MFRSR Cosine Bench and Planned ENGs

Ben Sheffer[1,2], Gary Hodges[1,2]
[1]University of Colorado, CIRES, Boulder, Colorado, 80309
[2]NOAA, Global Monitoring Laboratory, Boulder, Colorado, 80305
ben.sheffer@noaa.gov

MFRSR Cosine Error Measurement Bench

Quick Hits:
- MFRSR Cosine Bench was down 2 years due to control PC failure
- Fall 2024, control software completely rewritten
- MFRSRs again being fully characterized
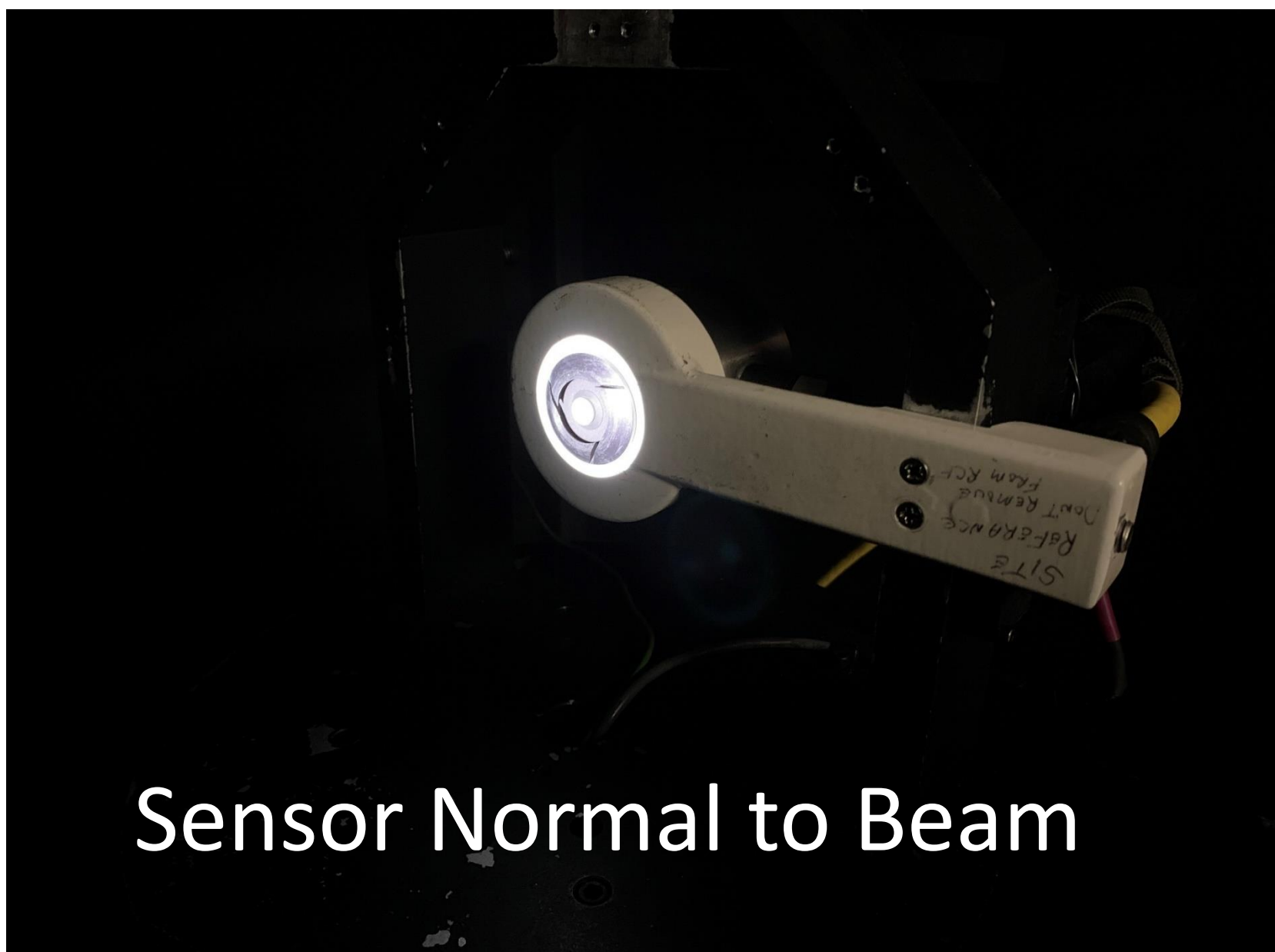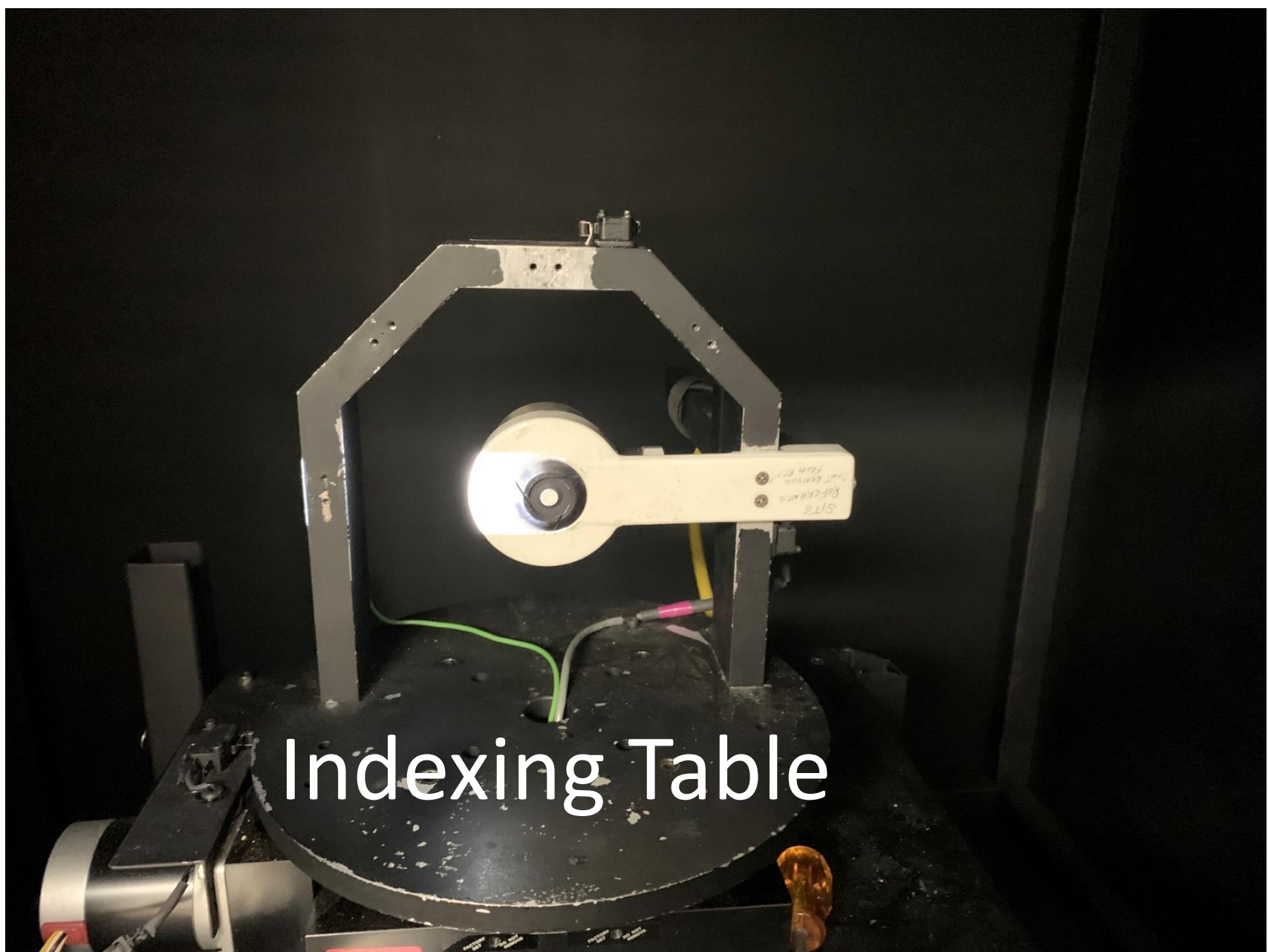

