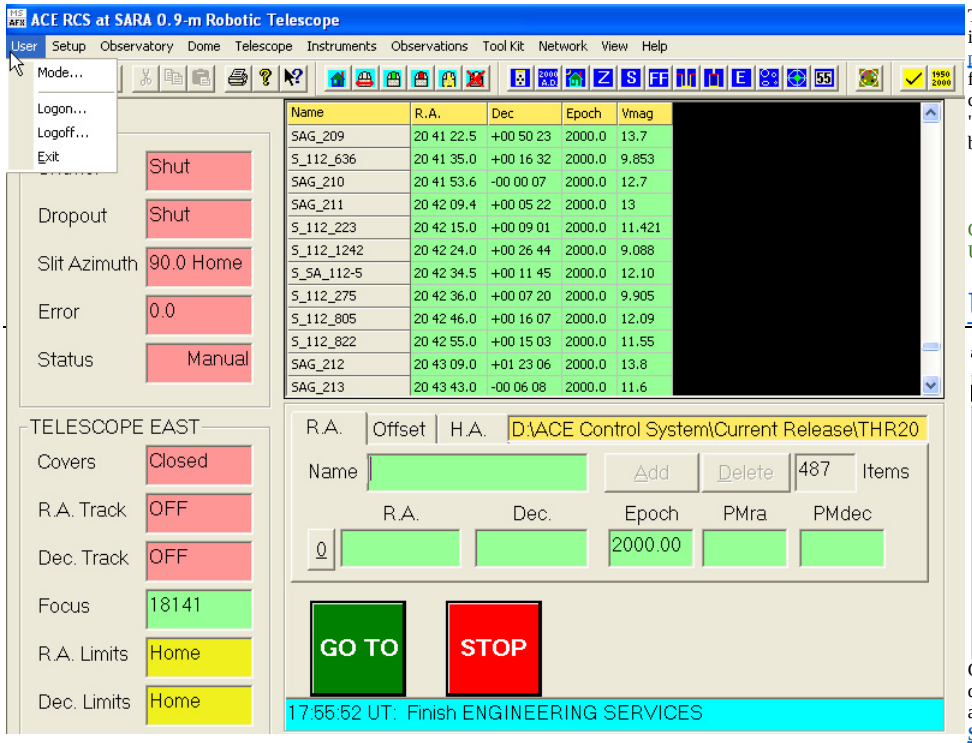
How To Use the Interactive Command Reference

This reference is designed to be graphically interactive by the use of image maps. Using a mouse, click on menus and tabs to navigate from topic to topic. Click on the link located in the title of the topic to move back (up) to the previous more general level. The main (root) screen, called the Main ACE Desktop, is the topmost level and has clickable regions- click on menus or on a region of the desktop to navigate to an appropriate topic.

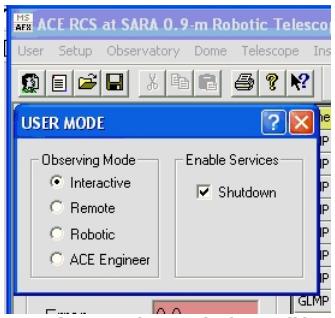
Menu | User



The User menu allows different people to log into the ACE software with different settings and privilege levels . Use the Mode option to change from interactive, remote, robotic or engineering configurations. The default mode is "interactive." Other modes can be programmed by ACE.

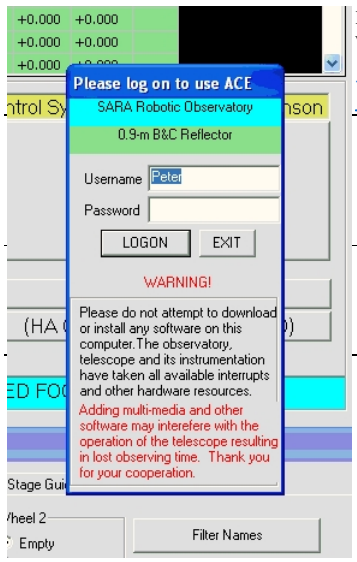
Click on the image to choose a selection under User or navigate to another menu.

User | Mode



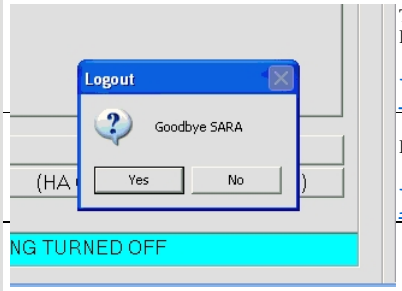
Currently not implemented. These will be different modes of observing that will utilize appropriate features in ACE. Enabling **Shutdown** will permit the observatory to close when shutdown conditions are met.

User | Logon



Log on to ACE by entering a Username and Password. Each user is associated with a privilege level that affects access to various ACE features. User names, passwords and privilege levels are defined under the Setup: Users menu.

User | Logoff



The Logout dialogue confirms the current user name and bids them farewell. Pressing Yes will bring up the Logon dialogue for the next user.

User | Exit

Exits the ACE program.

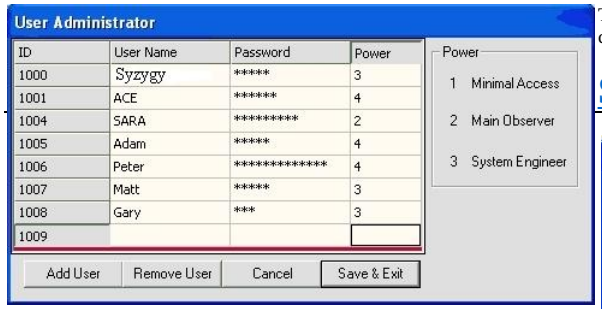
Menu | Setup

The services available under the Setup menu are generally used by a system engineer with appropriate privileges. The parameters that are adjusted in these options are specific to an observatory in terms of location, hardware, software and astronomical equipment (especially the mount and drives). Not shown here, Preload Motors can appear in this menu if they are installed (Setup | System Parameters | Telescope Extras).

Click on the image to choose a selection under Setup or navigate to another menu.

Setup | Users

Privilege Level: 4



This dialogue screen controls the names, passwords, and power levels (privileges) of users. Users can be added and removed from this dialogue and the database can be saved upon exiting.

Setup | Engineering Services

This screen can be used to warn (remote) observers that the observatory is being maintained and worked on.

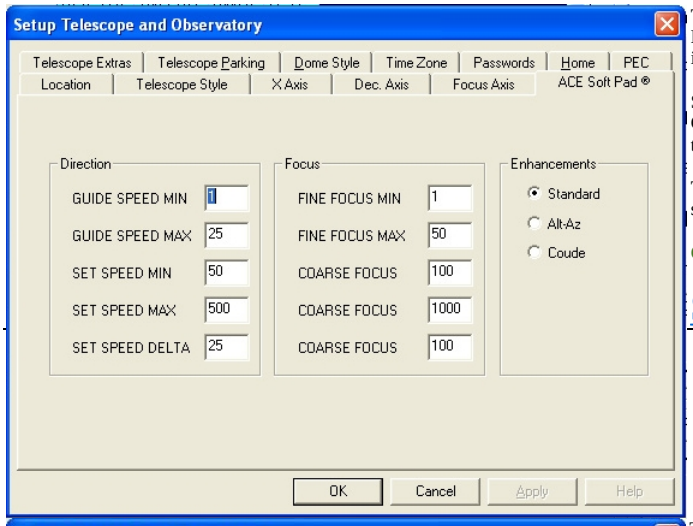
Also see the warning concerning any maintenance of the observatory's dome.

Setup | System Parameters | Location

Fill in the Name and Location (and Telescope) fields of the observatory. This information, as well as the geographic position and elevation will be recorded in the FITs header of image data if desired..

Click on this image to navigate to another tab.

Setup | System Parameters | ACE Soft Pad



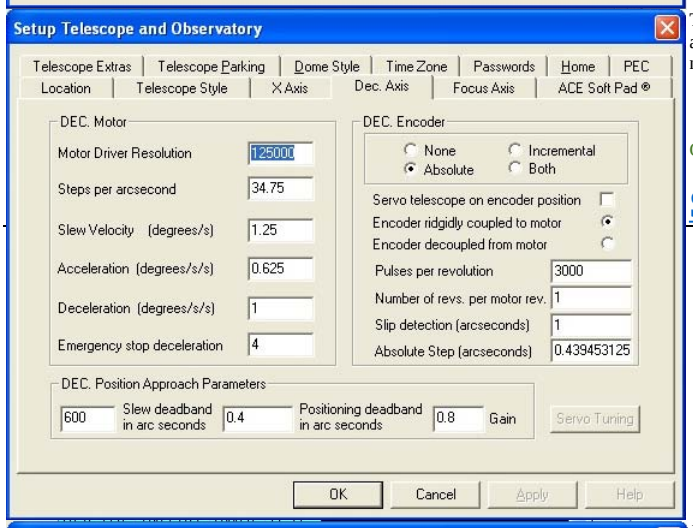
These settings control the functionality of the ACE Soft Pad GUI. Minimum and Maximum speeds for the Guide and Set rates are defined here. The Set Speed Delta is the increment or decrement used when adjusting the Set value.

Similarly the Focus minimum and maximum settings for each of Fine Focus and Coarse Focus can be set. The second to last Coarse Focus is the maximum value and the last field sets the increment.

The Enhancements will modify the ACE Soft Pad slightly depending on the mount style selected.

Click on this image and navigate to another tab.

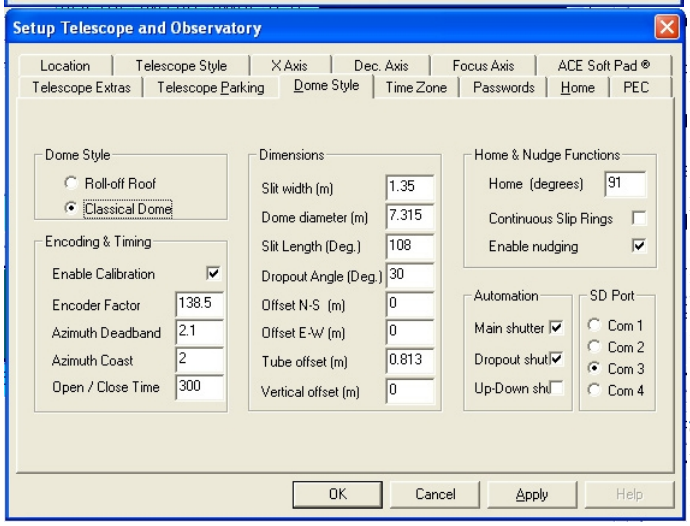
Setup | System Parameters | Dec Axis



These parameters control the motion, resolution, and pulses of the Declination motor and encoders. The values are carefully configured for a specific telescope system. Do not adjust without giving these parameters their full consideration.

Click on this image to navigate to any other tab.

Setup | System Parameters | Dome Style



Dome Style:

Roll-off Roofs generally slide horizontal to the ground and reveal the sky above a telescope. Since each of these systems are unique to the observatory the attributes shown in the image apply only to a Classical Dome.

Click on this image to navigate to any other tab.

A Classical Dome is defined to be an observatory with raised walls on which sits a vaulted roof (generally a hemisphere- but polygons and other designs abound) and an aperture (slit) that may have one or two parts. The roof (or building) will rotate to accommodate the telescope as it points skyward. The Dimensions define geometric relationship between the telescope and the dome so that ACE and point the telescope through the slit without obstruction. The diagram below defines this values.

Encoding & Timing:

Checking the Enable Calibration is necessary for domes that do not have ACE SmartDome™ installed in the observatory. With exception to the Open/Close Time (see below), the other values in this field need to be determined for domes without the ACE SmartDome system.

Encoder Factor:

The number of pulses per degree for the encoder.

Azimuth Deadband:

Number of pulses necessary to be at a new encoder position.

Azimuth Coast:

Number of degrees the dome will "coast" (motor is turned off) as it approaches a final destination/position.

Open/Close Time:

This feature is useful for any dome with a shutter that is commanded to open/close remotely. First measure (empirically) the amount of time necessary for the slit to open (fully). Then choose a time interval that is longer than this value. Should the dome not be fully opened (closed) after this time, ACE will generate a warning/error message and can be programmed to automatically shutdown.

Home and Nudge Functions:

These values are also for domes operating without the SmartDome system. Specify the Home azimuth position. Enable Nudging if the system uses partial slip rings (so that a Precise Seek on Home can be performed). If Continuous Slip Rings is checked, ACE will know to go to the particular absolute encoder position.

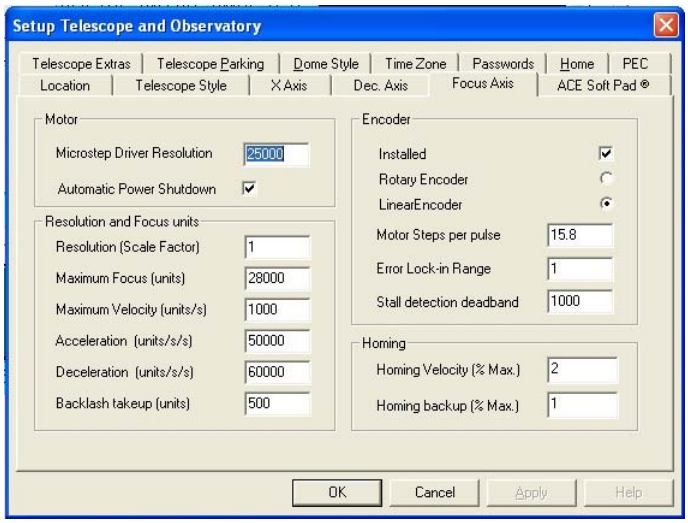
Automation:

Checking these boxes will tell ACE what is installed on the dome and display appropriate fields for Main Shutter, Dropout Shutter, and Up-down shutter in Region 1 (Dome, Telescope, Instruments) on the left side of the ACE Desktop.

SD Port:

Specifies which communication port SmartDome is using on the computer.

Setup | System Parameters | Focus Axis



The Focus Axis tab describes the particulars of the focuser length of travel, resolution, and motion(s).

