NEW LIFE FOR OLD TELESCOPES

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2023-06-03
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Many Mothballed Telescopes Around the World

In my travels, it's somewhat painful to me to see unused telescopes.

- Many were wonderful telescopes in their day.
  - Reasons of an idle telescope:
    - Old Broken Electronics
    - Software requires old PCI circuit boards, and old outdated computers.
    - Too Expensive to Repair
    - No person knows how to operate the old controls

Many Mothballed Telescopes Around the World

Solutions:

- Purchase a new telescope and mount
  - Planewave or Other
  - Discard the old telescope and mount

OR

- Upgrade the existing control system
  - DIY?
  - Contract a company that upgrades old telescopes (us) ?

Reasons for a new telescope and mount

All new hardware

All New Software

Planewave or Other

Get rid of troublesome and inaccurate gears

Reasons for upgrading an idle telescope and mount

Chief reason is economics

All New Modern Software

New Electronic Hardware

- Servo Controllers
- Servo Motors
- Modern Accurate Encoders (will correct for inaccurate gears)

Cost Comparison for upgrading a 24 inch vs. Purchasing and installing a New 24 inch telescope

24 inch with Direct Drive Mount, over $100,000 with a few accessories

Installation Costs ??

Cost Comparison for DIY upgrading a 24 inch vs. Purchasing and installing a New 24 inch telescope

A new professional, reliable controller for both telescope axes, @ $1,000 to $5,000

Use Existing Servo Motors

Don't install Accurate scope Encoders

Student help or volunteer help

Total Cost: $1,000 to $6,000 (depending on the controller)

Cost Comparison for Contracted upgrading a 24 inch vs. Purchasing and installing a New 24 inch telescope

Based on our upgrade of the 24 inch at Martz Observatory in New York

We provided new brushless motors to replace the old stepper motors

Re-Used existing Scope Encoder on Rt Asc

We added Mirror Cover control with controller and actuators

New Dome Controller which used the Existing Motor, Existing Contactors, and existing Encoder

Less than $30,000 including travel expenses.

Considerations:

- Cost:
  - Hardware
    - Motor Controllers
    - Motors (if necessary)
    - Scope axis encoders (if necessary)
    - Dome upgrades
    - Mirror Covers
    - Installation costs
    - Machining costs
- Cost:
  - Software
    - All of our software is free
    - We now have complete observatory control
    - (SGP? ACP? CCDC? Other?)

Considerations:

- Final Purpose:
  - Purpose, for instance GRB followup? NEA followup, Satellite tracking? Photometry, Astrometry? Education? Visual? All of the above?
- Final Goals
  - Tracking Accuracy?
  - Slew Speed?
  - Remote?
  - Robotic?

Considerations:

- Optics
  - Accuracy, (maybe worth an optical test)
  - ReCoating necessary?
  - Mirror Cell?
  - Thermal Management?

- Existing Motors OK?
  - Steppers?
  - Brushless?
  - Can we re-use existing motors?
  - Is there an existing Motor Controller that has step/direction inputs?

Considerations:

- New Motors:
  - Torque Requirements
    - Acceleration needed (F=MA)
    - Frictional component (spring pressure worm gears) have a lot of friction)
    - Imbalance component
  - A couple of sources for brushless motors:
  - https://www.electrocraft.com/
  - https://teknic.com/products/brushless-servo-motors/

Considerations:

- Mount Condition
  - Accuracy of drive train
  - On-Axis encoders to correct for mount errors?
- How to install mount encoders if necessary?
- Focuser?
- Rotator?
- Camera and Filter Wheel?

Considerations:

- Dome Control:
  - Any feedback for dome position?
  - Homing switch?
  - Bar Codes?

- Good Internet Service
  - A must for remote or robotic operations

Sidereal Technology Telescope Controllers:

ServoI, our first controller, first sold in 2004 or so (small brushed motors, about 50 watts per axis)

ServoII controller, first sold about 2008 (medium brushed motors, about 100 watts per axis)

ForceOne, first sold about 2013 (1000 watts per axis, brushed, brushless or direct drive)

ForceTwo, first sold about 2018 (5000 watts per Axis, brushed, brushless or direct drive)

StepDirection controller, first sold about 2020. Connects to our software, and can control industrial step/direction motor drivers at up to1Mhz

Sidereal Technology Controller.. ServoII:

Sidereal Technology Controller ServoII

Brushed Motors Only
4 amps per axis
up to 28 Volts Supply
26 bit or 32 bit Renishaw Encoder (Optional per Axis)
2 high speed TTL incremental encoders (each axis, total 4)

Sidereal Technology Controller
Force One

Sidereal Technology Controller
Force One

Brushed, Brushless, or Direct Drive motors

6 amps per axis continuous (conservative)

150 Volts Supply (conservative)

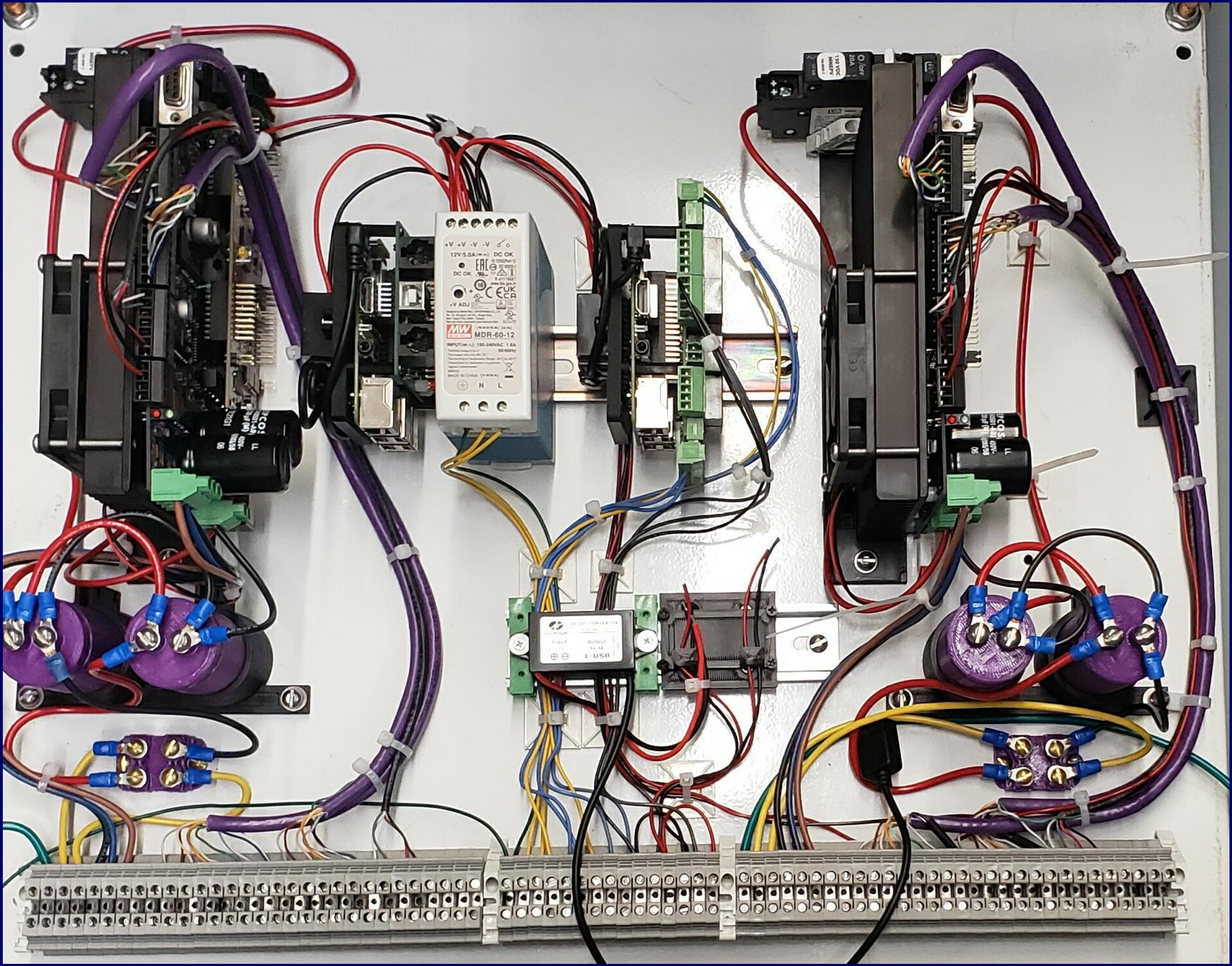
26 bit or 32 bit Renishaw Encoder (per Axis)

4 high speed RS422 incremental encoders

One Notch Filter (per axis)

Motor Power is fully isolated from the control power

Sidereal Technology Controller, ForceTwo, our latest Servo Controller as installed on 1.3 meter at CTIO Chile



Sidereal Technology Controller, ForceTwo, our latest Servo Controller as installed on 1 meter scope at SAAO

Uses One ForceTwo and Two ForceOnes.

Dr. Hannah Worters

Sidereal Technology Controllers, ForceTwo

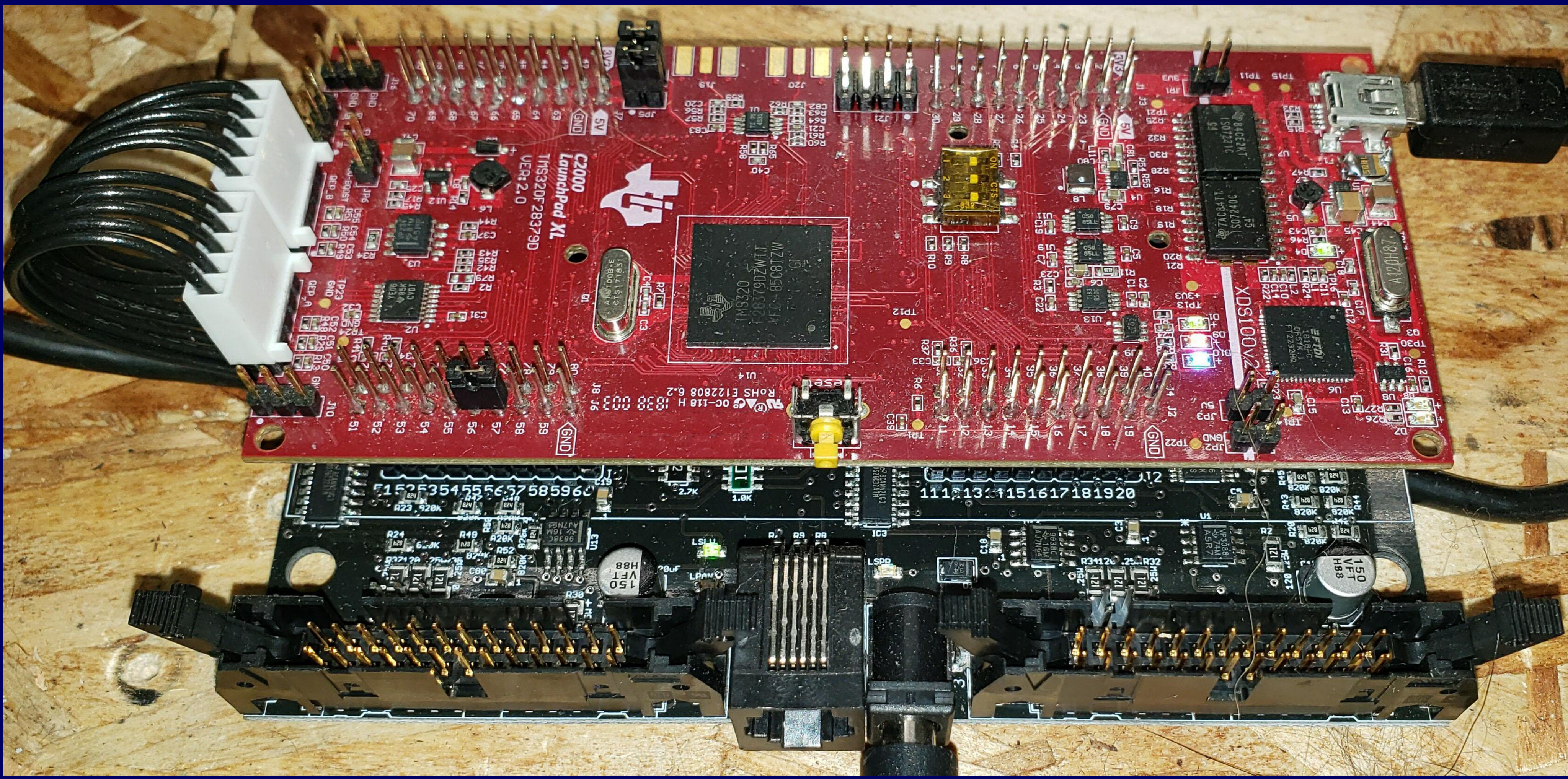
20 Amps Continuous (conservative)
250 Volts Supply (conservative)
26 bit or 32 bit Renishaw Encoder (per Axis)
Or Heidenhain Absolute Encoder (per Axis)
2 high speed incremental encoders (each axis, total 4)

