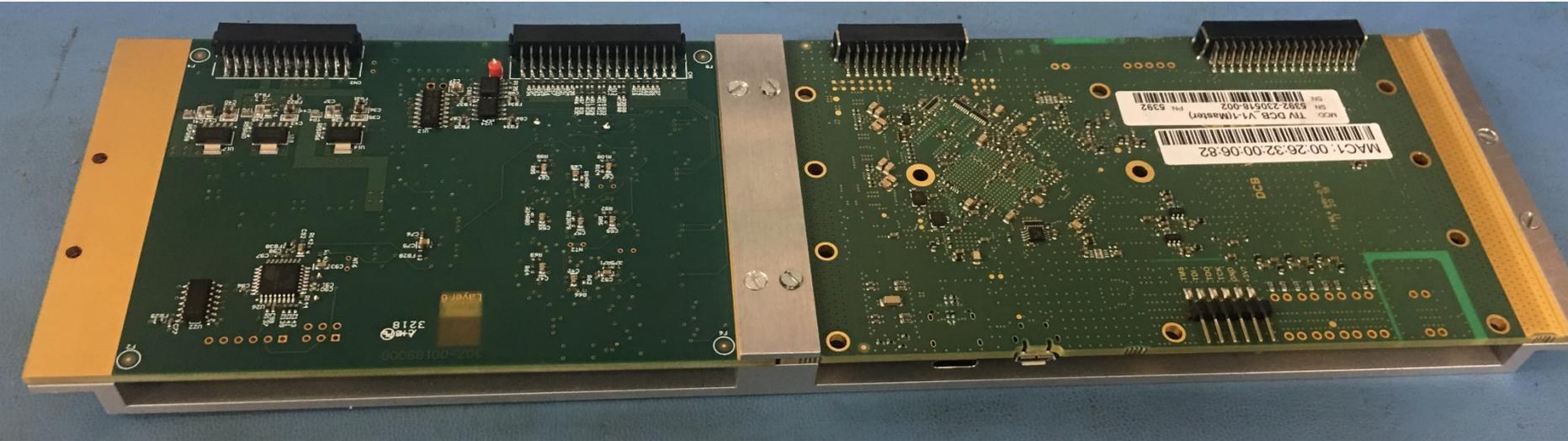
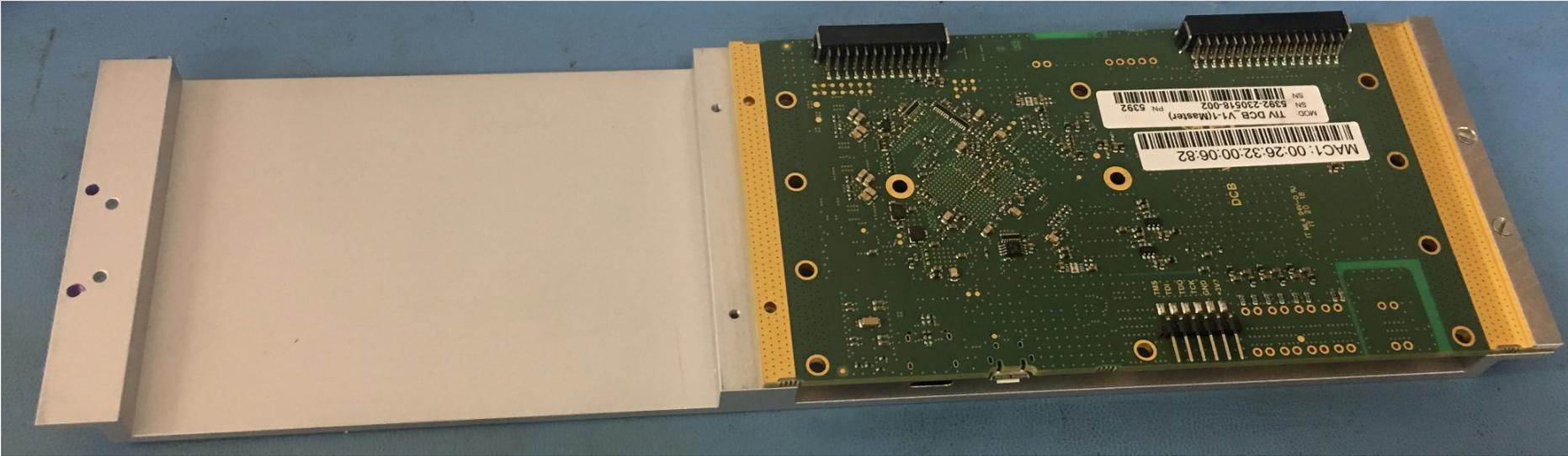


