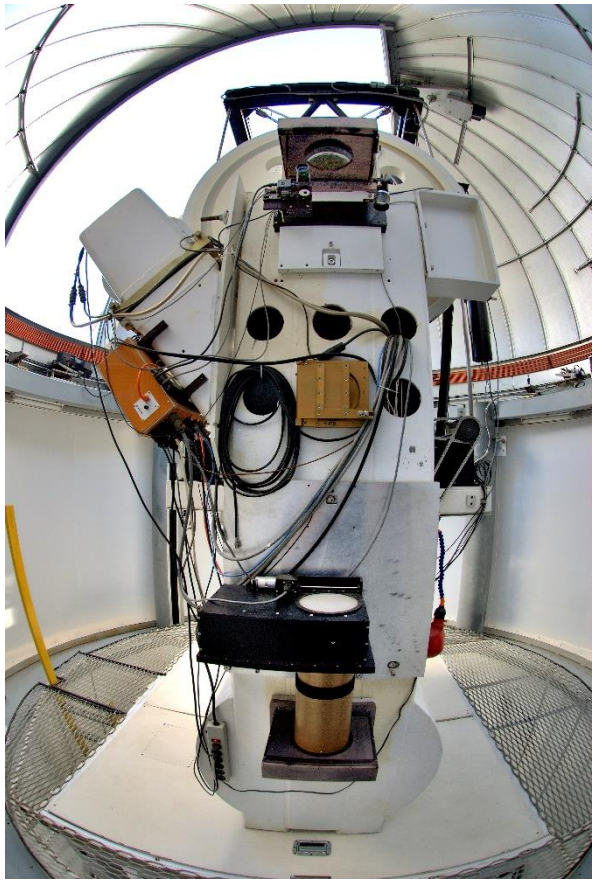
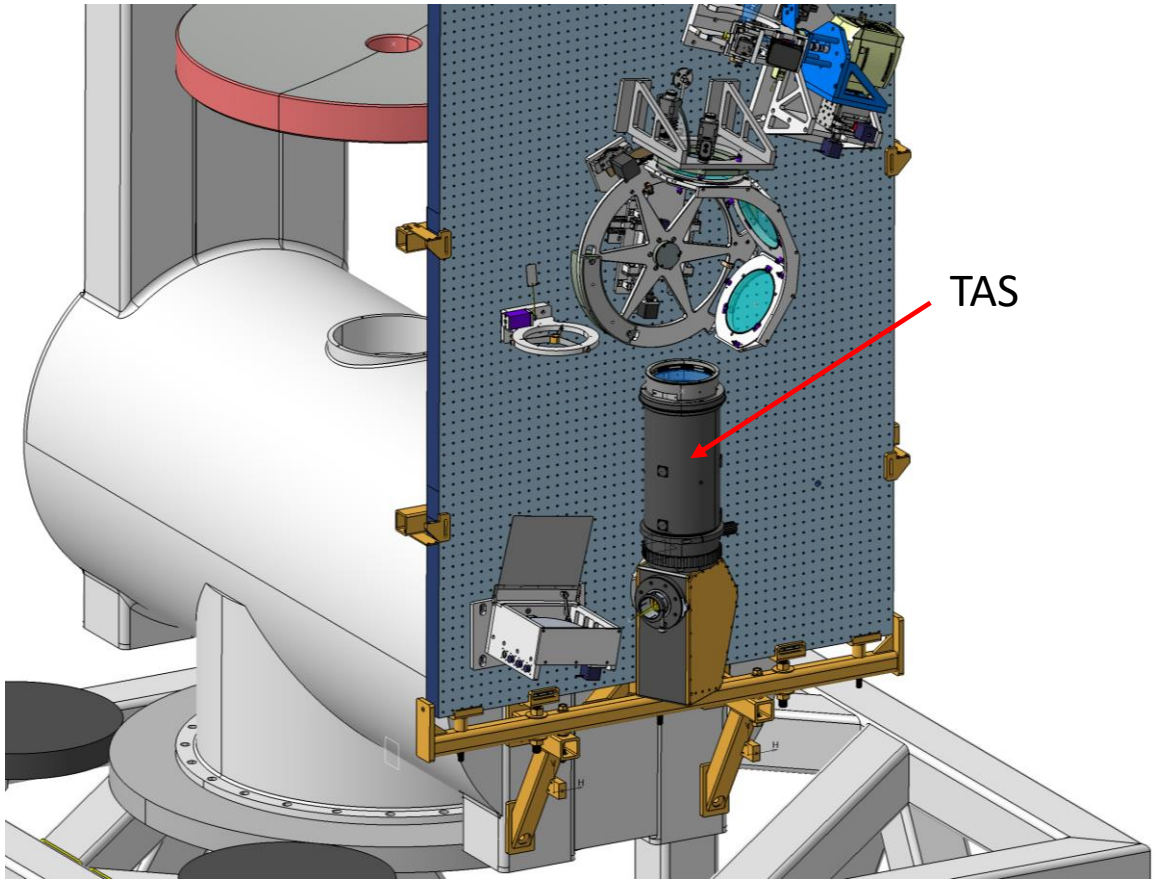
Telescope System Improvements