TI DSP
Position Loop
Velocity Loop
Current Loop
Four Notch Filters
3 Low Pass Filters

Sidereal Technology Controllers

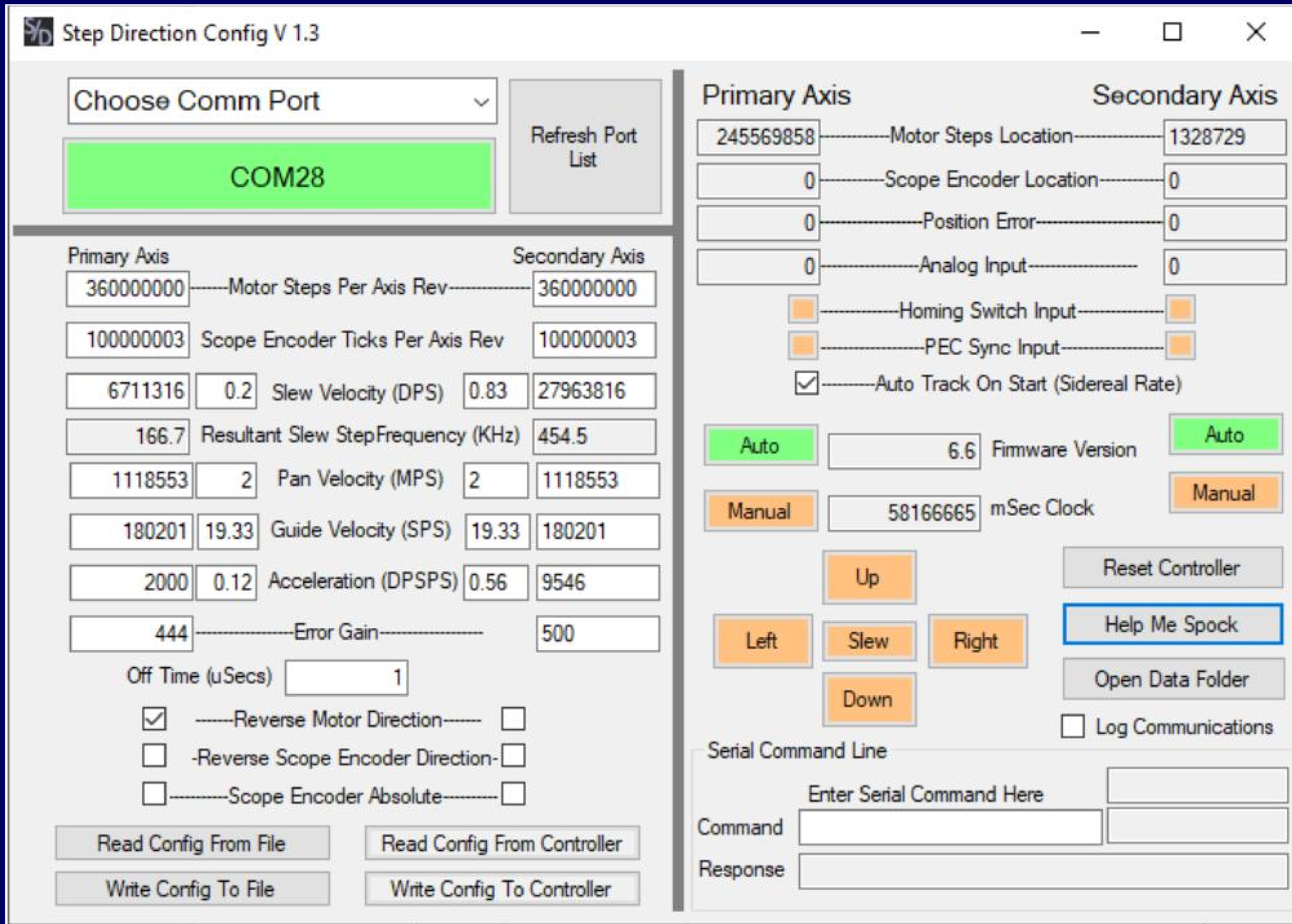
1 MHz (Per Axis) Step/Direction Controller

(Shown without case)



Step / Direction Controller

- Configuration Software



Some Installations with Tech Support only

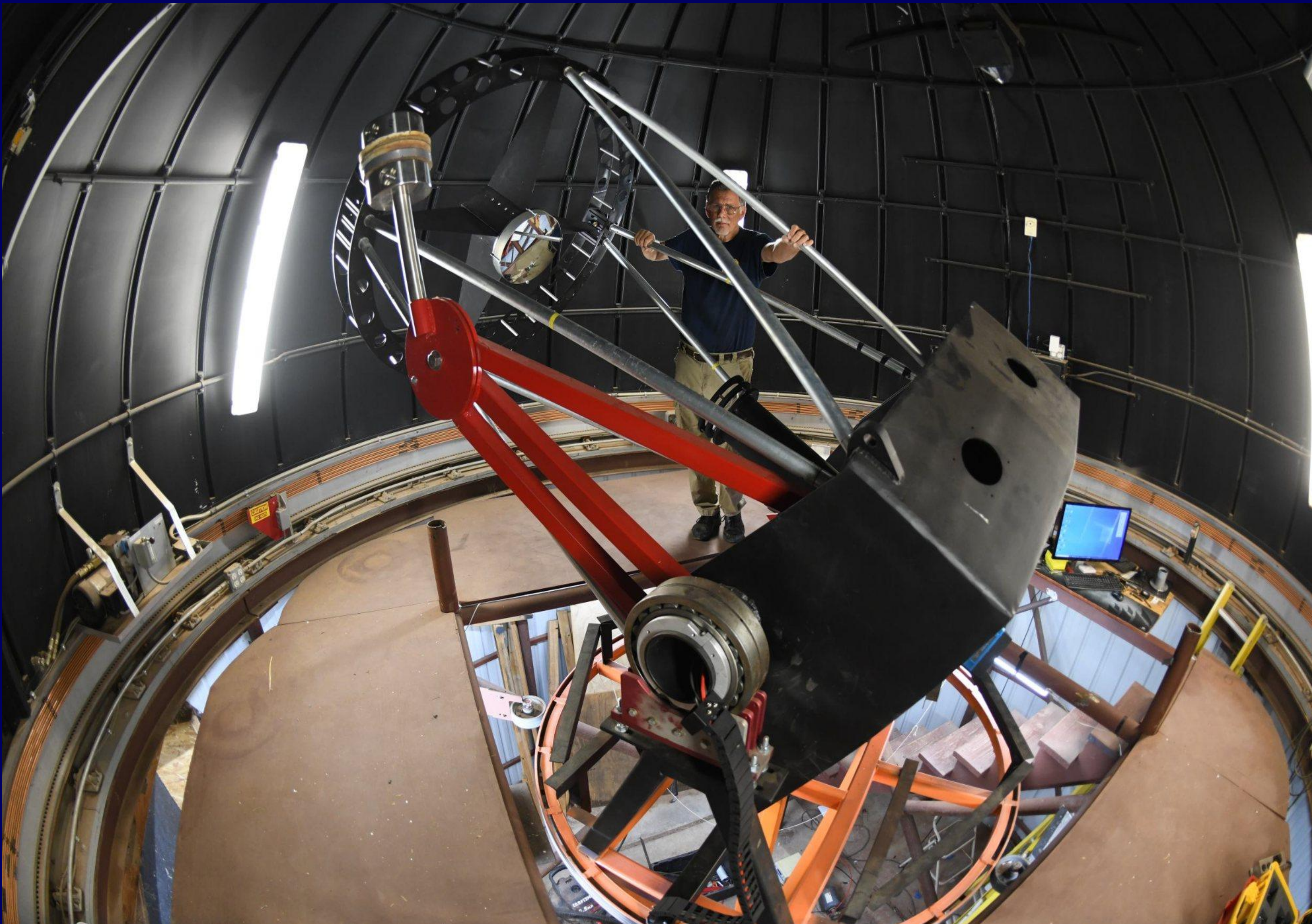
Astro-Research 30” Autoscope (Very First ServoII)

Mark Williams Madrona Peak Observatory (24” RCOS) re-used brushless motors and high resolution incremental encoders

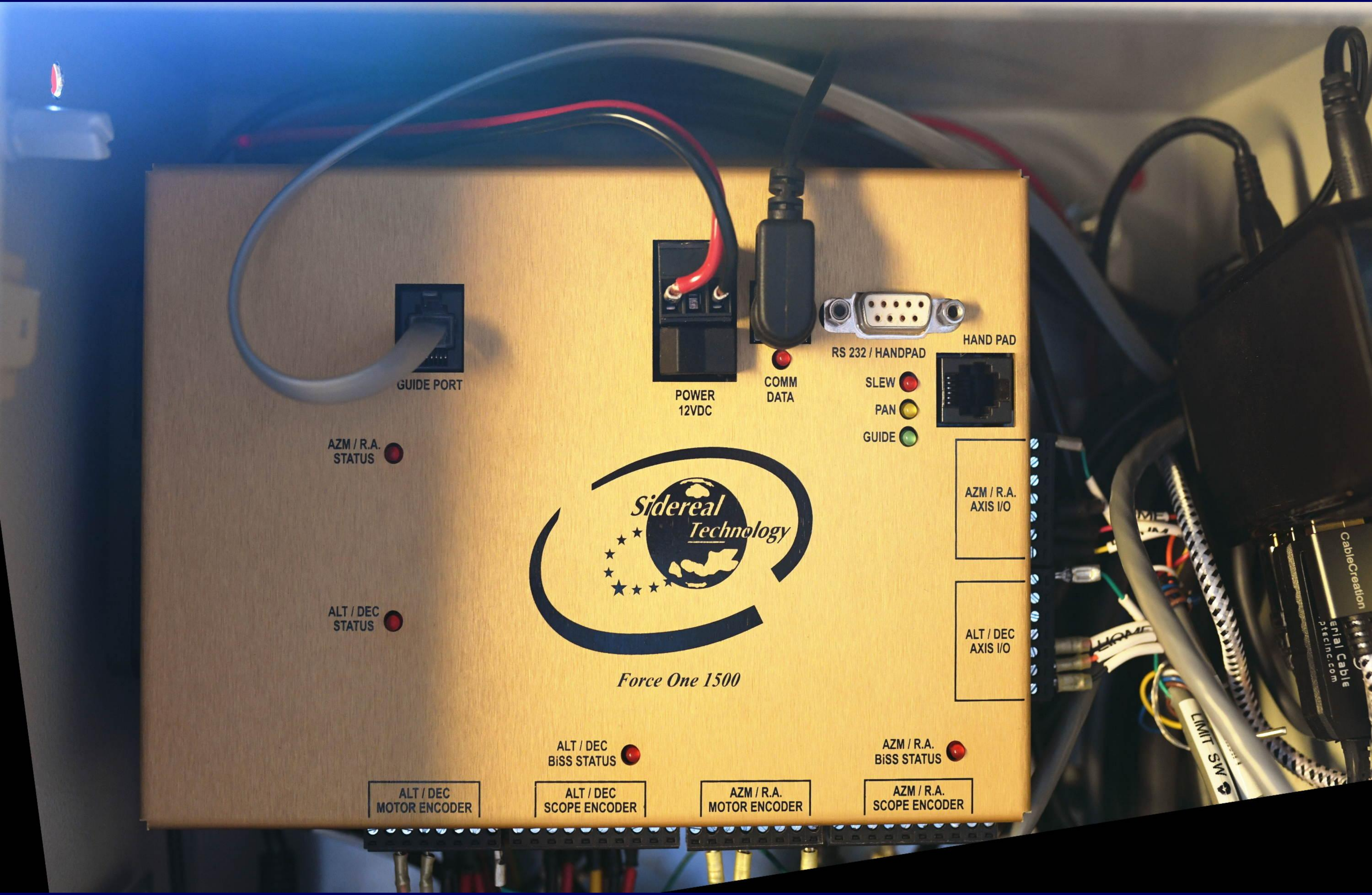
Mike Rice (New Mexico Skies) 24” RCOS. Mike installed new absolute encoders on each axis.