Head ID: 0xc8ca, Orientation: SN

- MFRSRs are subject to cosine error dependent on angle of incidence of direct beam irradiance
- Cosine bench maps sensor response across range of incident angles
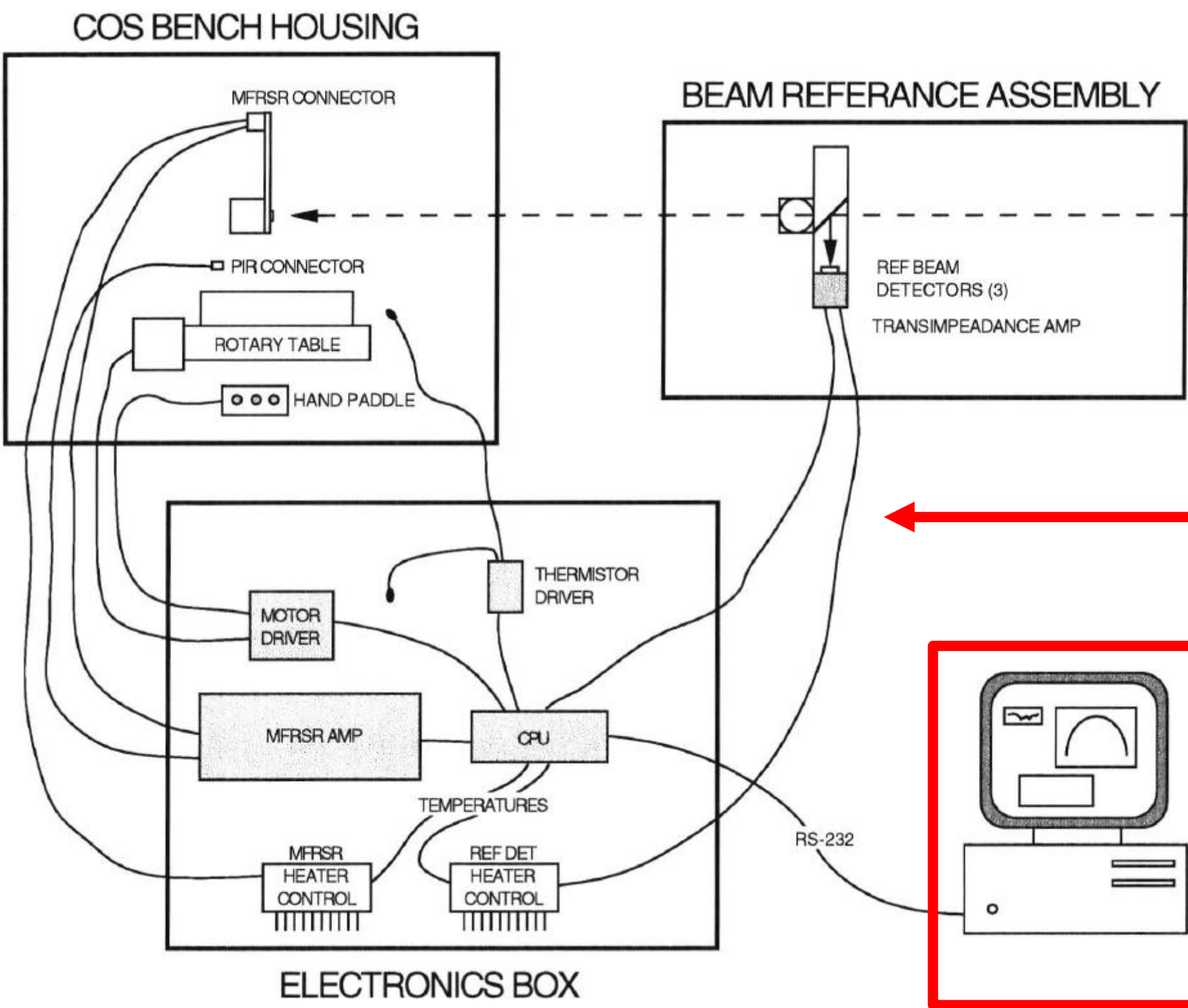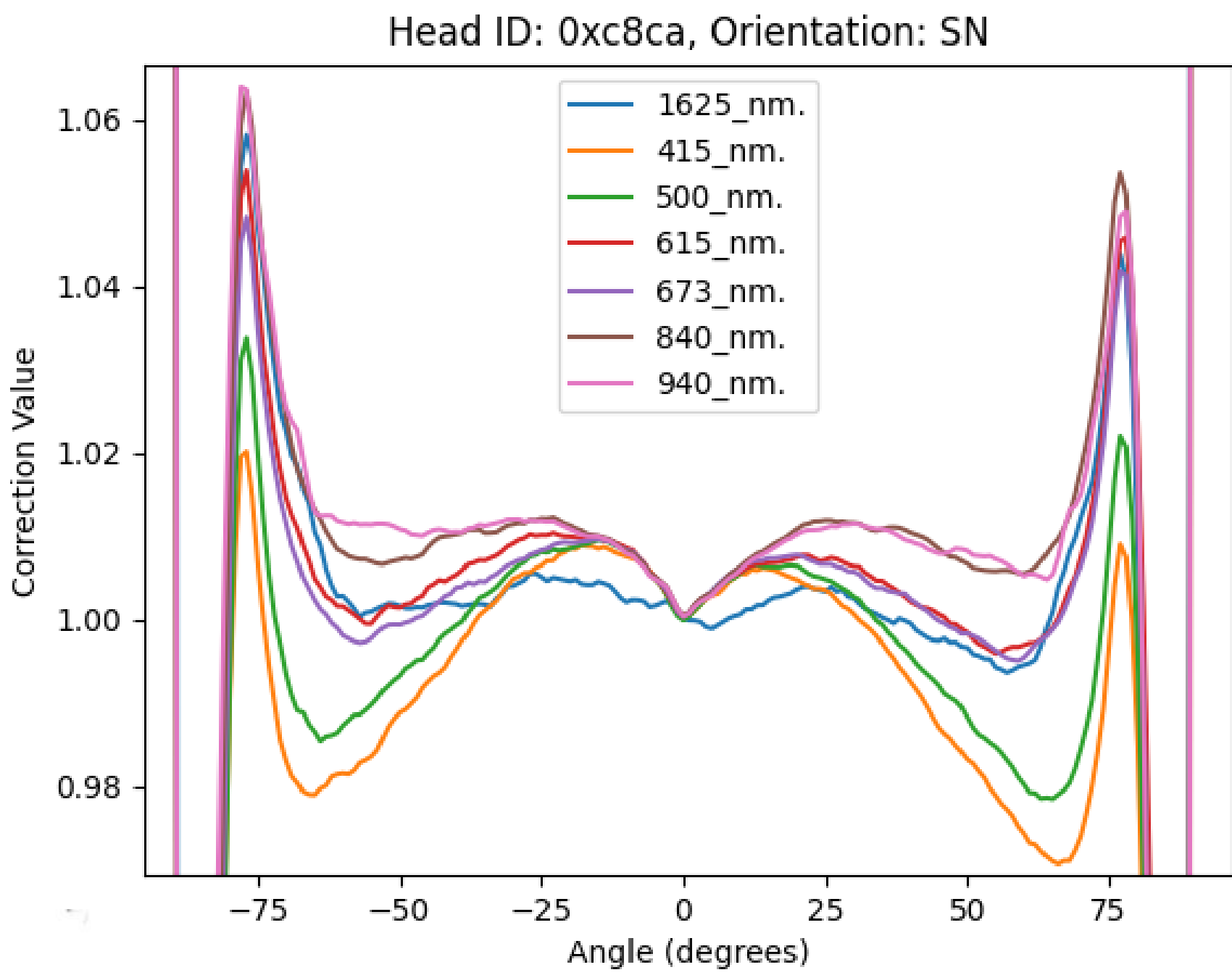
300 W Xenon arc lamp + collimation tube

