

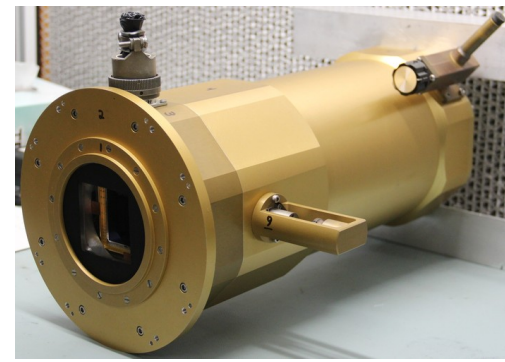
Spacewatch SCC-2 Camera Progress and Roadmap to Completion

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Electrical Engineer / Observer

The Spacewatch Project

SCC-2



- Developing a new CCD camera system
- For use on the 90" telescope on Kitt Peak
- Increase our sky coverage by a factor of 3.6x
- Spacewatch provides recovery observations and light curves of Near-Earth Asteroids
- 3 telescopes on Kitt Peak: 36", 72", 90"

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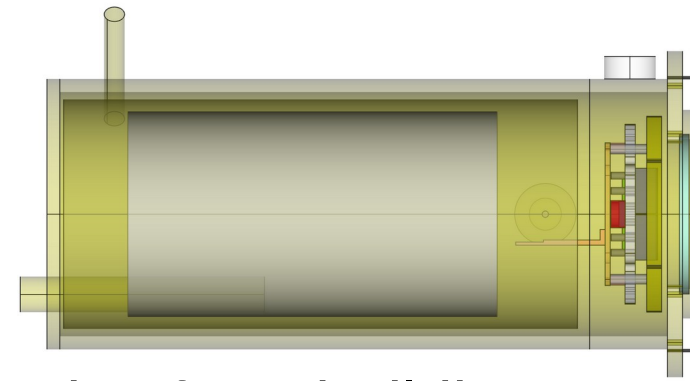
36" and 72" (0.9-m and 1.8-m):

- 36" Mosaic : e2v CCD42-90 2048 x 4612 (x 4)
- 72" FLI : ProLine PL3041 2048 x 2048

Plus bright time on 90" (2.3-m):

- 90" SCC ProLine PL23042 2048 x 2048
- 90" SCC-2 : e2v CCD42-90 2048 x 4612 (x 2)

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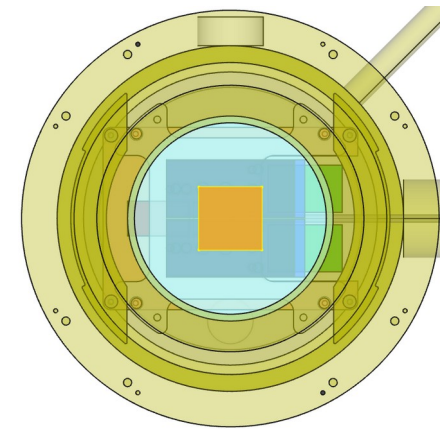


- Using existing hardware, designs, and expertise from building Mosaic to build a larger-area CCD imager for the 90" telescope

Camera Design:

- Use existing nitrogen dewar for cryogenic cooling
- Use spare detectors from 36" Mosaic project - science grade CCDs
- Use spare electronics boards - CCD readout electronics, Computer Interface
- Make minor modifications to existing software - LabView, etc

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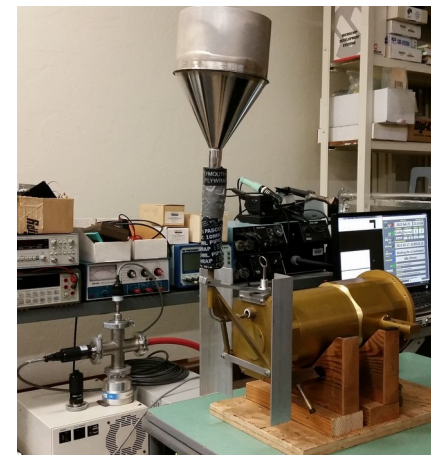
Problems:

- Larger field of view on the 2.3-m is needed to recover more asteroids
- Currently field of view with existing FLI camera is 5x5 arcminutes
- Limits our ability to recover faint objects with modest uncertainties
- In some cases, the lack of enough stars prevents good astrometry solutions
- Makes accurate asteroid measurements impossible due to few reference stars

Solution:

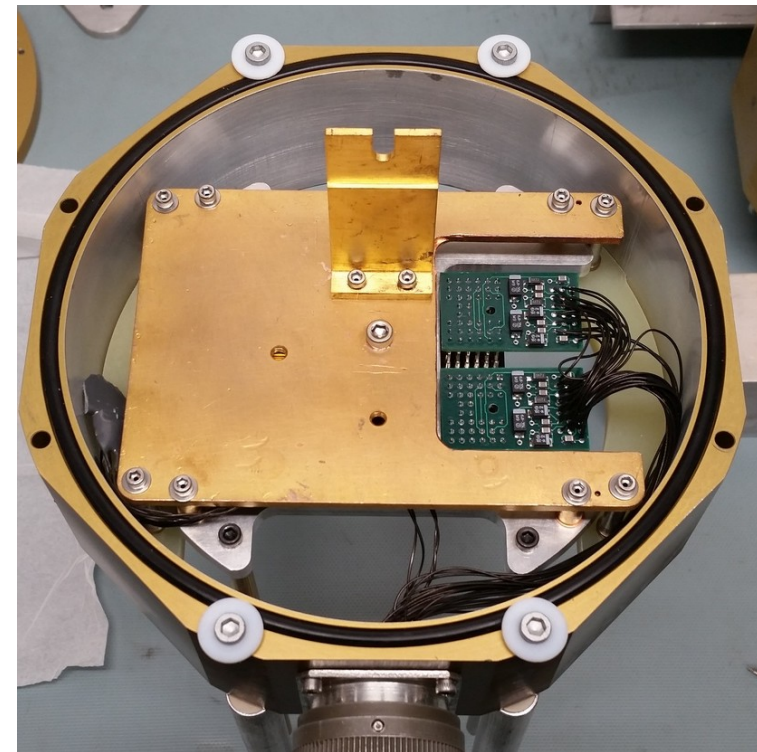
- Have 2 spare science-grade E2V CCDs in storage in the lab (Mosaic backups)
- Larger physical size of these chips allows a 3.6x increase in sky coverage
- Mix of reusing existing hardware and improvements to existing designs

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Milestones:

- Built new Computer Interface to read out CCD in lab
- Used clean room to disassemble dewar, retrofit, and install new CCDs
- Integrate dewar, electronics, and cables into final camera package
- Made CCD mounting plate
- Installed Engineering CCDs in dewar
- Thermal Testing of dewar
- Integration of hardware components



