# Schulman Telescope StartUp Procedure

## **Check Internet**

Go to the warm room closet and check that all internet cables are plugged in. There is one CAT5 cable that goes to the main observatory computer and another that goes directly to the telescope controller. During lightning shutdown these cables are often unplugged. While in the closet check to see that the StarDot video server is healthy.

## Power up the Main Observatory Computer and UPS's

Plug in and turn on the small UPS that delivers power to the main computer and telescope services (including the TIM unit via the remotely controlled power outlets). Login to the main Windows user account. This is currently labeled "Adam" and the password is the standard "I8...." Next plug in and turn on the larger telescope controller UPS. (Do not turn on the controller yet.)

## Interpret the Telescope Orientation and Clear Manual E-stops

Check the Telescope Orientation and assess the condition of the telescope. If the current position does not "make sense," consider investigating further before proceeding. If engaged, release any E-stops on the hand paddle, telescope controller, and dome controller. Although it should be in operable state by default, also check the upper shutter E-stop plunger by visual inspection. If this is inadvertently left pushed in it must be released or software shutter errors will follow. The key should be turned to the "on" position.

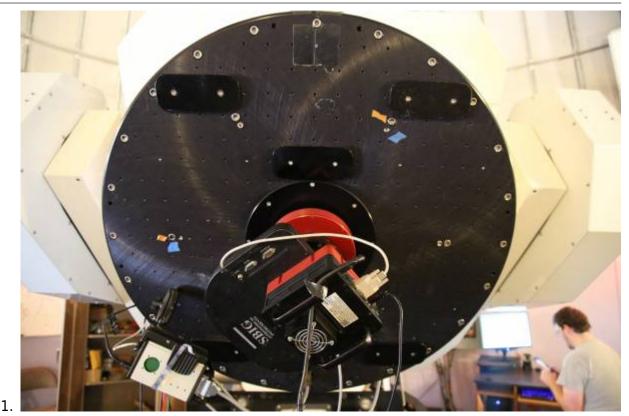
# Check the RA Optical Tape and Read Heads

Before turning on the controller (or moving the telescope for normal operation) examine the RA axis optical tape for signs of water condensation or insect "residue." This must be cleaned before operation. Make certain both the drive and idler bearings are also free of anything that might be transferred to the optical tape. Look closely at the read heads and check to make certain they appear aligned without anything in the space between the read head and the tape. (Use a thin Tek wipe or something similar to clear the space and clean the window if necessary.)

## Check the telescope Balance state

As of Fall 2016 the telescope is in a balanced state when the following conditions are met:

- 1. The CCD camera is attached to the back of the telescope. \* (see note below)
- 2. There are no extra hardware or eyepieces attached to the telescope (e.g. No eyepieces should be installed in the refractor.)
- 3. The number of weights and configuration are as in the picture below:



4. **THE MIRROR COVERS ARE OPEN** This will be done shortly.

#### Note (Eyepieces)

The combination of the 31mm Nagler eyepiece and adapter at the back of the telescope is sufficiently close to "balanced" that it is OK to follow the startup process in this state. Being optimized for the CCD configuration permits better success at automation and recovery from errors.

#### Manually Point the Telescope to the Zenith

When on site for startup purposes it is OK to move the telescope against the Declination brake to point the telescope vertically (at the zenith on the meridian). This step is necessary as mountain operations currently (Fall 2016) requires the telescope be pointed "up" before opening the mirror covers. During a recovery event when the controller is one but the telescope needs to be re-homed, opening the mirror covers in other positions will still be OK. Even if the mirror covers do not fully deploy ("Mid Position")- the balanced state will be achieved and initializing the system can proceed. The mirror covers can then be closed and re-opened later.