Original electronics box, optics, rotary table, etc. still used

Control PC replaced and software refactored

Indexing Table
- Lamp beam at -90°
- Measurements span -90° to +90°

Sensor Normal to Beam
- Response mapping performed in S-N (shown) and W-E positions
- Measurements at 1° increments
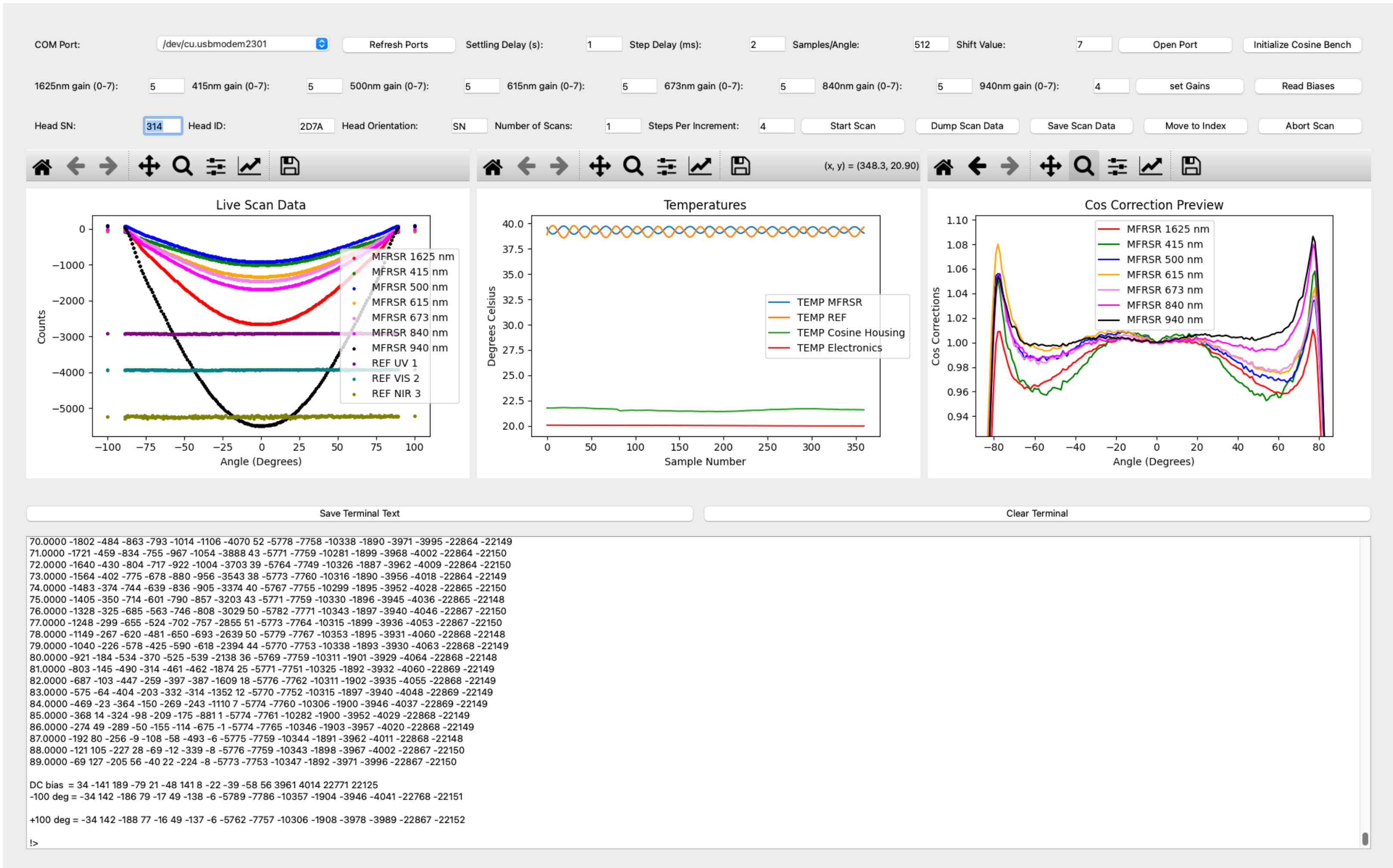
- Code refactored from Igor Pro to Python (PyQt6, Matplotlib) for ease of maintenance and cross-platform compatibility
- Control PC updated from 2000 era CRT iMac to 2023 Mac Mini