Click on this image to navigate to any other tab.

Motor:

The Microstep Driver Resolution is the number of pulses per revolution of the motor.

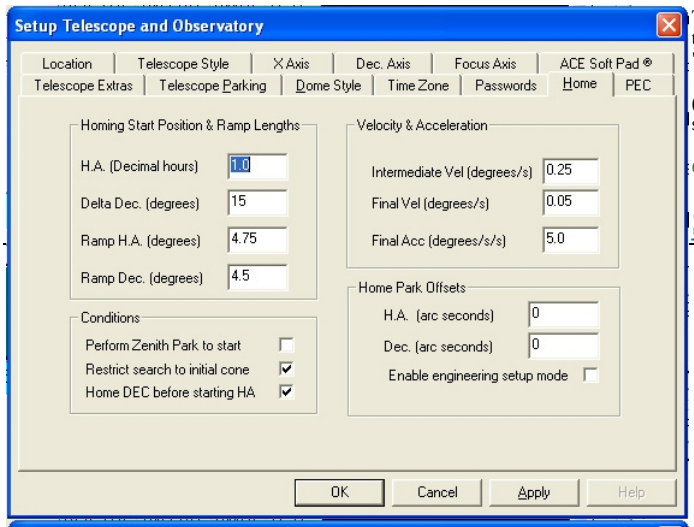
Automatic Power Shutdown turns of power to the motor so that no jitter from the servos takes place (this is the opposite of checking the Servo box in the Telescope | Focus tool).

Resolution and Focus units (Scale Factor):

The scaling factor the units will be displayed for the focuser.

Maximum Focus

Setup | System Parameters | Home

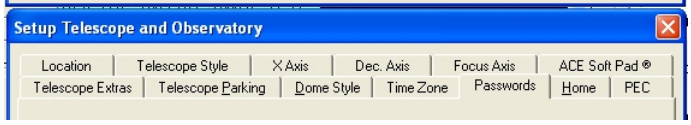


This **HOME** position is determined mechanically by a switch on each of the telescope axis. A ramp (triangular metal guide) is installed on the telescope such that "home" is defined as the position when the switch is closed at the apex of the ramp.

(not quite right, as has been explained- either simply or show geometry of the ramp system and how it relates to these parameters)

Click on this image to navigate to any other tab.

Setup | System Parameters | Passwords

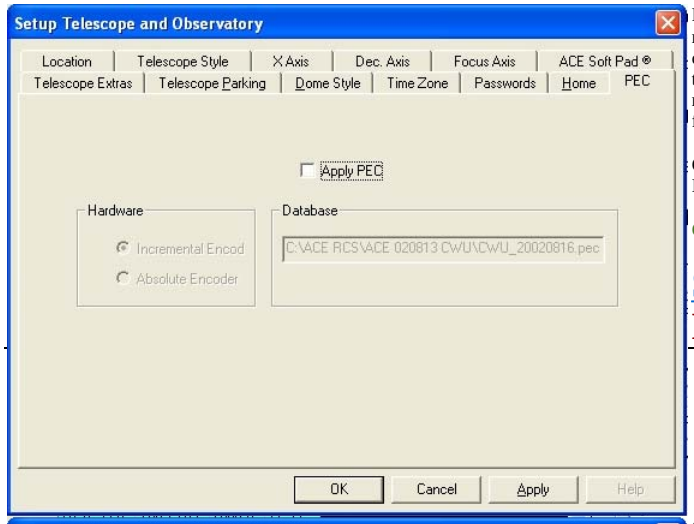


ACE queries users for this general ("System Engineer") PASSWORD each time changes are to be made to sensitive areas of the program. ACE will query for this password any time after 10 minutes of inactivity. This password is independent (and applies to all users) from the passwords assigned to individual users with their associated privilege levels. Checking the USER ACCESS box means that users must

logon to the program in order to use it.

Click on this image to navigate to any other tab.

Setup | System Parameters : PEC

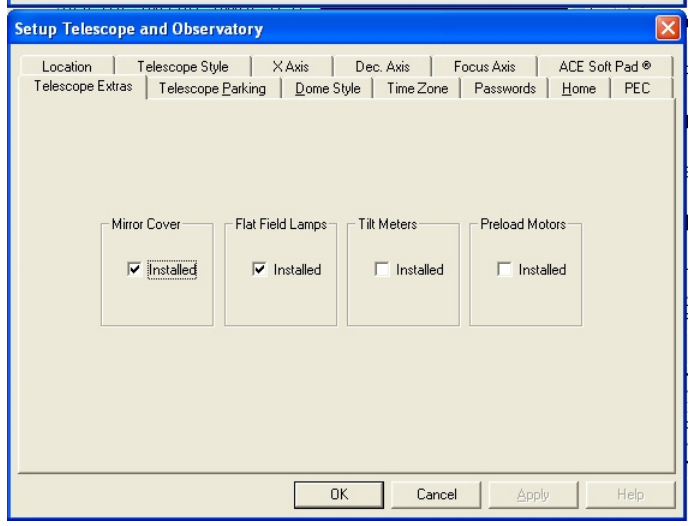


Periodic Error Correction (PEC) tables can be loaded in ACE in order to minimize minor deviations from sidereal rate in the Right Ascension drive. These small changes in rate are generally mechanical in nature and arise from non-uniformities in the RA (bull) gear, worm gear, and the interaction between the two. The changes in rate will repeat each rotation of the worm. PEC tables cannot be (easily) created for friction drives.

Check the PEC box to apply the corrections. Choose whether the drive uses Incremental or Absolute encoders.

Click on this image to navigate to another tab.

Setup | System Parameters | Telescope Extras



Check each of the features installed on your system.

Click on this image to navigate to any other tab.

Mirror Covers:

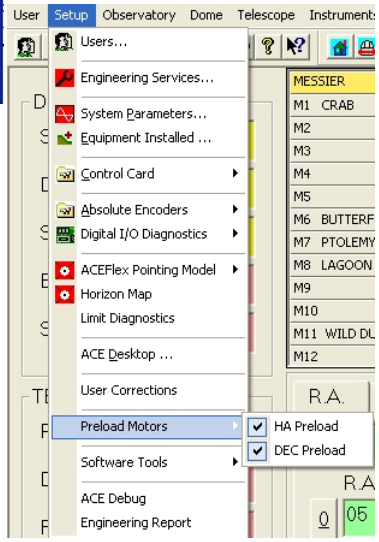
When checked, controls for opening and closing the mirror covers will appear under the Telescope Menu.

Flat Field Lamps:

When checked, the controls for turning the lamps on and off will appear somewhere....

Preload Motors

When checked, the Preload Motors can be enabled/disabled (each in HA and Dec) through the Setup Menu as a new option will appear as shown below:



Tilt Meters are no longer generally used.

Setup | System Parameters | Telescope Parking

These fields define various park positions for the telescope. A park position is a

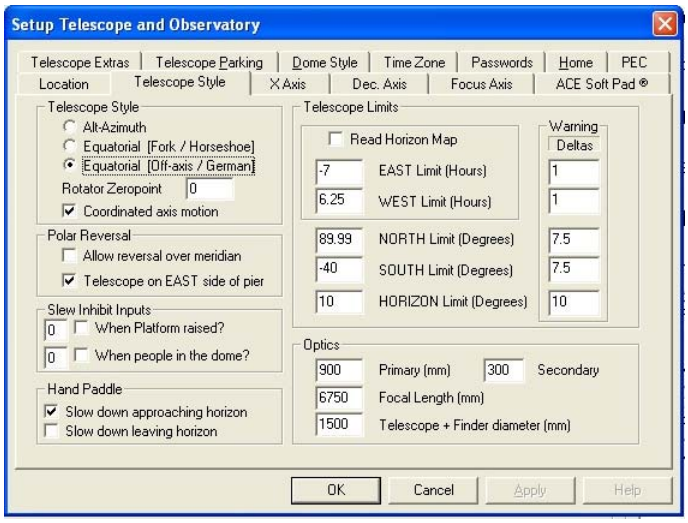
direction that the telescope will slew to and subsequently turn off the drives. The Mirror Cover Park might be a position that protects the mirror cover (and mirror beneath) from drips in a dome/observatory.

Click on this image to navigate to any other tab.

The Flat Field Park is a position that points the telescope towards a flat field screen in an observatory (or to a particular piece of twilight sky). Remember to define this position by putting the dome in a defined (or known) position as well (often Home) if using a flat field screen. This position can also be inputted from the Telescope: Dome Flat Park menu.

The position might be used to shutdown an observatory at the end of an observing session.

Setup | System Parameters | Telescope Style



Telescope Style

Choose the appropriate telescope mount for the system. Rotator Zeropoint defines a home position for the device (if one exists). This is especially useful for German Equatorial Telescopes that undergo pole reversal (transition through the North Celestial Pole when crossing the meridian, a flip) as a 180 degree rotation will be necessary to keep the same camera orientation. For Altitude-Azimuth mounts, the rotator will turn to compensate for field rotation. The rate is dependent on position in the sky (fastest near zenith).

Click on this image to navigate to any other tab.

Polar Reversal

These parameters permit (or disallow) the telescope to travel through the North Celestial Pole when crossing the meridian. If reversal is allowed and the telescope is pointed to the same coordinates in the sky, the field will be rotated by 180 degrees. Disallowing the reversal and constraining the telescope to one "side" of the mount will make the telescope ride above (or below) the polar axle as the telescope transits through the meridian.

Slew Inhibit Inputs

If the observatory has a platform, the telescope can be prevented from slewing if the platform is raised and thereby prevent a collision. Caution: This does not affect the RA drive which may still be tracking. The slewing motion of the telescope can also be locked if the condition of people in the dome is met (by using motion detectors).

Hand Paddle

The acceleration of the telescope when slewing with the hand paddle can be slowed based on the values inputted in the X-Axis tab.

Telescope Limits

The software limits as to how far the telescope can move in either axis are defined here. The East and West limits are inputted as Hour Angle (HA) from the meridian. The Warning Deltas define how many hours approaching the limits a warning would be given. From the screen capture above, a warning would be issued at an hour angle of 5.25 hours as the telescope approached the West limit. The East and West limits in the fields are over-ridden by a horizon map if the Read Horizon Map is checked.

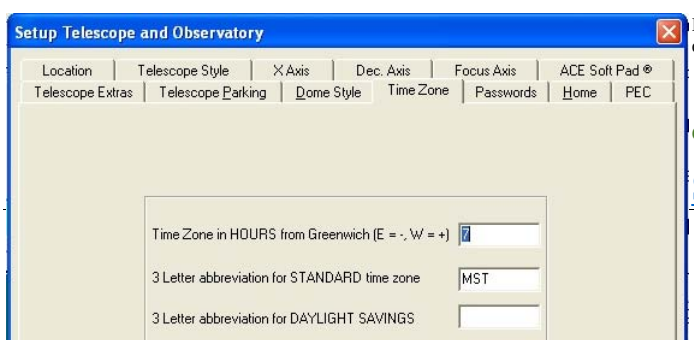
The North and South limits are defined in a similar way. This is where the values come from when generating a horizon map with a particular resolution in declination between the north/south limits. Warnings are given when the telescope approaches the limits and these units are in degrees.

A Horizon Limit is one final condition that will restrict the telescope motion from trespassing a particular low altitude in the sky. Again, a warning within some delta of this limit will be issued. From the above, a warning would be given anytime the telescope is within 20 degrees of the (true) horizon.

Optics

The diameter of the Primary and Secondary mirrors are inputted as well as the Focal Length of the entire system. These values can be used to compute the plate scale and other optical characteristics elsewhere in ACE. From the above, the telescope is an f/7.5 system with a plate scale of 31 arcseconds/mm (206265"/6750mm). The Telescope + Finder diameter is full extended front profile of the telescope from the edge of the telescope to the outer edge of the finder. This value is used to determine when moving the dome is necessary and ensuring both the main telescope and finder telescope are on the sky.

Setup | System Parameters | Time Zone



Input the **Time Zone** in Hours from Greenwich. Positive values are west of this line of longitude.

Click on this image to navigate to any other tab.

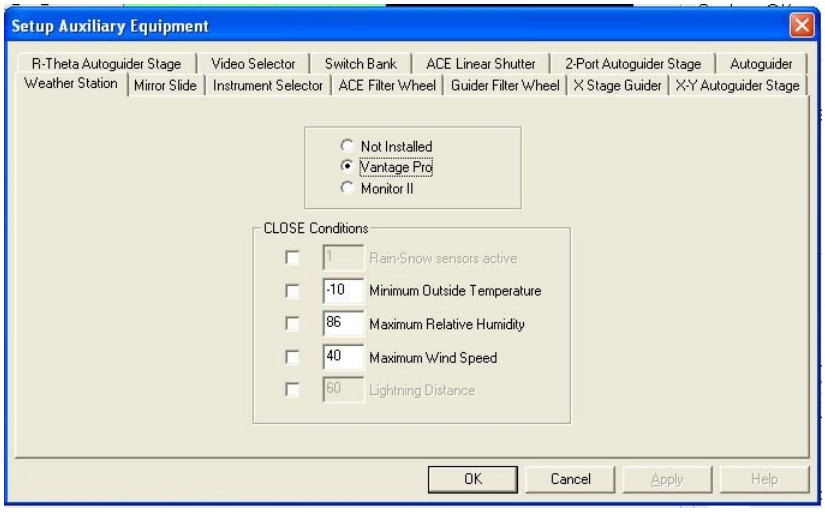
Setup | System Parameters | X-Axis

These parameters control the motion, resolution, and pulses of the HA motor and encoders. The values are carefully configured for a specific telescope system. Do not adjust without giving these parameters their full consideration.

Click on this image to navigate to any other tab.

Setup | Equipment Installed | Weather Station

Optionally Installed Equipment



The **Weather Station** is one of the most useful Auxiliary pieces of equipment an observatory can have.

Click on the image to navigate to other tabs under Auxiliary Instruments.

Close Conditions

When these conditions are met, the observatory will be Shutdown. Check the radio box to use each condition that will trigger a shutdown. Note that in this screen capture, the values are indicated but none of the conditions are being used.

