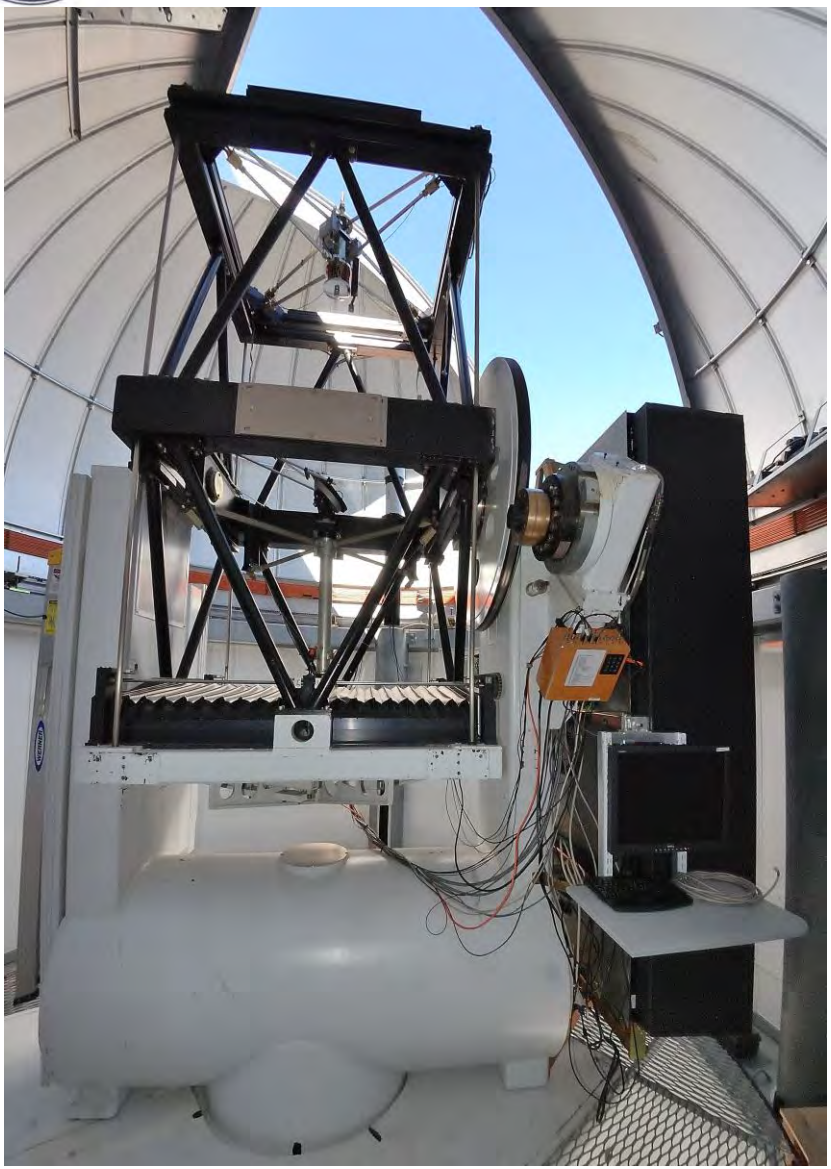
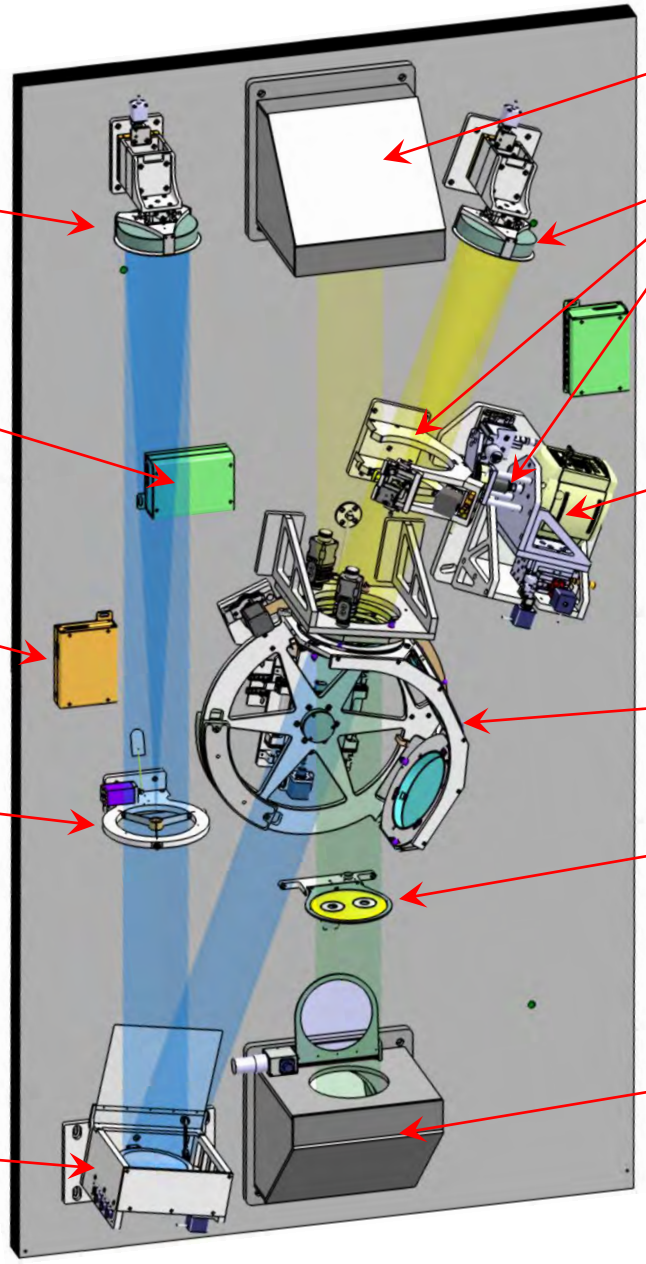


AO INSTALLATION UPDATE

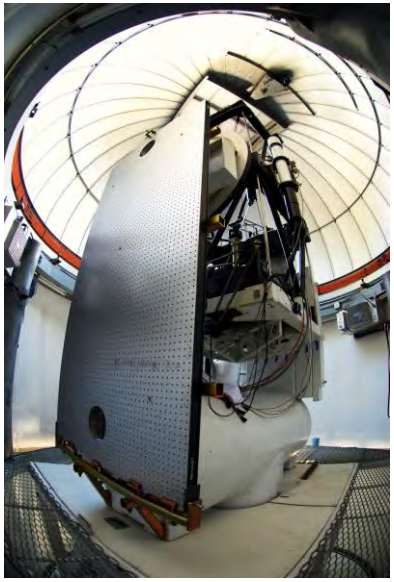
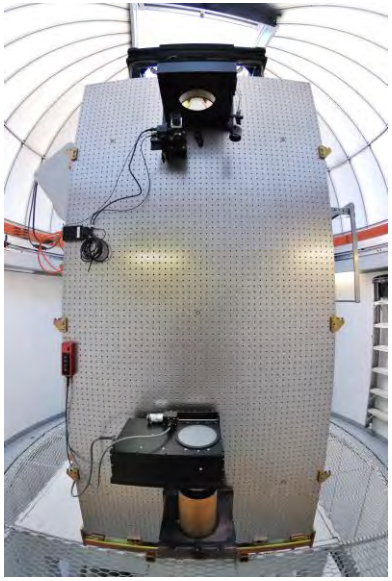
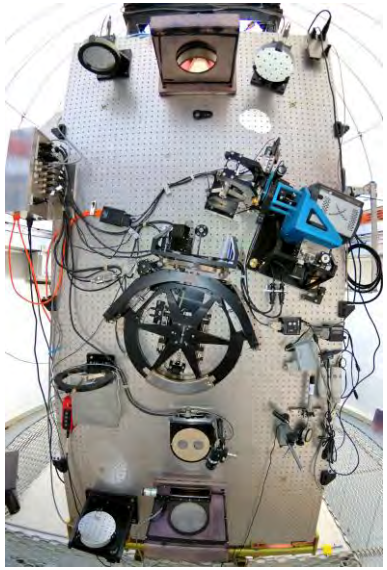
THE TELESCOPE END

