

# Maintenance of a Beam Steering Unit (BSU)

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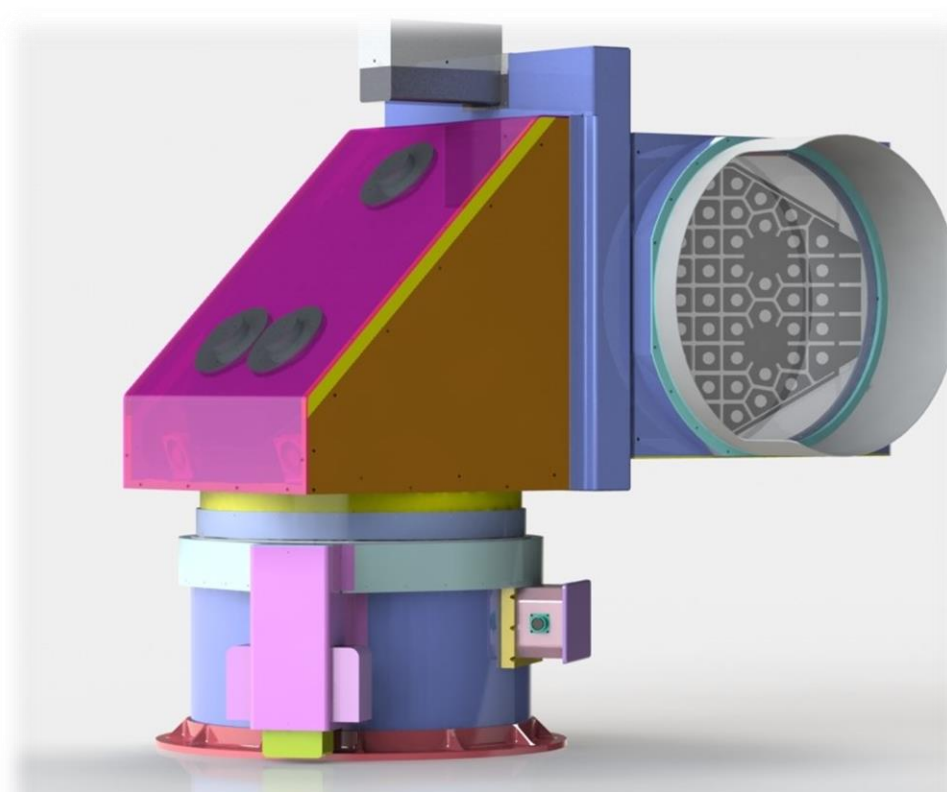
## Background