Rain-Snow sensors active: Specifies the number of Rain-Snow sensors reading inclement weather to trigger a closure. Normally this might be set to "1" so that any sensor detecting water would close the observatory. However, if one (of several) sensors is not functioning properly (and always sensing water, though there is none) it can be ignored by increasing the number of active sensors necessary to trigger a closure.

Minimum Outside Temperature

Specifies the coldest temperature the observatory will remain open.

Maximum Relative Humidity

Specifies the maximum reading of water vapor held in the air that will trigger a closure.

Maximum Wind Speed

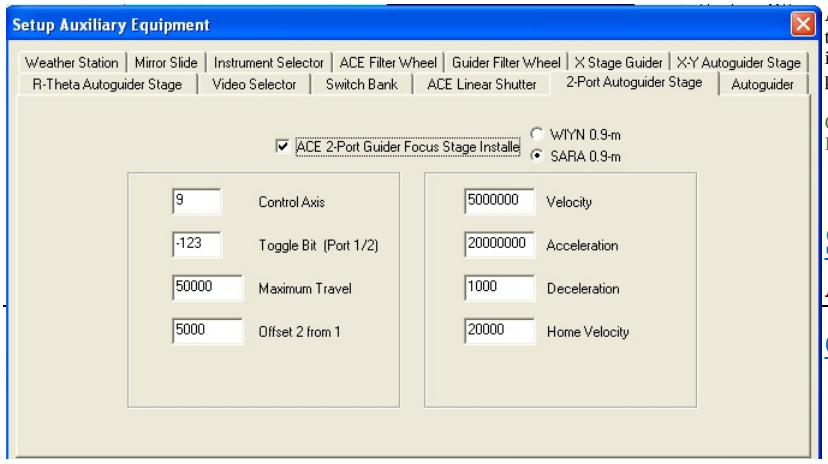
Specifies the maximum time-averaged wind speed (not gusts) that will trigger a closure of the observatory.

Lightning Distance

If the weather station supports/detects lightning, this condition can be used for automatic closure of an observatory.

Setup | Equipment Installed | 2 Port Autoguider Stage

Optionally Installed Equipment

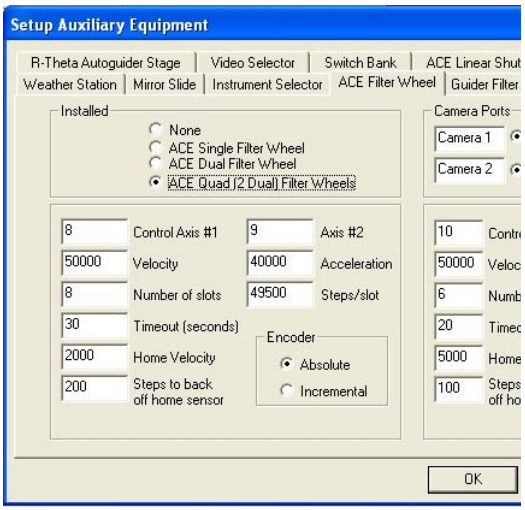


A dual port guider focus stage will position a guider in the telescope beam at two different positions to accommodate instruments at two different ports. These values control the position, speed and limits of the stage.

Click on the image to navigate to other tabs under Auxiliary Instruments.

Setup | Equipment Installed | ACE Filter Wheel

Optionally Installed Equipment

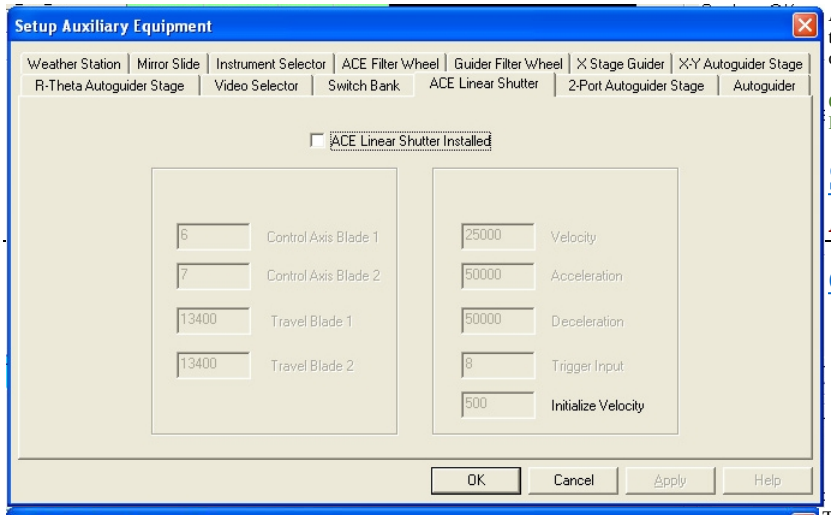


This one seemed like an extensive topic... Needs to be written.

Click on the image to navigate to other tabs under Auxiliary Instruments.

Setup | Equipment Installed | ACE Linear Shutter

Optionally Installed Equipment

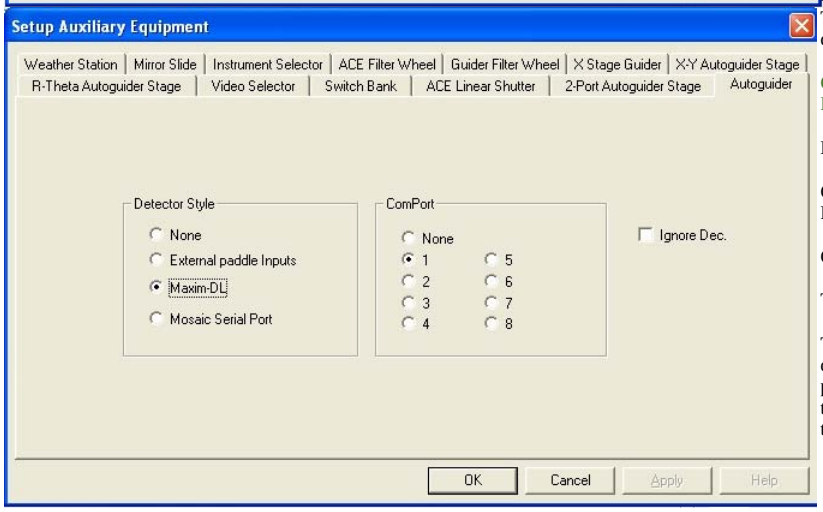


An ACE Linear Shutter is a two-blade (rectangular) camera shutter that results in even chip illumination through its opening and closing procedure (motion sequence).

Click on the image to navigate to any tab under Auxiliary Equipment.

Setup | Equipment Installed | Autoguider

Optionally Installed Equipment



The Autoguider tab controls the mode of communication with the device.

Click on this image to navigate to other tabs under Auxiliary Equipment.

Detector Style

Control signals can come directly from External Paddles, a Serial Port, or via software such as Maxim-DL.

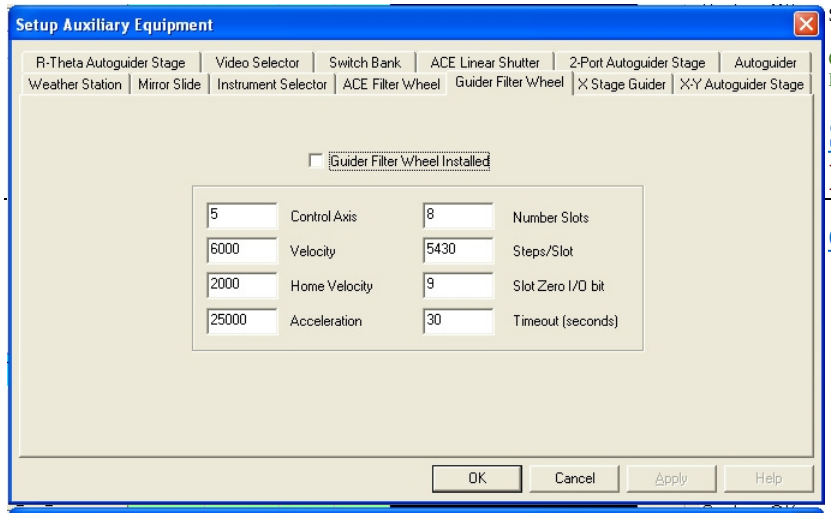
ComPort

The communication port through which the communications occur.

The Ignore Dec. will prevent corrections from being made in the declination axis. This will allow the guider to just correct for periodic error (especially for a well-aligned telescope). Turning off the declination corrections can also be a powerful troubleshooting tool for guiding issues.

Setup | Equipment Installed | Guider Filter Wheel

Optionally Installed Equipment

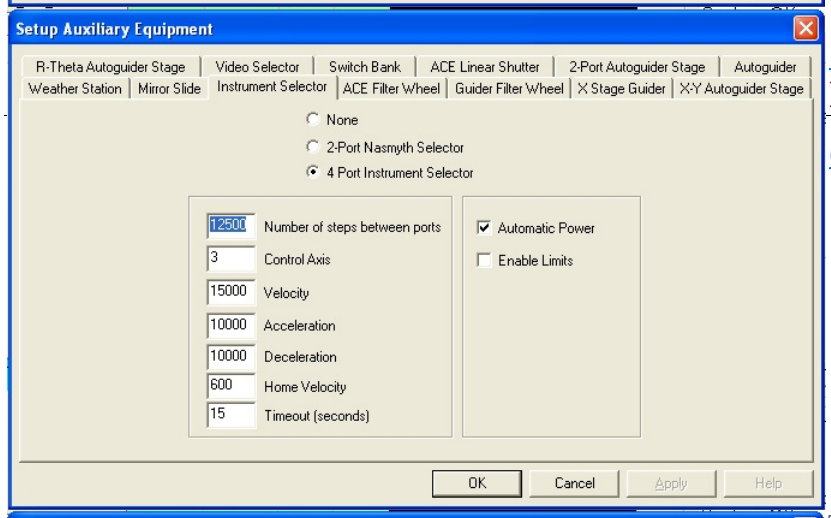


Specifies the details of a **Guider Filter Wheel** (if one is installed).

Click on the image to navigate to other tabs under Auxiliary Equipment.

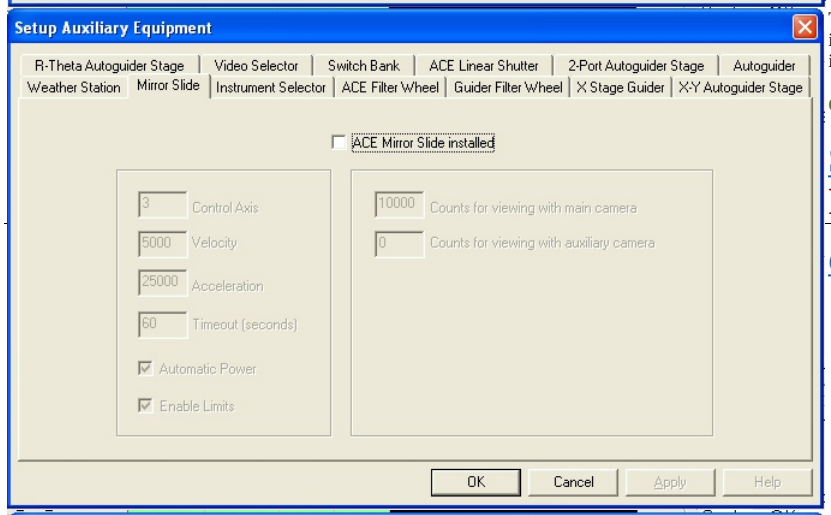
Setup | Equipment Installed | Instrument Selector

Optionally Installed Equipment



Setup | Equipment Installed | Mirror Slide

Optionally Installed Equipment

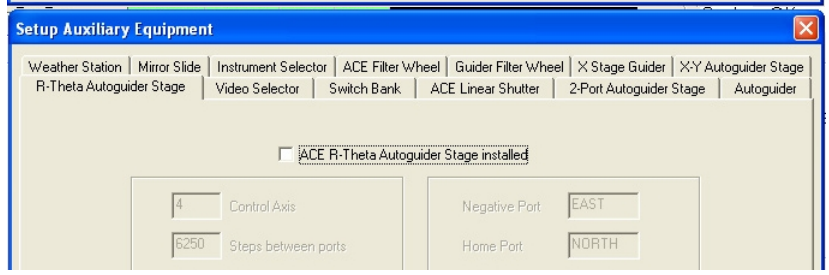


The ACE Mirror Slide is a movable mirror that can be positioned in the telescope beam to illuminate an auxiliary camera. Calibrate its motion and limits with options indicated here.

Click on the image to navigate to any other tab.

Setup | Equipment Installed | R-Theta Autoguider Stage

Optionally Installed Equipment

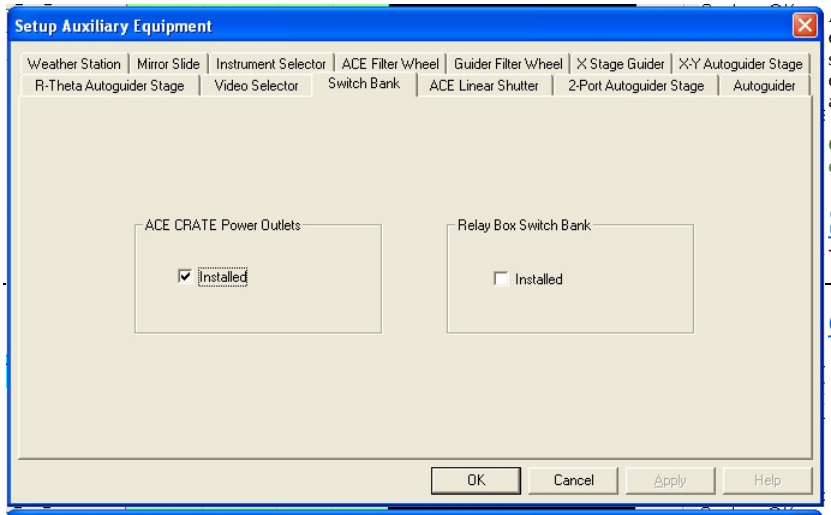


An R-Theta Autoguider Stage rotates around the a fixed position in a telescope beam at a given radius.