Alan Sliski and the Mittleman 36” Boller and Chivens (ongoing with Alan, Sliski Sons, Dennis di Cicco, John Briggs, Arne Henden, and I help out with Tech Support (mostly remotely))

• Tom Kaye's 1.1 Meter F/8 Cass

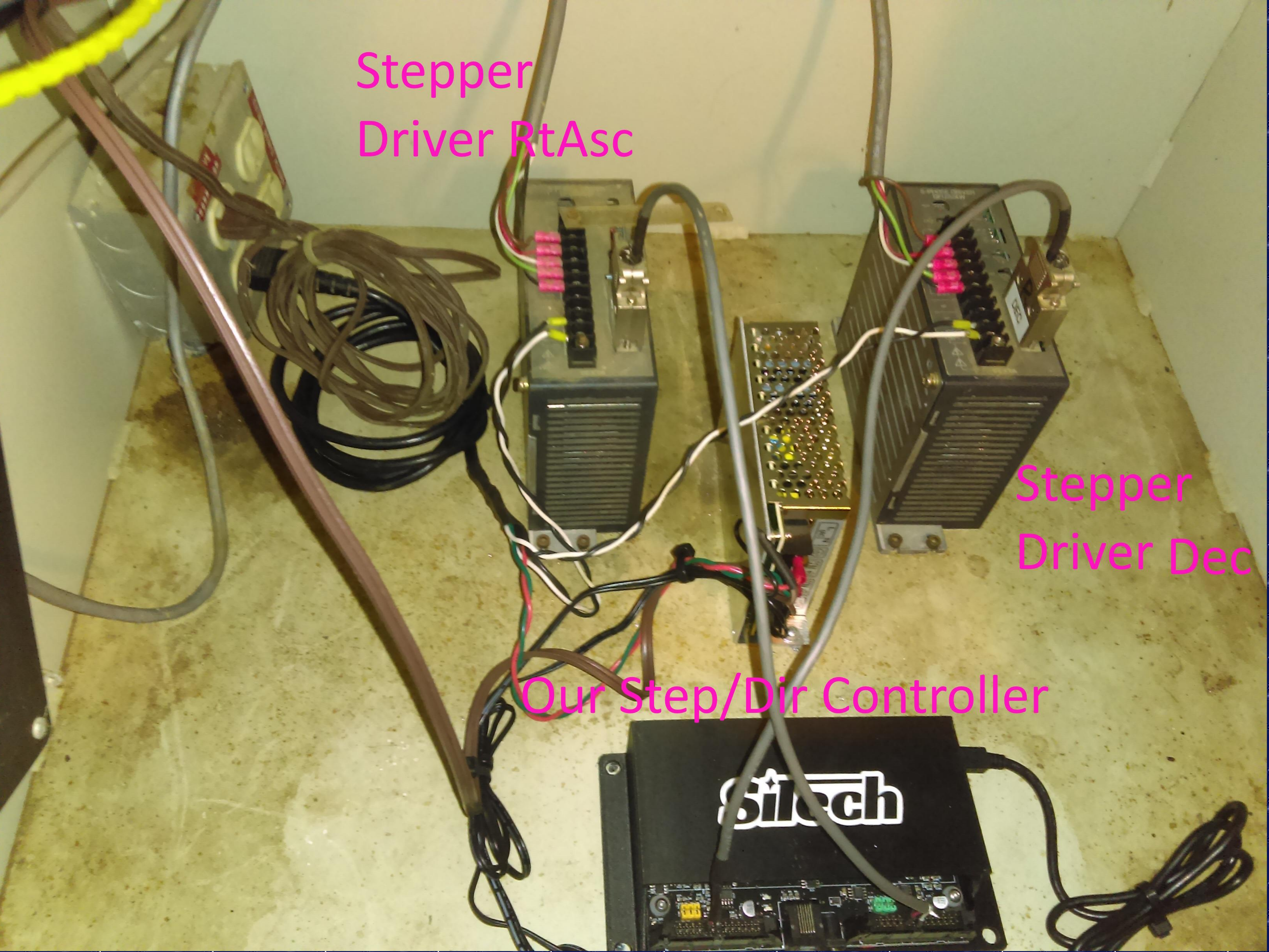


• Tom Kaye’s 1.1 Meter F/8 Cass



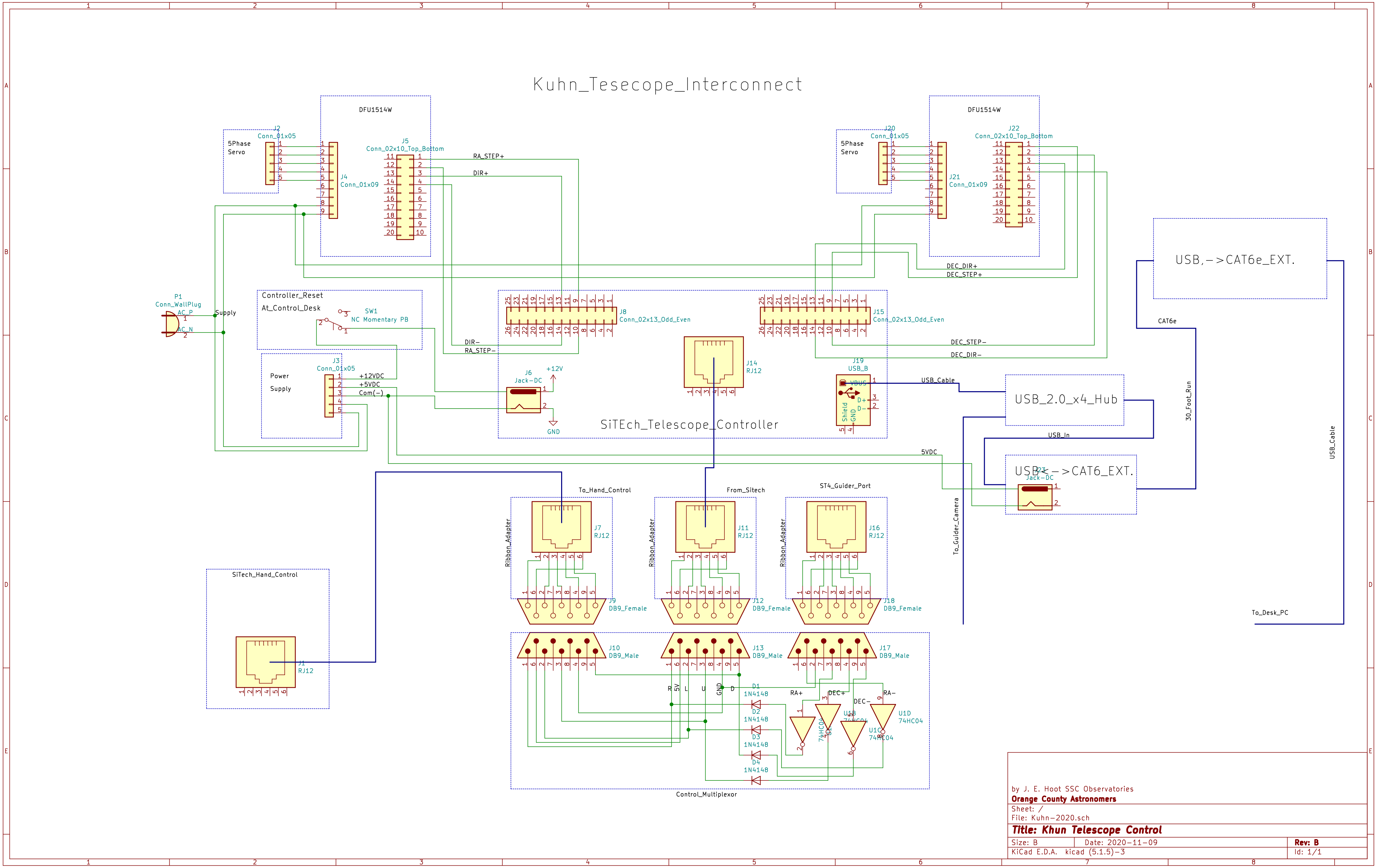
Tom Kaye 1.1 Meter F/8 Cass

John Hoot upgraded the Orange County 24 inch telescope. Cost, $1000


Stepper
Driver RtAsc
Stepper
Driver Dec
Our Step/Dir Controller

John Hoot upgraded the Orange County 24 inch telescope. Cost, $1000

Schematic by John Hoot



- CTIO 1 Meter Boller and Chivens

2017-10-05

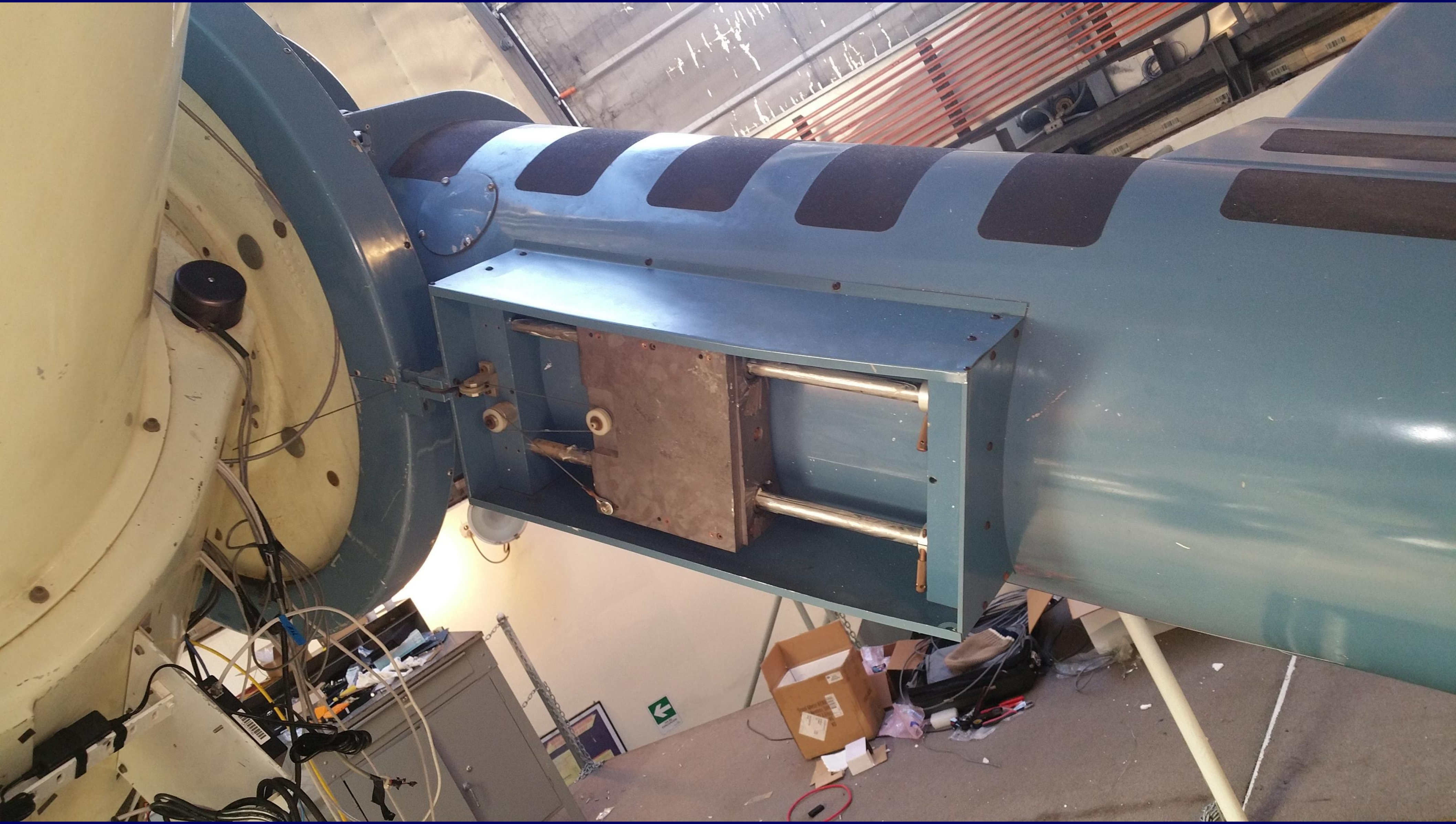
- Funded by NASA
- ForceOne Controller
- Re-Used Existing Conventional Brushless Motors
- New Power Supplies for motors and control
- Re-Used Tilt Switch and Limit Switches