LASZLO STURMANN

CHARA AO BOARD






AO INSTALLATION
PHASES
10/2013 - 3/2016

2015 – YEAR OF THE CABLES, PCBs AND BOLTS

MANUFACTURING OF THE MECHANICAL COMPONENTS HAVE BEEN COMPLETED (PETE WALKER, DWAYNE TORRES, SAM MAYBERRY IN ATLANTA AND NORM VARGAS ON MT. WILSON).

OVER 150 PCBs AND 120 CABLES HAVE BEEN BUILT MOSTLY BY STEVE GOLDEN.

THE OPTICS AND ELECTRONICS ARE INSTALLED ON ALL TELESCOPES BUT E1
THE E1 INSTALLATION IS IN APRIL

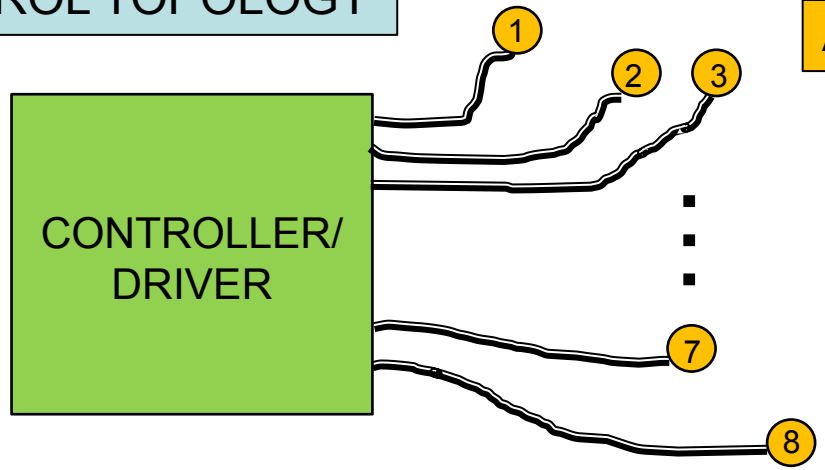
THE CONTROL SOFTWARE IS WORKING.

WFS CAMERA INSTALLED/ALIGNED IN S1 AND S2.

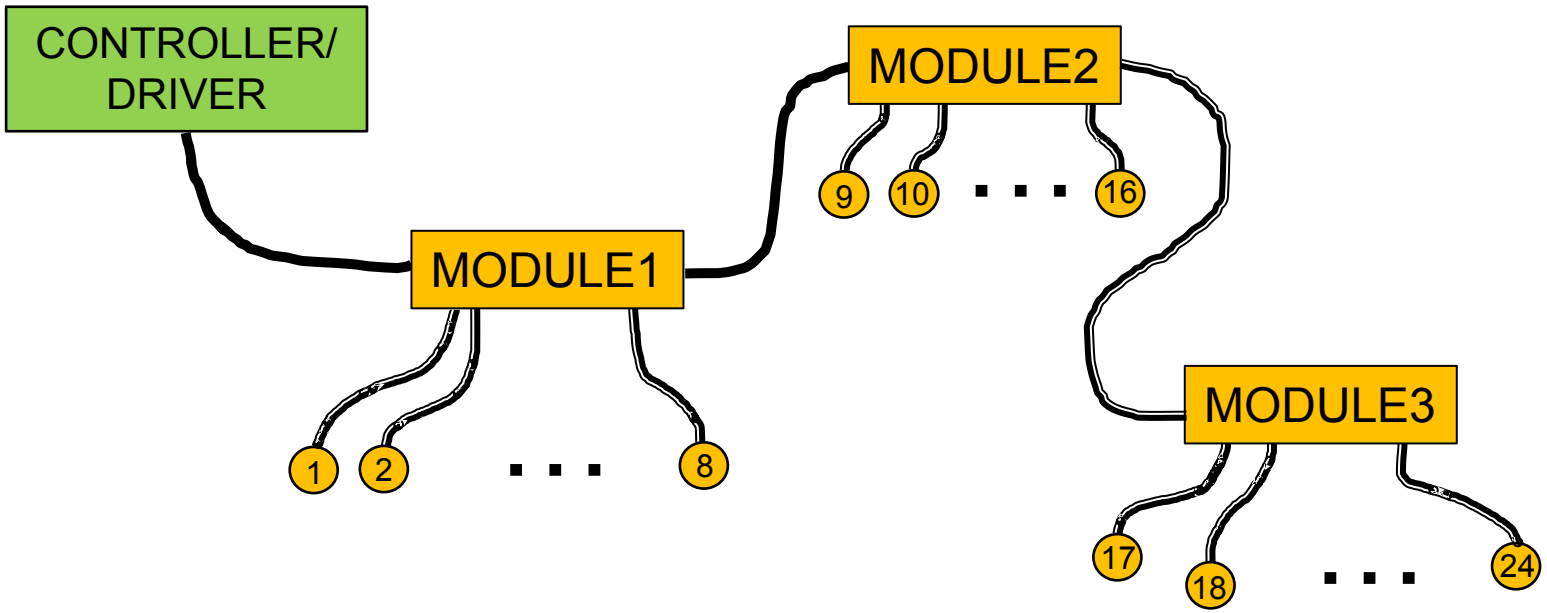
A PROTECTIVE COVER FOR THE AO BOARD IS COMPLETED IN S1 and S2. THE REST WILL BE COMPLETED BEFORE THIS SUMMER.