#### Turn on the TIM Unit, Connect, and Open Mirror Covers

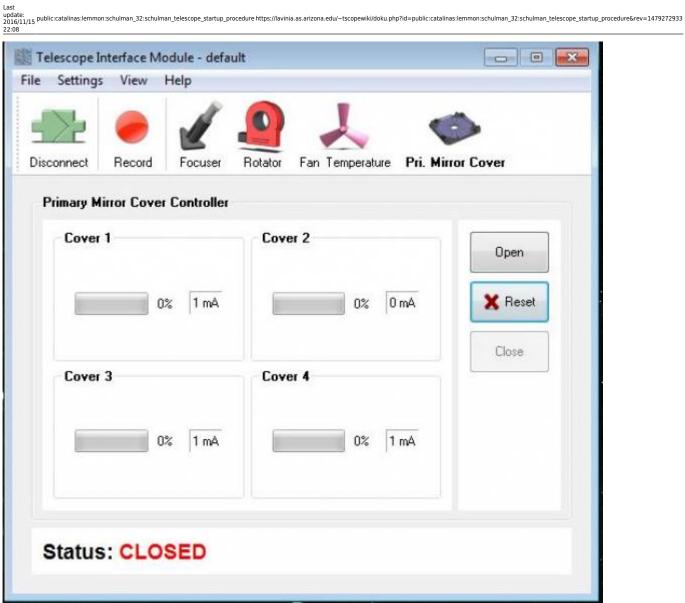
The TIM Unit must be turned on in order to open the mirror covers. Before turning it on make certain all connections are firmly seated into the enclosure. Turn the unit on with the rocker style toggle switch.

Next on the computer open the RCOS TIM software.

https://lavinia.as.arizona.edu/~tscopewiki/



Connect to the TIM unit and navigate to the "Primary Mirror Covers" tab.

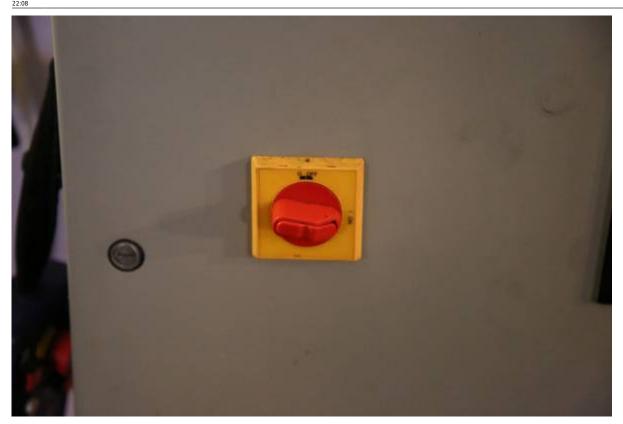


Open the Mirror Covers:

connect Record Focus	er Rotator Fan Temperature <b>Pri</b> .	Mirror Cover
Primary Mirror Cover Contro	ller	
Cover 1	Cover 2	Open
0% T m	A 0% 1 mA	X Reset
Cover 3	Cover 4	Close
0% O m	A 0% 1 mA	

## **Turn On Telescope Controller**

Turn the red switch to the "on" position. Fans and other noises will be heard as the system comes on. Wait for 3 minutes for the Mic and PubSub internal computers to boot. Generally when the MIC completes booting the drives/servos are alive and holding the telescope (listen for them).



### **Connect to the PubSub Machine using VNC**

Open VNC and type the address to PubSub shown below:

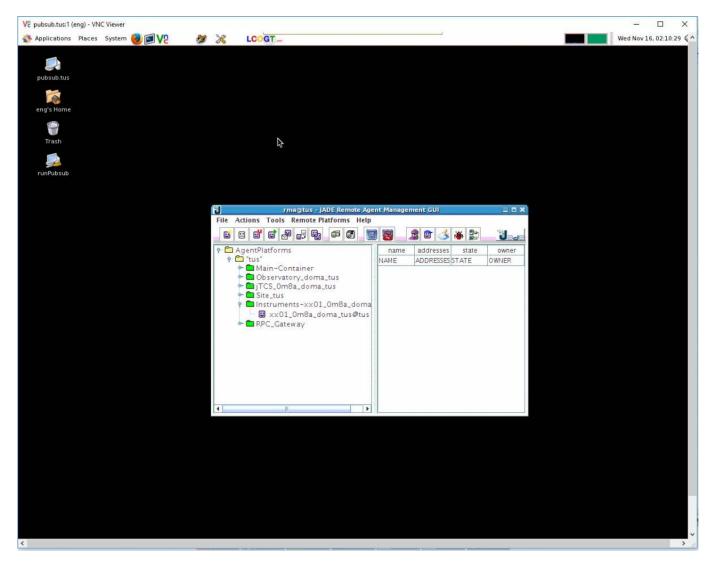
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About	Options	]	Connect

(It is assumed the user has the password.)