Josh Haislip
Dome Control

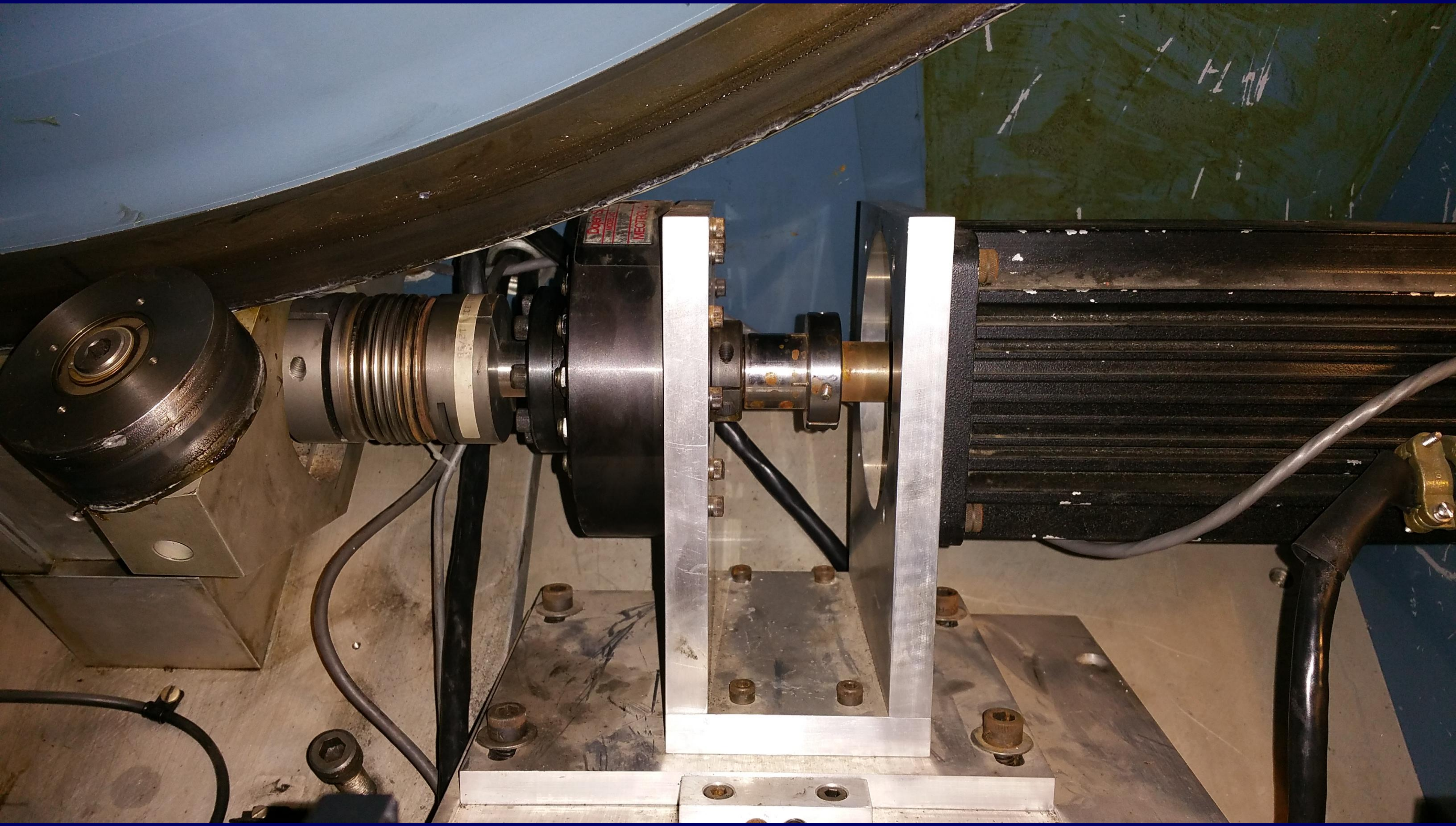
Me

Robert Holmes
PI

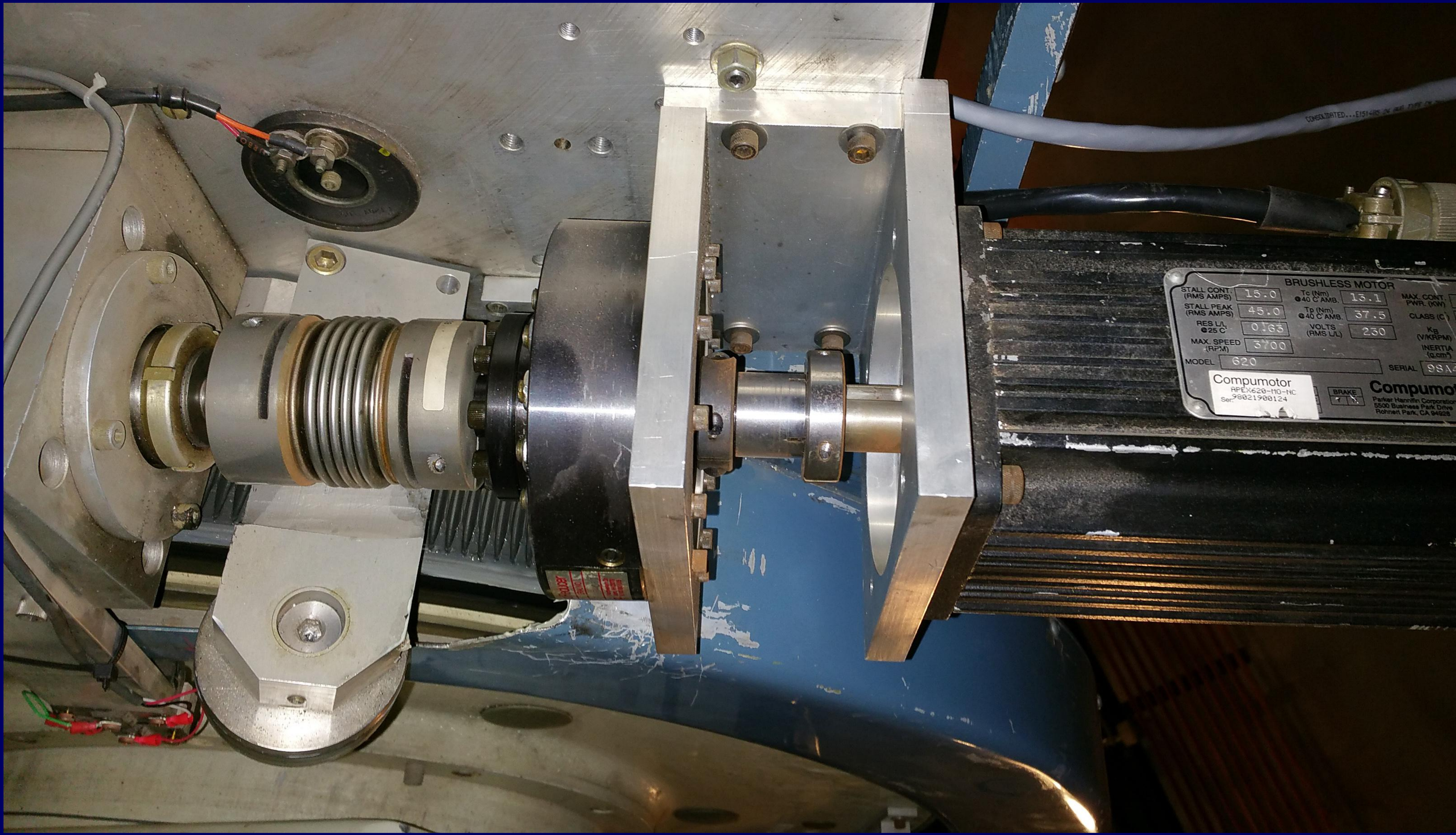
Tyler Linder
Co-Investicator



- Declination Anti-Backlash Counterweight and pulley system

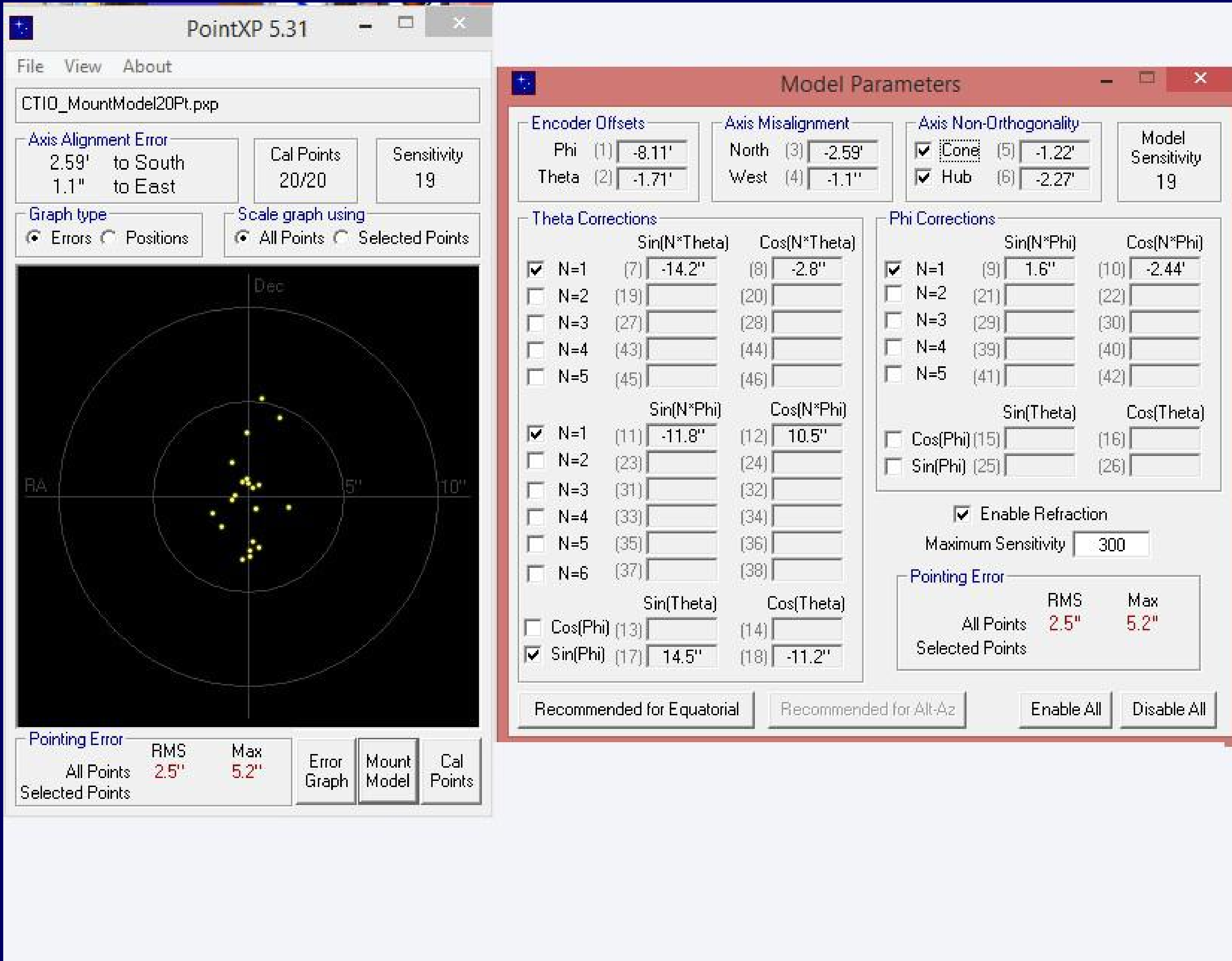


- Right Ascension Motor, Reducer and Worm Drive