AO BORD CONTROL TOPOLOGY

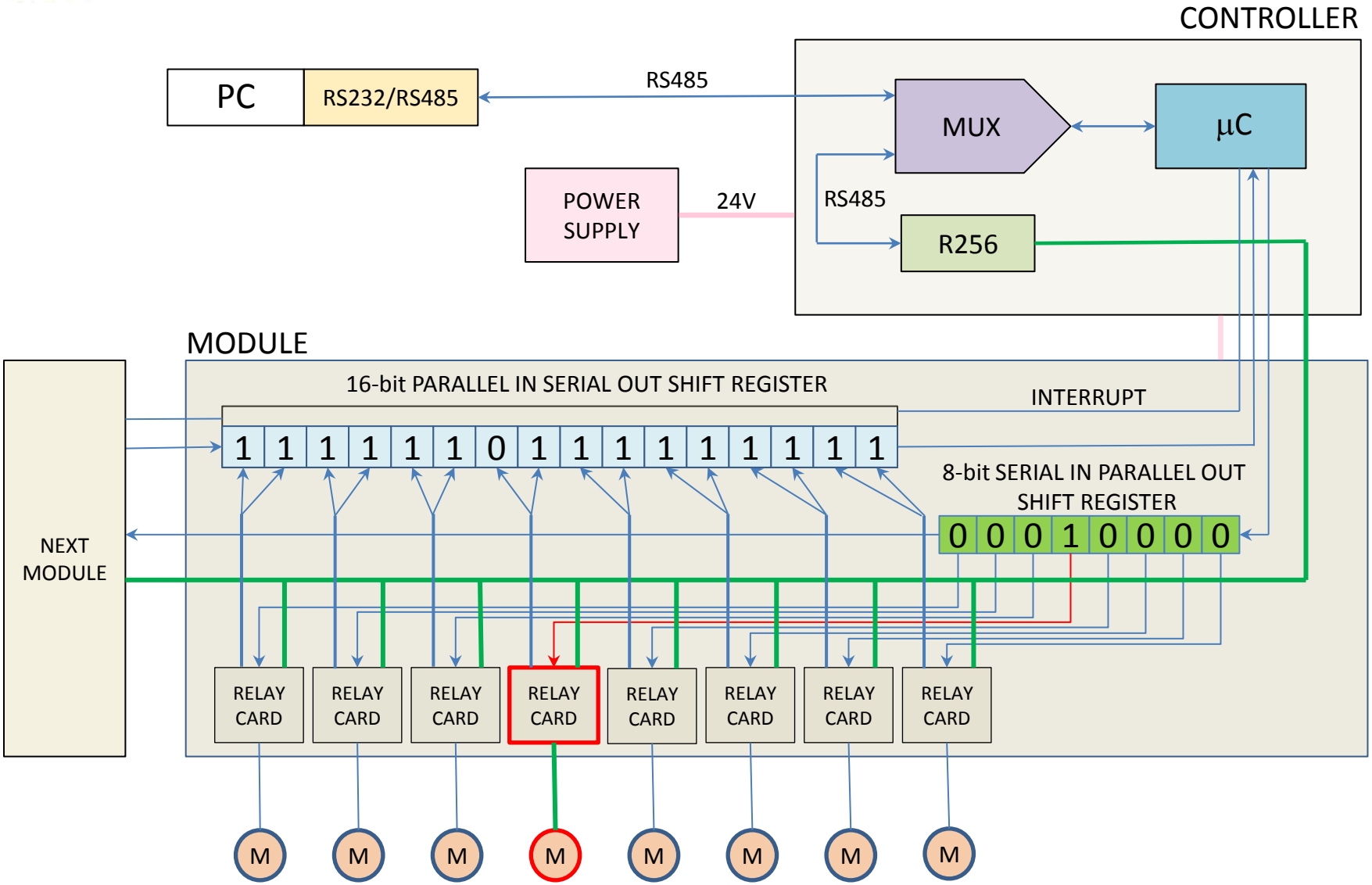
VER. 1



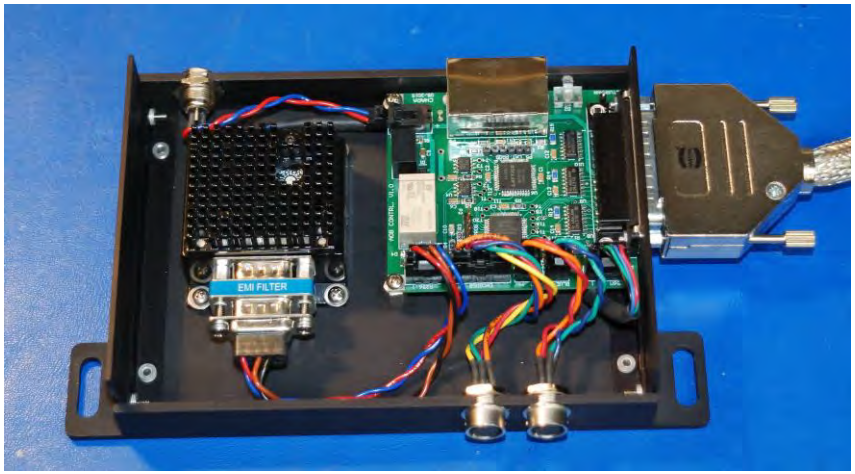
VER. 2

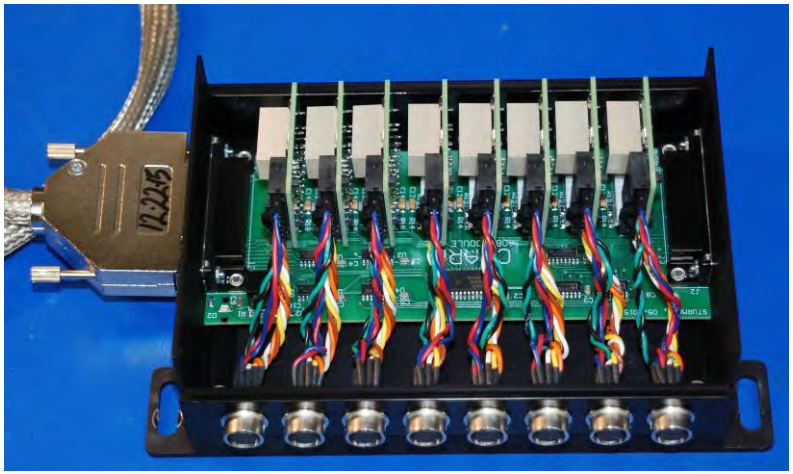


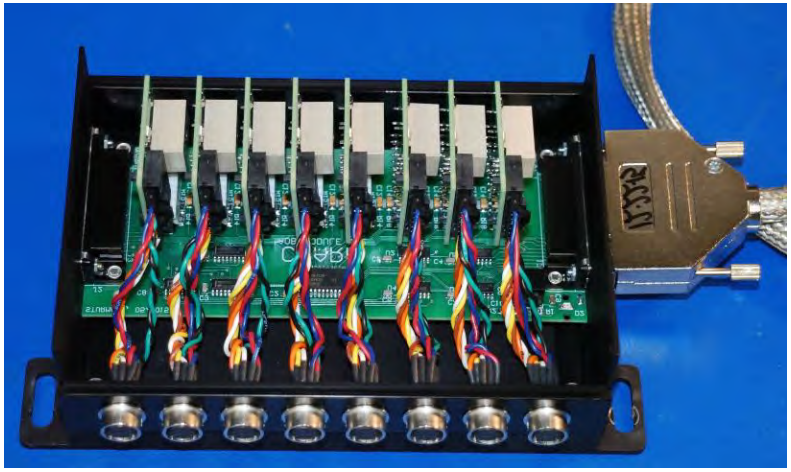
MULTI-CHANNEL ACTUATOR CONTROLLER/DRIVER