Initially the desktop will be blank (black). Start PubSub processes by pressing the tool utility icon at the top of desktop. It is circled in the image below:



This will clear the database and give everything a clean start. Eventually (a few minutes) the "JADE" agent will load and the desktop will look like the below:

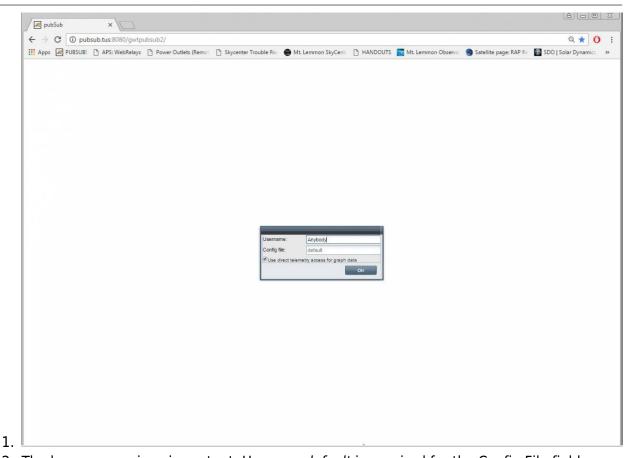


The small icons to the right of processes can be pressed to expand them and reveal the list as shown. Once the "Instruments-xx01\_0m8a\_doma" process is loaded under its section PubSub is ready to communicate with the telescope (and the user). The "RPC\_Gateway" process will not show up until communication to PubSub through the web browser commences. This is in the next step. It is OK to close the VNC window.

# Access the LCOGT GUI

Now that the system is up and running with drives, servos, and PubSub- access the LCOGT GUI:

1. Open the Chrome Browser and click the quick link labeled PubSub (leftmost icon). You will be presented with the screen below:



The log on name is unimportant. However *default* is required for the Config File field.
 Press the "OK" button to continue.

- 2. Wait for PubSub to send all of the data to the browser. It will take 2-4 minutes. If you simply have a blank/white screen  $\rightarrow$  going back to PubSub through VNC may be necessary to make certain it is setup correctly.
- 3. Once the GUI comes up you will be presented with the Site heads up information. Note the small tab is labeled "tus." This stands for "Tucson." None of the capabilities on this screen are currently in use.

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	7	100		Boltwood Sky Minus Ambien		Azimuth	242.68 deg
	Ok To Open	False				Angular Diameter	0.54 deg
	Countdown To Open	0 sec		Failures		Morning Astronomical Twilight	12:17:44.304 h
	Interlock Reason	Sun Up	,	Battery State		Morning Civil Twilight	13:15:31.680 h
	Threshold Class			Electric Field Sensor State		Sunrise	13:40:55.524 h
	All Sky Camera			Humidity Sensor State		Sunset	00:33:00.972 h
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4. Click on the tab beneath "tus" to expose the information under the "doma" tab. The LCOGT software can be used to control multiple telescopes at a site. Our single site has a single telescope in the "A" dome which is roughly "doma." Again this functionality is not being used.

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5. Finally click on the "0m8a" tab to expose the controls for the Schulman Telescope. This tab roughly translates to 0.8m a (or first 0.8m telescope).

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		Other States		Axes	0	Monitor	9
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		Astrometric	Okay	InstrumentSelector	0	Paddle	31
		[not available]	[not available]	Monitor	0	SdbAgent	10
		Container State	Okay	[not available]	(not available)	[not available]	[not available]
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6. Take note of the color of the fields in the column on the left in the above image. They should all be green when the telescope is ready to be used. The "astrometric kernal" can be "yellow" when the drives are not tracking. If the telescope is tracking, this will also be green. If you come to this tab/screen quickly after rebooting PubSub, you may see fields such as "Mount State" indicate "initializing." This is OK provided that the agent does eventually initialize the drives and the field goes to green after a minute or two.