High speed Network communication

Slot for SD card with OS

RF IO and high speed counter

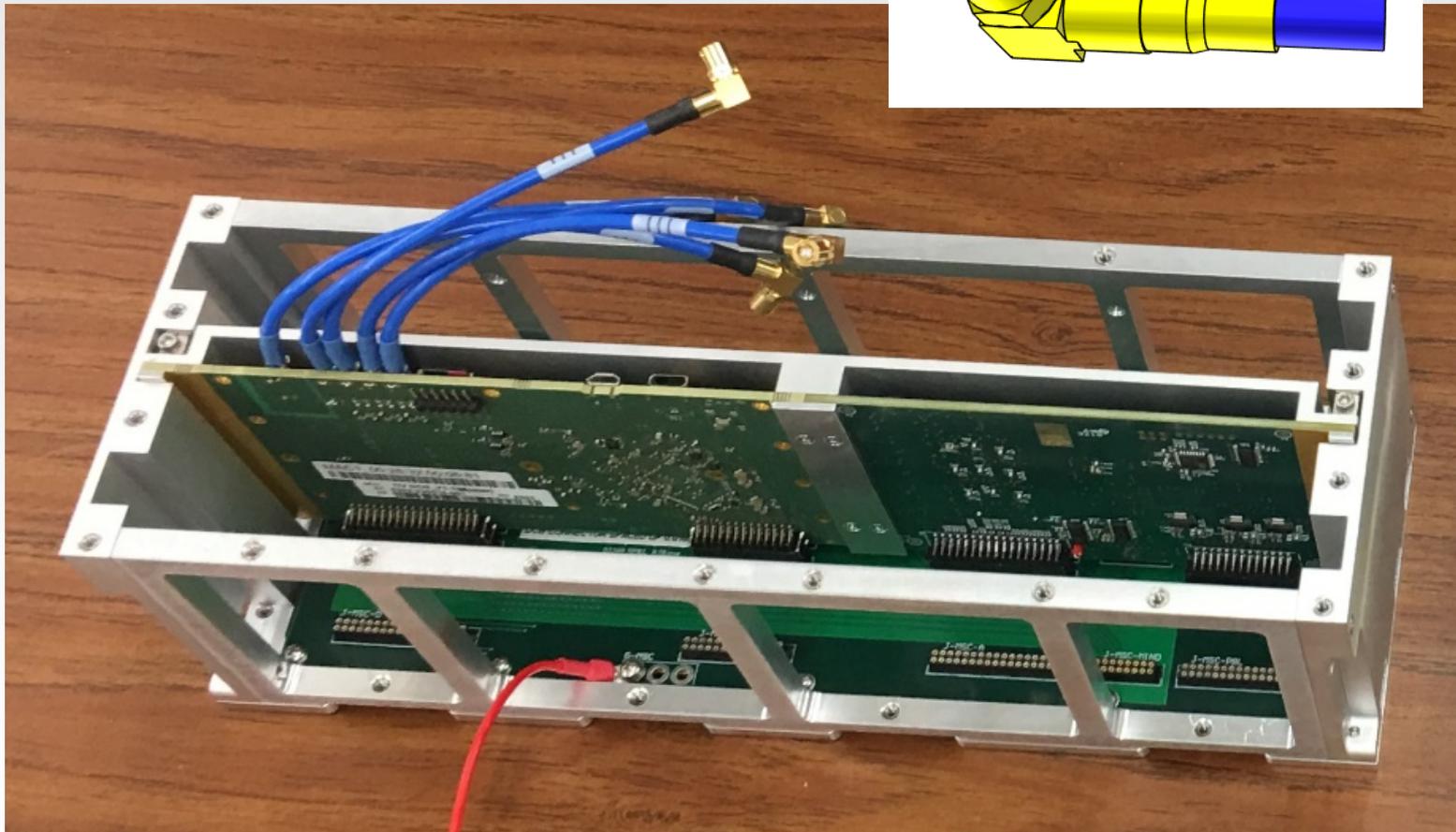
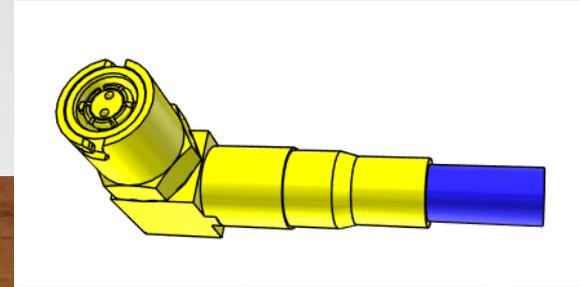
ADT and DCB heatsink



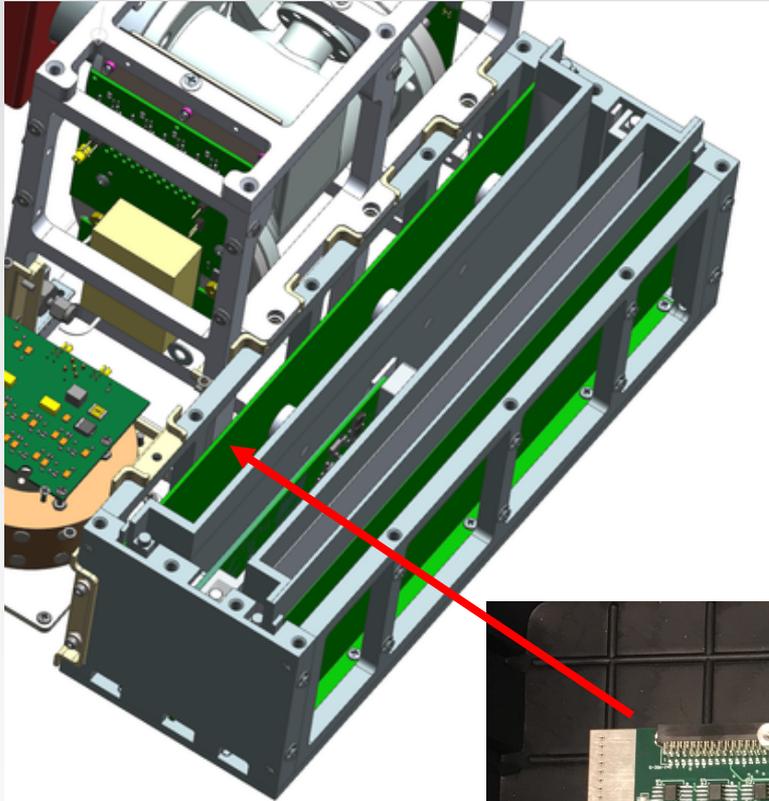
DCB and ADT

Samtec Circular RF Shielded Twisted Pair Twinax Cable:

- 100 ohm differential pair signal routing
- 28 AWG shielded twisted pair cable

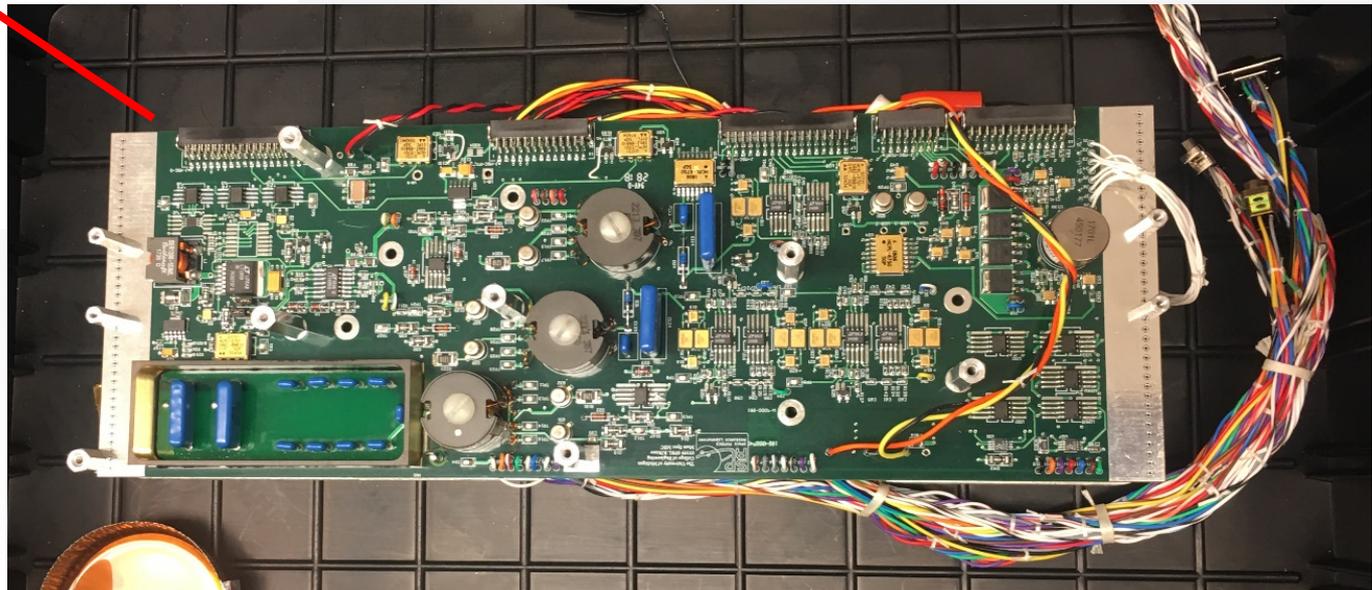


Mass Spec Control (MSC) board

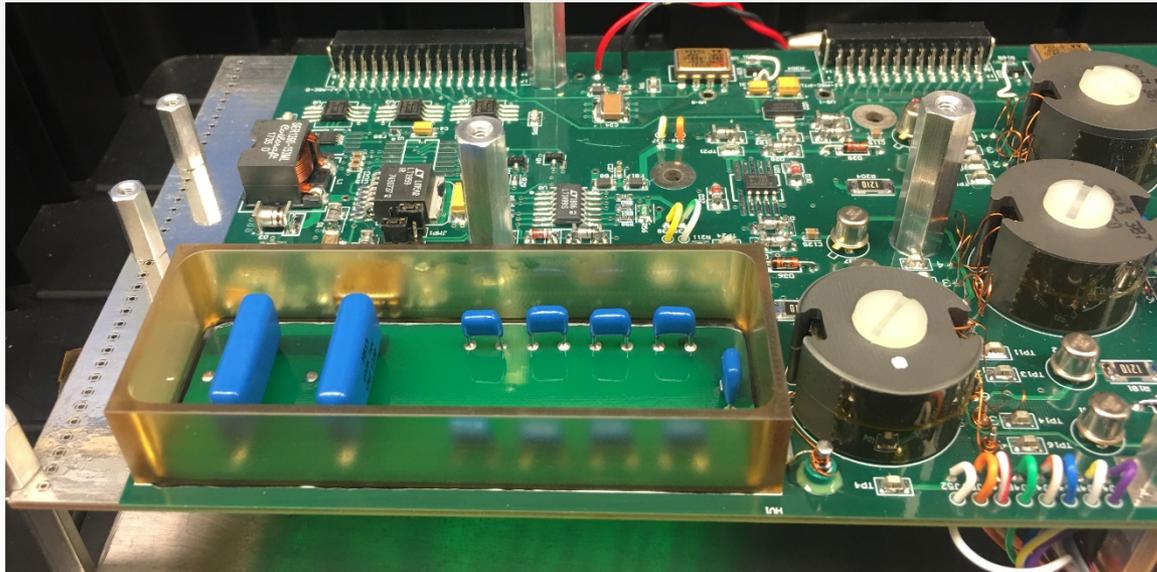
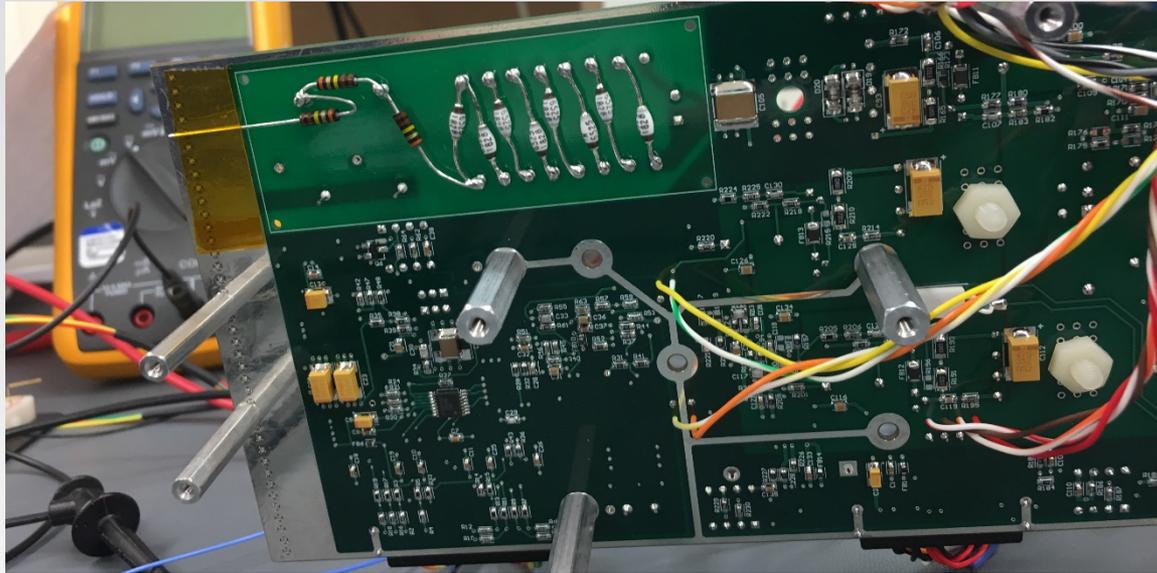