Click on the image to navigate to any other tab.

Setup | Equipment Installed | Switch Bank

Optionally Installed Equipment

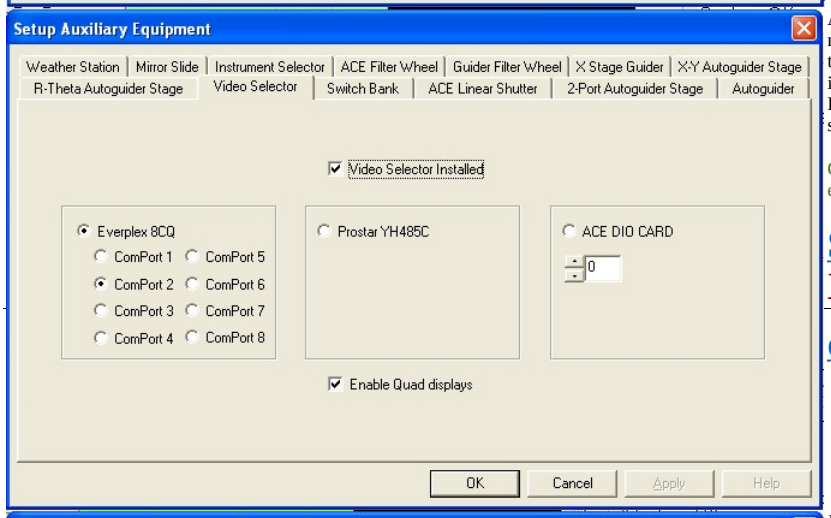


A **Switch Bank** allows a user to remotely power cycle any device connected to them. Check how many Power Outlets (or synonymously Relay Boxes) are installed on your system. If checked, it will appear as a choice under the Instruments Menu and a tab will appear in the Auxiliary Instruments dialogue.

Click on the image to navigate to other tabs under Auxiliary equipment.

Setup | Equipment Installed | Video Selector

Optionally Installed Equipment

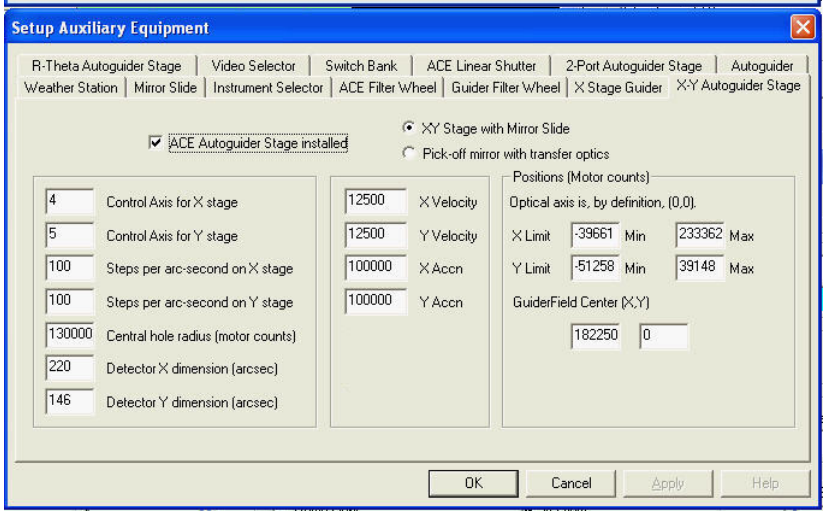


A Video Selector is a electronic box or video card that accepts multiple video signals (from web-cameras for example) and sends the information to a computer. Select the type of selector that is installed and the communication port it uses. Enable Quad Displays will permit multiple camera images to be seen simultaneously if the selector/card supports this feature.

Click on the image to navigate to other tabs under Auxiliary equipment.

Setup | Equipment Installed | X-Y Autoguider Stage

Optionally Installed Equipment



Like the X-Stage and R-Theta Stage, an X-Y Autoguider Stage positions a guider camera in the beam of the telescope. This design has two freedoms of movement (axes) in the focal plane. The values here control the position, motion, and limits of each control axis.

The optical axis is, by definition, at (0,0). Move the stage so that it is on axis, looking at the same star as the main camera. Then enter into the low level command too the command:

AU LP0; AV LP0;

This example is for axes U and V. The axes are defined as follow:

0 = X, 1 = Y, 2 = Z, 3 = T, 4 = U, 5 = V, 6 = R, 7 = S.

Then drive the stage all the way to the limits by enetering the command:

AU JF-10000; AV JF-10000;

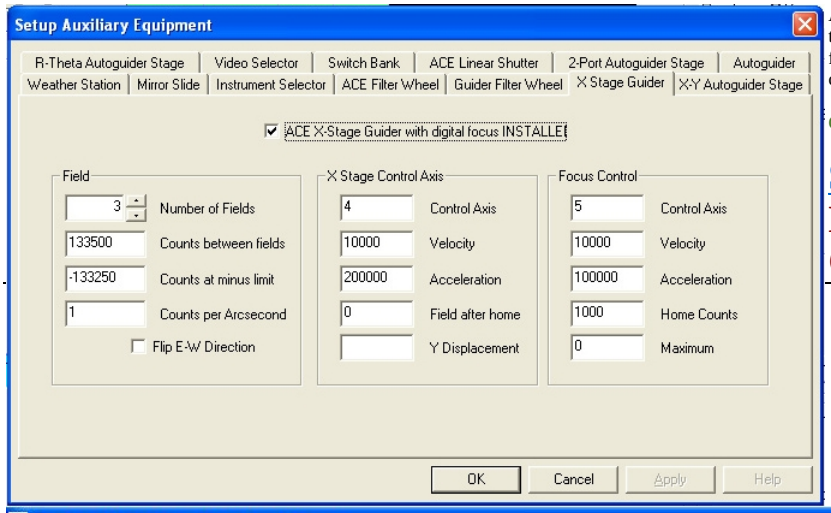
When the limits are reached load the motor counts values shown in the diagnostics tools for the relevant axes.

Then repeat the same process but for the positive limits by entering the JF commands with a positive sign. The guider Field Center is the position of the center of the guider field.

Click on the image to navigate to any other tab.

Setup | Equipment Installed | X Stage Guider

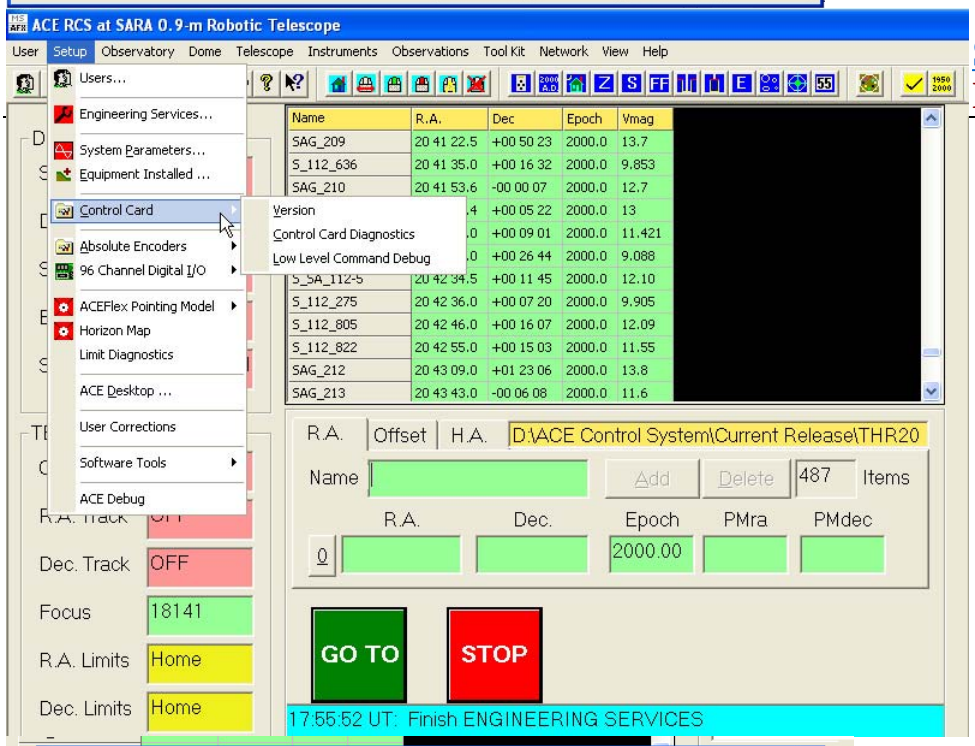
Optionally Installed Equipment



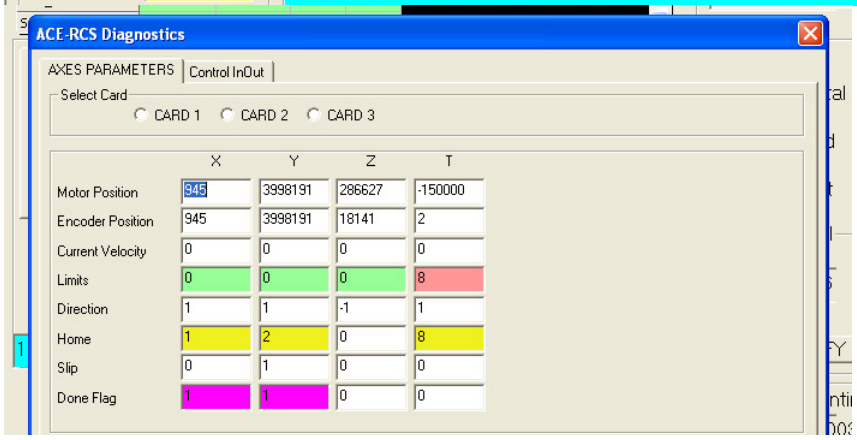
A linear stage that moves in a line to position a guider camera in the beam of the telescope. The stage also moves in and out of the focal plane (Focus Control) in order to focus. The values here control the stage's position, motion, and limits.

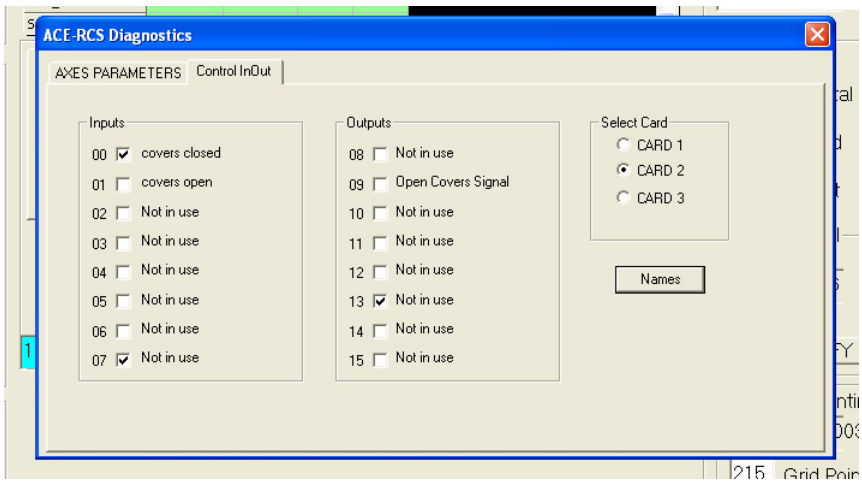
Click on the image to navigate to any other tab.

Setup | Control Card (Version, Diagnostics, Low Level Command Debug)

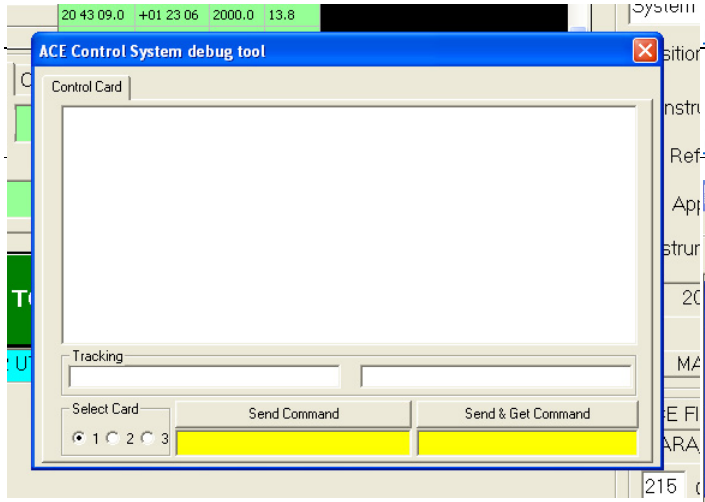


Setup | Control Card | Diagnostics



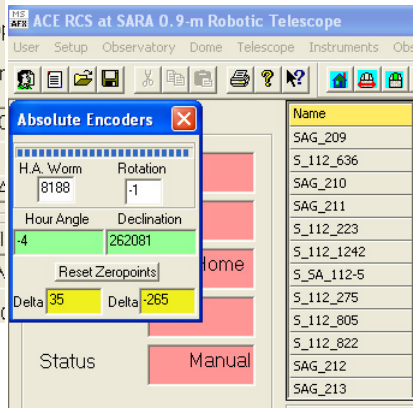


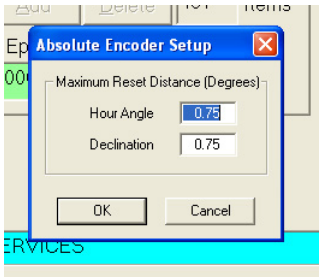
Setup | Control Card | Low Level Command Debug



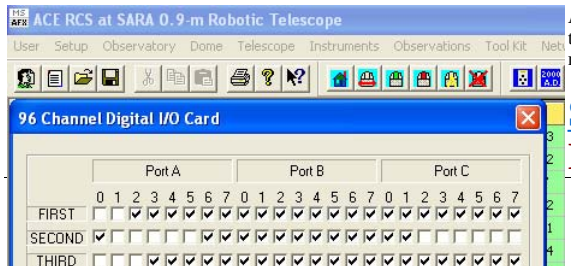
Setup | Control Card | Version

Setup | Absolute Encoders





Setup | 96 Channel Digital I/O



A **96 Channel Digital I/O Card** takes external signals (bits) from a circuit board and sends them to the card through a 96 pin cable/connector. The input could come from encoders, for example, and record the position through binary representation.