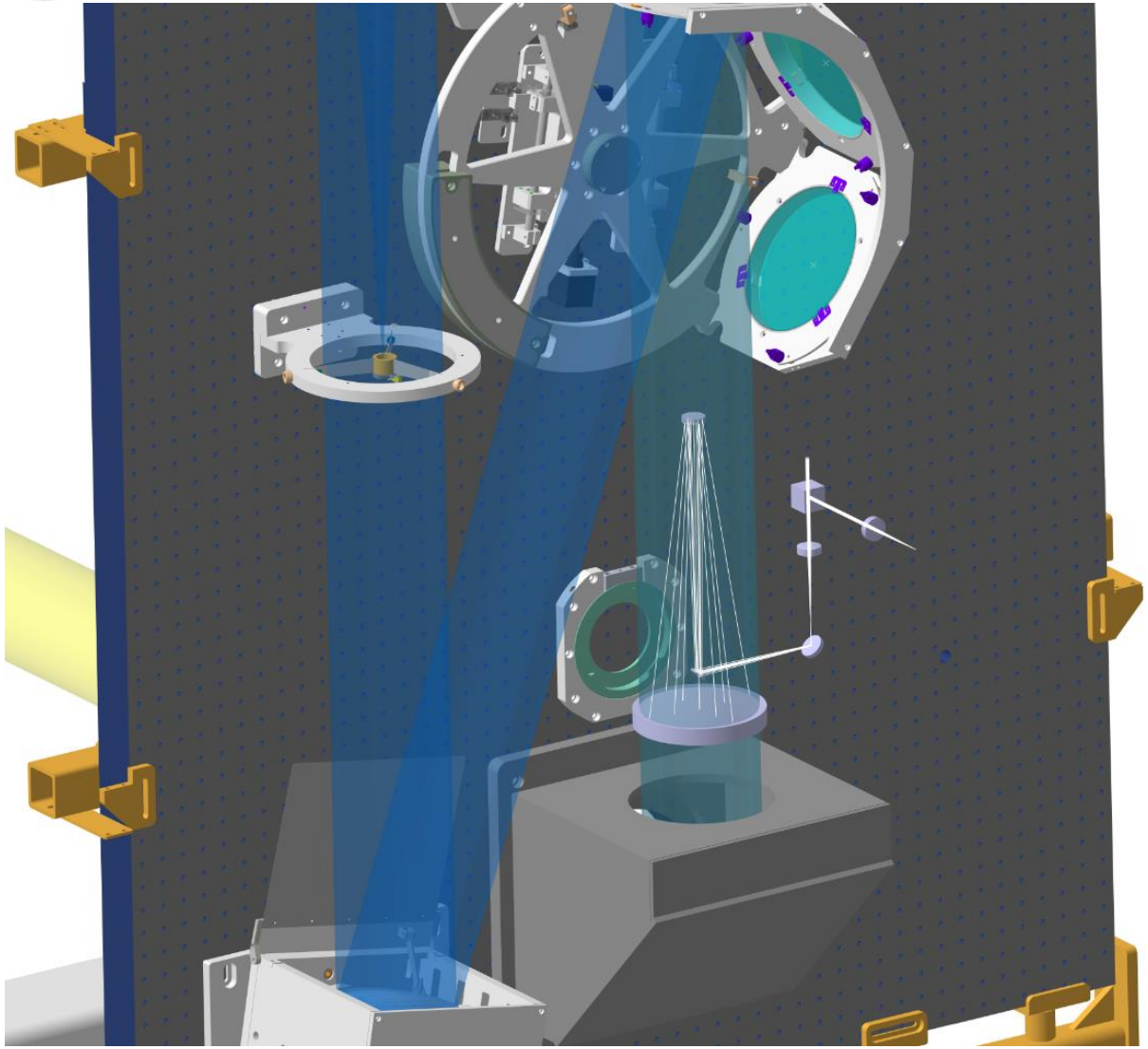
Laszlo Sturmann

TAS2

MOTIVATION: No room for TAS on the AO table







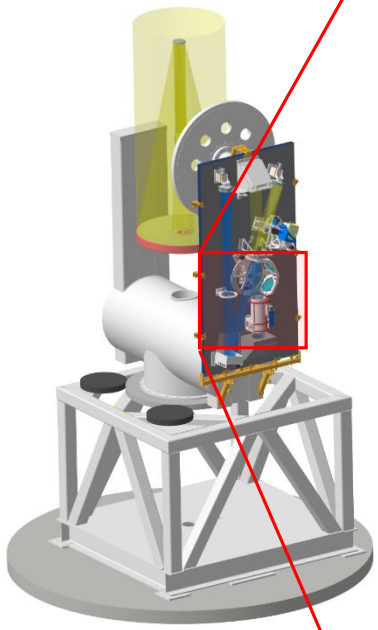
classical Cassegrain-Nasmyth system

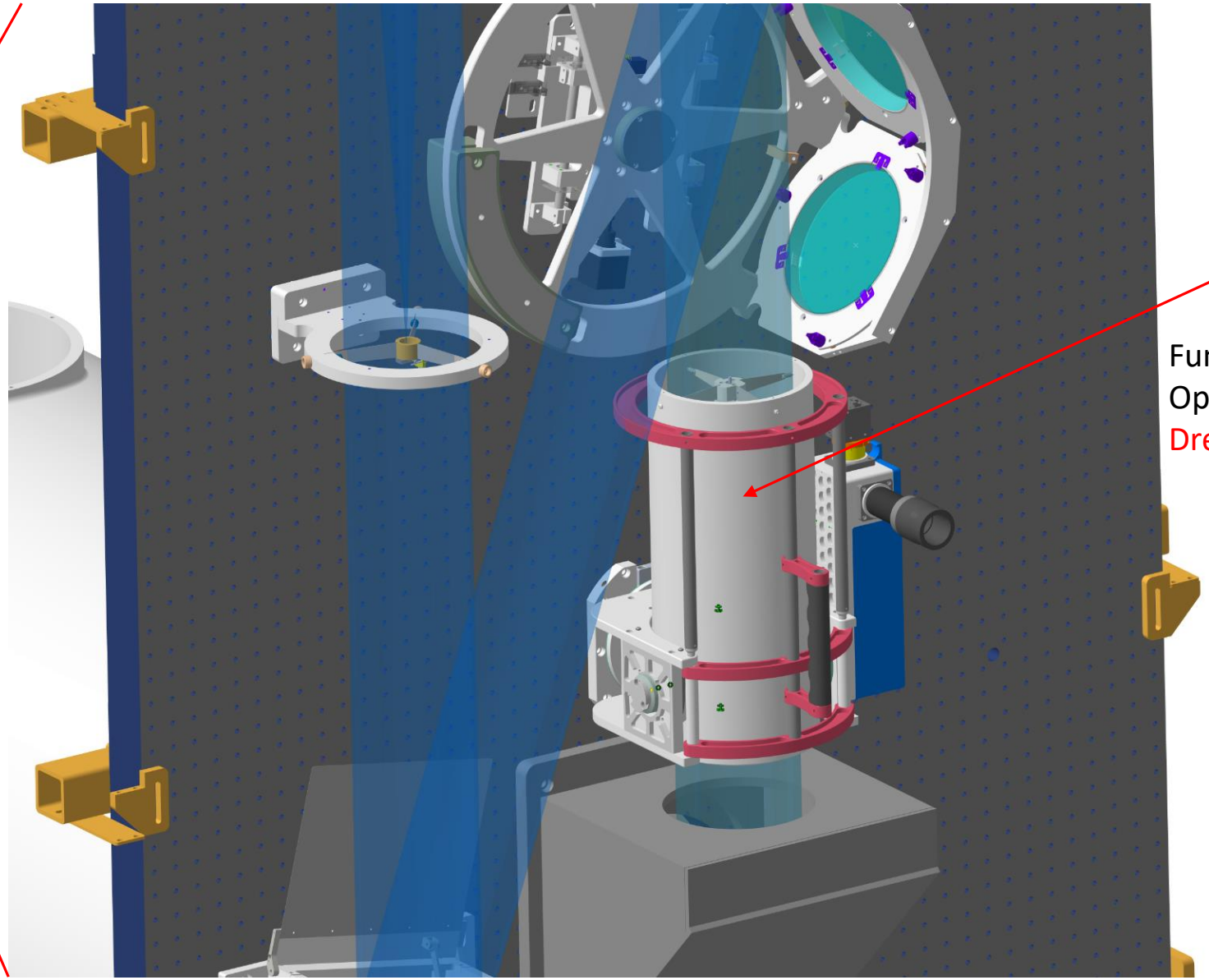
D1=140 mm,
D2 = 25 mm,
R1= -770 mm,
d12 = -318.12 mm,
R2 = -157.88 mm,
d23 = 278.12 mm,
D34 = 159.58 mm,
Conic constants (M1) = -1
(M2) = -1.822