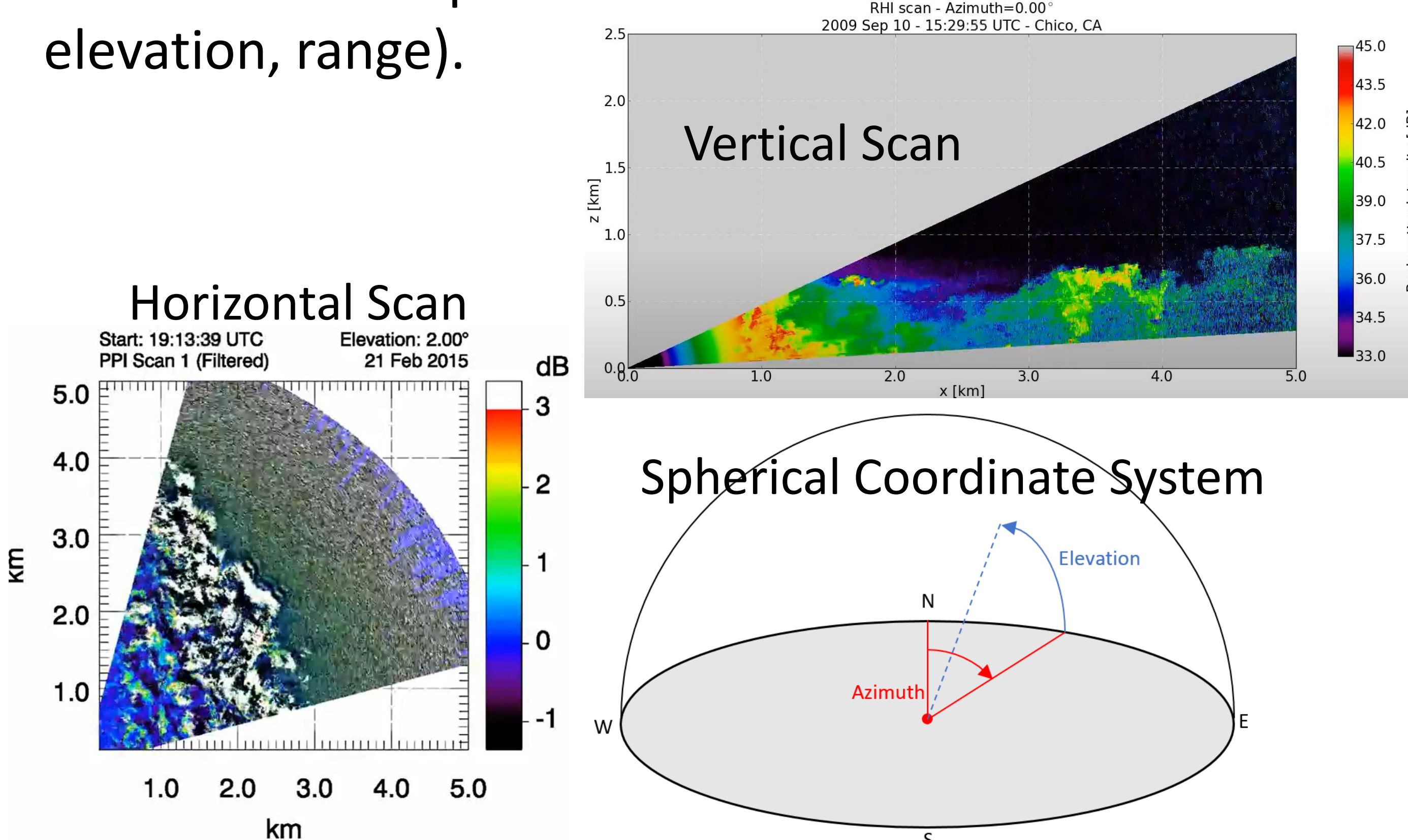
The REAL (Raman-shifted Eye-safe Aerosol Lidar) is a scanning atmospheric lidar at California State University Chico. It is used for atmospheric research.

A LIDAR (Light Detection And Ranging) works like a radar except that it uses laser radiation instead of microwave radiation.

To scan the laser beam across the sky, an optomechanical device called a "beam steering unit" (BSU) or "scanner" is used.



The BSU uses mirrors and servomotors to point the laser beam in a spherical coordinate system (azimuth, elevation, range).



## Objectives

1. Ensure the device is fully functional
2. Write a user manual for the device

## Methods

### Removal of the BSU from the REAL

- We used a jib crane to remove the BSU and lower it onto a custom shipping pallet
- Brought the BSU into an optics lab in the Physics Department
- Began cleaning and disassembly process



### The Disassembly Process

- No instructions available on the disassembly of the BSU
- Utilized existing SolidWorks files of the BSU to figure out the steps
- Logged our progress along the way in our manual