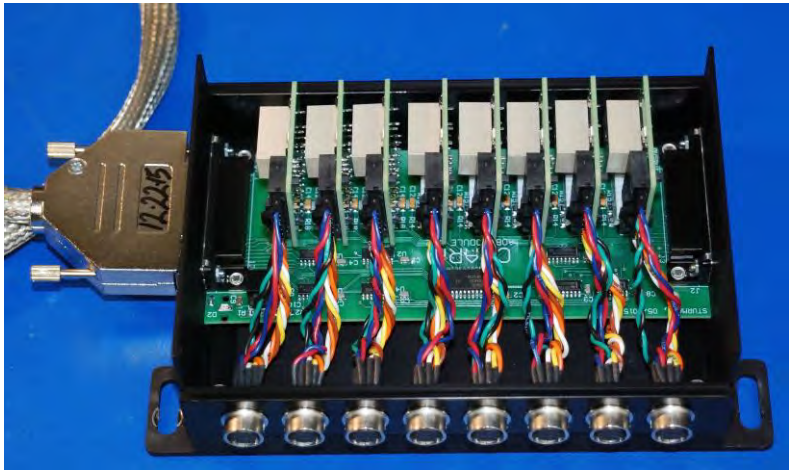


ONE CONTROLLER CAN DRIVE 24+ ACTUATORS

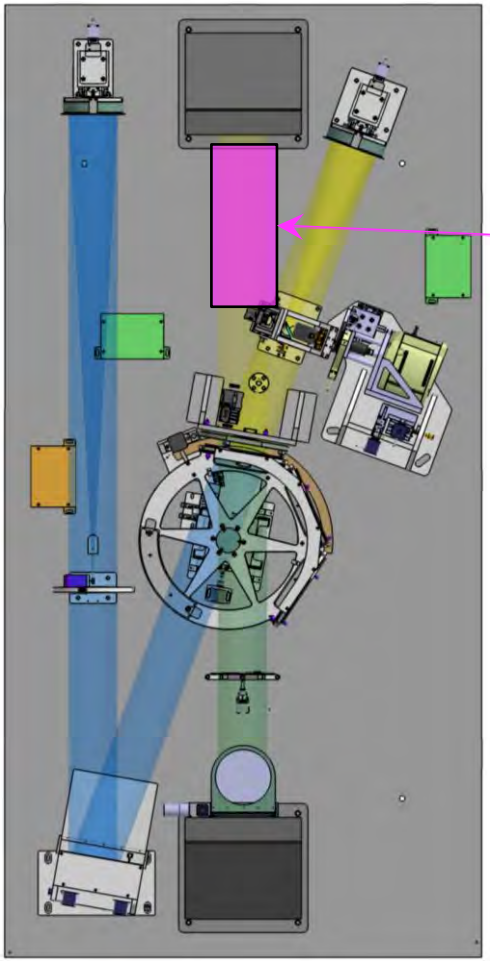








THE CALIBRATION OF THE WFS ON THE AO BOARD IS MORE COMPLEX THAN EXPECTED



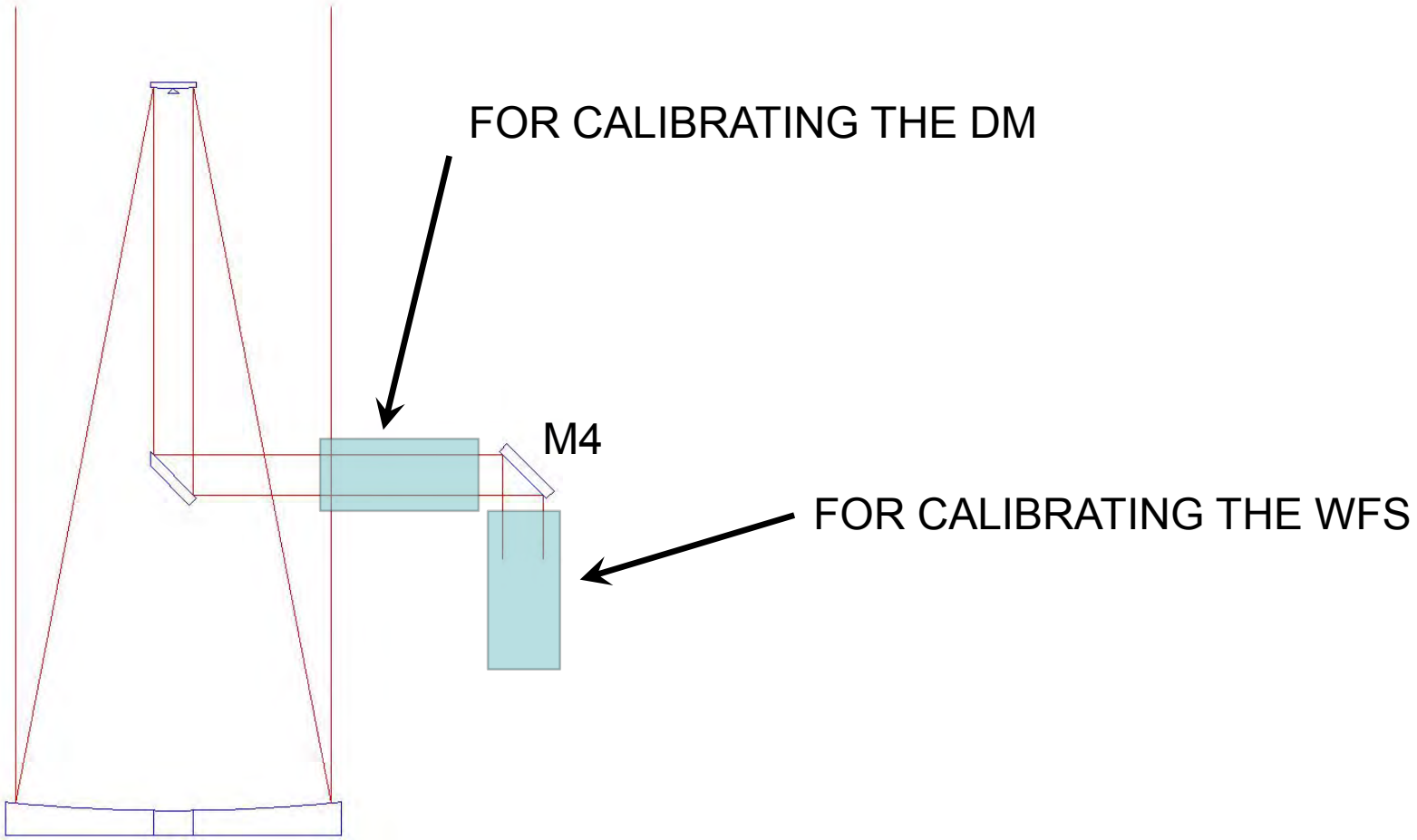
THE DICHROIC TRANSMITS THE BEACON AND REFLECTS THE STARLIGHT TOWARD THE WFS. CALIBRATING THE WFS WITH THE BEACON IGNORES THE FACT THAT THE DICHROIC IS NOT FLAT.

WE NEED A WFS CALIBRATION SOURCE THAT IS REFLECTED FROM THE DICHROIC.

DM REPLACING M4 WILL ALSO NEED A CALIBRATION SOURCE THAT COULD BE A PARABOLOID WITH A FIBER SOURCE AT ITS FOCUS.