Setup | ACEFlex Pointing Model | Pointing Diagnostics

The Pointing Diagnostics dialogue shows the positional corrections that are being applied

to a target's catalogued coordinates in order to point the telescope with both accuracy and precision. These corrections are both astrometric, atmospheric, and mechanical in nature.

Catalogue:

The coordinates as recorded in a reference with an associated Epoch.

J2000

These are the coordinates precessed to Epoch 2000 coordinate system.

Apparent

The apparent position of a target is the precessed position plus positional corrective terms including aberration, proper motion, and parallax.

Refracted:

The refracted position, based on the target altitude, temperature, and barometric pressure, corrects for atmospheric effects. This correction is applied to the apparent position above. Note that a separate field displays the actual Refraction correction in RA and Declination.

Instrumental:

The position on the sky as expressed by the encoders of the telescope necessary to point the telescope at a target after applying all corrections.

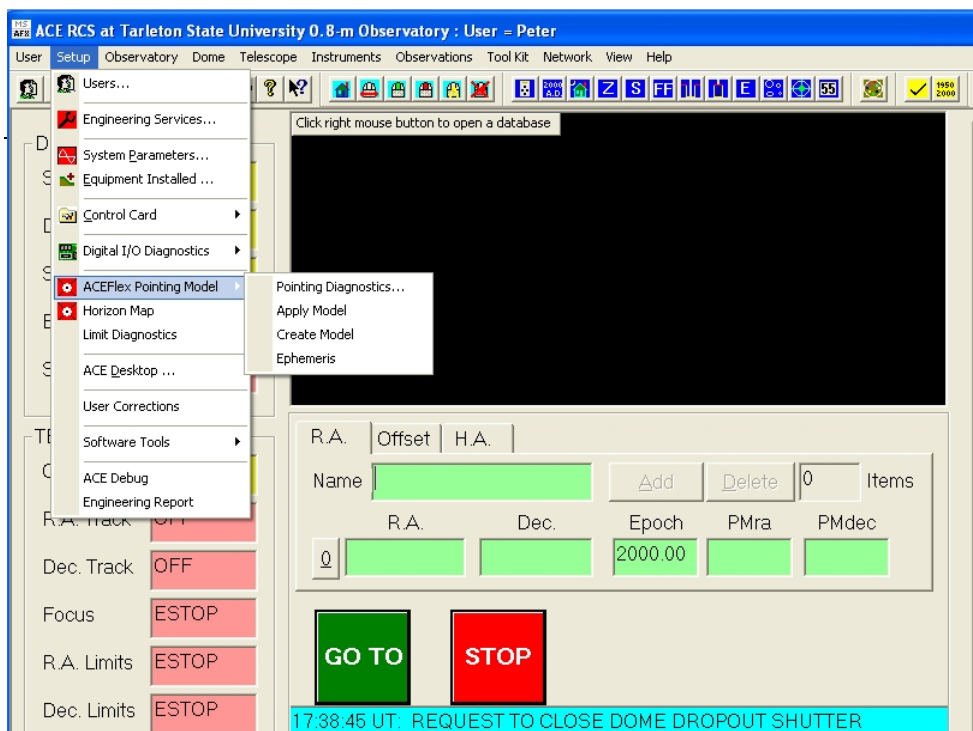
Refraction:

The amount of shift that a target undergoes due to the refractive effects of the atmosphere at a given altitude, temperature, and pressure.

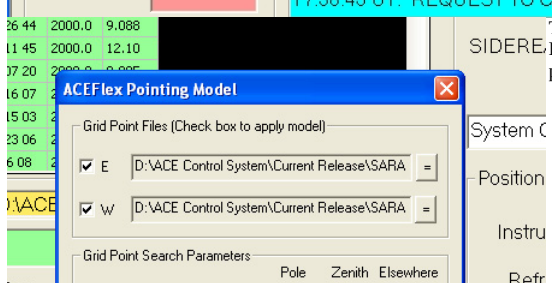
Flexure:

Based on a pointing model, this is a correction that compensates for the mechanical pointing errors of the telescope and mount. Polar alignment, flexure of the mount/OTA, non-perpendicularities of the optical tube axes, and index errors are typical terms that are folded into this correction.

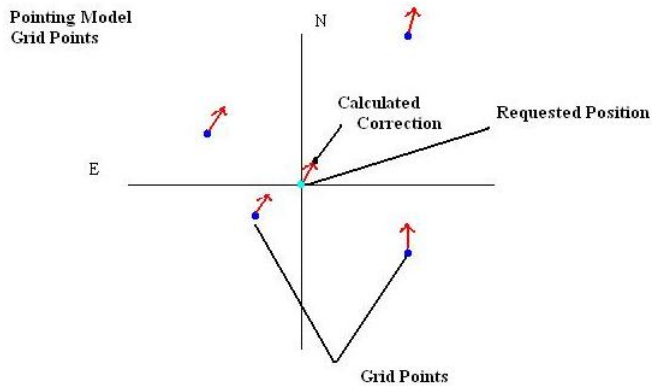
Setup | ACEFlex Pointing Model



Setup | ACEFlex Pointing Model | Apply



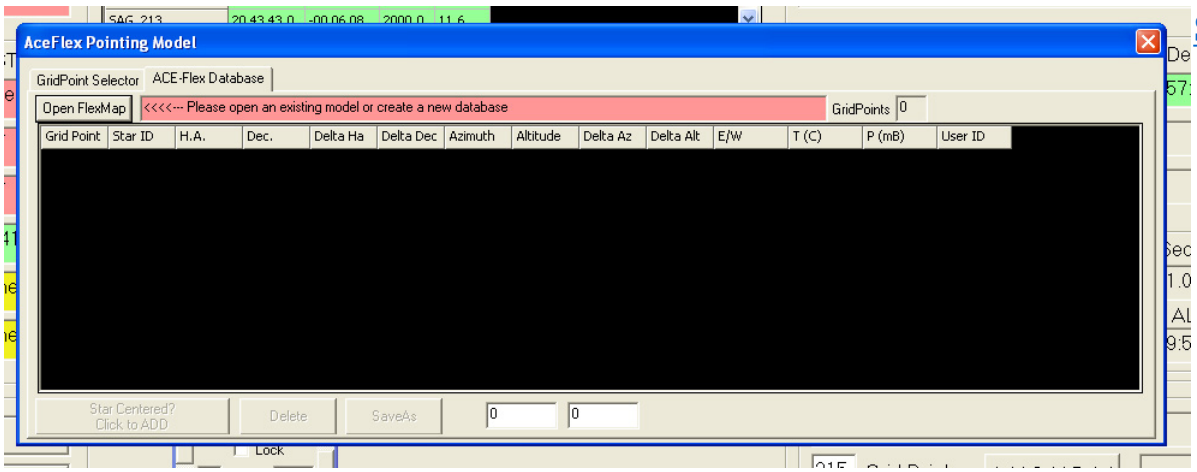
The ACEFlex Pointing Model is a database of positional points (evenly) distributed across the sky. Each point records a correction vector for that position. When the telescope is commanded to point to a particular position in the sky the corrective offset is calculated from neighboring points. (See Below)



Shown above, ACE indicates how many Grid Points are next to the requested position within the Radial Distance of the Grid Point Search Parameters. The Elsewhere field is the general search radius with the near-Pole and near-Zenith positions having different values to accommodate the geometry of the mount (equatorial, offset (German equatorial, or altitude-azimuthal). The correction is calculated from the neighboring points and weighted according to distance from a neighbor (if the Apply distance weighted solution with a power law behavior is checked). The temperature and barometric pressure should be inputted so that the calculation of a grid point can be generated and without refractive effects. This atmospheric values can be measured by a connected Weather station if Read Station is checked.

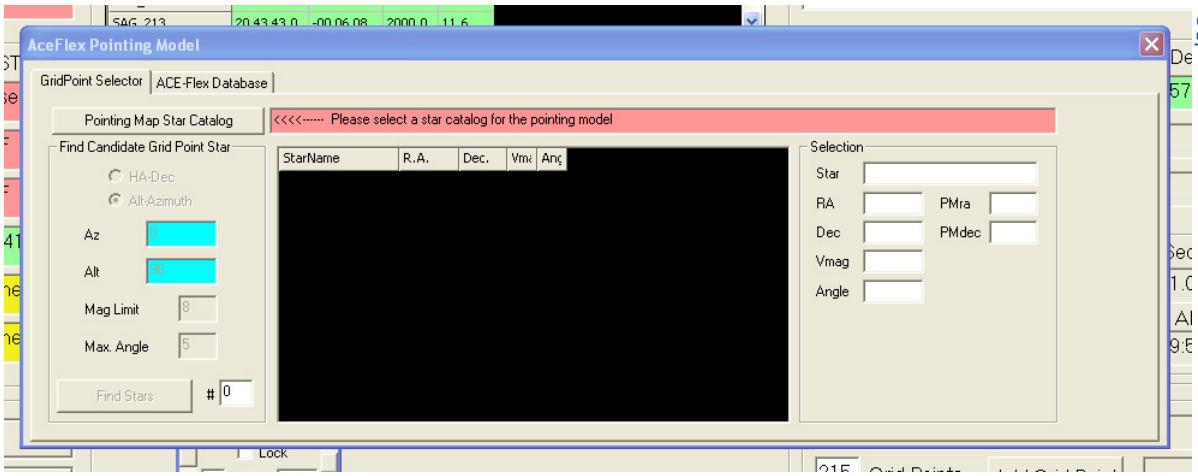
Pointing Ephemeris Parameters: Used with Alt/Az telescopes to control track rates with position on the sky.

Setup | ACEFlex Pointing Model | Create Database



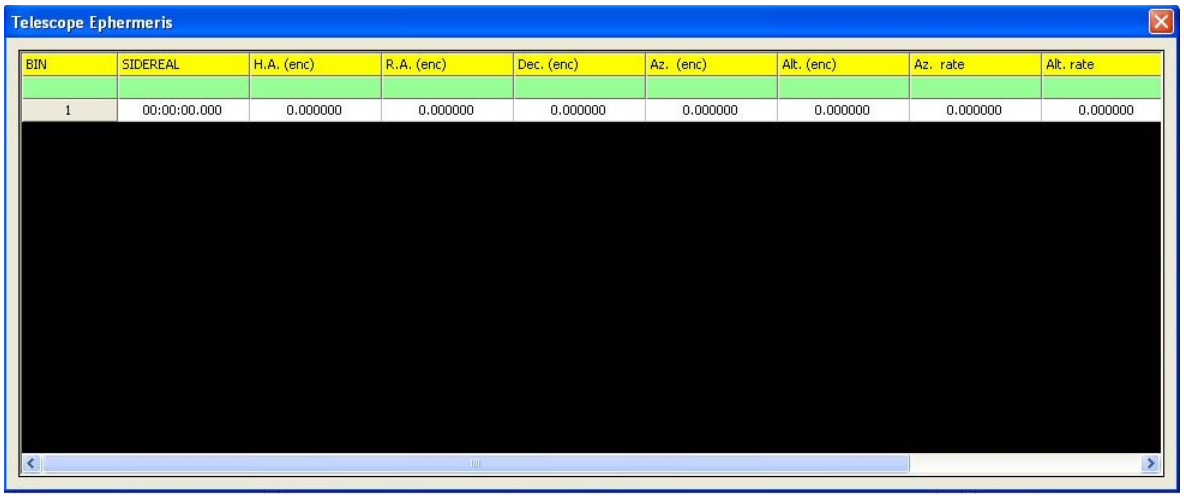
Setup |

ACEFlex Pointing Model | Create Grid Point Selector

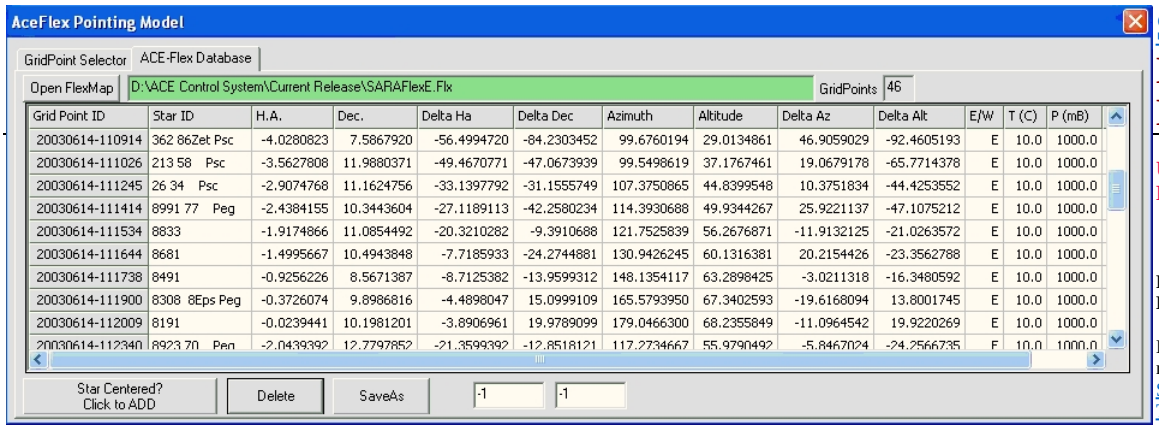


Setup |

ACEFlex Pointing Model | Ephemeris



Setup | ACEFlex Pointing Model | Open FlexMap



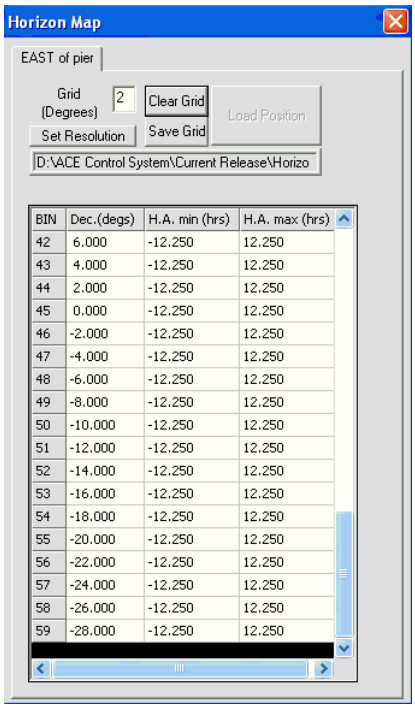
Setup | Horizon Map

User Privilege Level: 2

Fork Mounted Equatorial (General):

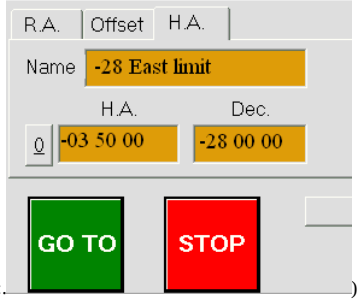
Load a Horizon Map by navigating to the Setup System Parameters: Telescope Style menu and checking the appropriate box.