MSC

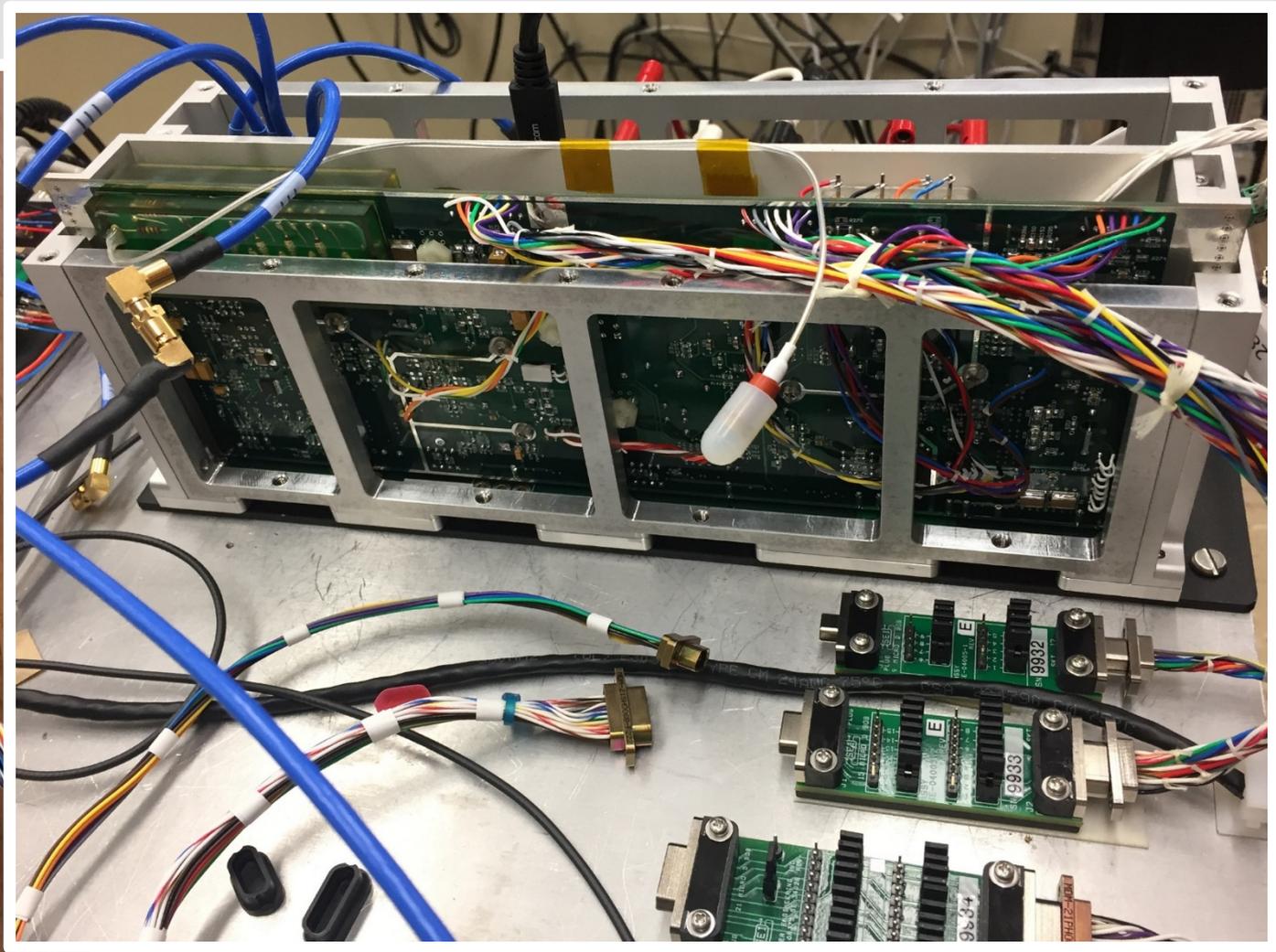
- Built in Space Physics Research Laboratory (SPRL), University of Michigan
- Layout for flight
- Rad hard 300 kRad
- High Voltage (3kV) for Micro Channel Plate detector
- Voltages for electron gun (constant and pulsing)
- Filament current