SPACE IS TIGHT BECAUSE THE PARABOLOID HAS TO BE SLOWER THAN THE N.A. OF THE FIBER OTHERWISE IT WILL NOT BE FULLY ILLUMINATED.

POSITIONING THE CALIBRATION SOURCE

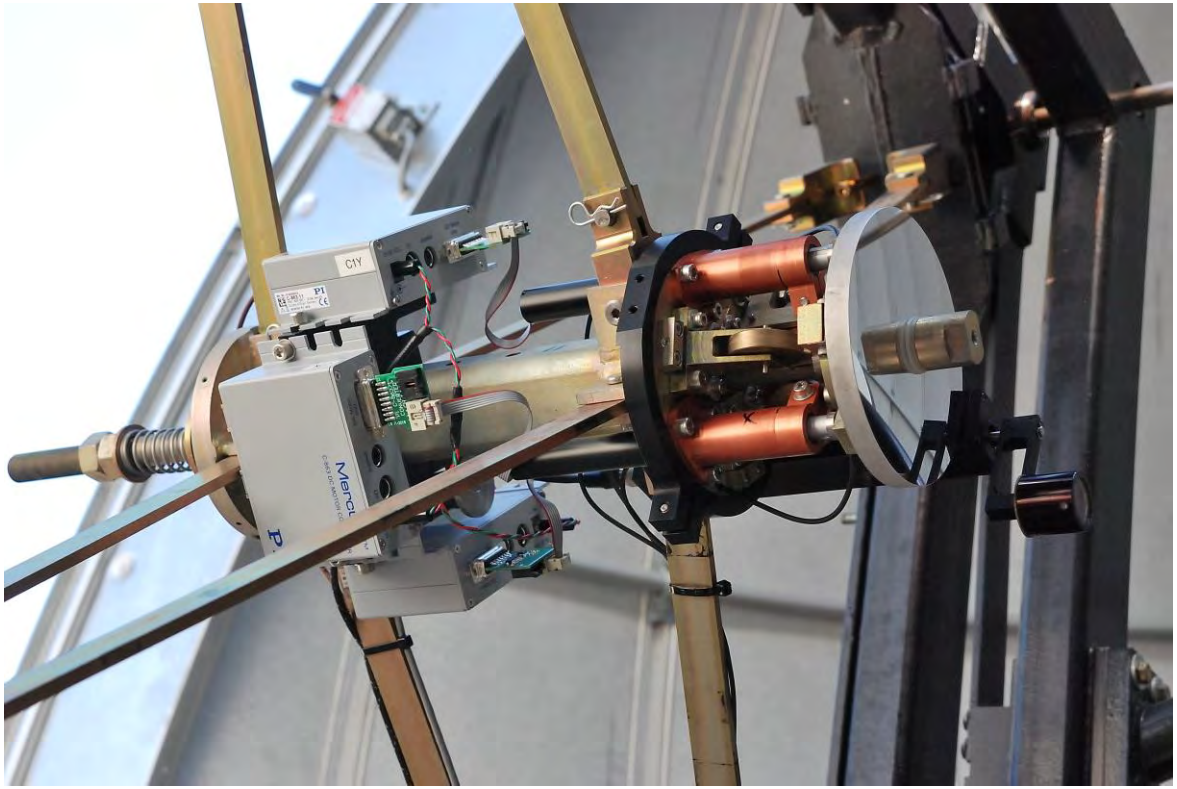


NEW FOCUS CONTROLLERS

FASTER AND EASIER TO OPERATE (Nils, Theo)

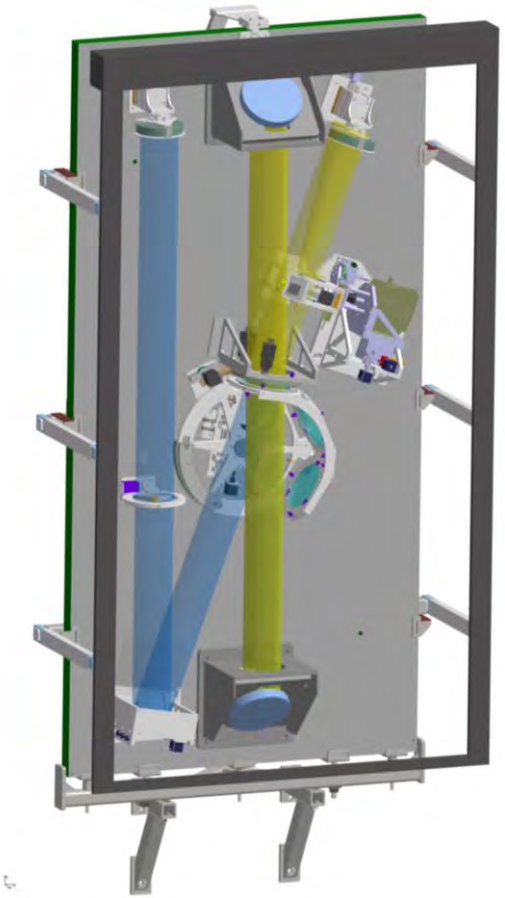
HOPEFULLY MORE RELIABLE THAN OLD CONTROLLERS

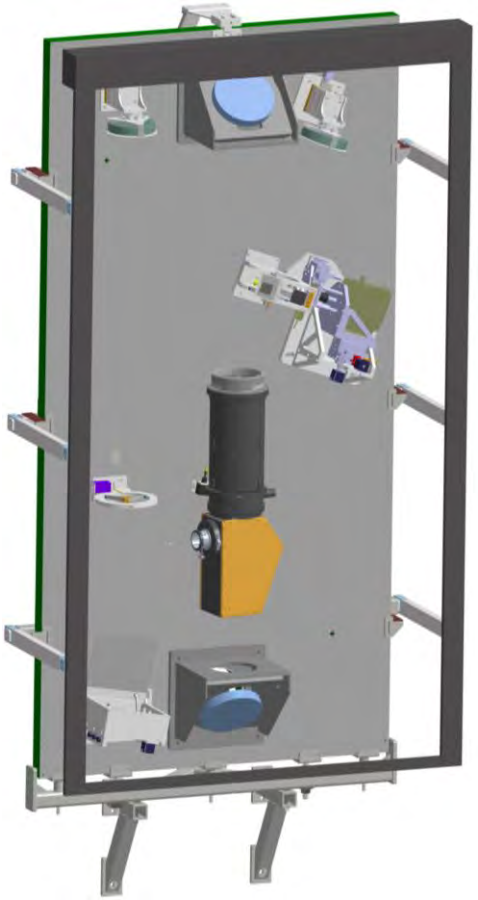
WFS WILL CONTROLL THE FOCUS OF THE TELESCOPE $\Delta Z_4(d_{M1,M2}) \cong 4\Delta Z_4(d_{PAR,COL})$



PI Mercury C-863
DC Motor Controllers

THE TELESCOPE ALIGNMENT PROCEDURE REMAINS THE SAME BUT
THE CAROUSEL NEEDS TO BE REMOVED TO MAKE ROOM FOR TAS
NOT DIFFICULT AND HAS MINIMAL IMPACT ON THE AO ALIGNMENT