### User Manual

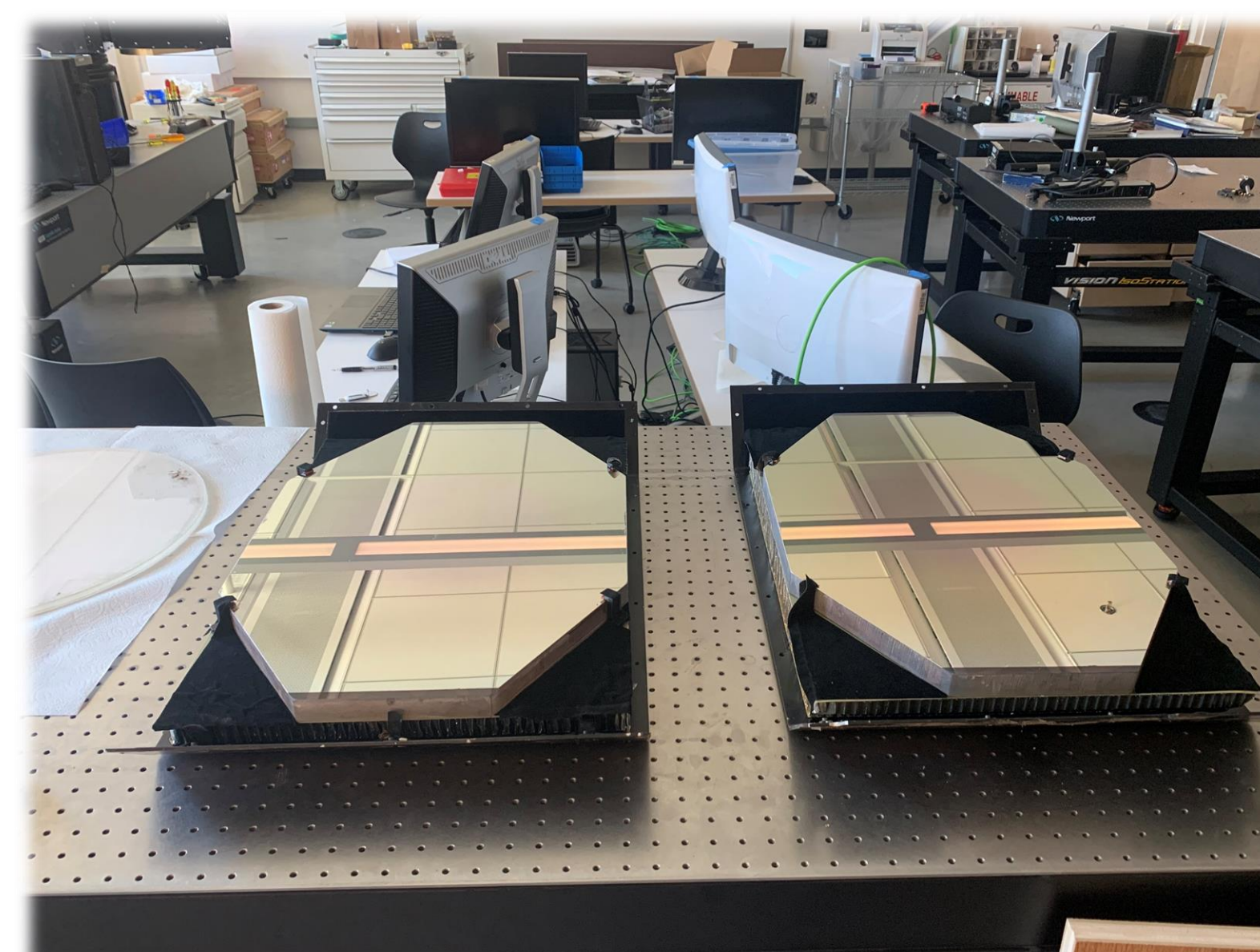
The manual describes in detail procedures such as:

- Cleaning
- Disassembly
- Reassembly
- Operation
- Troubleshooting
- Maintenance
- Wiring



BSU installed on optics table in SCI 245.

During field experiments, the BSU is operated continuously on the roof of a shipping container. Therefore, it must be waterproof and withstand daily thermal cycling.