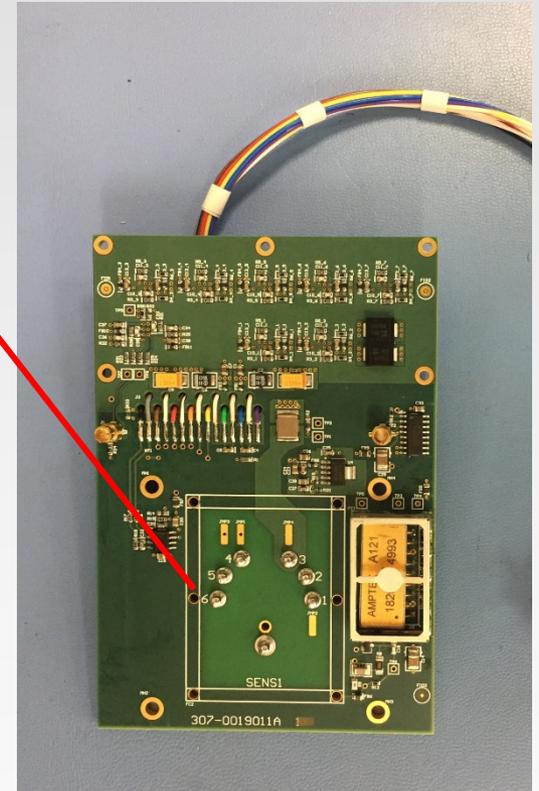
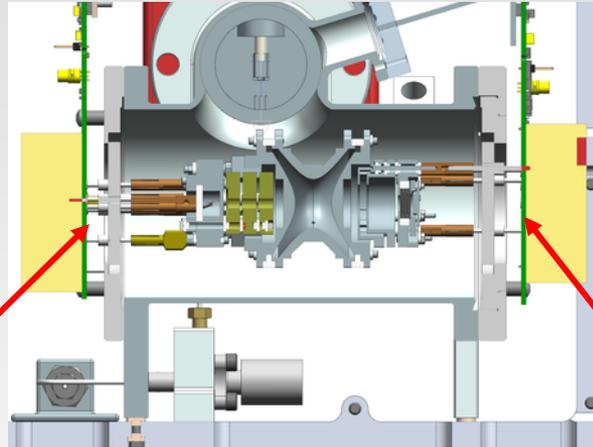
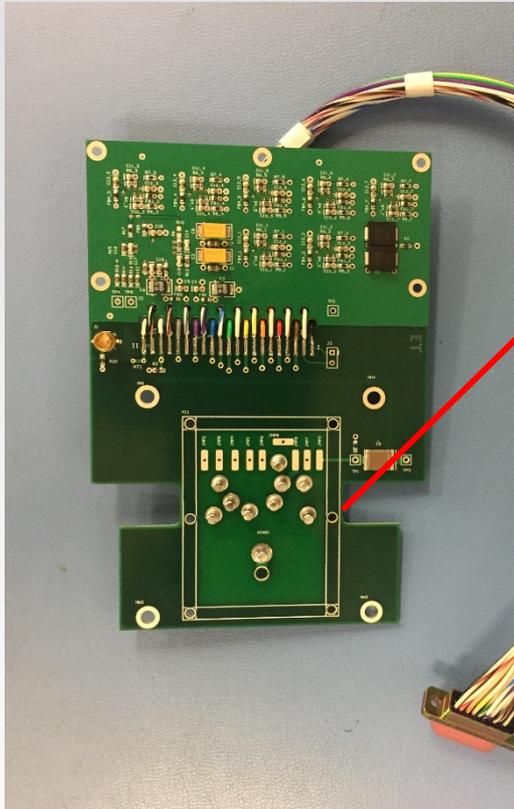
Mass Spec Control (MSC) HV power supply board before potting