Central obscuration 23%

F/18

Image is diffraction limited within 13 mm and fully illuminated within 3.5 mm to the axis

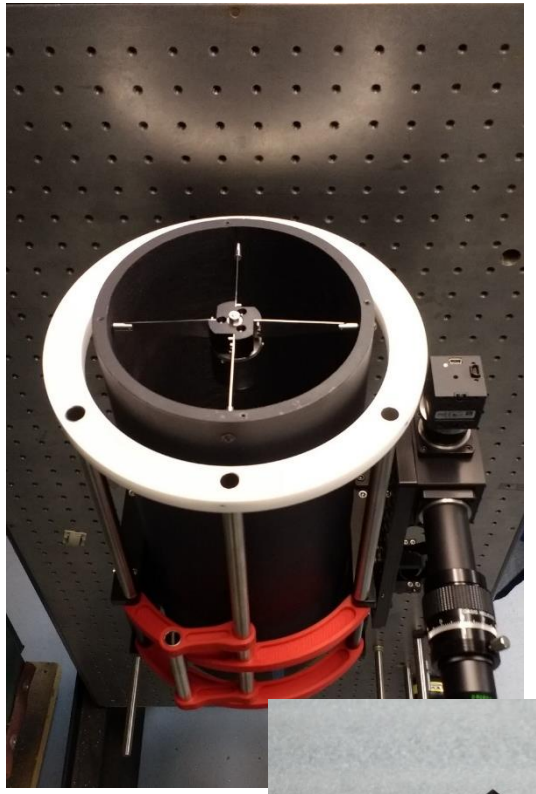




TAS2

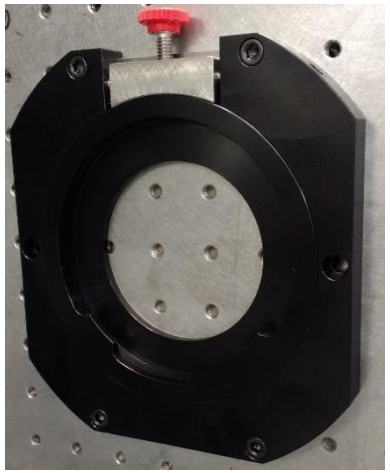
Funded: Kyoto University
Optics and tube assembly:
Dream Telescopes, Inc.

TAS2 in the shop 03/2021

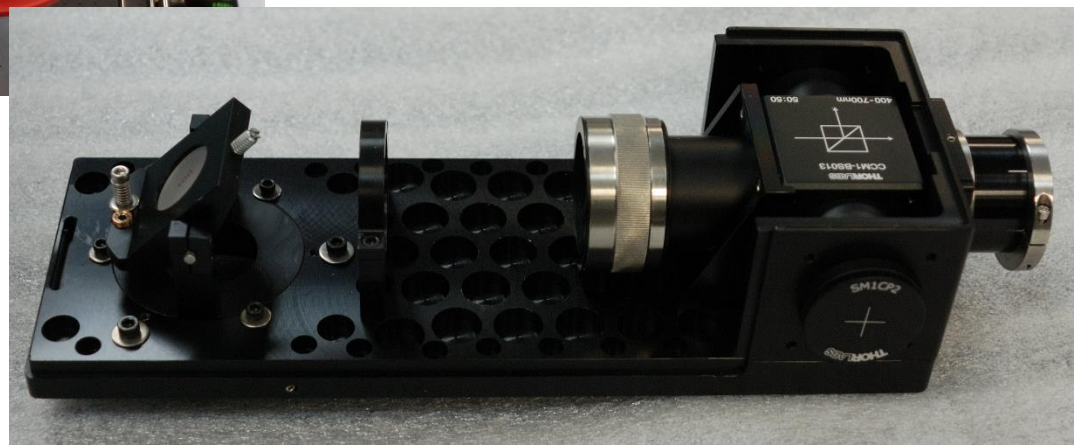


tip/tilt adjustment

pre-aligned dovetail-mount
on each AO table



detachable collimator for WFS



The alignment process is underway.

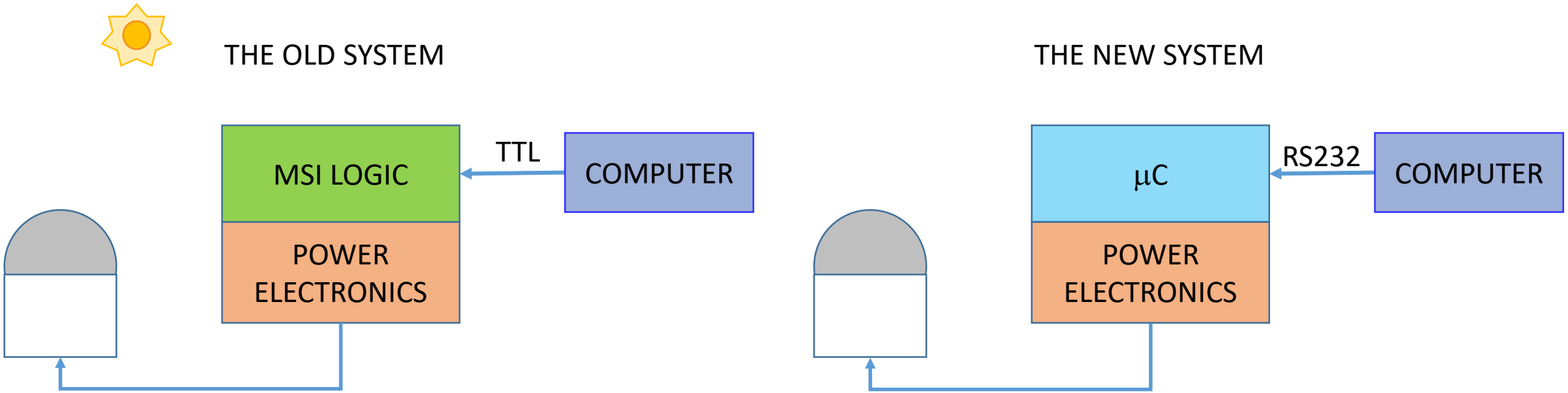
Mount for M2 and M3 were unusable, had to be redone.