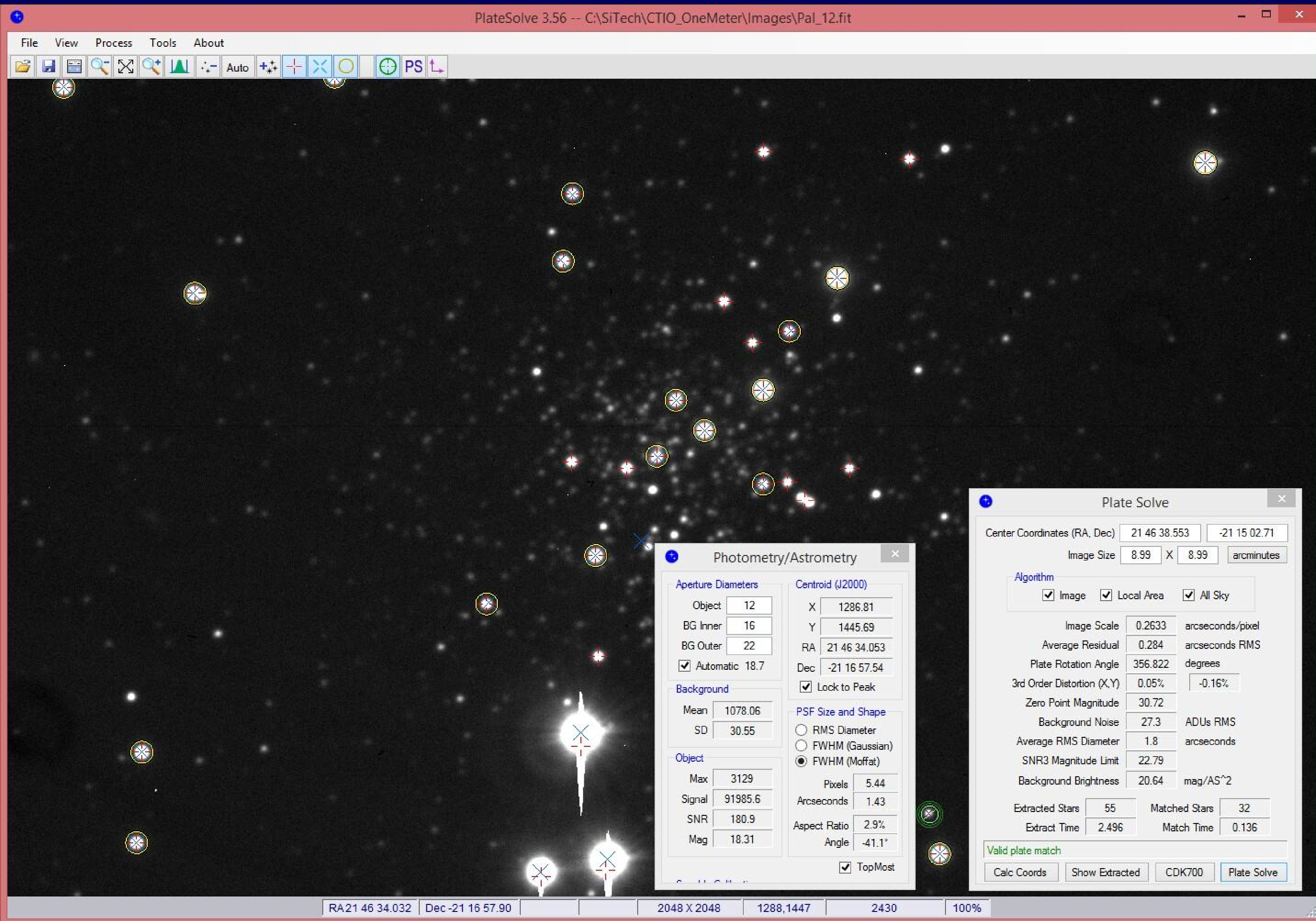


- Declination Motor, Reducer and Worm Drive

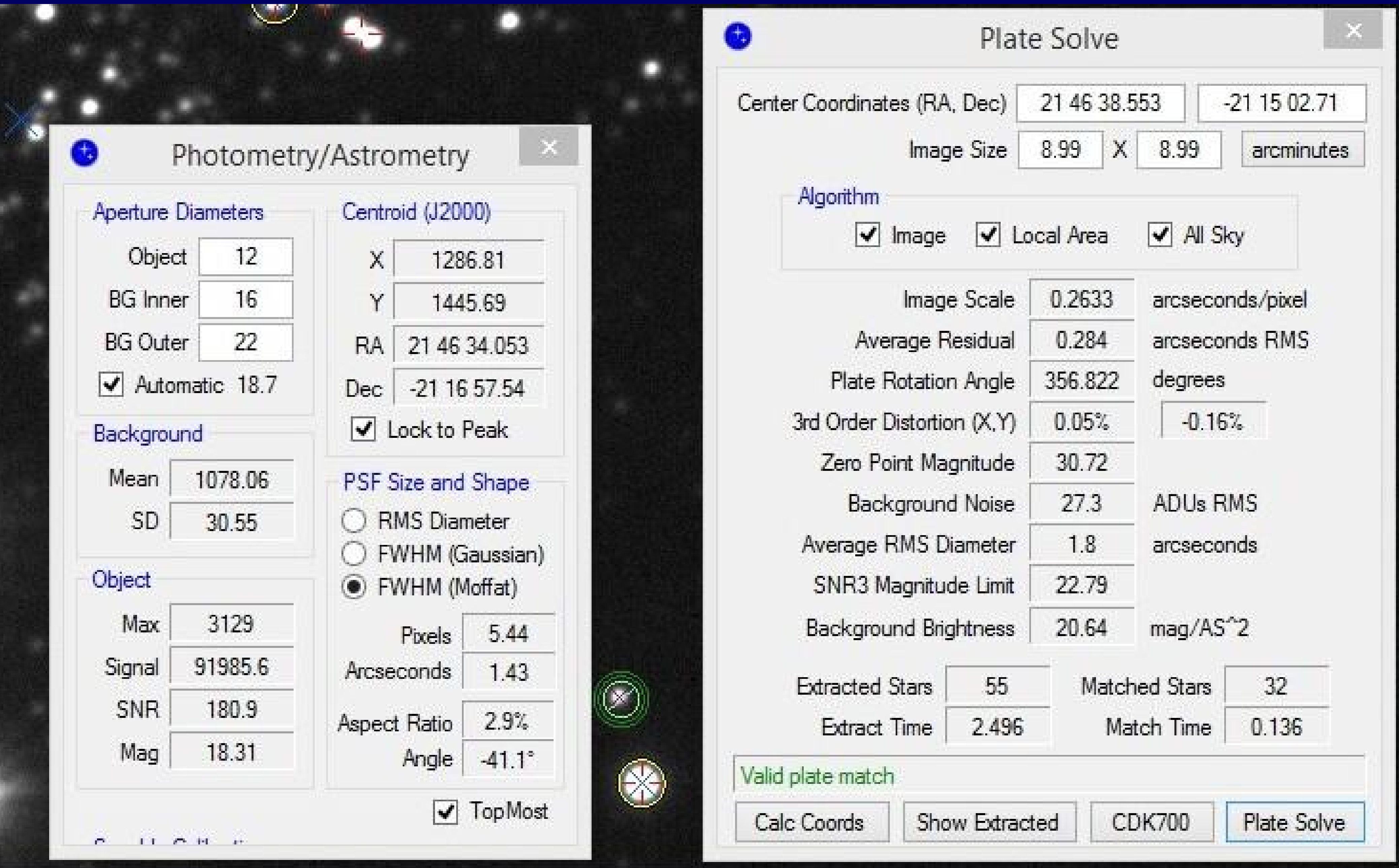
- This controller replaced over 100 lbs of equipment



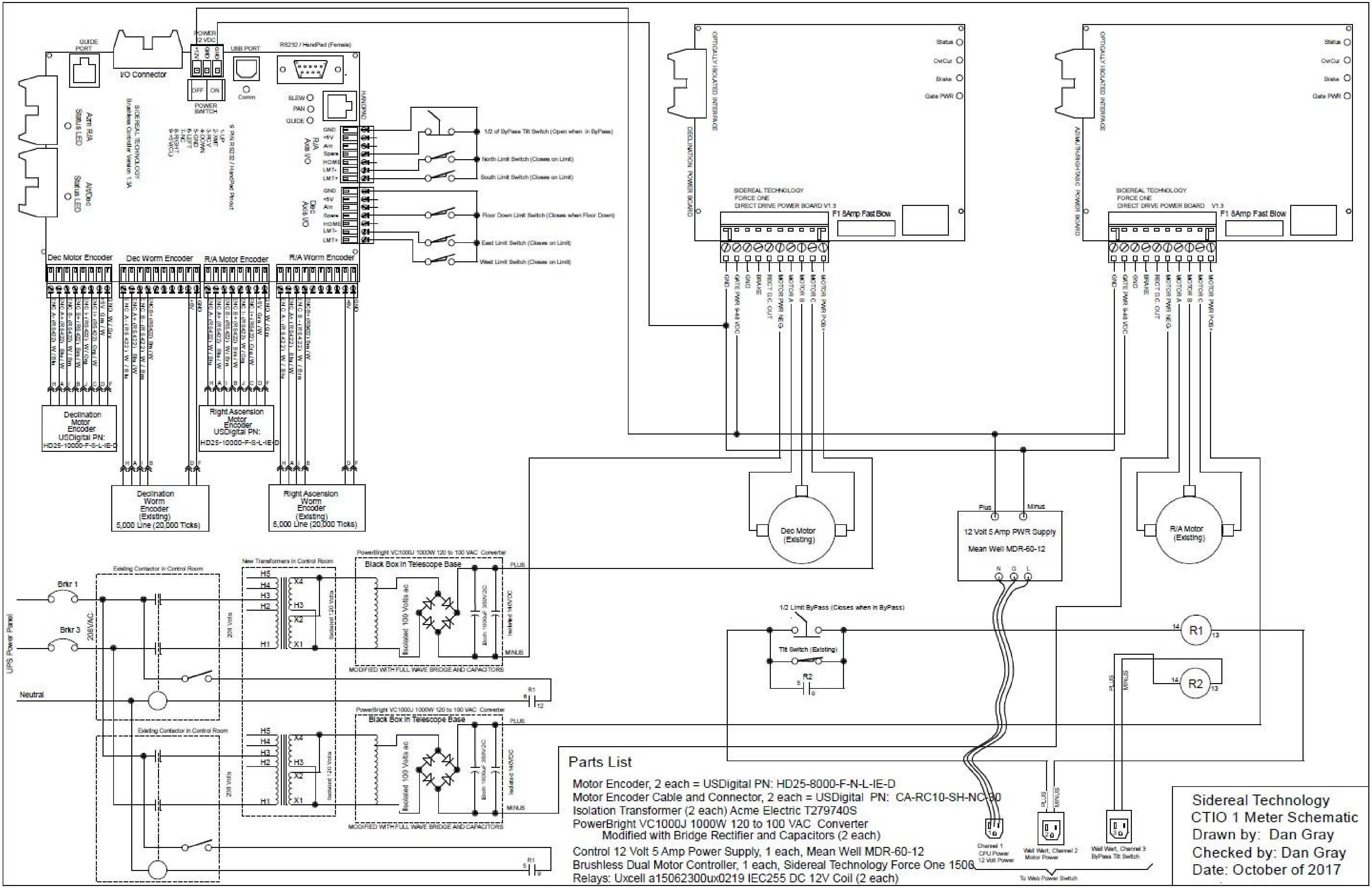
- The mount model (PointXP by Dave Rowe Courtesy of Planewave Instruments)