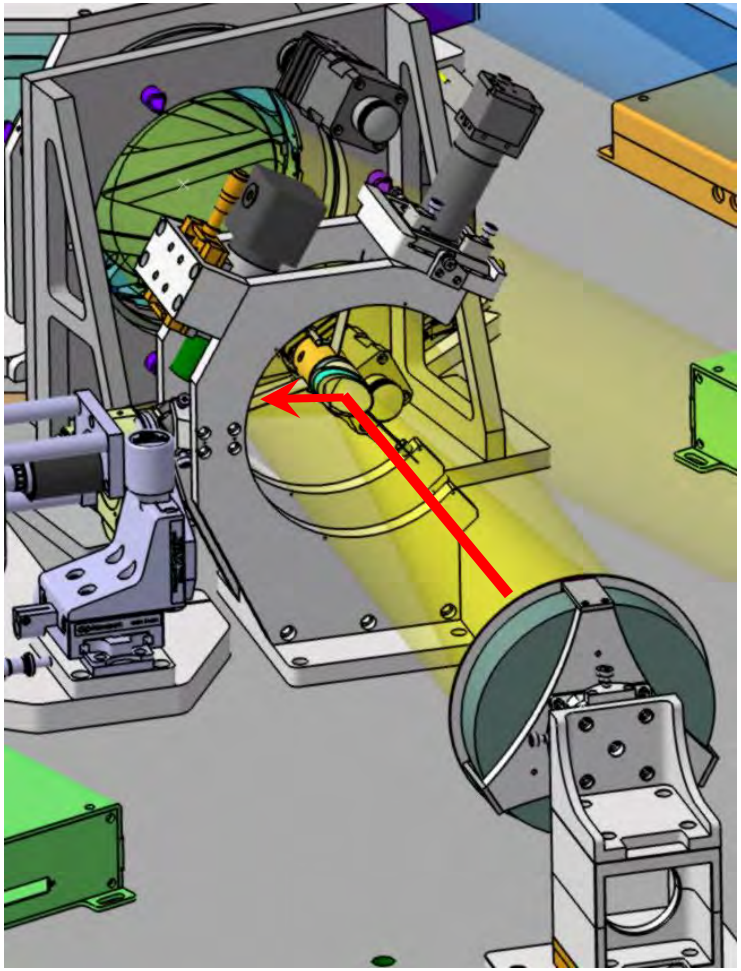


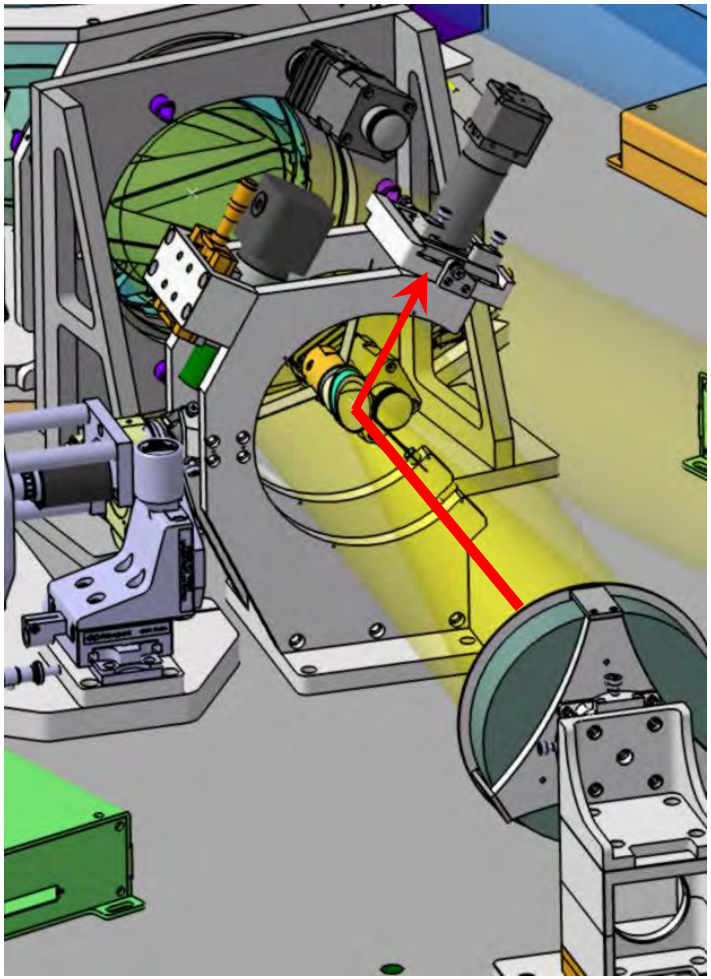
ACQUISITION TELESCOPE SECONDARY CAN BE TURNED

TOWARD AO WFS

OR

TOWARD ALIGNMENT WFS OR AN EYEPIECE



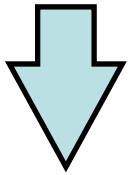


CHARA TELESCOPE DRIVES

FRICTION DRIVES AND SERVO MOTORS

- THE STIFFEST FORM OF GEARING
- VERY EFFICIENT
- VERY SMOOTH
- MODERATE COST

SERVO PARAMETERS VARY WITH TIME/TEMPERATURE

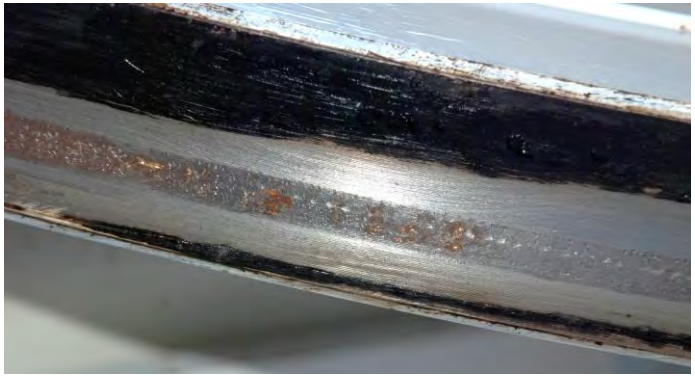


FREQUENT TUNING OR OSCILLATIONS

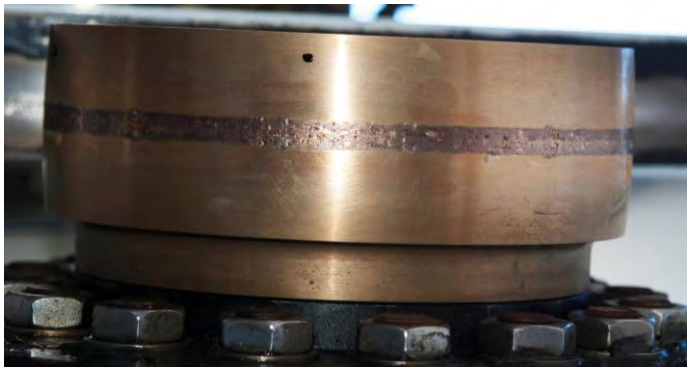
THE DC GAIN REQUIRED FOR STABLE/RESPONSIVE OPERATION IS TEMPERATURE DEPENDANT

WHEN THE DRIVES ARE TUNED AT 70 F° AND THE TEMPERATURE DROPS TO 30°- 40° IN FALL, THE DC GAIN NEEDS TO BE INCREASED TO MAKE THE DRIVES RESPONSIVE. IF THE WEATHER WARMS UP AGAIN THE DC GAIN MAY BECOME TOO MUCH AND THE TELESCOPE WILL OSCILLATE.