New Dome Slit Controller

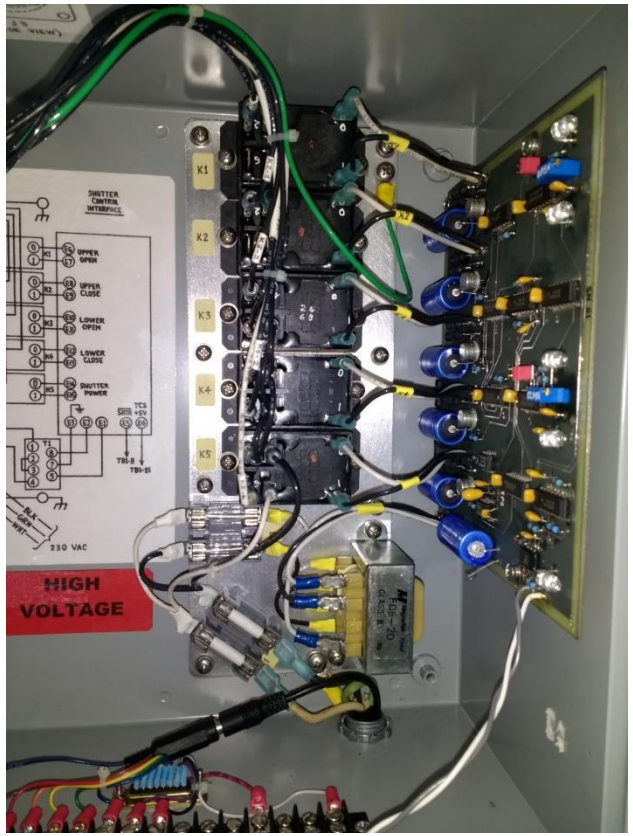
Motivation: Improving dome seeing

The original controller only allowed opening and closing the dome completely. Therefore the domes were opened late for ventilation during the summer months to protect the telescopes from direct sunlight.

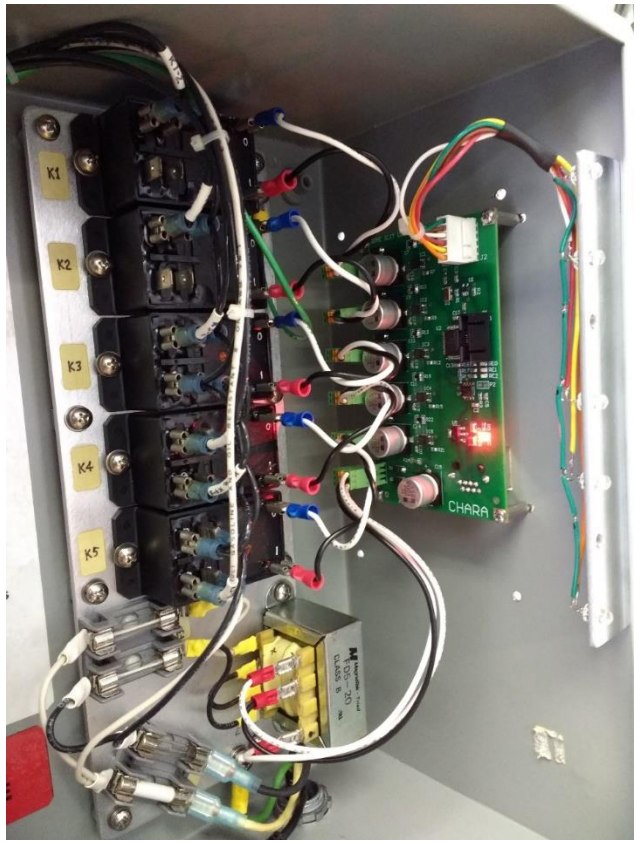
The new controller allows incremental operation of the slit and drop door. Now the domes can be opened earlier and gradually while keeping the telescope in the shade.



The original dome-slit controller



The new μC-based controller board



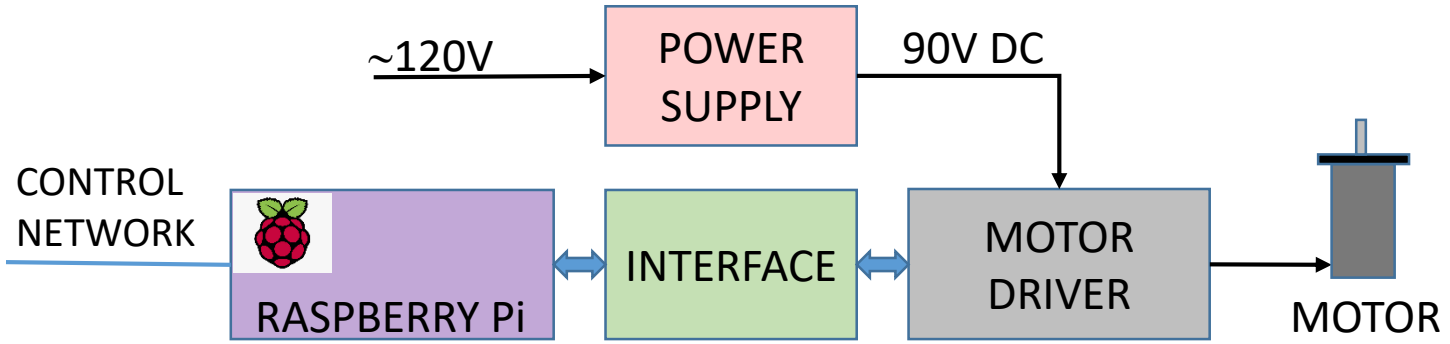
No encoder on the slit, only limit switches.
The μC opens the slit/drop door for a # of seconds and takes care of safety

New Cylinder Controller/Drive

Motivation: Improving dome seeing

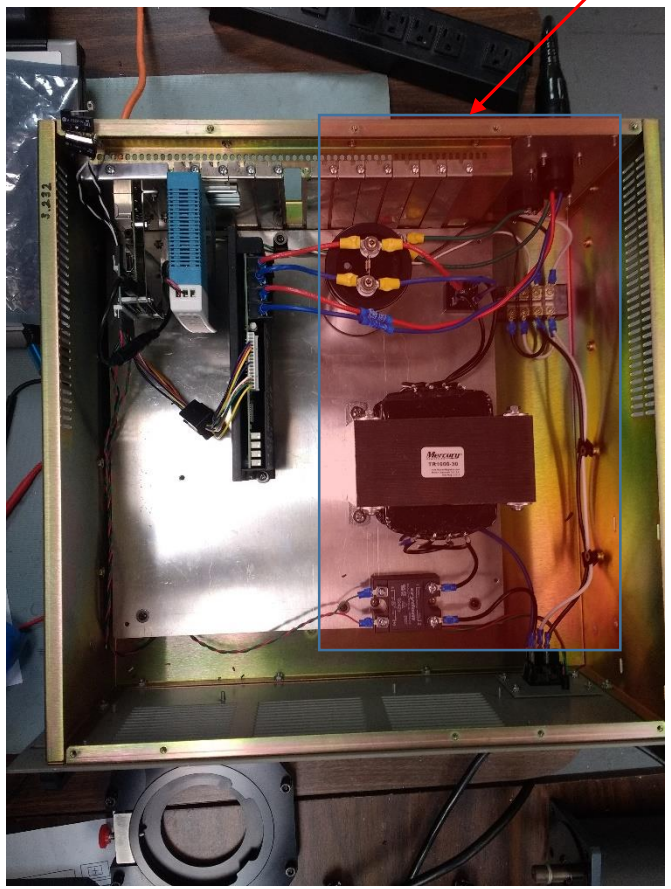
The servo drives are old and some of them do not work. Replacing them with similar drives is expensive and the precision these servo systems are capable of is not needed.