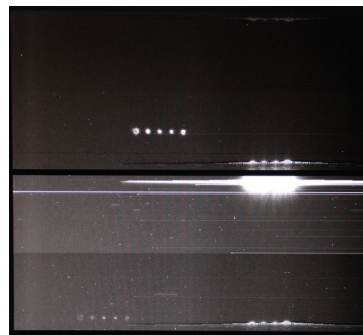
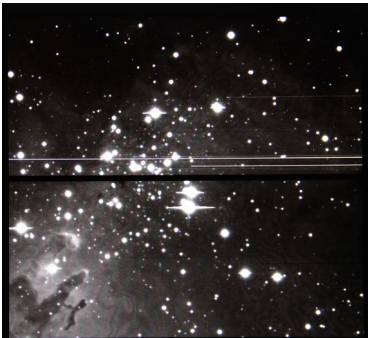
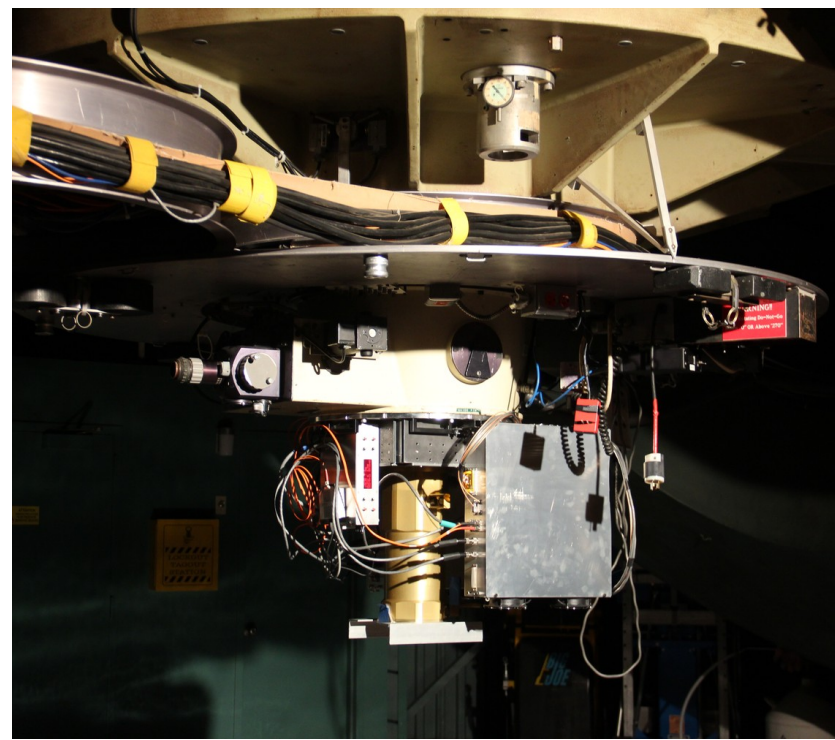
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Engineering Test Run #1

April 12-13, 2022 UT

Achieved all of our objectives for first test

- Verified mechanical interface to telescope
- Tested functionality of all equipment & software
- Demonstrated thermal control of CCD at -140 C
- Tests of shutter mechanism
- Initial test of dry air system
- Acquired sequence of images through focus



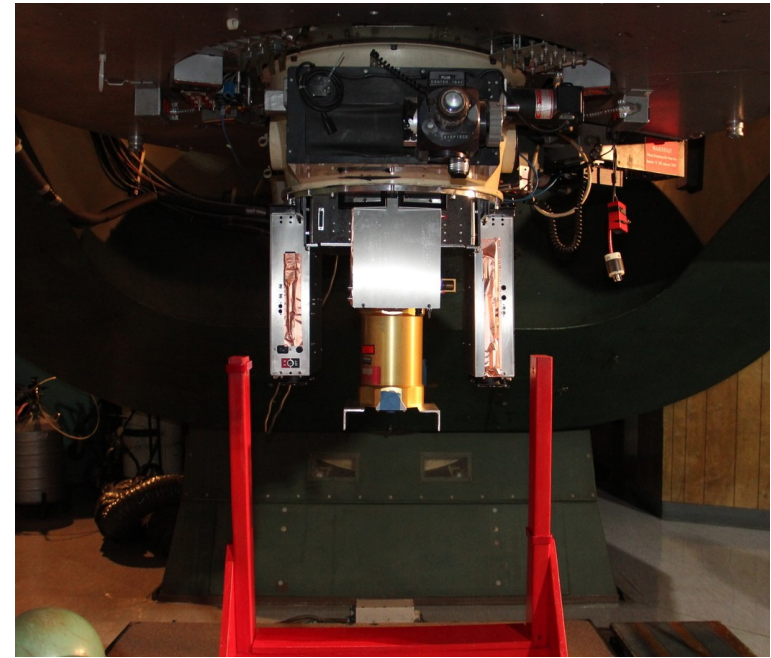
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Engineering Test Run #2