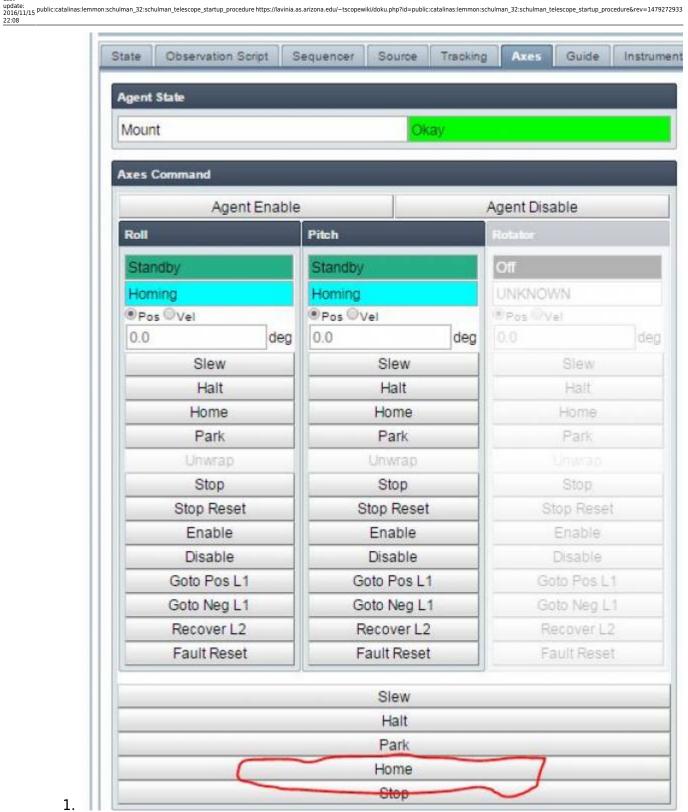
#### Homing the Schulman Telescope

The telescope must be homed before it can be operated.

1. Go to the *Axes* tab. Note that the axes are **Unhomed**.

Mount		
	Okay	Successed - 60 2016-11-16 02
xes Command		
Agent Enable		Agent Disable
Roll	Pitch	Rotator
Standby	Standby	Off
Unhomed	Unhomed	UNKNOWN
Pos      Vel	Pos      Vel	(6)Pos Ovel
0.0 deg	0.0 d	leg 0.0 d
Slew	Slew	Slew
Halt	Halt	Halt
Home	Home	Home
Park	Park	Park
Unwrap	Unwrap	Unweap
Stop	Stop	Stop
Stop Reset	Stop Reset	Stop Reset
Enable	Enable	Enable
Disable	Disable	Disable
Goto Pos L1	Goto Pos L1	Goto Pos L1
Goto Neg L1	Goto Neg L1	Goto Neg L1
Recover L2	Recover L2	Recover L2
Fault Reset	Fault Reset	Fault Reset
	Slew	
	Halt	
	Park	
	Home	
	Stop	

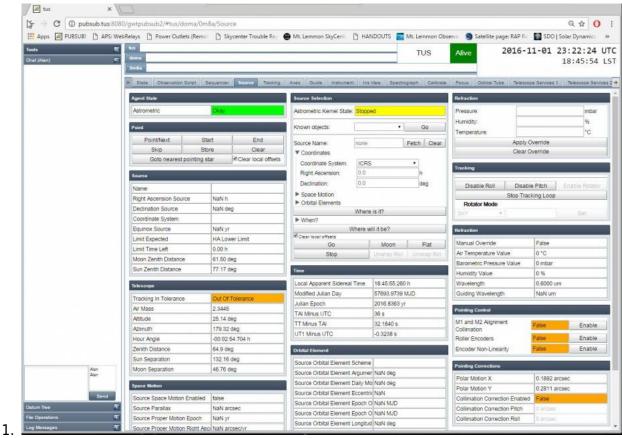
2. Press the large HOME button (circled below) to move both axes simultaneously to the home position. See Telescope Orientation for the correct position.



3. Once homed successfully the state field will briefly go to "stopped" and then finally "L1 Positive Limit" in both axes:

Mount			Okay				
xes Command							
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Roll		Pitch			Rotator		
Okay		Okay			Off		
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Enable		En	able		Enable		
Disable		Dis	able			Disable	
Goto Pos	L1	Goto	Pos L1		5	Goto Pos L1	
Goto Neg	L1	Goto	Neg L1		9	Goto Neg L1	
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Fault Res	et	Faul	t Reset			Fault Reset	
		S	lew				
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- 1.
- 4. Now go to the Source tab and move the telescope out of the limits to a valid sky position. If the telescope is not going to be used immediately typically the telescope is send to the park position. Remember to stop the tracking loop if observing is not going to start. See the
- 1. The most important tabs are Source, Axes, and Tracking. Only the Source tab will be illustrated here as it is where controls for moving the telescope are found.
- 2. The top center of the Source tab has a section labeled "Source Selection." This is the section for the telescope movement controls.



3. Under the "Coordinate System" select "Apparent HA." This is typically the engineering method for moving the telescope to particular positions. "Alt\_AZ" (Altitude, Azimuth) is another. Please read the section on Astronomical Coordinates Review for more information on the range of values for this coordinate systems.

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4. Now input an Hour Angle and Declination that corresponds to the desired position. Shown below

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is the input for Zenith. Press the "GO" button that is below the coordinate systems to move the telescope.