The servo drives and motors will be replaced by inexpensive DC servo drives and brushed DC motors which we obtained from Advanced Motion Control through their educational program essentially free of charge.

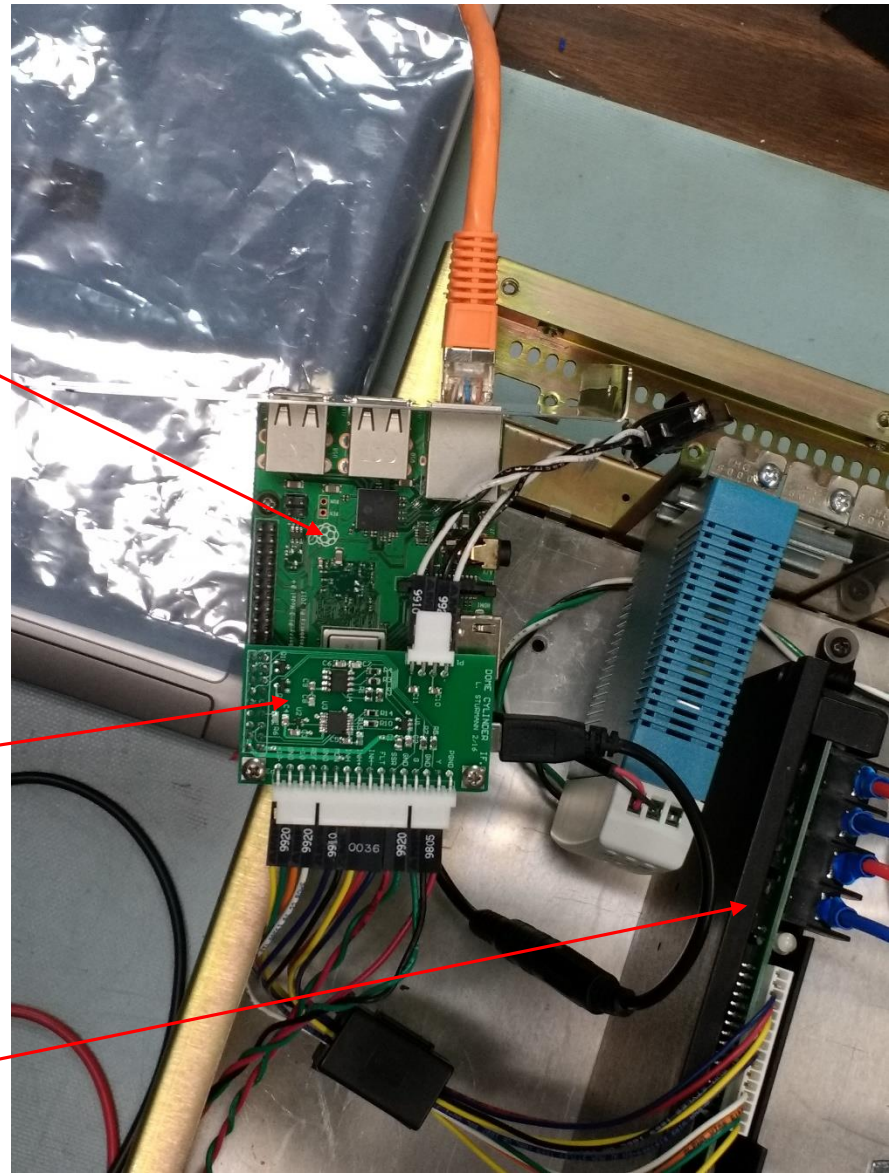


The motor will go for a certain amount of time to open/close the lower cylinder
It can be extended to move the upper cylinder as well, but probably no need for that.

linear 90V/25A DC power supply



SBC



interface

generate ±10V control signal,
monitors motor current,
handles limit switches,
power,
emergency stop

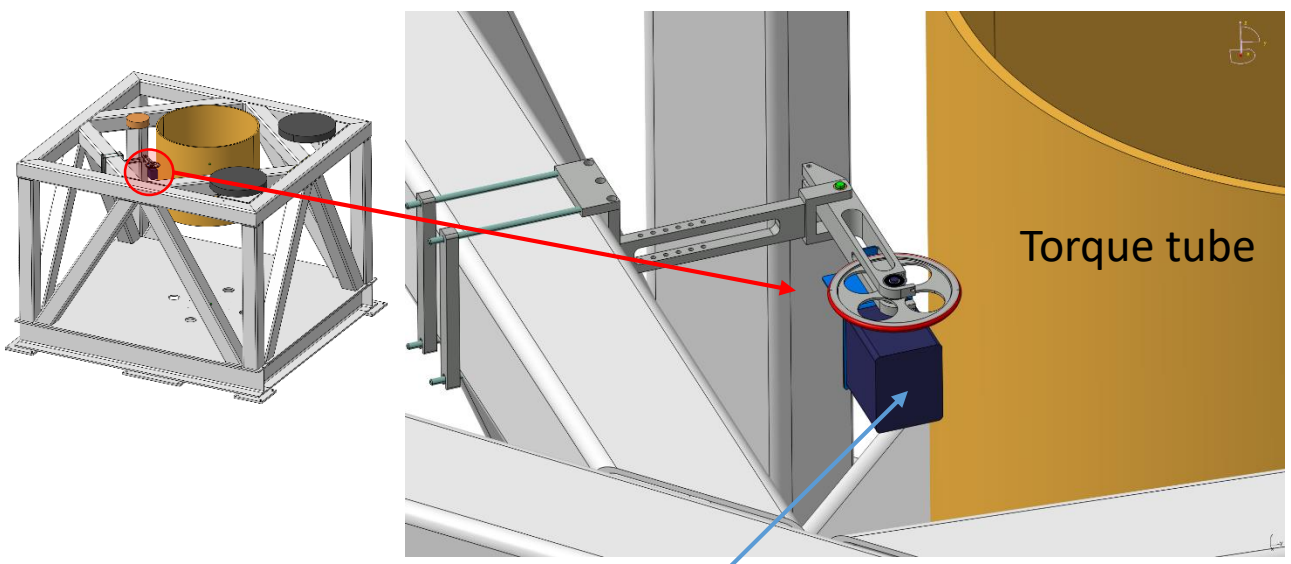
DC motor driver

Cylinder encoders are independent of the motor controller

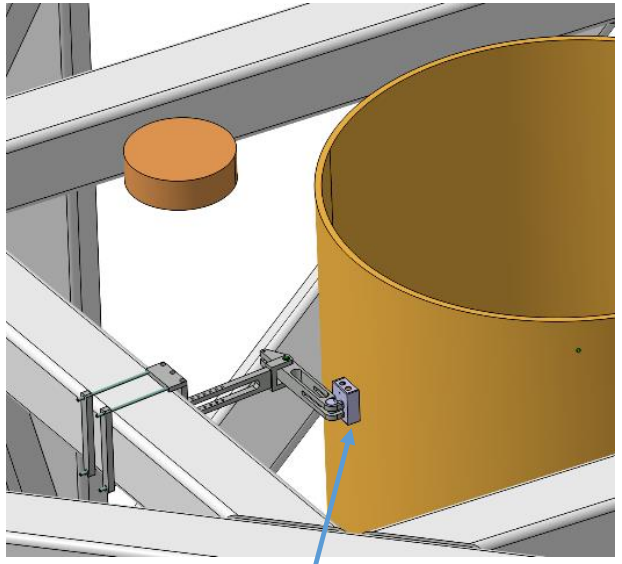
Non-Contact AZ Limit Switches

New electronics to handle the telescope limit switches and new EL switches were installed in 2017.