- 5 minute unguided image with PlateSolve data (by Dave Rowe Courtesy of Planewave Instruments)



- 5 minute unguided image with PlateSolve data Zoomed



- Final As-Built Schematic

- CTIO 1 Meter Boller and Chivens

Nasa's Largest Full Time Southern Hemisphere NEO Followup Telescope (now the 1.3 meter on same CTIO site

Limiting Magnitude V 24.0

Operate 315 nights per year

About 30 NEA Measurments per night

Three College Observatory (May 2014)

- Three Stage Roller Drive
- Re-Used Existing "Brushed" D.C. Motors
- Installed Industrial Incremental Encoders on the Motors
- Installed Absolute Encoders on Each Axis

Three College Observatory

University of North Carolina
North Carolina A&T State University
Guilford College

Three College Observatory

- 32 inch Cassegrain built in the late 70's by Sigma Research, Richland Washington

SIGMA 32 at Three-College Observatory, Greensboro, North Carolina

STANDARD SPECIFICATIONS *

OPTICAL

Primary mirror	16- to 32-inch clear aperture, f/3 focal ratio.
Secondary mirror	4- to 9-inch diameter.
Effective focal ratio	f/13.5
Field size	0.5 degree—1.89 to 3.78-inch diameter image.
Optical quality	80% of light from a point source must be focused within one-half second of arc at the center of the principal focus.
Mirror coatings	Vacuum aluminized with silicon monoxide overcoat.
Finder	4- to 6-inch aperture, f/10 refractor finder.

ELECTRONICS

Console	Desk-top cabinet with LED display and keyboard.
Drive motors	Single dc torque motor on each axis drives telescope through range of tracking rate to slew rate.

MECHANICAL

Mount	16- to 24-inch diameter: equatorial, off-axis; 24- to 32-inch, equatorial fork mount.
Slew rate	2 degrees per second of time.
Set rate	3 minutes per second of time.
Guide rate	5 seconds per second of time.
Drive	Roller-type drive.
Tracking accuracy	2 arc seconds in 5 minutes of time; 6 arc seconds per hour.
Position readouts	Illuminated setting circles: LED display.
Controls	Hand paddle "joy switch" for telescope control; keyboard switches on console for data entry.
Tracking rate	Nominal 15.000 arc seconds per second in RA; variable from keyboard.

* Can be modified to meet the customer's special requirements.

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2950 GEORGE WASHINGTON WAY
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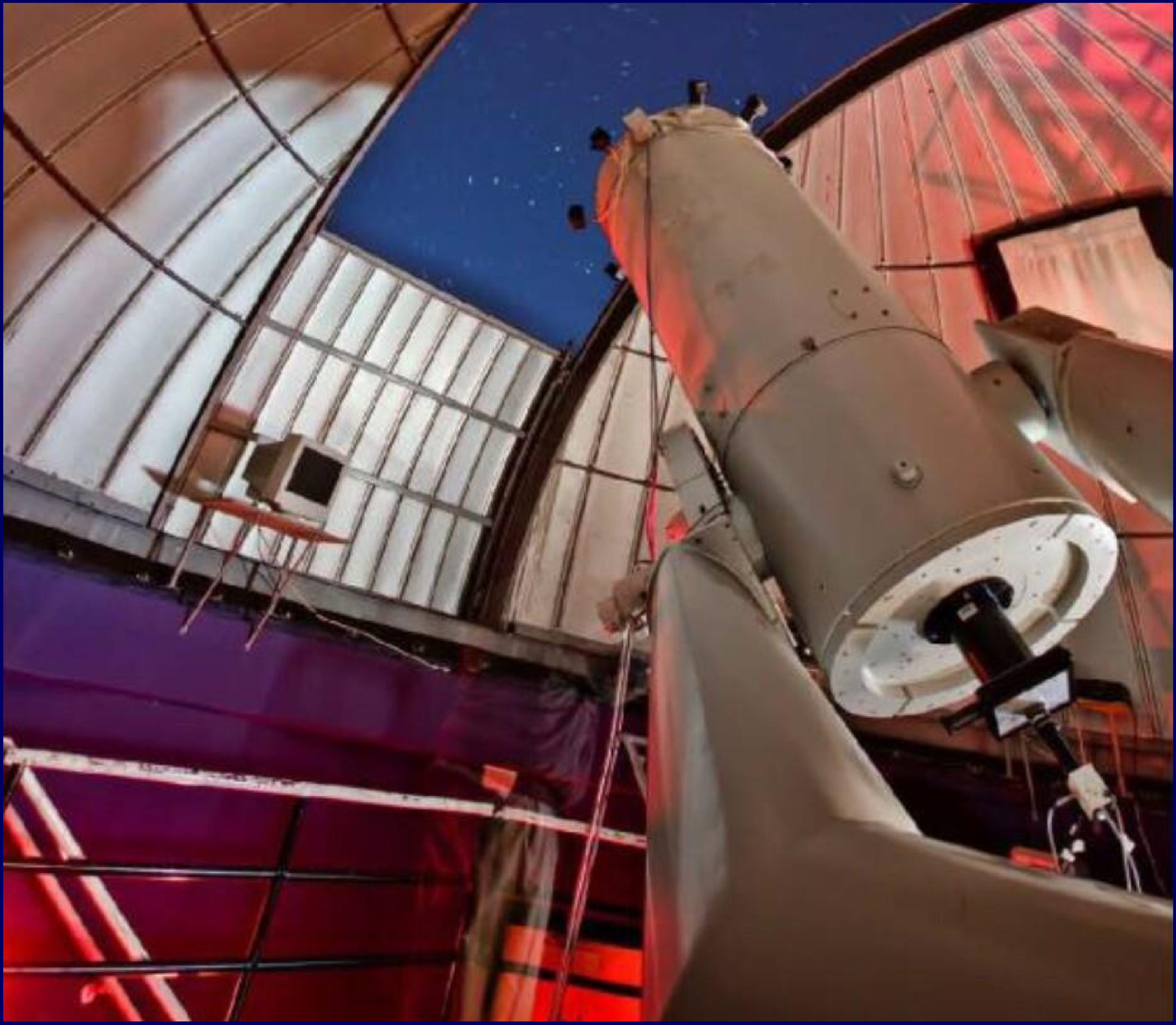
(509) 375-0663

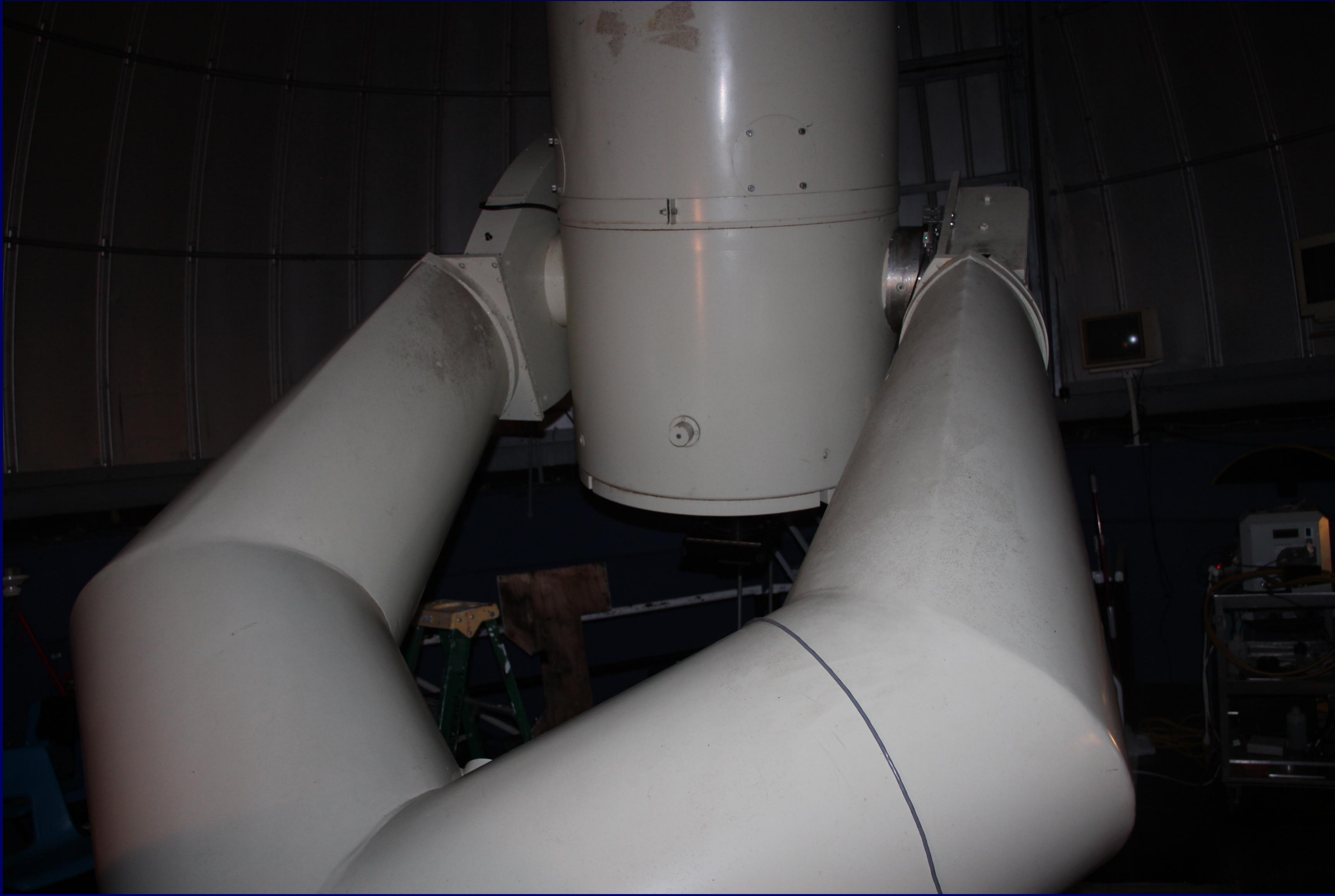
SIGMA
CASSEGRAIN TELESCOPES

WHEN YOU'RE INVESTING
FOR MORE THAN A LIFETIME

EXPANDING THE HORIZONS OF VISIBILITY



- Scope And Stars



- Fork and Tube Assembly

- Declination Motor and New Incremental Encoder

- Rt Asc Motor and New Incremental Encoder

- We bolted and pinned these together, with the breaks, 90 deg’s apart. Then we machined them on the lathe.