Integrating MSC



Electronics



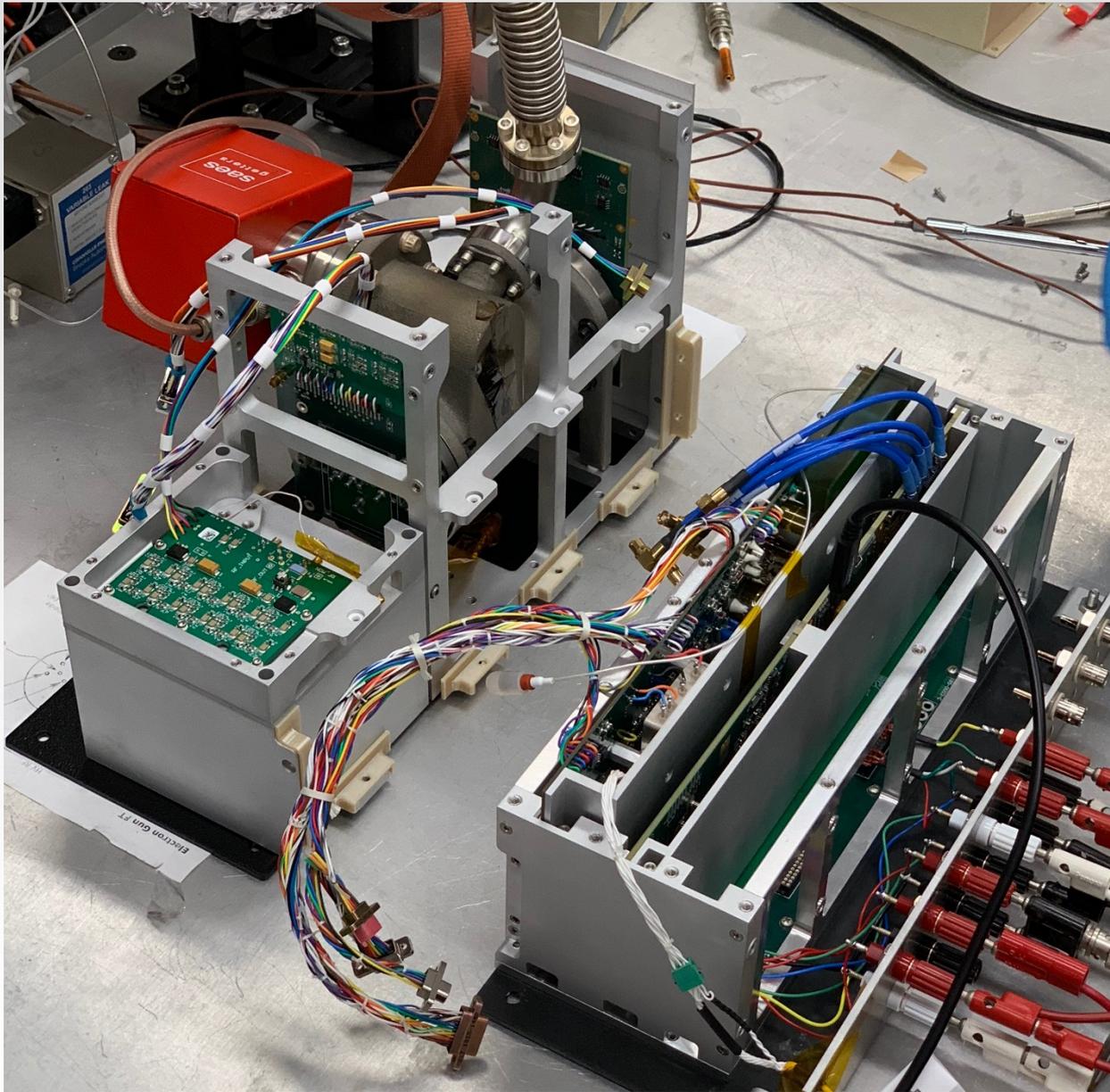
Top Cap PCB:

- e gun electrodes feedthrough
- 10 pins
- RF amp

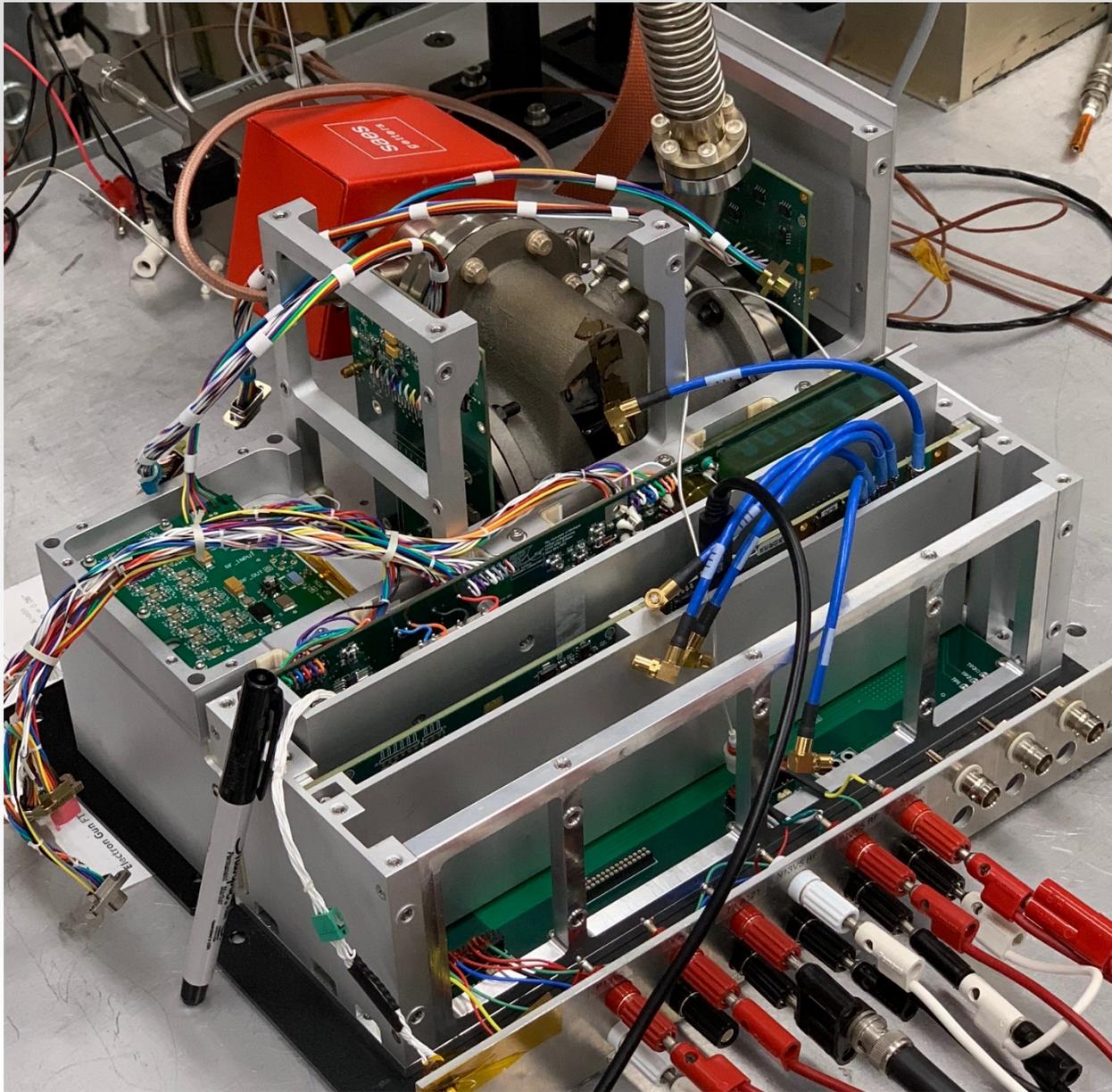
Bottom Cap PCB:

- MCP detector feedthrough
- 7 pins
- RF amp
- A121 preamp

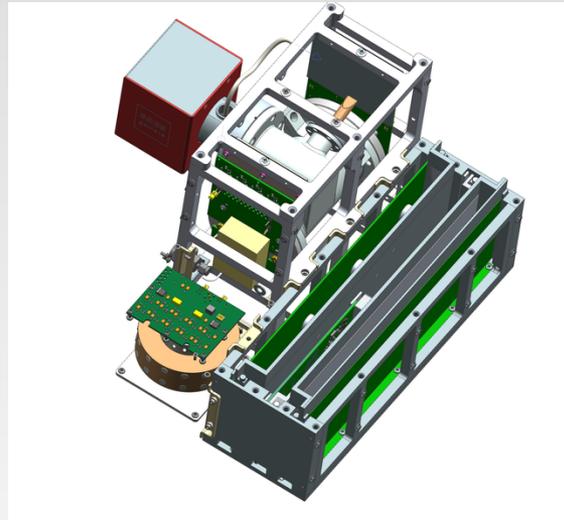
Assembly



Assembly



Science



Atmosphere profiling
High repetition rate
full range measurements

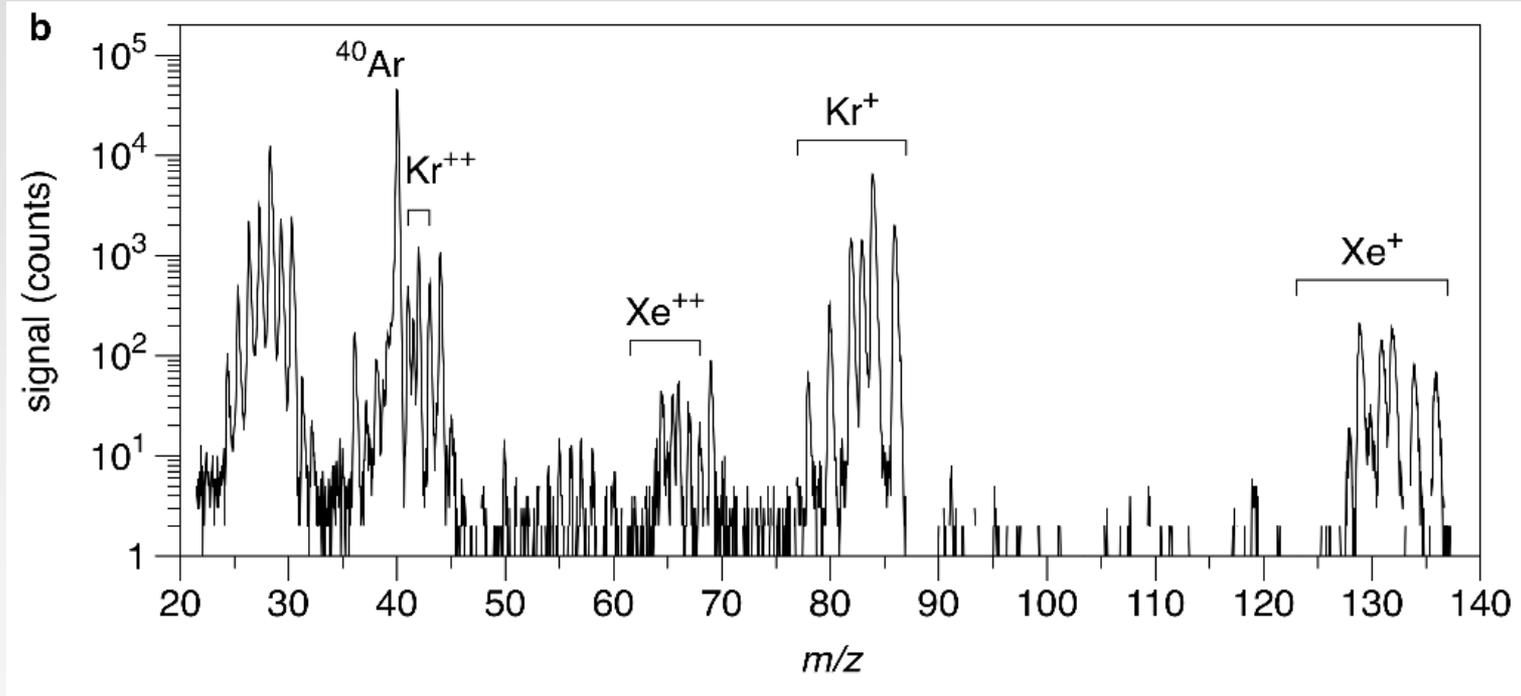


Geochronology
Accurate noble
gas measurements



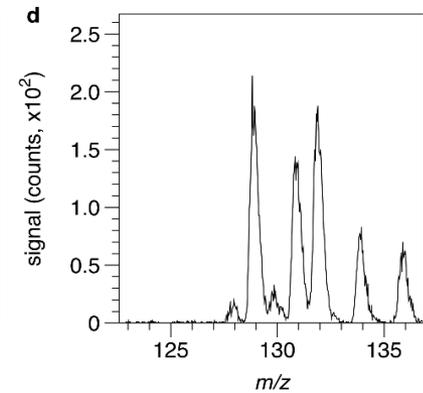
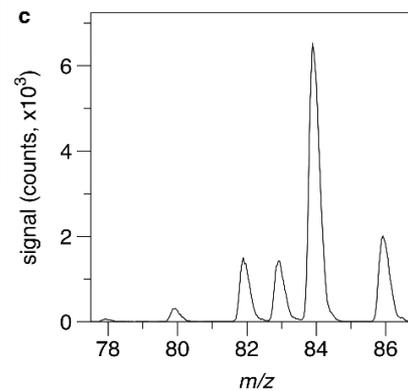
Life detection
Biosignatures
Amino and fatty acids
MS/MS

Data

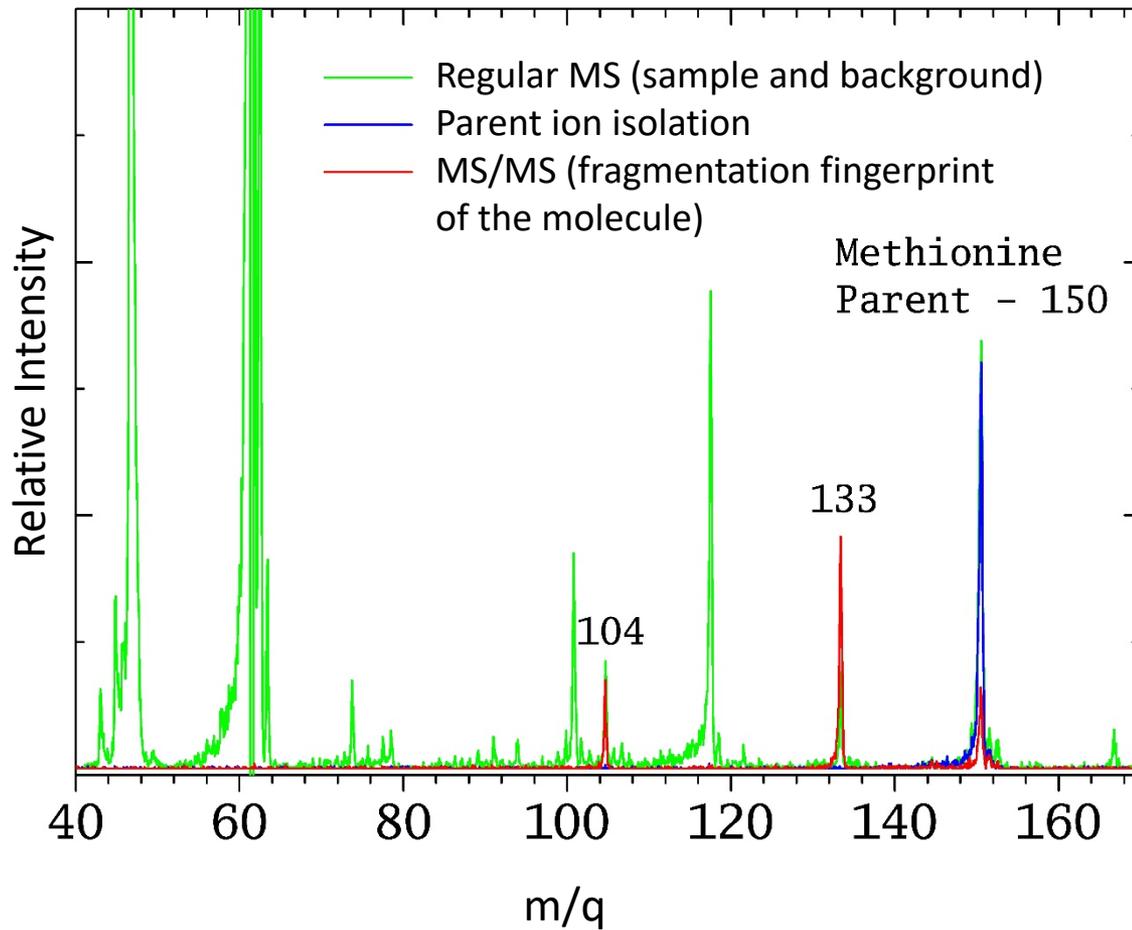


Static measurement of noble gases:

- Accurate isotope ratios
- Full mass spec every scan
- 20 scans per second



Data



Reliable identification of organic molecules using MS/MS

Conclusions

- CubeSat compatible: **3U** electronics, **4U** sensor, **1U** high Q RF coil. **8U total**
- 4 kg, 25W
- Rad Hard components up to 300 Krad
- All boards designed for flight
- Heatsink design for reliable operation in vacuum
- Battery pack module supports more than 2 hours of continuous measurements

Thank you!

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