THE OBSERVER CAN SEE SIGNS OF OSCILLATIONS WHILE TRACKING AND CAN MAKE STEPS TO CORRECT IT BUT NOT WHILE SLEWING.
THE DAMAGES CAUSED BY THESE OSCILLATIONS OVER TIME ARE CLEARLY VISIBLE ON THE JOURNALS AND ROLLERS.



JOURNAL



ROLLER

THE PROBLEM

THE DC GAIN IS ADJUSTED BY A SINGLE TURN 500 kΩ RHEOSTAT AND BY A PROGRAMMABLE GAIN MULTIPLIER. THE RHEOSTAT IS USED AT THE VERY BEGINNING OF ITS RANGE. IF THE DC GAIN IS NOT SET TO THE OPTIMAL VALUE, CHANGING THE GAIN MULTIPLIER IN DISCRETE STEPS (4x,7x,11x…) MAY NOT BE SUFFICIENT.

THE SIMPLEST WOULD BE SWAPPING THE RHEOSTAT WITH A MULTITURN 100 kΩ ONE. THIS WOULD MAKE THE MANUAL ADJUSTMENT EASIER AND LESS SENSITIVE TO SMALL CHANGES IN THE ENVIRONMENT.

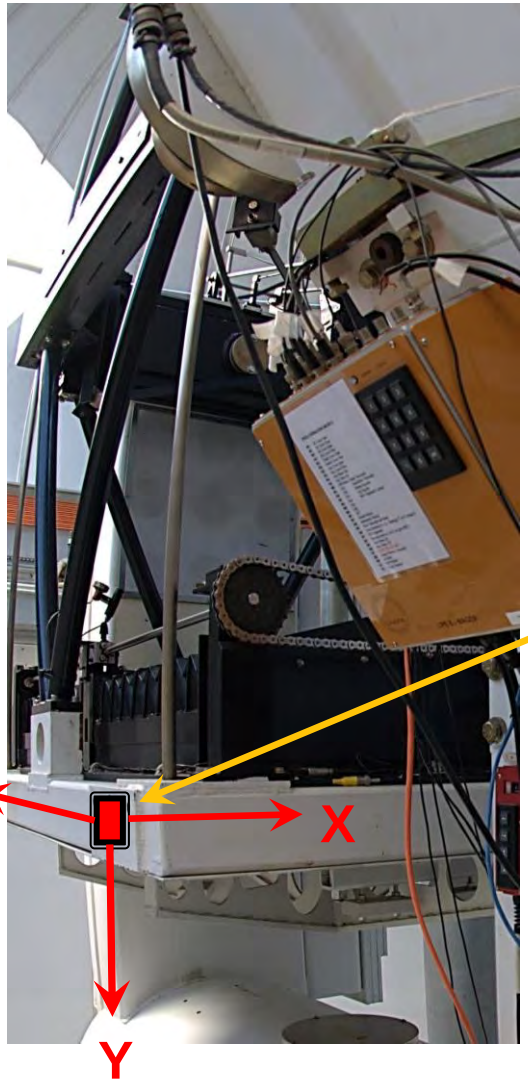
IT WOULD BE EVEN BETTER TO USE A PROGRAMMABLE NON-VOLATILE RHEOSTAT.

THESE CIRCUITS ARE READILY AVALIABLE

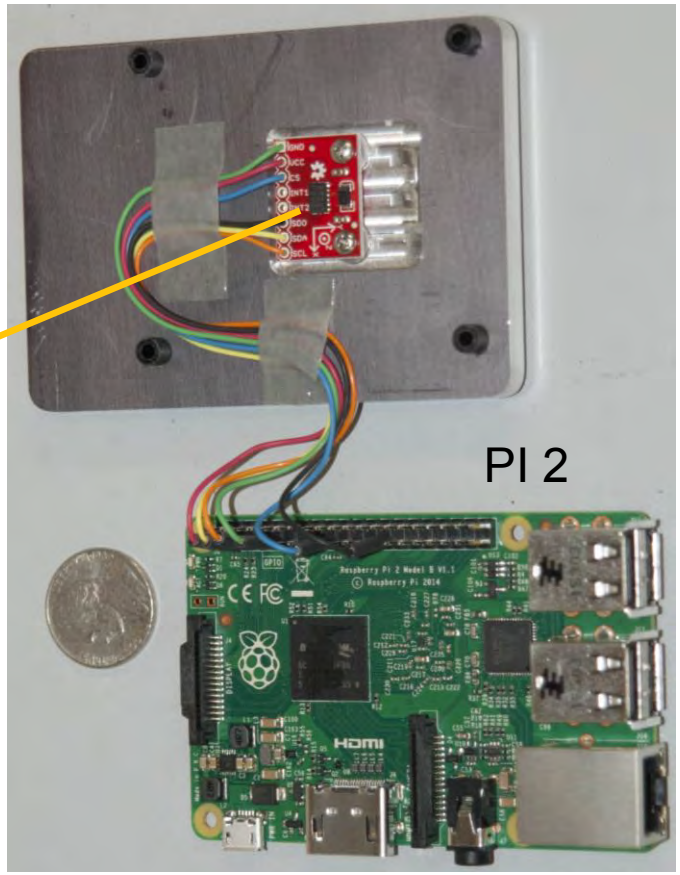
THE SCHEMATICS ARE NOT AVAILABLE FOR THE DRIVES, THUS SOME REVERSE ENGINEERING WILL BE NEEDED