The Grid is created from a range of equally spaced declination values and the H.A. limits that are inputted into the chart. The resolution determines how many declination values are between the North and South limit. Here the North limit is 90 degrees in declination and the South limit is -28 degrees. With a resolution of two degree increments, there are 59 (118/2) values of declination to input a minimum and maximum HA. The North and South limits are defined in Setup: System Parameters: Telescope Style.



Procedure:

1. Set the declination of the telescope in ACE to one of the values in the chart and the H.A. to a value near a limit

(Example: 

)

2. Manually slew the telescope until the optical tube assembly (OTA) is just about to be occulted by the artificial horizon (e.g. edge of the dome).

3. Click on the corresponding minimum H.A. cell if you are EAST of the meridian. Click on the corresponding maximum H.A. cell if you are WEST of the meridian.

4. Press the "Load Position" button. This will insert the current value of the H.A. from the main ACE software.

5. Once the chart is filled out, press the "Save Grid" button to save this horizon map.

Example:

Let's use the chart on this page as an example.

1. Set the Declination in ACE to -28 degrees and an H.A. of -03 50 00 as shown above (near the east limit).

2. Slew the telescope further to the EAST until you reach the artificial horizon.

3. Click on H.A. min (hrs) cell (the first cell to the right of -28 in the 59th bin).

4. Click "Load Position." Instead of reading a limit of -12.25 (which is pointing to the ground) the new limit is updated here (perhaps -05.27).

5. HINT: Instead of slewing across the sky to go to the maximum HA in the WEST, choose to, instead, work on the next value of declination on the same side of the sky and input another minimum H.A. limit. This is a much more expedient way to input the values.

6. Once you have completed all of the minimum H.A. limits, continue by working the other half of the sky west of the meridian.

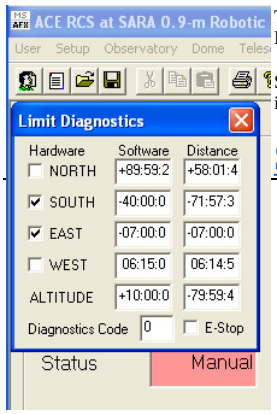
German Equatorial Mount with a Flip:

For a telescope that slews through the North Celestial pole, the optical tube assembly (OTA) will transition from one side of the meridian to the other. A flip may be necessary either due to the geometry of the telescope in the observatory or due to the mechanical limits of the mount in order to continue tracking at the same declination. In this case it will be necessary to create a map for each side of the meridian where these limits are met. Positions are recorded for the minimum HA above the artificial horizon (e.g. edge of the dome wall) up to a maximum H.A. limit (that is not the West limit). This map is saved as the "EAST of pier" database. Another map is generated for the "WEST of pier" and in the same manner recording the maximum H.A. at the artificial horizon (e.g. edge of the dome wall) and the minimum HA (but should not equal the EAST minimum limit). There can be overlap between the maximum limit from the East and the minimum defined HA from the West.

Offset German Equatorial Mount:

Some German equatorial mounts have the telescope offset along the polar axle. Thus it may be possible to have the optical tube assembly rotate around the polar axle and go across the sky (to the western limit) unhindered. In this case, if the OTA is on the East side of the pier, then the telescope will ride "above" the polar axle when pointing to the west (reverse the language for an OTA on the West side of the pier). The horizon map will read which side of the pier the OTA is on and it will only be necessary to create a single map just as is done with a standard fork mount.

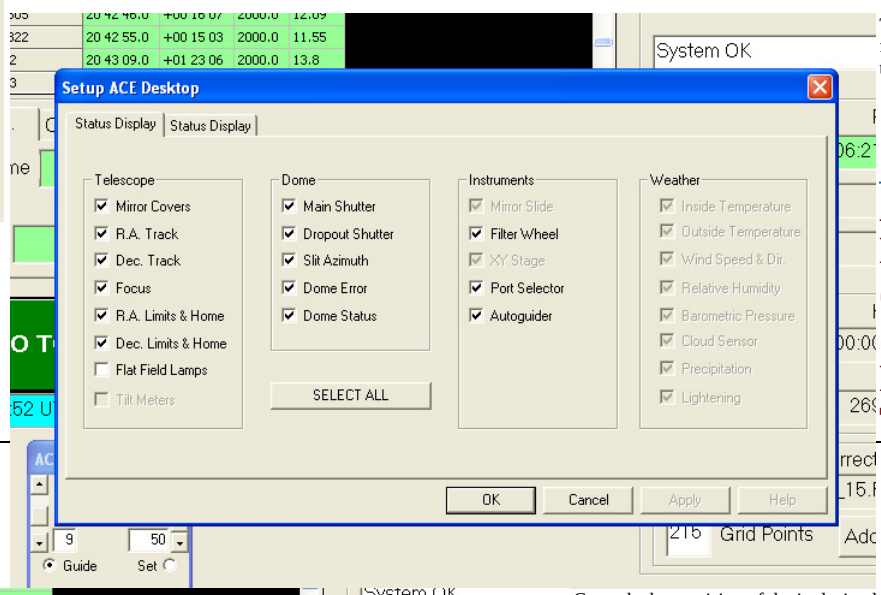
Setup | Limit Diagnostics



The Limit Diagnostics gives real time information on the angular Distance the telescope is from a particular software imposed limit. For RA (EAST/WEST) this is expressed in Hour Angle (HA). For Declination (NORTH/SOUTH) and Altitude this is expressed in degrees.

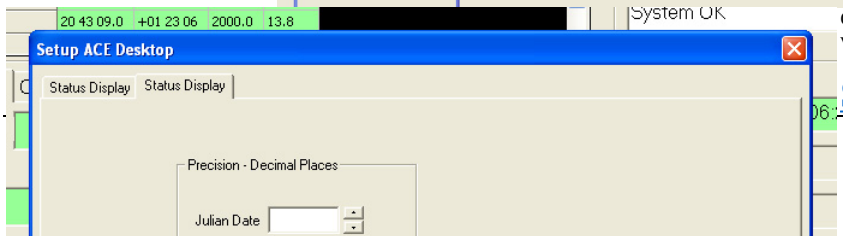
Should the telescope reach a limit a Diagnostic Code would be displayed and the E-Stop (Emergency Stop) box would be checked to indicate the state of the telescope.

Setup | ACE Desktop (First Status Display Tab)



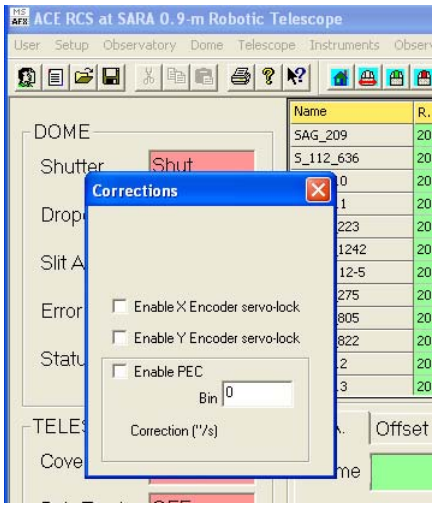
This dialogue controls the fields that are visible on the desktop of ACE.

Setup | ACE Desktop (Second Status Display Tab)



Controls the precision of the in decimal places of numerical values that are displayed on the ACE Desktop.

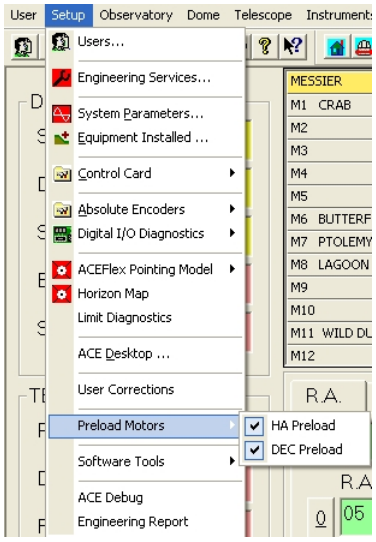
Setup | User Corrections



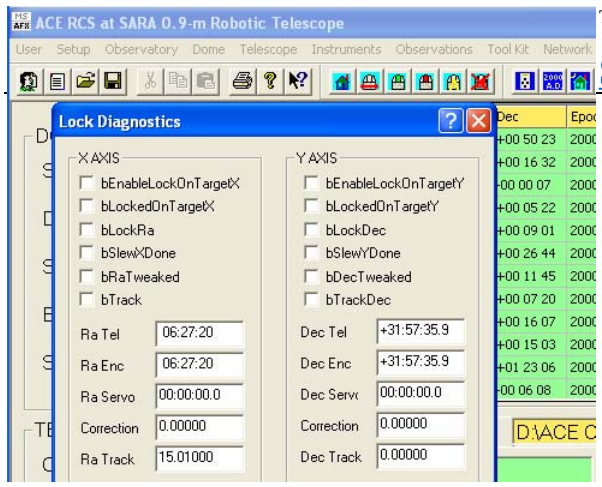
Setup | Preload Motors

Optionally Installed Equipment

Preload motors can come in many different styles. However, they are all used to apply torque to gears or axles of telescope drives and mounts. The torque maintains firm contact between moving parts, and helps to minimize hysteresis and backlash. If these are installed (Setup | System Parameters | Telescope Extras) a menu option will appear under the Setup Menu (as shown below) to enable or disable the motors.

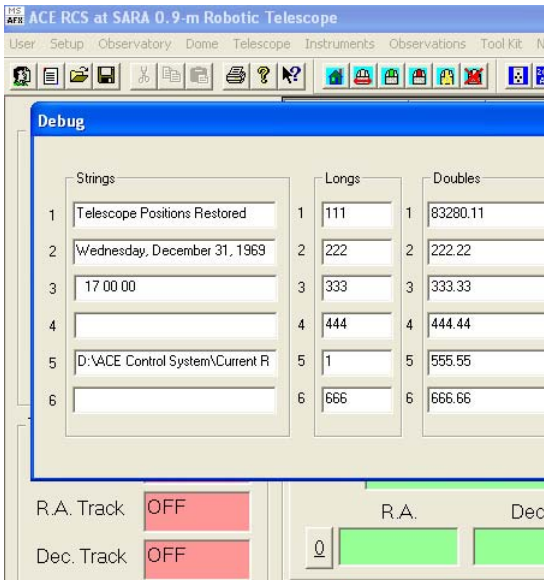


Setup | Software Tools



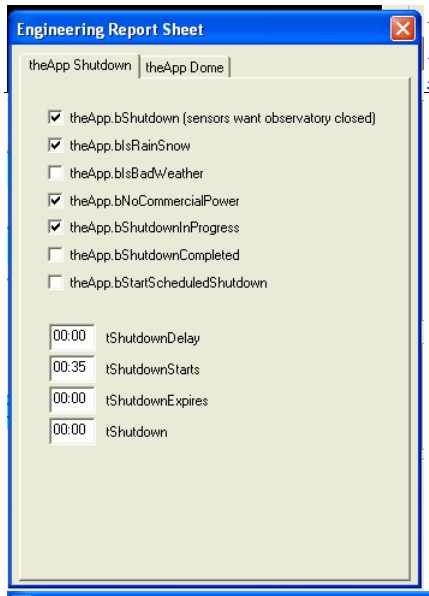
This menu is a programming information tool for debugging the software.

Setup | ACE Debug



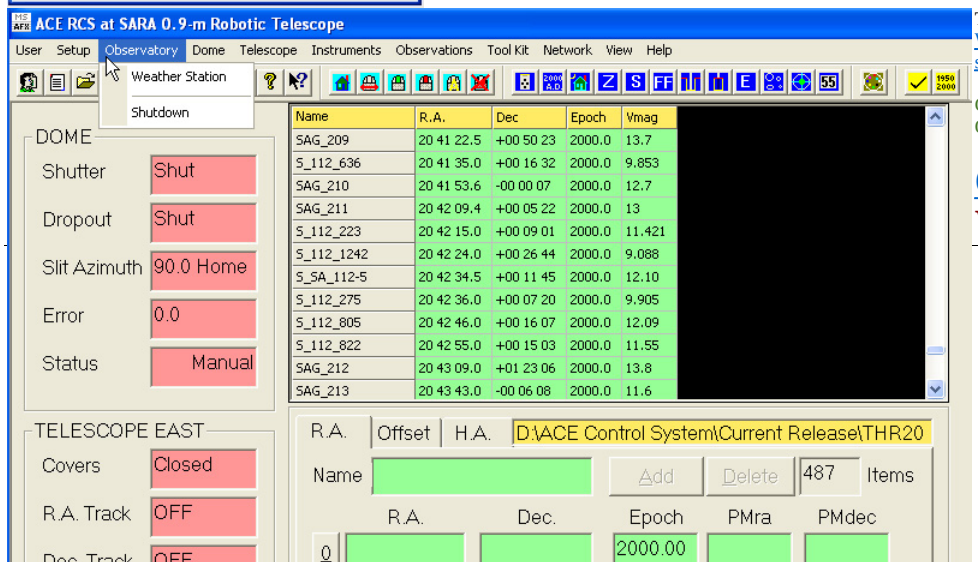
A programmer's (that is Peter Mack's) software development tool .

Setup | Engineering Report



Another programming tool.