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	Name	1	Declination:	32	dég	Disable Roll Disab	le Pitch	Enable Rotato
	Right Ascension Source	NaN h	Space Motion				cking Loop	
	Declination Source	NaN deg	Orbital Elements	Where is	40	Rotator Mode		
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	Moon Zenith Distance	61.89 deg	Stop		Inetap Roll   Unerap Rol'	Barometric Pressure Value	0 mbar	
	Sun Zenith Distance	77.69 deg	Time			Humidity Value	0.96	
			Local Apparent Sidereal	Time	18:48:46 944 h	Wavelength	0.6000 um	
	Telescope		Modified Julian Day		57693.9759 MJD	Guiding Wavelength	NaN um	
	Tracking in Tolerance	Out Of Tolerance	Julian Epoch		2016.8363 vr	and the state of t	Transform	
	Air Mass	2.3429	TAI Minus UTC		96 s	Pointing Control		
	Attitude	25.15 deg	TT Minus TAI		32.1840 s	M1 and M2 Alignment	False	Enable
	Azimuth	179.23 deg	UT1 Minus UTC		0.3238 s	Collimation		
	Hour Angle	-00:03:18.493 h	[hereiter and second se		1	Roller Encoders	Faise	Enable
	Zenith Distance	64.8 deg	Orbital Element			Encoder Non-Linearity	False	Enable
	Sun Separation	132.20 deg	Source Orbital Element	Scheme		Pointing Corrections		
Alan	Moon Separation	47.44 deg	Source Orbital Element	Argumer	NaN deg		In these	
	Space Motion		Source Orbital Element (	Daily Mo	NaN deg	Polar Motion X	0.1892 arcs	
Send		Tolog	Source Orbital Element 8	Eccentric	NaN	Polar Motion Y	0.2811 arcs	30
ine	Source Space Motion Enabled	false NaN arcsec	Source Orbital Element B	Epoch O	NaN MJD	Collimation Correction Enabled	ACTION OF ACTION	
		NaN yr	Source Orbital Element 8	Epoch O	NaN MJD	Collimation Correction Pitch Collimation Correction Roll	d arcsec	
entions	Source Proper Motion Epoch							

5. Once the telescope reaches the desired position it will be tracking at the sidereal rate. Note that "Astrometric Kernal State" is green and reads "Tracking." In addition the "Tracking Tolerance" field reads "In Tolerance."

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Tools R Chat (Alan) R	kus doma OmEa			TUS		11-01 23:23:11 18:46:41
	+ State Observation Script I	iequence: Source Tracks	to Axes Guide Instrument Ins	View Spectrograph Calorate	Focus Optical Tube Telesco	ipe Services 1 Telescope Se
	Agent State	-	Source Selection	_	Refraction	
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	Point/Next St		Source Name: none	Fetch Clear		Override
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	Source		Right Ascension: 0.0	h		
	Name	NONE	Declination: 0.0	jaeg	Disable Roll Disab	e Pitch Enable Rotate
	Right Ascension Source	18:49:26.508 h	Space Motion     Orbital Elements			cking Loop
	Declination Source	-32:25:12.976 deg	When	is #?	Rotator Mode	
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	Equinox Source	NaN yr	Where w	fill it be?	Refraction	
	Limit Expected	Horizon Limit	Clear local offsets G0	Moon Flat	Manual Override	False
	Limit Time Left	3.68 h	Stop	Unwap Roli Unwrap Rol	Air Temperature Value	0 * 0
	Moon Zenith Distance	61.61 deg	_		Barometric Pressure Value	0 mbar
	Sun Zenith Distance	77.31 deg	Time		Humidity Value	0%
2	Telescope		Local Apparent Sidereal Time	18:46:42.708 h	Wavelength	0.6000 um
	Tracking In Tolerance	In Tolerance:	Modified Julian Day	57693.9744 MJD	Guiding Wavelength	NaN um
	Air Mass	2.3430	Julian Epoch	2016.8363 yr	Bula San Disated	
	Altitude	25.15 deg	TAI Minus UTC	36 s	Pointing Control	
	Azimuth	179.11 deg	TT Minus TA	32,1840 s	M1 and M2 Alignment Collimation	Faise Enable
	Hour Angle	-00:03:48.023 h	UT1 Minus UTC	-0.3238 s	Roller Encoders	False Enable
	Zenith Distance	64.8 deg	Orbital Element		Encoder Non-Linearity	False Enable
	Sun Separation	132.22 deg	Source Orbital Element Scheme	1		
Alan Alan	Moon Separation	47.11 deg	Source Orbital Element Argume	Constantine Constantinatine Constantine Constantine Constantine Constantine Co	Pointing Corrections	
	Provide and the second	50	Source Orbital Element Daily M		Polar Motion X	0.1892 arcsec
Send	Space Notion	1	Source Orbital Element Eccentr	10000	Polar Motion Y	0.2811 arcsec
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Datum Tree	Source Parallax	NaN arcsec	Source Orbital Element Epoch (		Collimation Correction Pitch	B arcsiec-