Multi-Filter Rotating Shadowband Radiometer


Reduce DQPRs/DQRs

Heater board failures and shading issues are common causes of DQPRs.

Modify Motor Brackets

To ease MFRSR setup and reduce shading errors, we propose redesigning the motor bracket replacing continuously adjustable version to one with fixed positions.

Bonus: Will allow remote shadowband adjustments.

Left: Continuously adjustable
Right: Fixed position
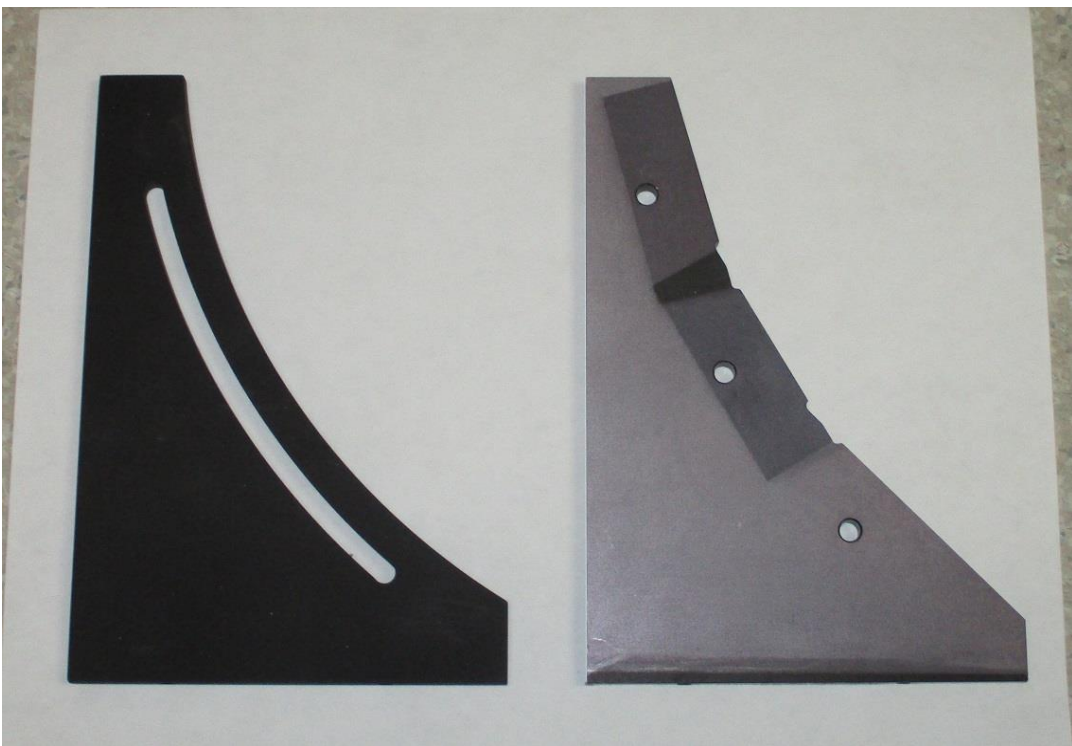
Redesign MFRSR/MFR Heater Boards

Attempted a few years ago without arriving at acceptable solution. Armed with new ideas, mentors believe robust solution possible for relatively low cost.

- Redesign to transition from unreliable hTC Temperature controller
  - Simple op-amp based linear control loop
  - Single power transistor for linear power control
- Upgrade voltage regulators
  - Higher precision and stability for analog voltage rails used by instrument preamps
- Selectable temperature settings (40°C or 45°C)