FIRST WE NEED TO DETECT DRIVE OSCILLATIONS DURING SLEWING

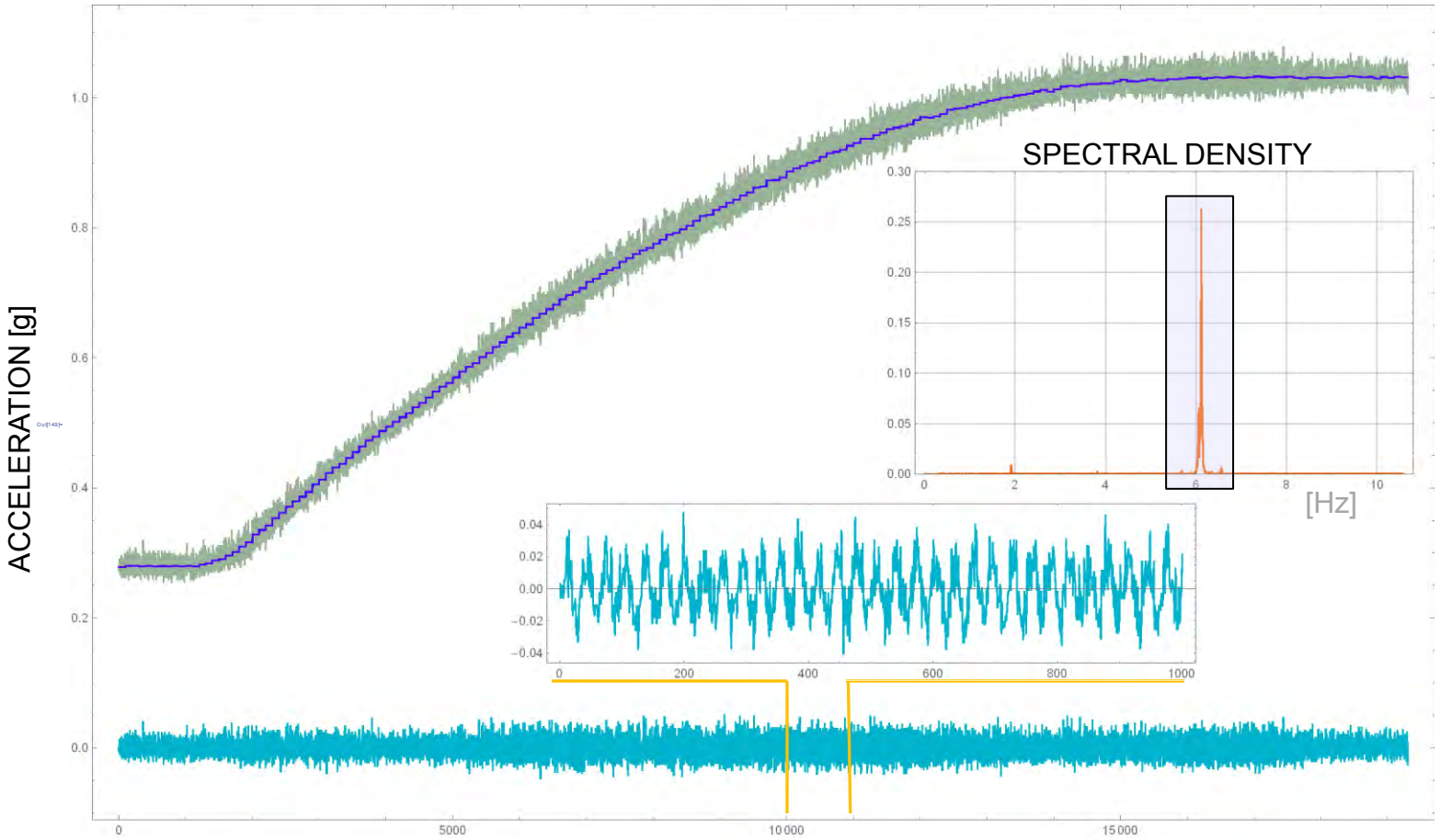
3-AXIS ACCELEROMETER ON THE TELESCOPES FOR DETECTING BOTH AZ AND EL OSCILLATIONS



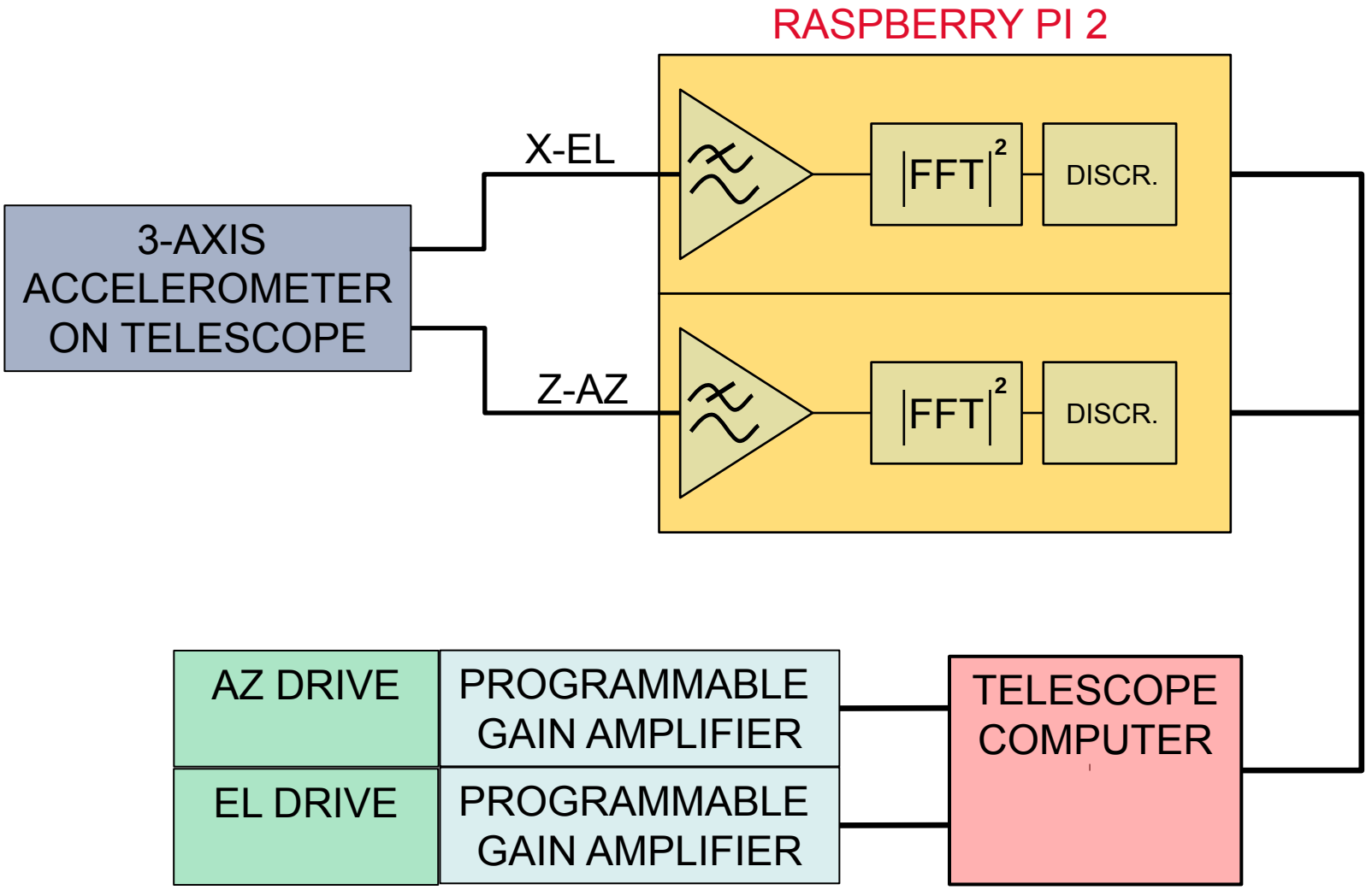
ADXL345



ACCELEROMETER DATA AS E1 SLEWING FROM 16° TO 90° IN ALTITUDE



AUTOMATIC DC GAIN CONTROL



SUMMARY

- THE INSTALLATION OF AO ON ALL SIX TELESCOPES IS ONLY WEEKS FROM COMPLETION.
- THE OPTICAL ALIGNMENT IS STRAIGHTFORWARD
- CALIBRATION IS NOT SO MUCH
- BETTER TELESCOPE FOCUS CONTROL IS BEING IMPLEMENTED
- TELESCOPE OSCILLATION WILL BE REDUCED

THANK YOU FOR YOUR ATTENTION