• Here’s the Rt Asc Ring after machining

- Here’s the Rt Asc Ring Installed

- Here’s the Declination Ring Zoomed

- SiTech Control Box

- Dr. Steve Danford and Dr. Anatoly Miroshnichenko

- Mittelman 36” Boller and Chivens at NMSkies

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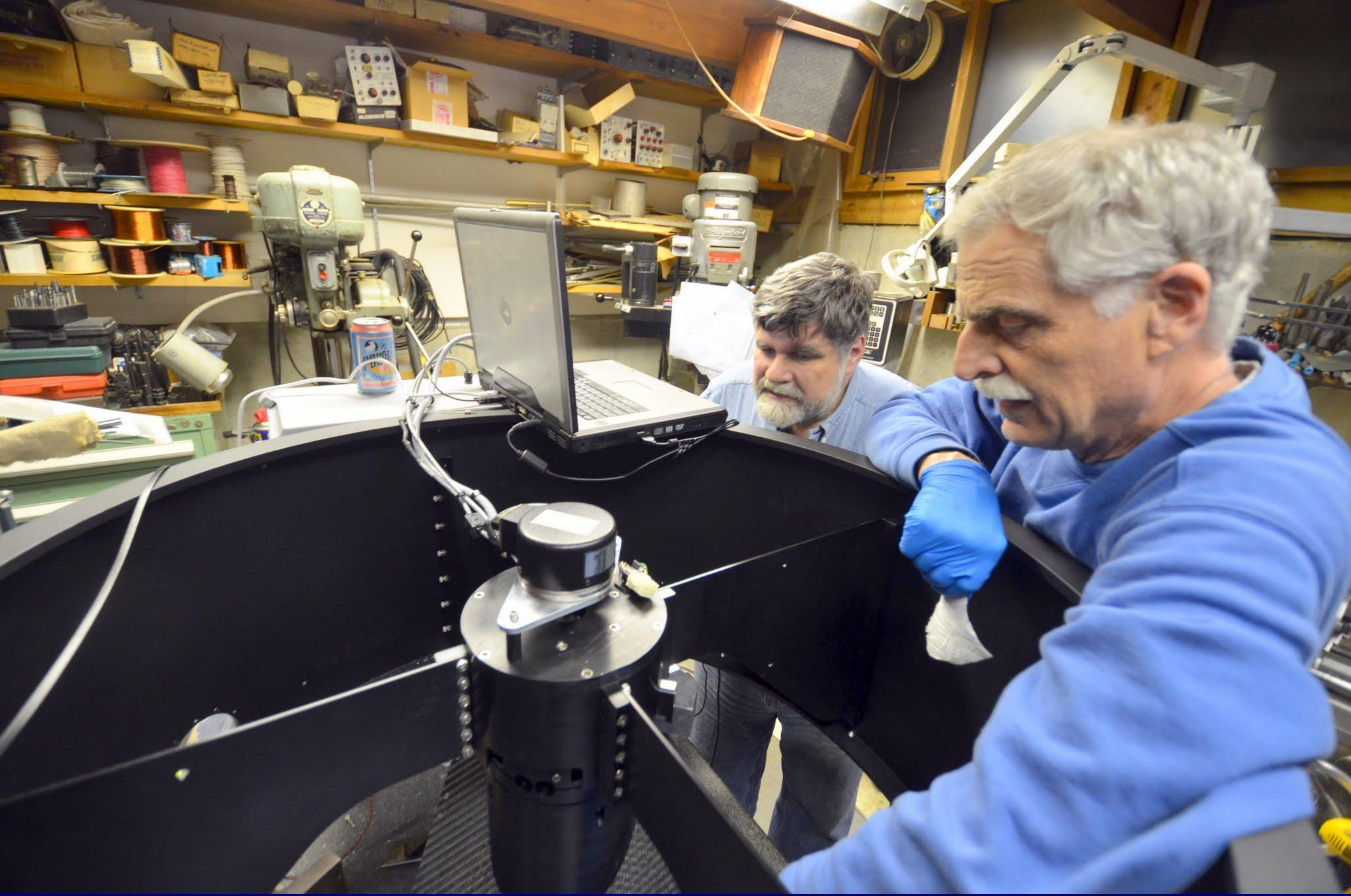
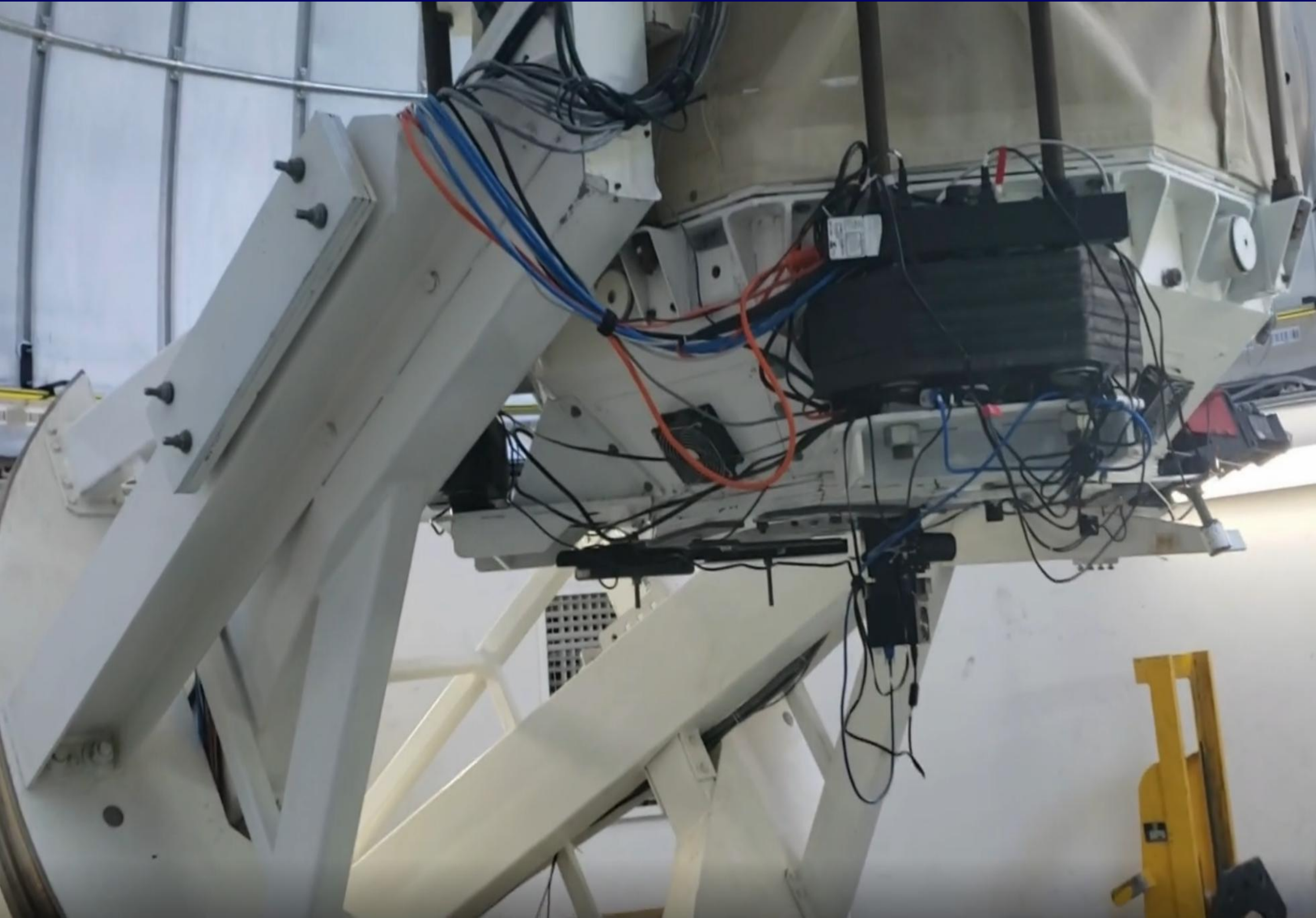
- Mittelman 36” Boller and Chivens at NMSkies



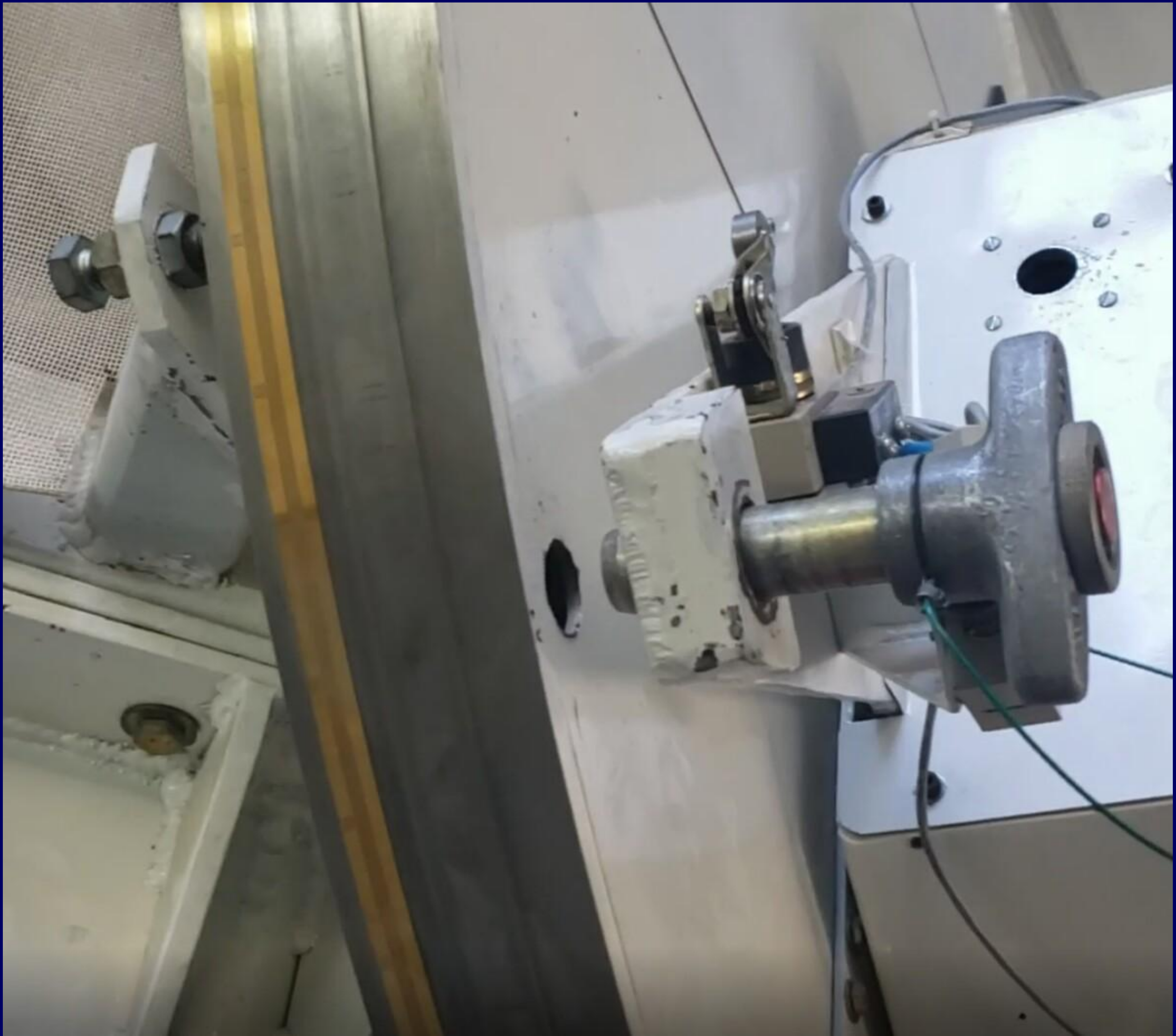
• Alan and Dennis working on the Rotating Secondary