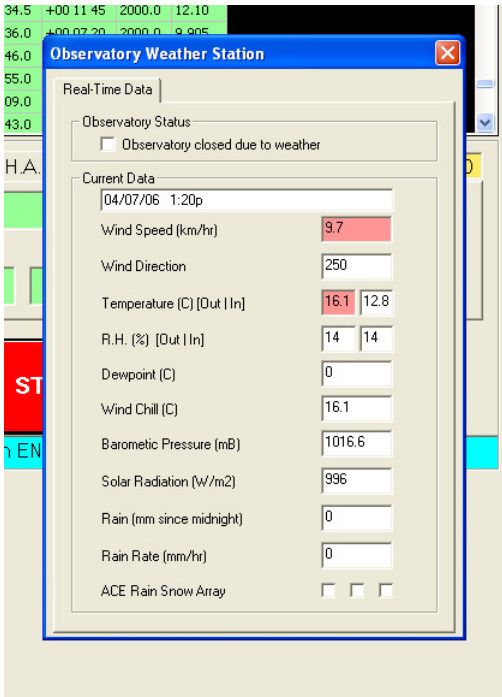
Menu | Observatory



The Observatory menu controls access to a Weather station and a scripted routine for shutting down the observatory.

Click on the image to choose a selection under Observatory or navigate to another menu.

Observatory | Weather Station



Real-time environmental data is retrieved from a connected weather station in this dialog. If the observatory was closed having been triggered by a rain/snow sensor , the Observatory Status field would be checked. The dialog will refresh automatically each time it receives new data from a weather station. Thus, under rapidly changing conditions it may be beneficial to leave this dialog open and monitor the conditions closely.

Wind Speed: Know your observatory's upper limit for closure. Recognize that the value reported here is a time-averaged result. Under certain conditions the wind can gust to values significantly greater than the average. (Typically 20%-50% more)

Wind Direction: Displayed in degrees from North (going through East), the azimuth . Monitor this value under windy conditions to correlate telescope shake with the direction of observations. Know your observatory's upper limit for closure.

Temperature: The "Inside" value displays the temperature of the environment where the weather station stand alone module is found. The "Outside" reports the outside temperature that the telescope is exposed to. Fast changes in the outside temperature will generally result in poor seeing due to atmospheric instability and temperature differential between the environment and the dome and telescope (which generally lags behind due to thermal momentum). Many observatories have a lower limit at the temperature they will operated, know this value.

Relative Humidity: (R.H.) The percentage of how much water is in the air compared to how much water the air can hold (at this temperature). Know your observatory's upper limit for closure to prevent unwanted water from condensing on the mirror.

Dew point: This is the temperature at which water will condense on surfaces. Compare this temperature with the ambient (Outside) temperature to estimate how closely these conditions might be met. Note various surfaces in the observatory and on the telescope will condense water at different values due to departures from the ambient temperature.

Windchill: This is what it might feel like if you still had to manually guide the telescope by hand for hours at a time!

Barometric Pressure: Fast changes may indicate the arrival of a High or Low pressure system (and a change in the weather). This (changing) value can also be used to predict the seeing when coupled with information about the Jet Stream if it is over an observatory.

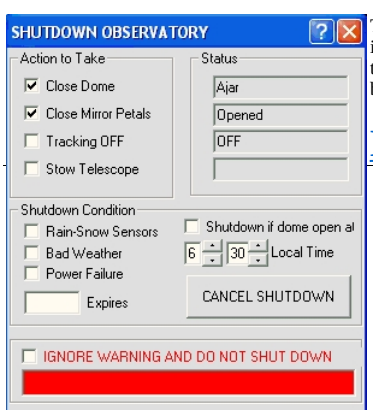
Solar Radiation: If you are seeing a value here, and you are not a solar astronomer, it might be a good time to close the observatory!

Rain: Historical amount of precipitation since midnight.

Rain Rate: Telescopes are supposed to be light buckets, not water buckets! (Current rate of rain within a recent period of time)

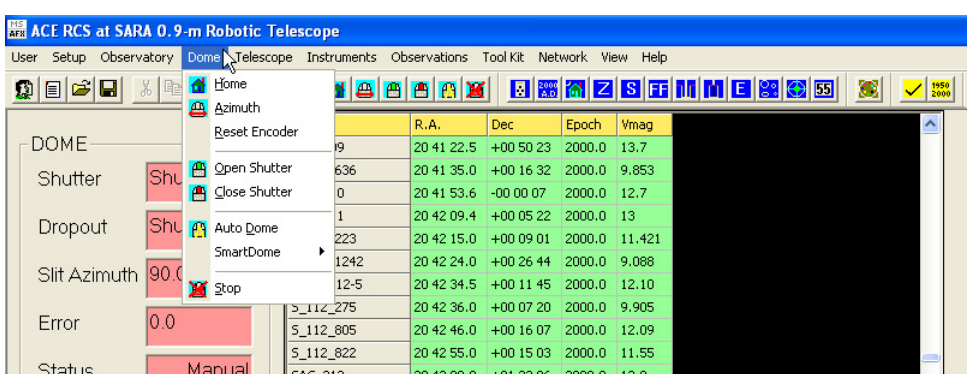
ACE Rain Snow Array: If a rain/snow sensor is triggered, the corresponding sensor will be checked or shown here. Consider how many active rain/snow sensors is necessary to close your observatory.

Observatory | Shutdown



The Observatory will be closed in the order of the events under Actions to Take. The current state of each observatory function is shown under the Status fields. Here at least one dome shutter is open and the mirror covers are also open; however, the telescope is not currently tracking. Shutdown conditions can be set to trigger an automatic shutdown. In addition the dome will be Shutdown if dome open at a particular local time. This feature could be used to close the observatory in the morning.

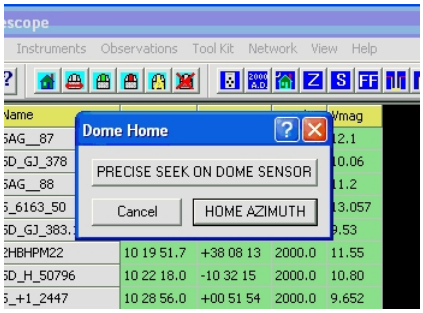
Menu | Dome



The Dome menu controls all dome settings and motions. Note that many of these commands are represented on the dome toolbar for easy access.

Click on the image to choose a selection under Dome or navigate to another menu.

Dome | Home

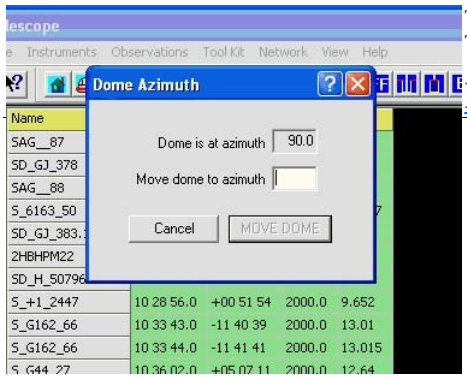


Within this dialog there are two choices. The Precise Seek On Dome Sensor command is used for observatories that have contactor boxes . The dome will rotate until the encoder position that aligns the contactor boxes is found and this position is defined as the home position.

Home Azimuth is the command used for observatories with slip rings . This command defines the azimuthal position of the home position. This is the same as sending the low level HZ command to an ACE SmartDome™ module . With contactor boxes installed, Home Dome will merely find the home position just like the Precise Seek, but it will not subsequently define the position.

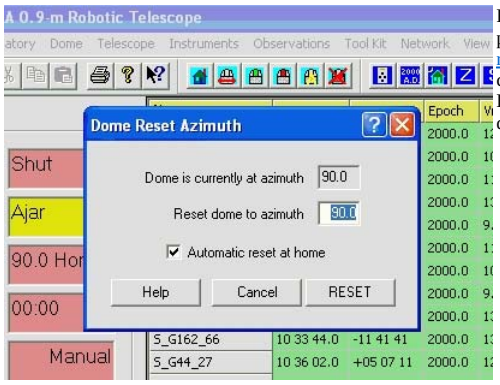
See also Setup | System Parameters | Dome Style.

Dome | Azimuth



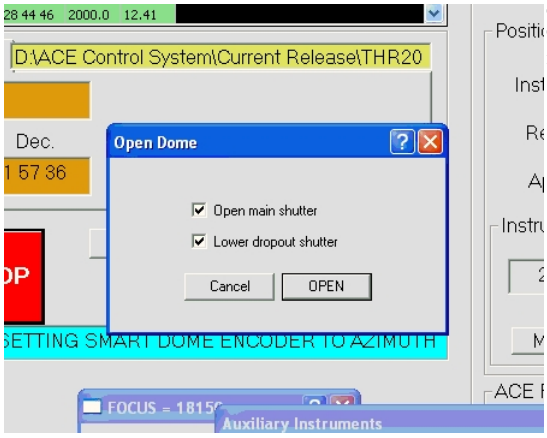
This dialog reports the current azimuth of the dome and allows the user to move the dome to any other position. This is the same as sending the low level command MV to the SmartDome™ module.

Dome | Reset Encoder



Resetting the encoder defines the azimuthal position of Home for observatories with slip rings . If the **Automatic reset at home** option is checked, each time the telescope goes to the Home position the azimuth will be reset to the defined value.

Dome | Open Shutter



The **Open Shutter** dialog commands the main and dropout (if it exists) shutters to open if checked. The main shutter will open first followed by the dropout shutter (reversed when Closing Shutter). ACE recognizes the observatory as open if either shutter is open.

Dome | Close Shutter

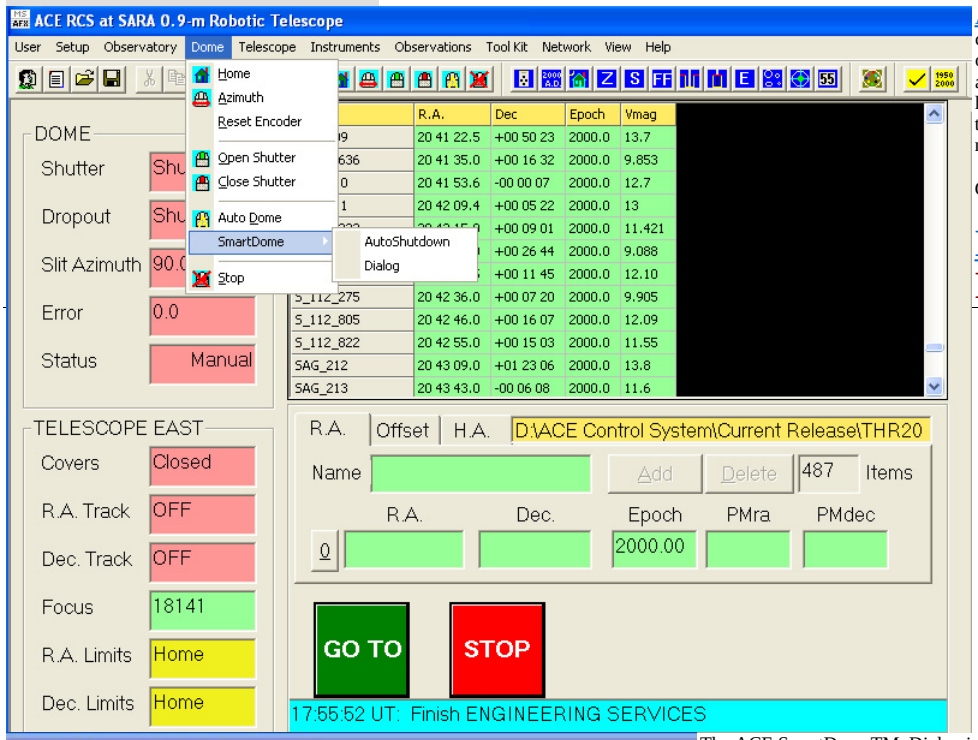
The **Close Shutter** dialog commands the main and dropout (if it exists) shutters to close if checked. The dropout shutter

will close first followed by the main shutter (reversed when Opening Shutter). ACE recognizes the observatory as open if either shutter is open.

Dome | Auto Dome

AutoDome is a feature that when enabled will permit ACE to drive the dome automatically and keep the telescope pointing out of the observatory without obstruction. The computer will determine when bumps to the dome occur based on the geometry of the observatory (telescope and enclosure) as well as position in the sky. These parameters are stored under the Setup menu in System Parameters (Setup Telescope and Observatory).

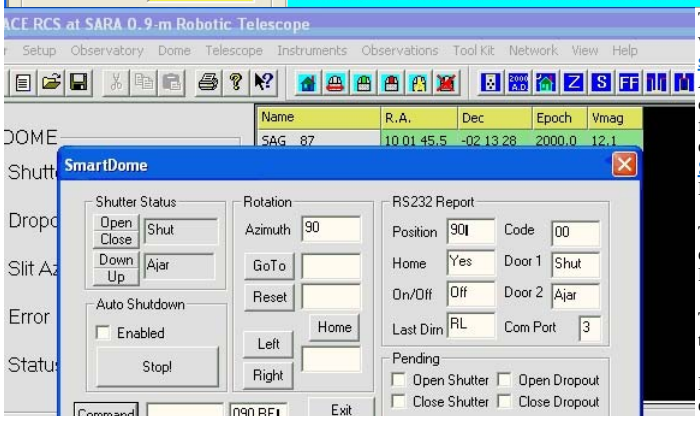
Dome | SmartDome



ACE SmartDomeTM is a hardware system that controls the operation of a dome in an observatory. In addition to opening, closing, and motion of the dome, SmartDomeTM also handles monitoring rain/snow sensors as well as the automatic closure of the observatory if necessary.

Choose between Autoshutdown and Dialog.

Dome | SmartDome Dialog Menu



The ACE SmartDomeTM Dialog is the general user interface (GUI) for interacting with the SmartDomeTM system. This dialog has the same functionality of the stand-alone software that is supplied with the SmartDomeTM units (see Appendix). The dialog both commands the dome to move as well as reports the current state of the dome in real time. In addition, AutoShutdown can be enabled from here. The GoTo button sends the dome to the inputted Azimuth. Reset will define the Azimuth at the current position to be zero. Home performs a Precise Seek on the Home Sensor. It is also possible to input an angle and rotate the dome Left or Right.