Motivation: The wheel slips on the torque tube → HW limits change and the wheel needs resetting

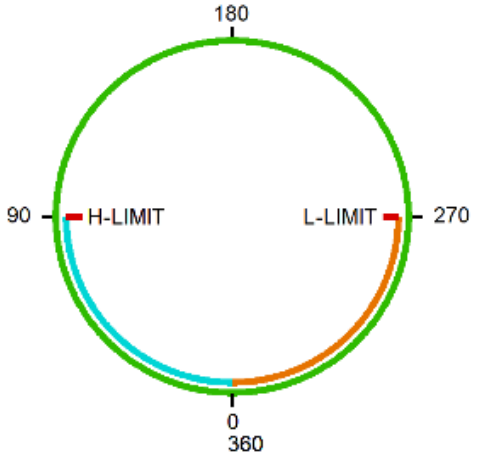


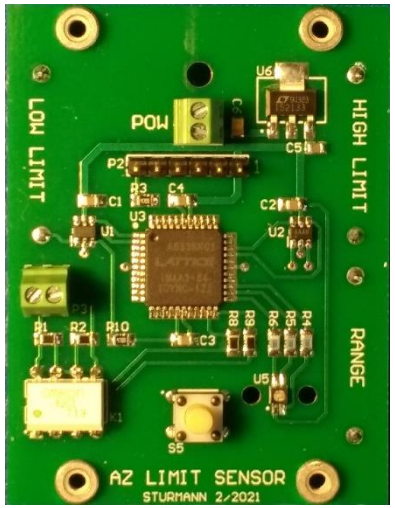
mechanical limit switches

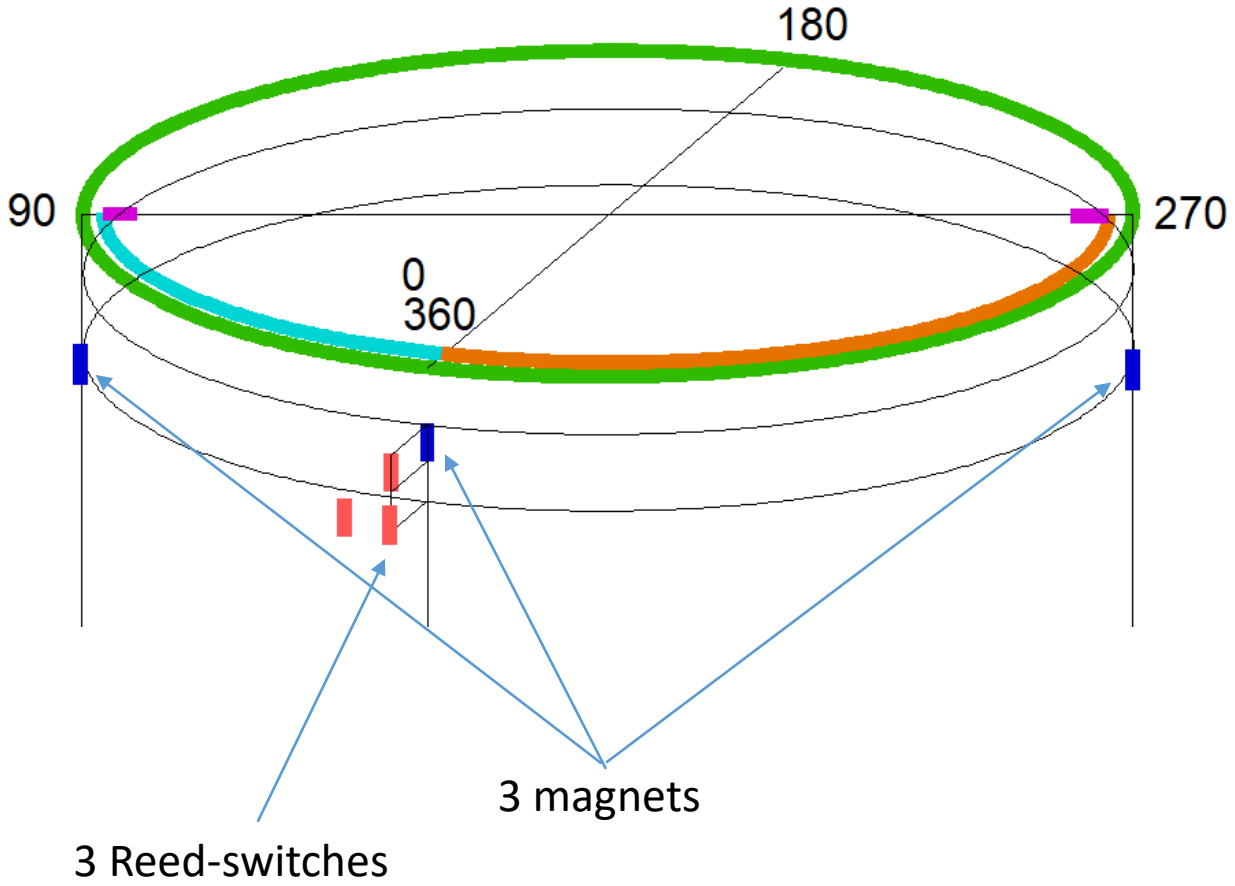


non-contact switches

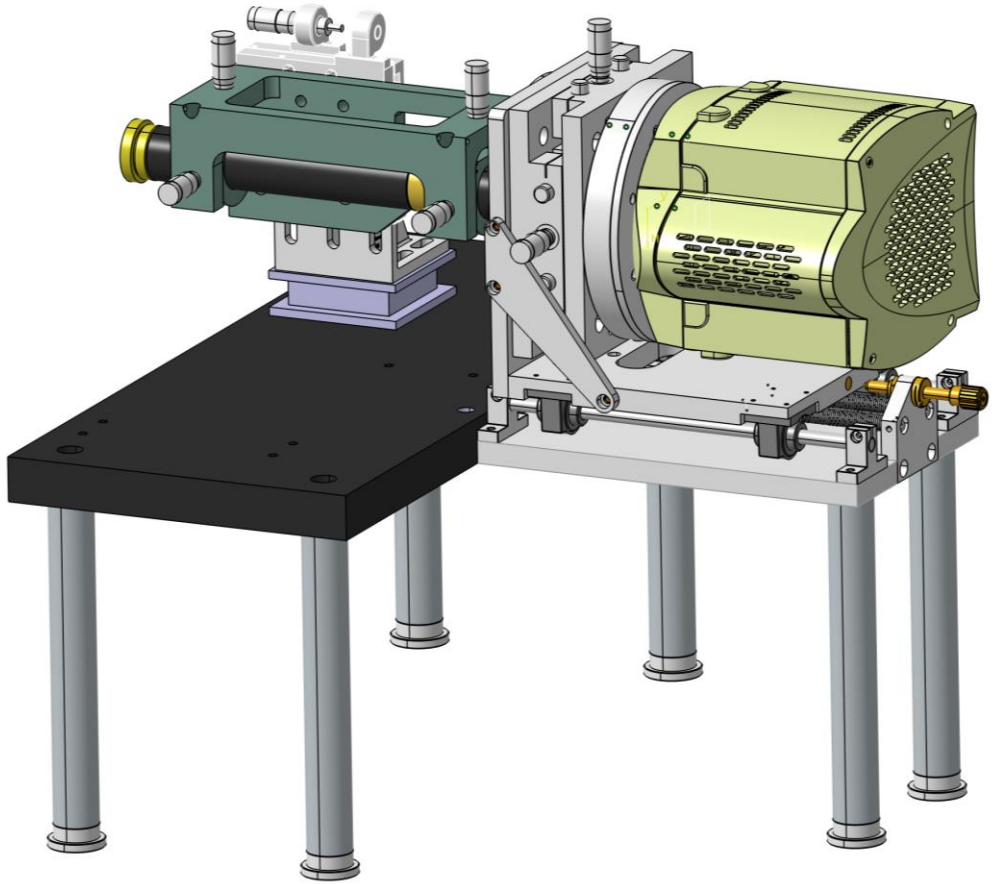
The telescope can travel more than 360°







Updated Tip/Tilt camera in the Laboratory



Replaces the Leach camera that is based on a CCD39-2 by e2v.

The new camera is an Andor iXon+EM (DU80_BV) with a EMCCD also by e2v (128x128 px, 24x24 μm).

The optics needed modification because the CCD in the Andor camera is further back from the window compared to the Leach camera.

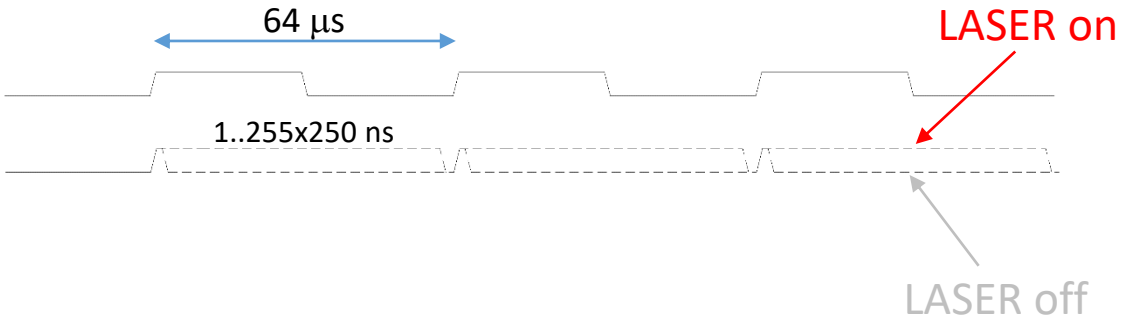
The optical modification will not change the on-sky pixel-scale.

LASER Diode Driver for the Beacons

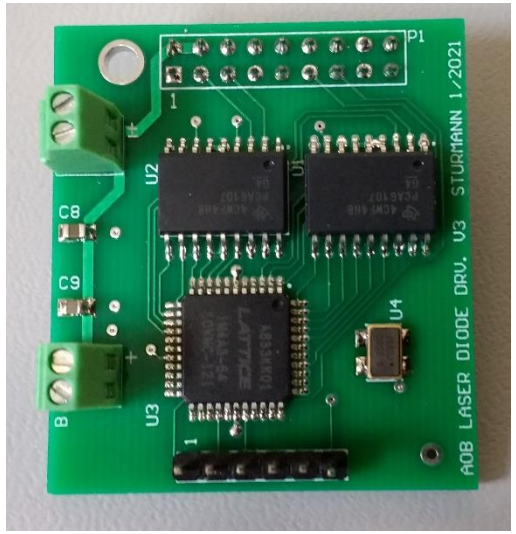
The AOB controller drives a red and a blue LED to provide a beacon for the telescope T/T and the Lab AO, respectively.

The LEDs are being replaced with LASER diodes to have more light. This required a 2-channel PWM controller to set the proper brightness of the LASERs. An 8-bit PWM controller was built and interfaced with a Raspberry Pi 4 which also controls the finder and acquisition cameras.

The pulse frequency is 31.25 kHz and the width of the pulses can be programmed from 250 ns to 63.75 µs.
So even at 1 ms exposure 31 bright LASER pulses with variable length hit the cameras.



PWM driver



AOB2

AOB controls the actuators associated with the AO system at the telescopes. It was built about 4 years ago. It is a modular, open system architecture which currently allows the remote control of 24 stepper motor based actuators. One of its main feature is that it switches one motor driver among the different actuators. This was a major cost saver then and also it seemed enough to move one actuator at a time. As we gained more experience with the operation of the AO system the need to drive more than one actuator at a time became apparent. Also, inexpensive intelligent motor controller ICs became available so it is time to update AOB. The new AOB2 will also address some issues with the motor driver and the susceptibility of AOB to intermittent EMI.