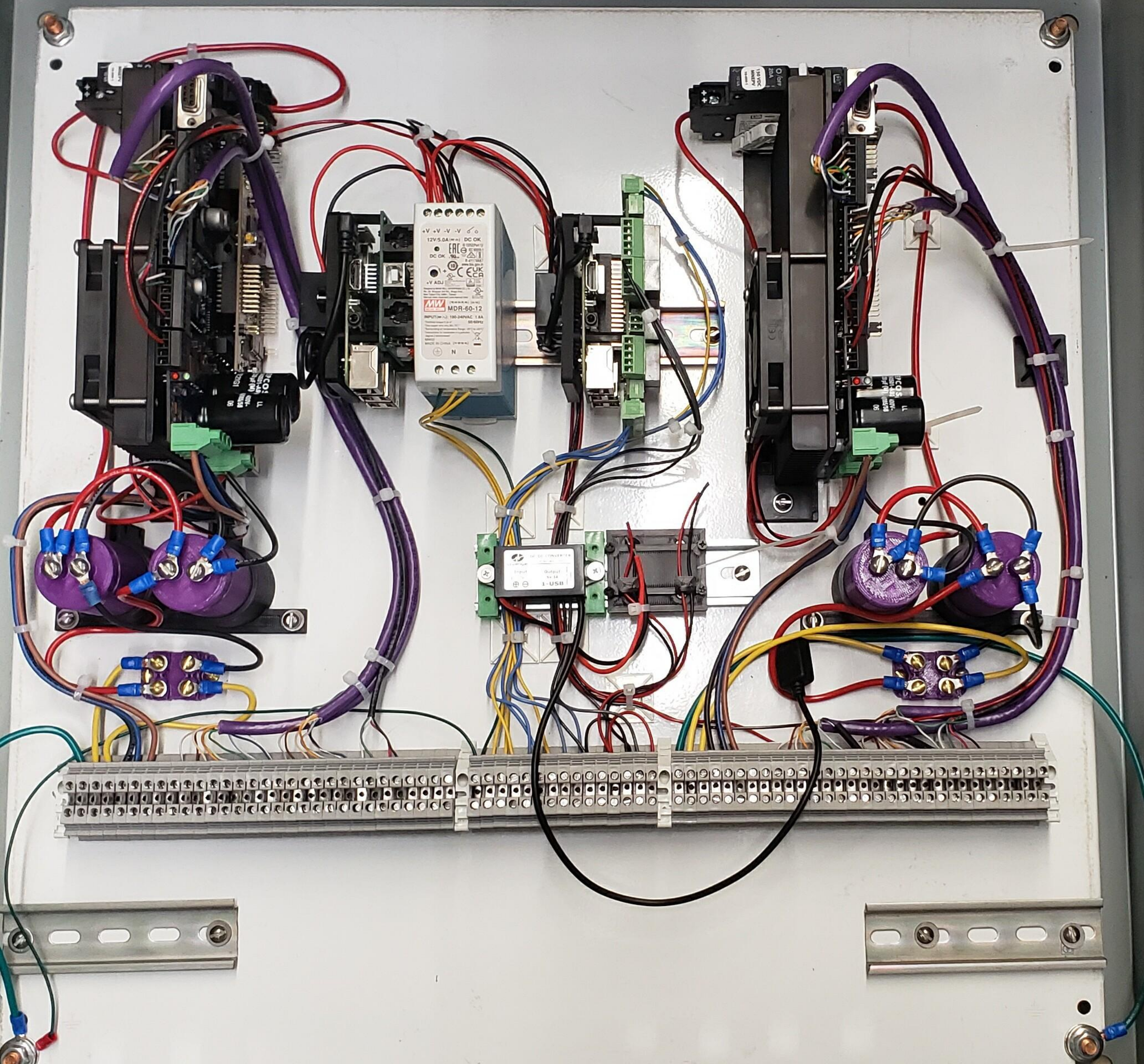
- Two Mass Infra Red Survey Telescope, CTIO



- Two Mass Infra Red Survey Telescope, CTIO

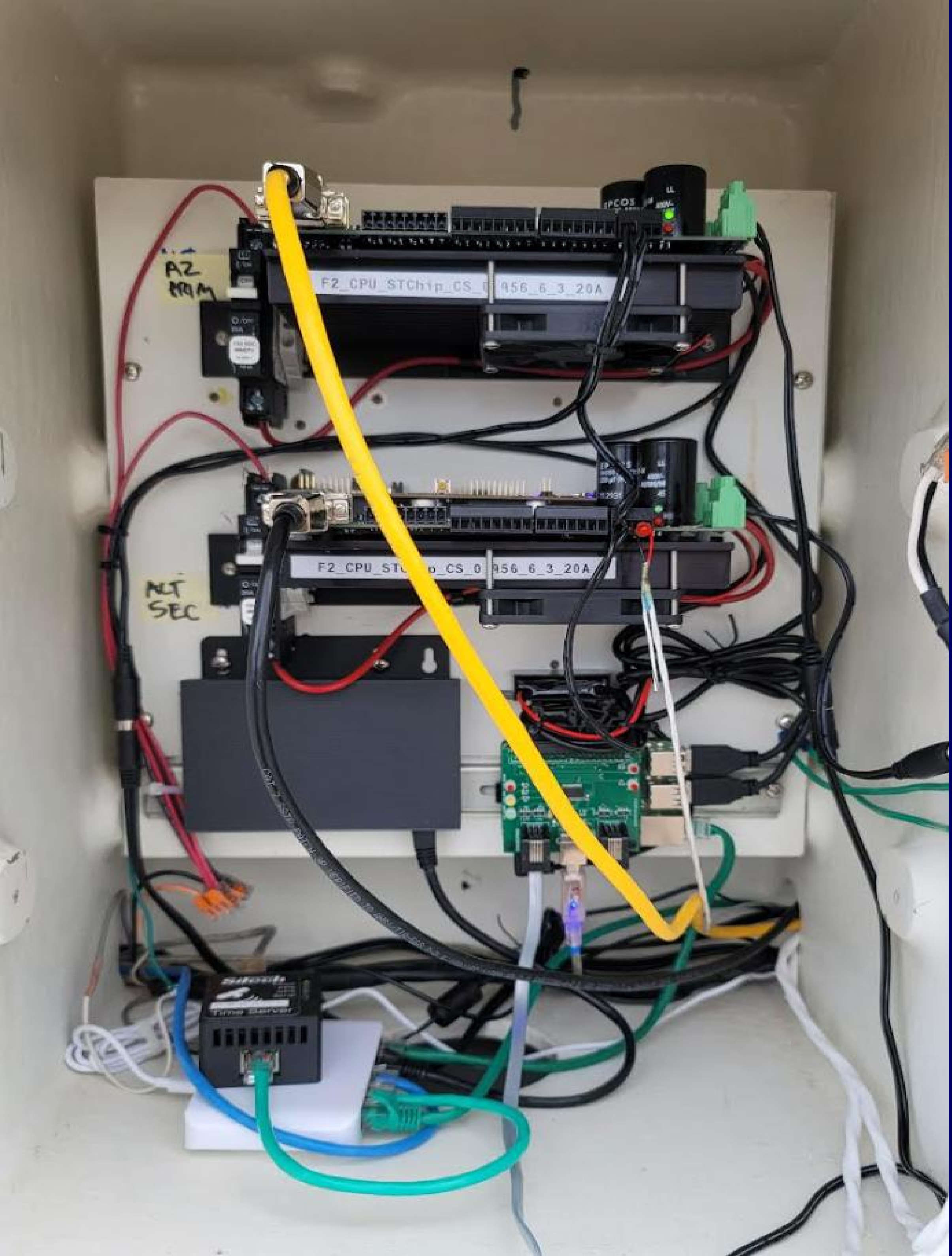
- Heidenhain Incremental Encoder Tape





- Force Two Before Shipping

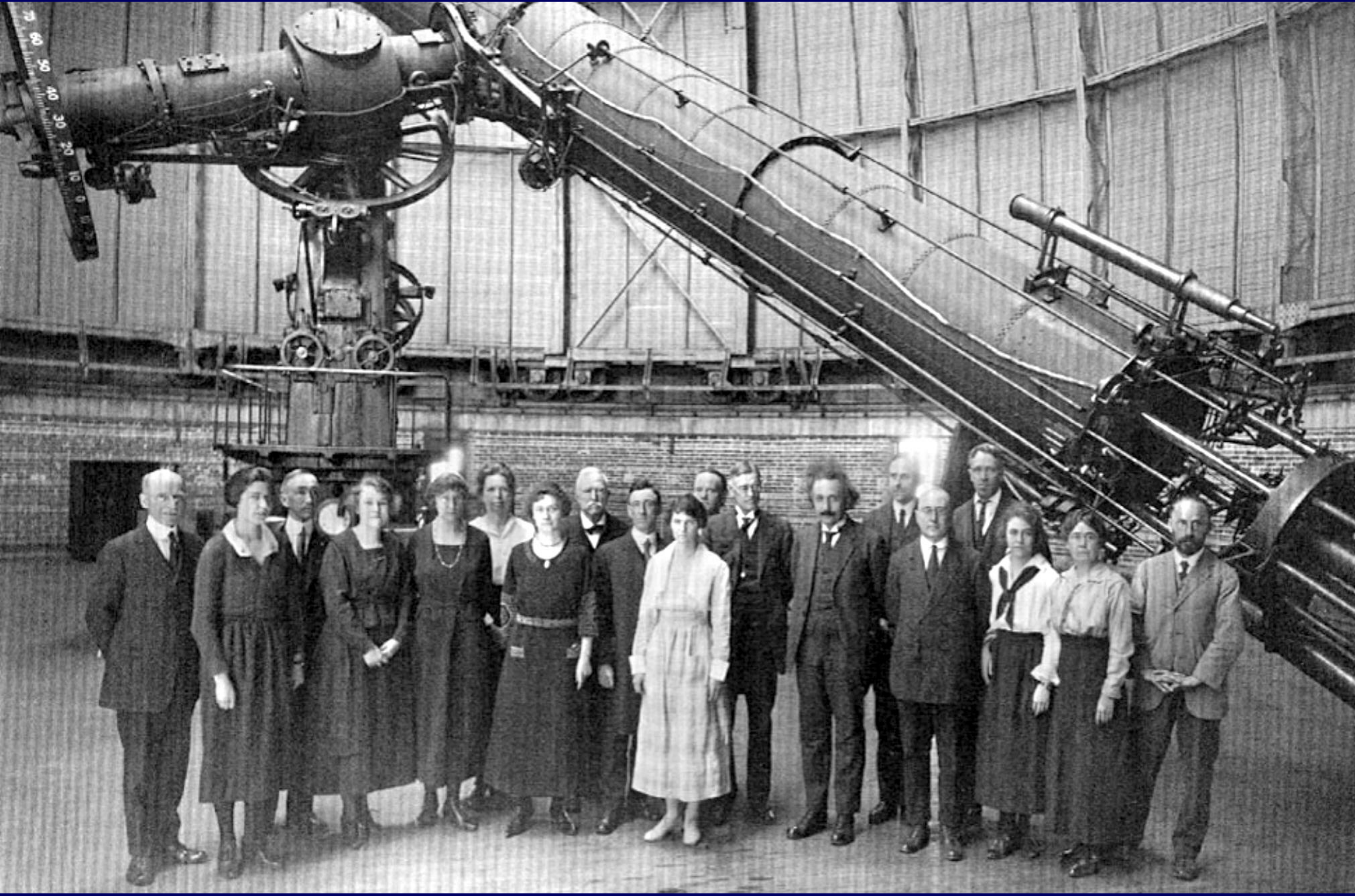
- Eric Toops (Magdalena NM) (unbelievable)



- Eric Toops (Magdalena NM) ForceTwo Installation

- Eric Toops First Light Image with Visitor

- On my wish list



- On my wish list

- Me, Albert, Dr. Amanda Bauer (and daughter), Vivian Hoette, Ed Struble, Ralph Nye (Lowell Observatory)

Questions?

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https://siderealtechnology.com/NewLifeAAS.pdf