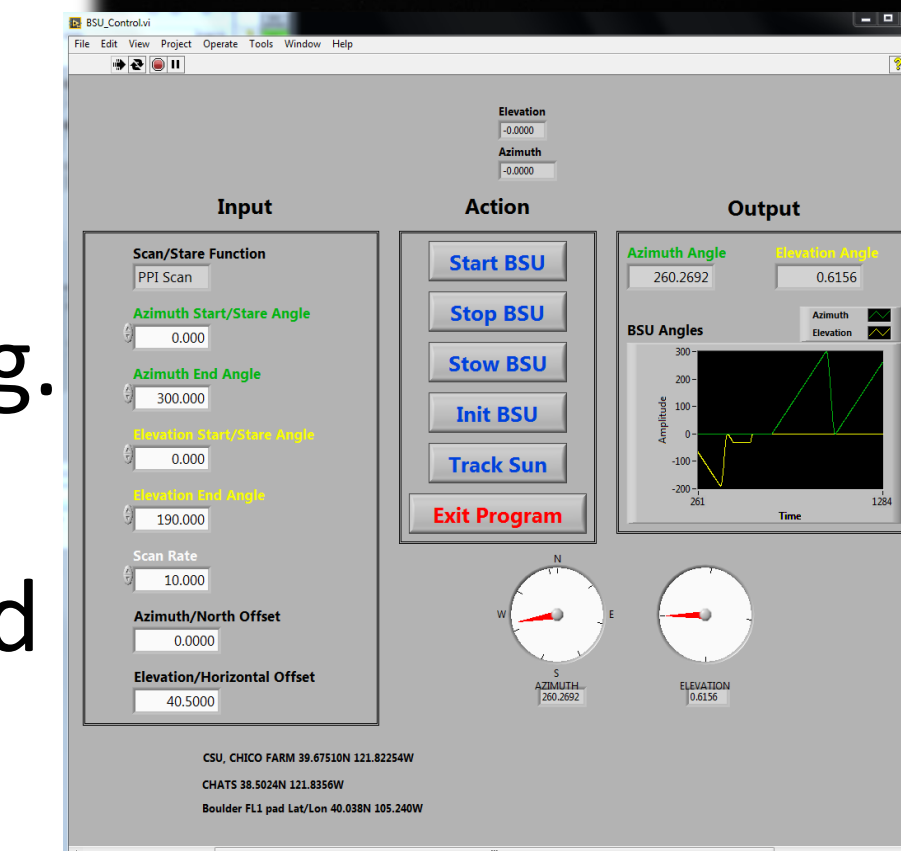
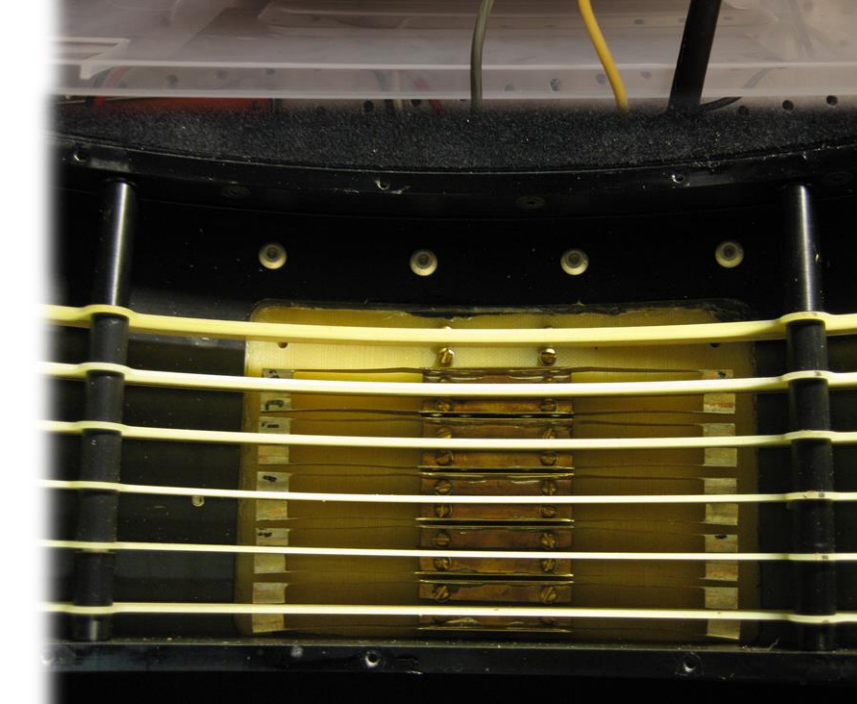
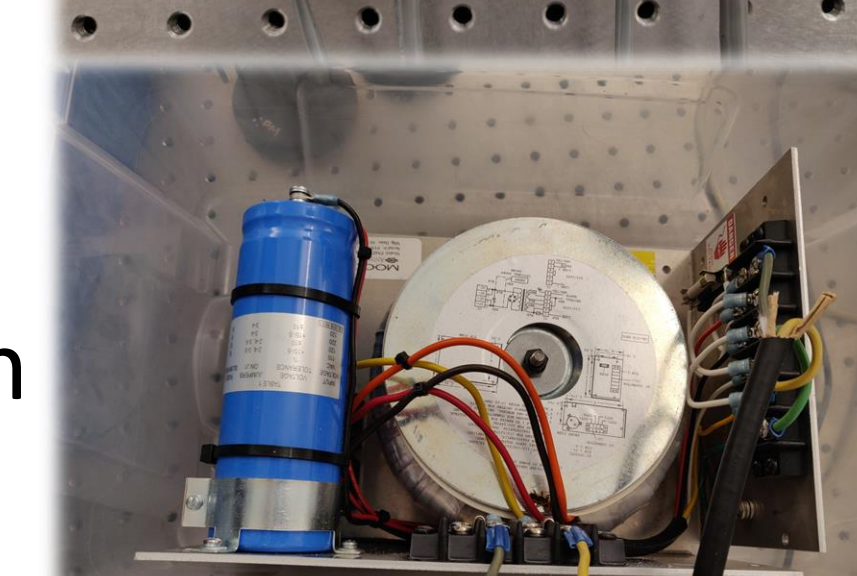
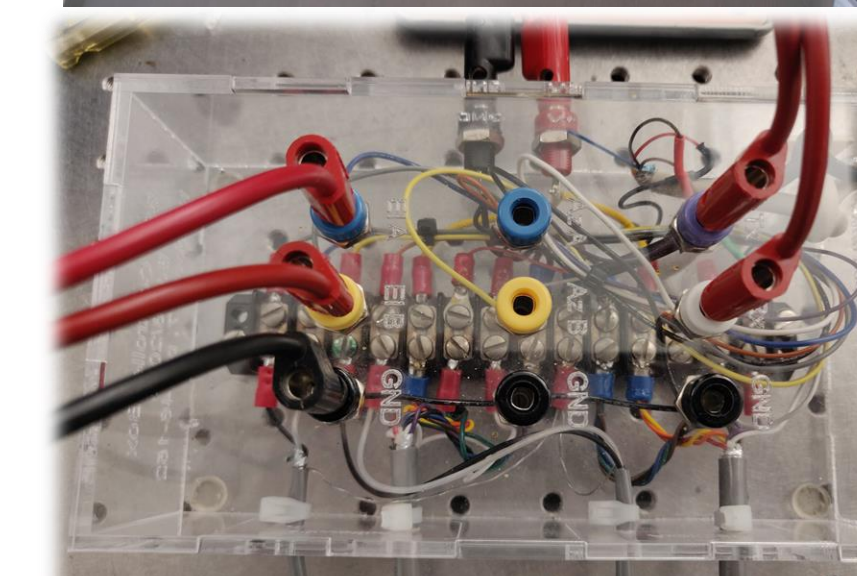