6. In order to keep the telescope at a particular position the Tracking must be stopped. Press the

"Stop Tracking Loop" in the "Tracking Section" to the right of the coordinate systems. Once pressed the state of the system will be as the below:

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lools 🤻	tes				TUS	Alive 2016-1	11-01 :	23:22:24
Shat (Alan)	doma				105	PARY Contraction of the second s		18:45:54
	SmBa							
	+ State Observation Schot S	equencer Source Tiscking	Axes Guide Instrument	Ins View Spe	ctrograph Gallbrate	Focus Optical Tube Talesco	pe Services 1	Telescope Serv
	Agent State		Source Selection			Refraction		
	Astrometric	Okay	Astrometric Kernel State:	Stonned		Pressure:		mbar
	10-section in					Humidity:		46
	Paint		Known objects:		GO	Temperature:		'C
	Point/Next St	art End	Source Name	none	Fetch Clear	Contraction (1997) In the second s	Override	
	Skip Sto	re Clear	V Coordinates	10412	, ciun Ciedi		Override	
	Goto nearest pointing s	tar Clear local offsets	Coordinate System:	ICRS				
	Plant		Right Ascension:	0.0	h	Tracking		
	Source		Declination:	0.0	deg	Dural Dat 1 Date	N DEN	entry Billion
	Name		<ul> <li>Space Motion</li> </ul>		009	and a second sec	ale Pitch	Enable Rotator
	Right Ascension Source	NaN h	<ul> <li>Orbital Elements</li> </ul>			Rotator Mode	cking Loop	
	Declination Source	NaN deg		Where is it?		501 *		Set
	Coordinate System		▶ When?				_	0.016
	Equinox Source	NaN yr	W.Clear local offsets	here will it be?		Refraction		_
	Limit Expected	HA Lower Limit	Go	Moon	Flat	Manual Override	False	
	Limit Time Left	0.00 h	Stop	and a second second	Unwrap Rot	Air Temperature Value	0 °C	
	Moon Zenith Distance	61.50 deg	and the second sec			Barometric Pressure Value	0 mbar	
	Sun Zenith Distance	77.17 deg	Time		1	Humidity Value	0 %	
	Telescope		Local Apparent Sidereal	Time 18:45:55.2	260 h	Wavelength	0.6000 un	n
		Out Of Tolerance	Modified Julian Day	57693.973	I9 MJD	Guiding Wavelength	NaN um	
	Air Mass	2 3445	Julian Epoch	2016.8363	3 ут		_	
	Atitude	25.14 deg	TAI Minus UTC	36 s		Painting Control		
	Azimuth	179.32 deg	TT Minus TAI	32.1840 s		M1 and M2 Alignment Collimation	False	Enable
	Hour Angle	-00:02:54.704 h	UT1 Minus UTC	-0.3238 s		Roller Encoders	False	Enable
	Zenith Distance	64.9 deg	Orbital Element		_	Encoder Non-Linearity	False	Enable
	Sun Separation	132.16 deg				and the second second		
Alan	Moon Separation	46.76 deg	Source Orbital Element S			Pointing Corrections		
Alan			Source Orbital Element A	and the second second second		Polar Motion X	0.1892 an	csec
	Space Motion		Source Orbital Element D	the state of the second se		Polar Motion Y	0.2811 ar	csec
Send	Source Space Motion Enabled	false	Source Orbital Element E	and the state of the		Collimation Correction Enable	and the second second second	
Seture Tise	Source Parallax	NaN arcsec	Source Orbital Element E	and a second second second second second		Collimation Correction Pitch	0 arcsec	
Re Operations	Source Proper Motion Epoch	NaN yr	Source Orbital Element E	poch Ulvan MJD		Collimation Correction Roll	0 arcsec	

2. The "Astrometric Kernal" reads "Stopped" and the "Tracking Tolerance" field reads "Out of Tolerance."

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