September 7-8, 2022 UT

Progress:

- Reduced installation time & complexity
- Achieved better thermal control
- Tested improved shutter mechanism
- Tested improved dry air system
- Tested filter performance



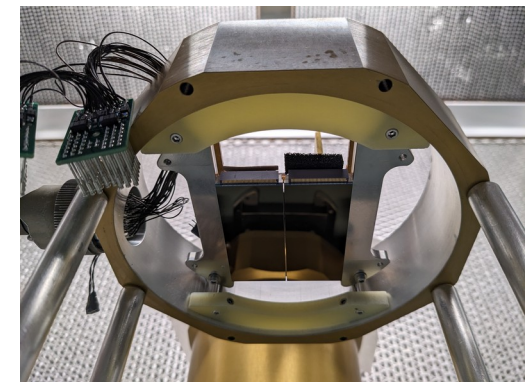
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Engineering Test Run #3

April 4-5, 2023 UT

Progress:

- first run with Science CCDs
- verified performance of Invar CCD mounting plate
- added old data processing computer to run TargetList & Astromatic
- bias, flat, and fringe master generation with Astromatic
- stitched image calibration using master files



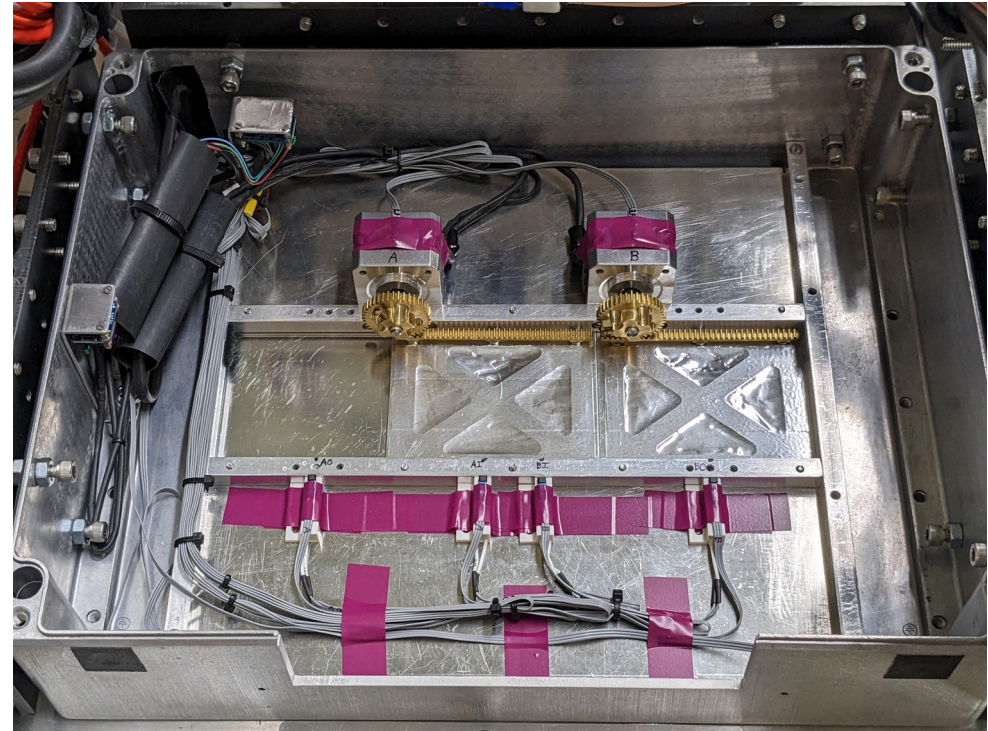
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Engineering Test Run #4

June 28-29, 2023 UT

Progress:

- faster, more reliable shutter
- better integration between labview & beltane computers
- communications with Bok TCS computer to command telescope moves



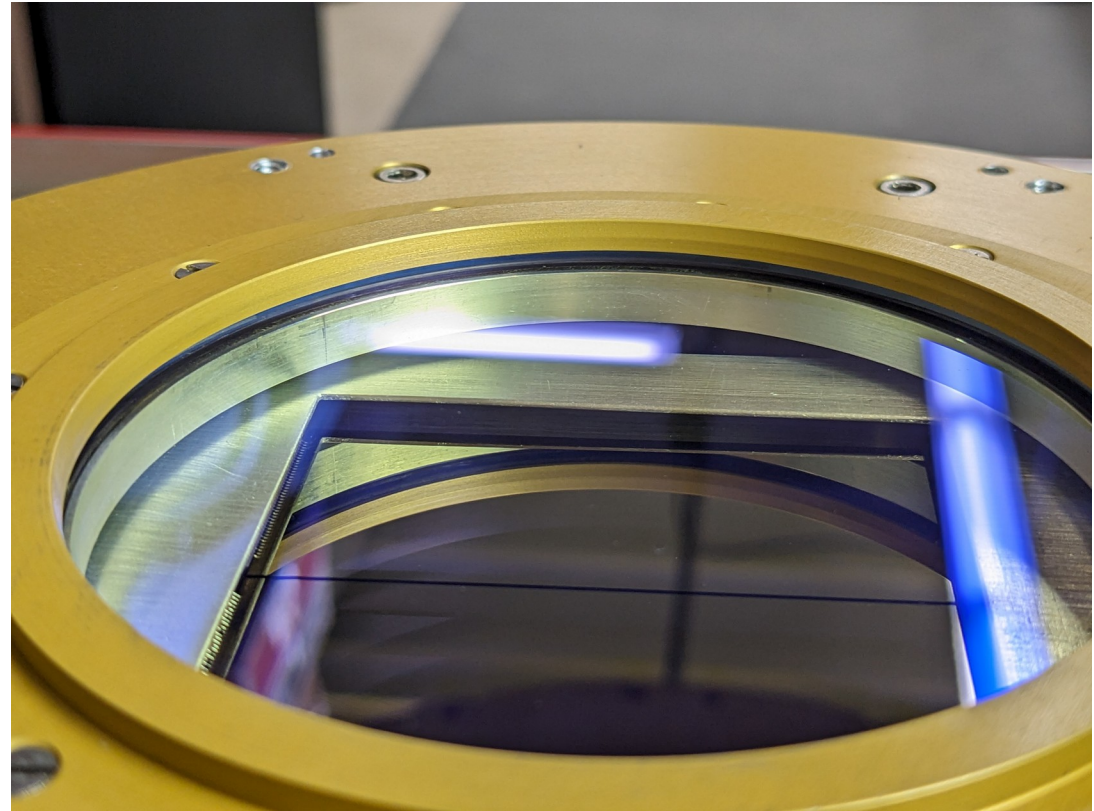
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Engineering Test Run #5

January 24-25, 2024 UT

Progress:

- dewar serviced
- short LN2 fill time
- longer LN2 hold time
- lower readout noise configuration found