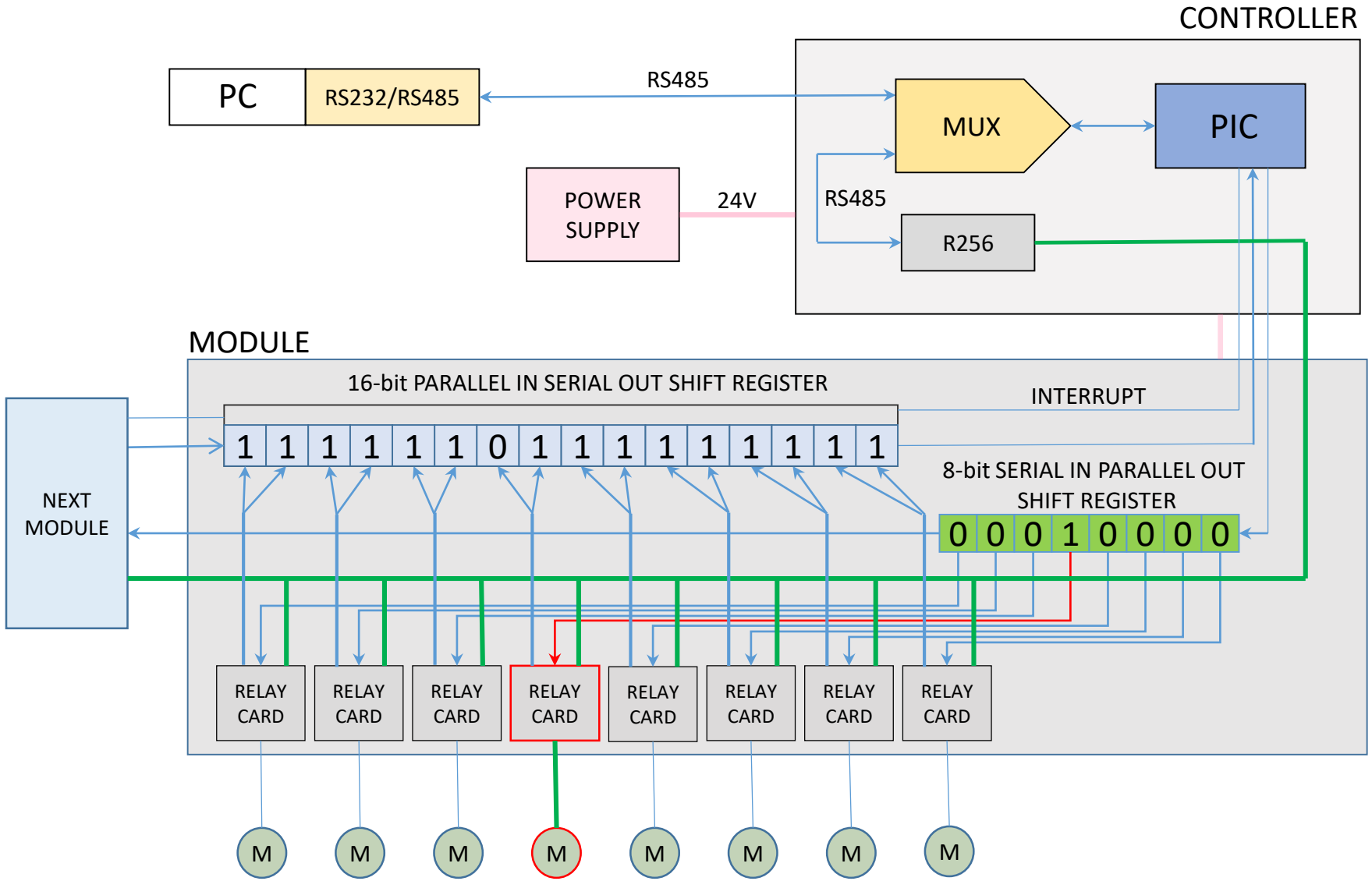
RS256 Motor driver

INTERFACE

AOB

3 MODULES FOR 24 STEPPER MOTORS

AOB


CONTROLLER
PC
RS232/RS485
RS485
MUX
PIC
POWER SUPPLY
24V
RS485
R256
MODULE
16-bit PARALLEL IN SERIAL OUT SHIFT REGISTER
INTERRUPT
1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1
NEXT MODULE
8-bit SERIAL IN PARALLEL OUT SHIFT REGISTER
0 0 0 1 0 0 0 0
RELAY CARD
RELAY CARD
RELAY CARD
RELAY CARD
RELAY CARD
RELAY CARD
RELAY CARD
RELAY CARD
M
M
M
M
M
M
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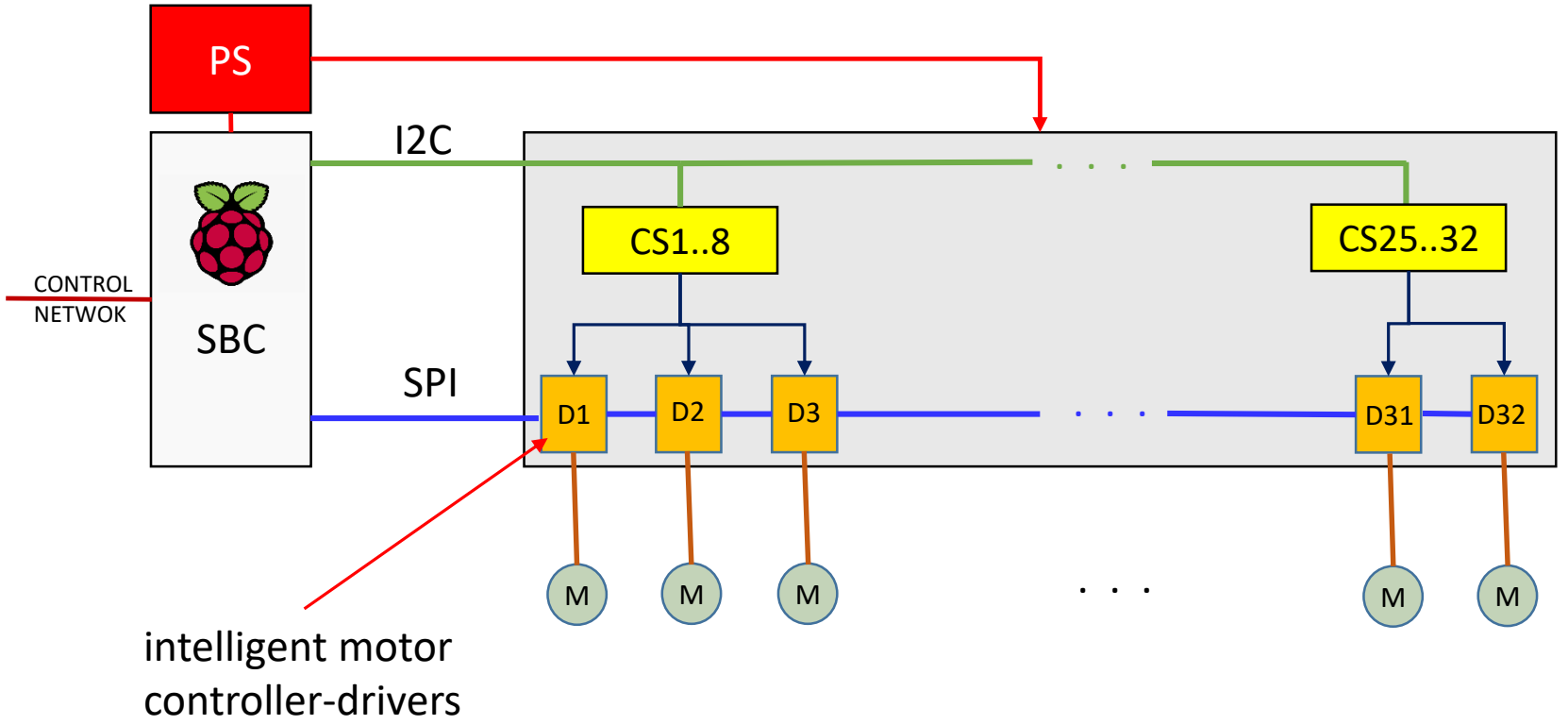
M

AOB2 plan


PS
I2C
CONTROL
NETWOK
SBC
SPI
CS1..8
CS25..32
D1
D2
D3
D31
D32
M
M
M
M
M
intelligent motor
controller-drivers