Both mirrors on an optics table

The mirrors inside the BSU are made of Zerodur, a type of glass that does not contract or expand as the temperature changes. The Zerodur is glued to Teklam aluminum honeycomb panels with silicon adhesive. The Teklam is screwed to the aluminum BSU plates.

## Electronics

- The BSU uses two servo motors.
- The servo motors are controlled using serial connections and they receive power through a power supply.
- For the elevation motor to receive power and send and receive data, custom-made slip rings are used. This eliminates the need for cables which could get wrapped up.
- The motors are controlled using modified LabVIEW programs.
- For us to operate the BSU in the lab, we modified the existing programs to run without input from additional sensors that are part of the LIDAR system.
- In addition, we used the LabVIEW to count the pulses from the servo motors to create a more rapid and precise way to receive position data from the elevation and azimuth assemblies.
- The motors transmit two phase-shifted square waves when the motor is moving.
- We used quadrature decoding in LabVIEW to measure the phase shift and count the pulses of the square waves to determine the azimuth and elevation angles.



## Conclusion

Throughout our time in the research program, we used what we had learned in coursework and our own ingenuity. We had little information to work from for disassembly and operation. We wrote a comprehensive user manual.

We learned to use software that we previously were unfamiliar with, like LabView to operate the BSU, and LaTeX to write the user manual.

The BSU has been successfully prepared for use in future atmospheric field research projects.

## Acknowledgements

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