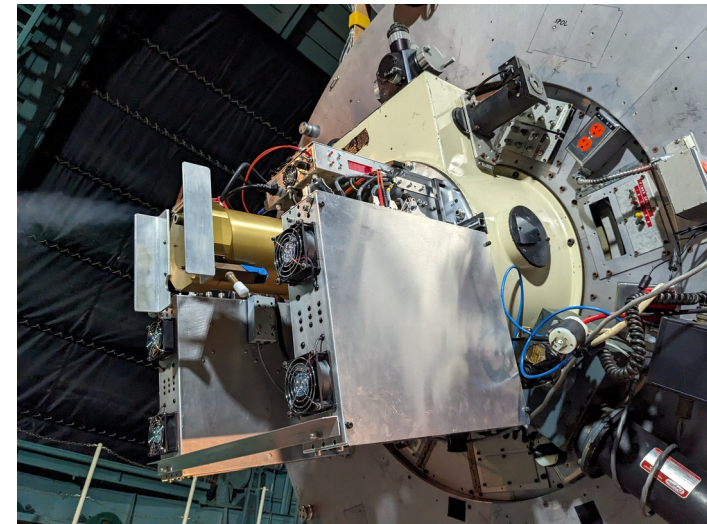
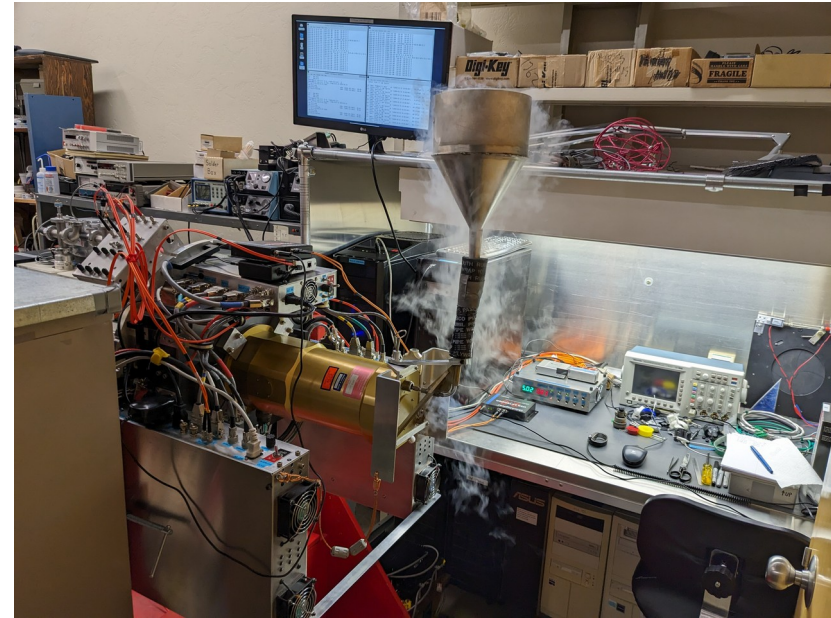
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Engineering Test Run #6

June 18-20, 2024 UT

Progress:

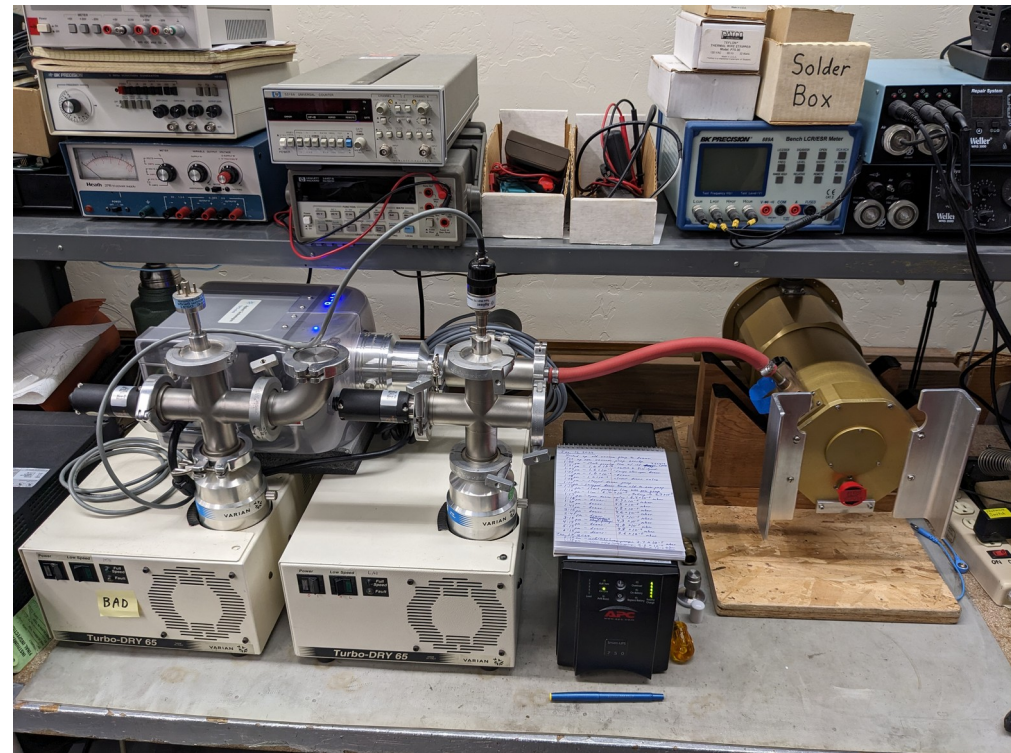
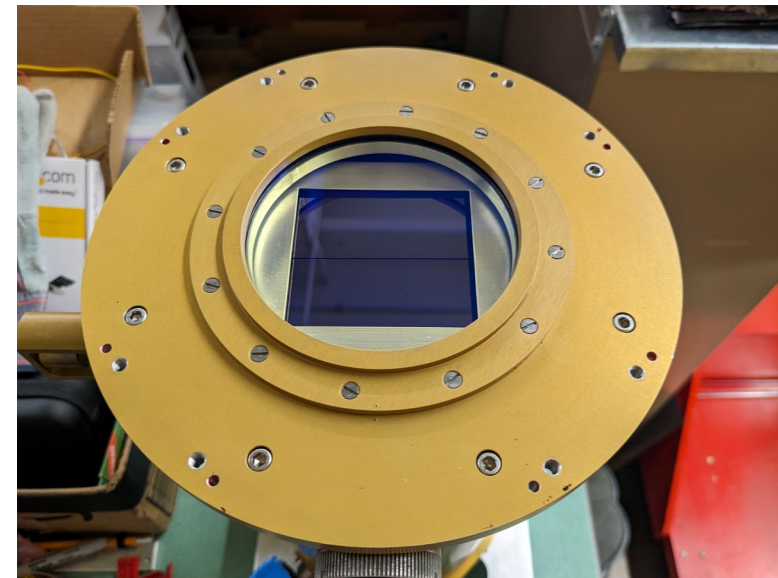
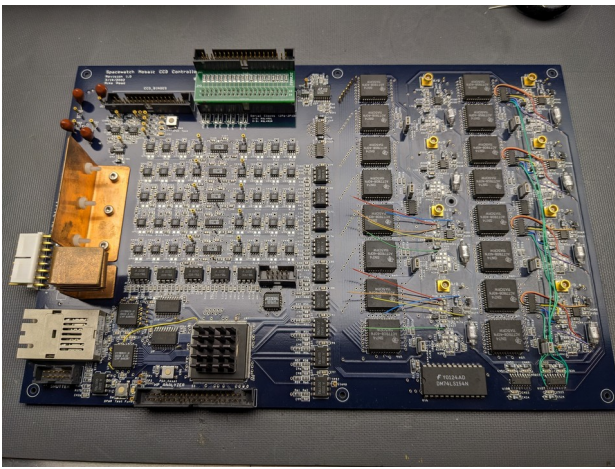
- shorter cables, better grounding & shielding
- very low readout noise configuration found
- almost no channel crosstalk
- no channel 0 offset
- no CCD noise coupling to temperature sensor



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Final Test Run: January 15-16, 2025 UT

- Increase readout speed of electronics
- Develop new shutter mechanism with timing sensors
- Complete data pipeline
- Finishing touches





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Thank You

Questions ?