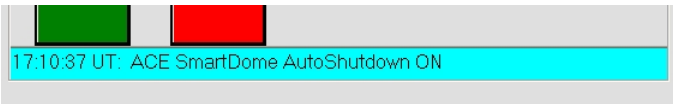
The Command field permits the user to send low level commands (which are more extensive then this GUI provides) to the SmartDomeTM module. However, the RS232 Report displays the states/codes that the SmartDome module is returning.

The shutter and dropout boxes will be checked if these are Pending states (waiting to open/close).

From the information shown to the left, the dome is currently at an azimuth of 90 degrees. It reached this position by moving left (RL , "rotate left"). The dome is

currently idle (Code 00) but the last command that was sent to the unit was "reset encoder" (RE).

Dome | SmartDome and AutoShutdown

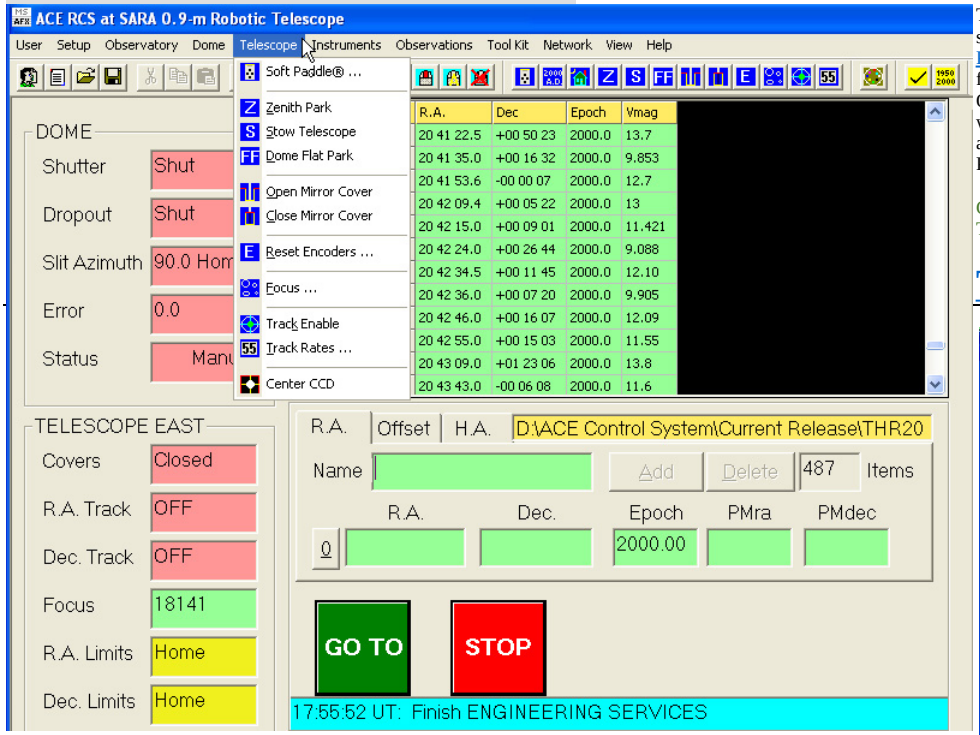


Once AutoShutdown has been selected, a message will appear to indicate the current state. A check mark also appears in the pull down menu when AutoShutdown is turned ON. This is the same as sending the low level ON command to an ACE SmartDome™ module .

Dome | Stop

Commands the dome to stop and turns off all relays. This is the same as the low level command ST that can be inputted through the SmartDome dialog.

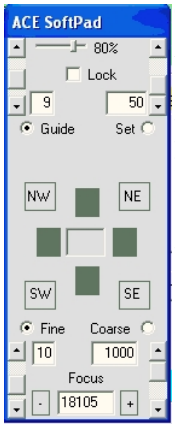
Menu | Telescope



The Telescope menu moves the telescope or sends it to predefined positions such as Zenith Park and Dome Flat Park. The telescope focuser is accessed through the Focus option. Open Mirror Cover and Close Mirror Cover will only appear in this menu if mirror covers are installed in the system (Setup | System Parameters | Telescope Extras).

Click on the image to choose a selection under Telescope or navigate to another menu.

Telescope | SoftPad

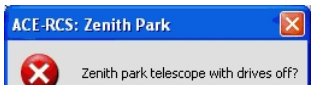


The ACE SoftPad is a software generated version of the hand control paddle and focus controller. With respect to the hand paddle, this tool sets the rates that the hand paddle will output if buttons are depressed. In addition, the buttons can be pressed through the through this GUI and adds another way to drive the telescope when needed. A fast "slew" rate drives the telescope across the sky to acquire positions/objects. The slew rate set by the ACE software may be slightly different than the slew rate of the hand paddle (though both are fast). Hand paddles often support slower centering or guide rates as well. The slider at the top of this tool controls the percent of the full slew rate that the hand paddle will drive the telescope. The Set rate is a slower (centering) rate that is good for moving the telescope angles that subtend arcminutes on the sky. The Guide rate can be used to move the telescope arcseconds on the sky with precision. The units for these two rates are arcseconds per sidereal second of time. Select the radio button to set each of rates. Lock the rates by checking the box and removing the scroll bar adjustments.

The N S E W buttons can be pressed (and held down) to drive the telescope. NE SE SW NW buttons drive the telescope in both axis at the given rate. The ACE SoftPad may have a different look (and options) depending on the type of telescope selected in System Parameters.

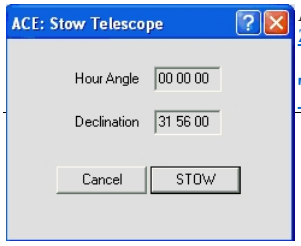
The bottom of the window displays the current focuser position and the number of steps that the focuser will move. Change from Fine and Coarse adjustments to settle on a desired focus value.

Telescope | Zenith Park



ACE commands the telescope to point to the zenith (HA = 0 and Declination = Observer's Latitude) and turns off the telescope's drives. This is a specific variant of the more general **Stow Telescope** command.

Telescope | Stow Telescope



ACE commands the telescope to slew to the user-defined Stow position and turn off the drives. This position can be different than Zenith Park if desired. This position is defined under Setup: System Parameters: Telescope Parking.

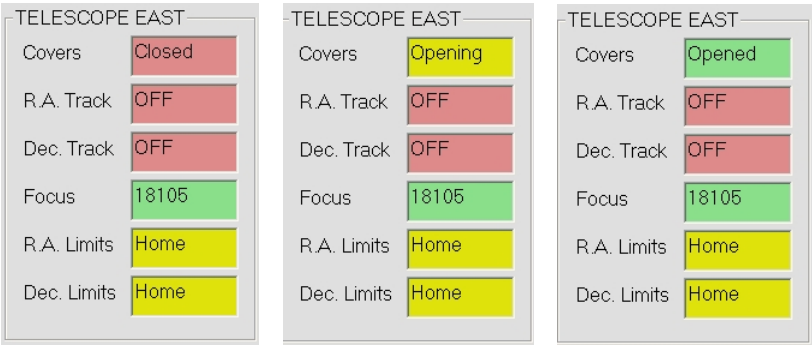
Telescope | Dome Flat Park

ACE commands the telescope to move to the user-defined position that points the telescope towards a flat field screen in an observatory. The dome will rotate to the home position if checked so that the flat field screen will also be at the defined position. Therefore, determine the Dome Flat Park with the dome in the home position. Open Mirror Covers will automatically ready the telescope for flat fields if desired. Keeping it unchecked would allow this position to act as a Stow position with the mirror covers closed. Once the PARK button is pressed and the telescope reaches the defined position, the drives will be turned off automatically. Press Save to retain the values in the ACE software. This position can also be defined under Setup: System Parameters: Telescope Parking.

Telescope | Open Mirror Cover

Commands ACE to open the mirror covers of the telescope

Note that while opening, the **Covers** field on the main desktop will show the current state of the mirror covers:

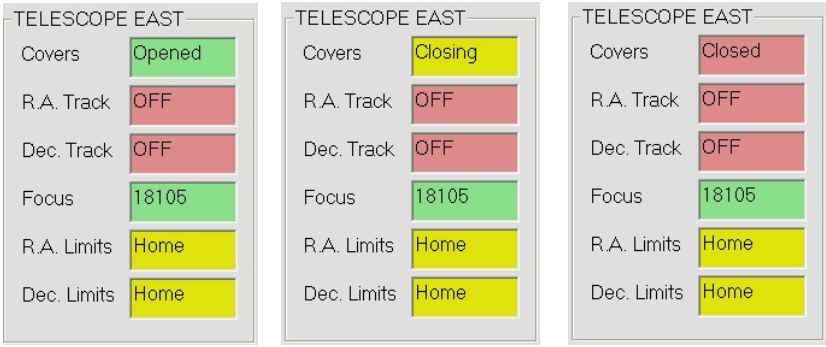


This illustrates the 'Traffic Light" color theme (Red, Yellow, Green) used throughout ACE software.

Telescope | Close Mirror Cover

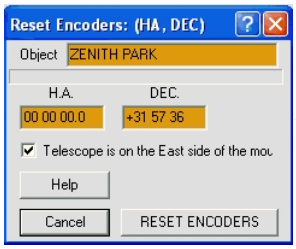
Commands ACE to close the mirror covers of a telescope.

Note that while closing the **Covers** field on the main desktop will show the current state of the mirror covers:



This illustrates the "Traffic Light" color theme (Green, Yellow, Red) used throughout the ACE software.

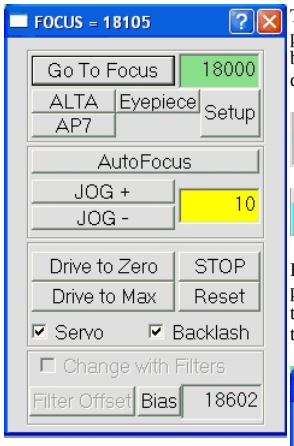
Telescope | Reset Encoders



The Reset Encoders tool synchronizes a current telescope position with a known set of coordinates. As an example, the telescope may have been sent to Zenith Park by a user. However, upon reaching this position, the Declination field on the desktop of ACE reads a current position of 0 degrees in Declination. A quick check of the telescope shows that it is vertical and pointing at the Zenith (and we are not on the equator!). Thus the encoders must be made to agree with the true current position of the telescope. Pressing the Reset Encoders button will force the known value of Zenith to be the new current position reported by ACE. Zenith Park is useful since it is a well defined position that does not require stars to find. Note that for certain telescope styles, it is necessary to specify the side of the mount/pier the telescope is currently located.

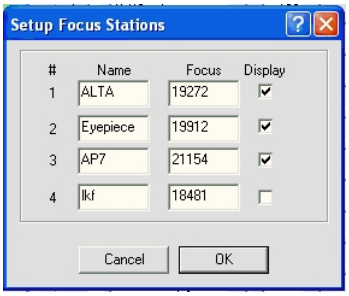
For systems with absolute encoders, this type of reset is often very small (less than 1 degree) and unnecessary.

Telescope | Focus



The title bar of the Focus tool indicates the current focus position. The Go To Focus button is used to move the focuser from one position to another. Once the focuser begins to move (after pressing the Go To button) the change in position can be monitored from both the title bar of this tool and in the Focus field of the main desktop. Messages will also be displayed in the main message field on the desktop indicating the current state of the focuser:

Buttons for each named Port appear beneath the Go To Focus button. Pressing these buttons will send the focuser to pre-defined focus positions for each instrument. These approximate positions allow an observer to quickly bring the telescope to focus; small changes to these values may be necessary to accommodate changes in the optical system, filters, and other minor effects. The Setup button defines the values for each instrument:



Autofocus

This feature is coming soon.

Jog buttons will move the focuser the number of units shown in the field. Drive to Zero and Drive to Max will send the unit to the extreme ends of the length of travel or motion of the focuser unit. Driving to zero is particularly useful to Reset the encoder if it should become lost. Pressing the STOP button will stop the focuser in its journey to its final position.

Checking the Servo radio box commands ACE to monitor the encoder position of the focuser and adjust the mirror as necessary to maintain a position as the telescope moves across the sky. This means the mirror (motor) is constantly powered up. However, leaving this field unchecked and having the servo automatically powered down after each focus move is the other (opposite/normal?) option. (put into same menu?) Engaging the Backlash option will force the focuser to approach its final position from the same direction each time a move is made. This minimizes backlash in the gears of the system and allows for more precise positioning. Keep in mind, engaging this option will mean the focuser may pass its final position initially and then reverse its motion in order to approach from the same direction.

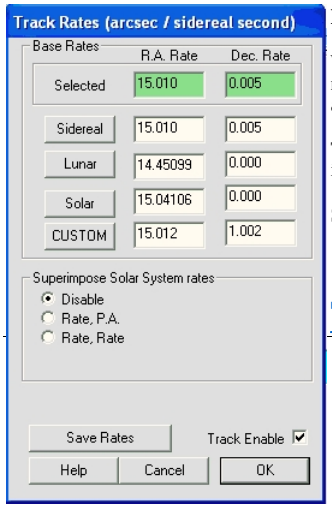
Filter Offset and Bias

The Bias value is the focus position for the detector without any filters (or optics) in the path. Adding filters will increase the focal length and require a new focuser position. Pressing the Filter Offset button (when active) will calculate the difference between the Bias value and the current focuser position. This Filter Offset can be inputted into the Filter Wheel database.

Telescope | Track Enable

Turns on the telescope tracking. See also Telescope Tracking Rates.

Telescope | Track Rates



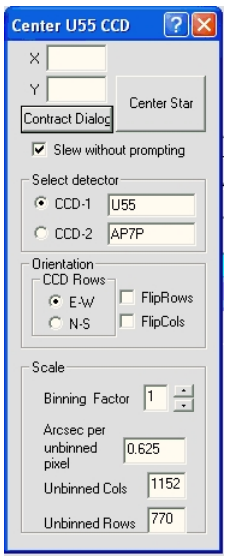
Base Rate

When the Base Rate is sidereal, the RA generally defines the value that most closely approximates the true sidereal rate of the rotating Earth for an polar aligned telescope. The Dec Rate here can help compensate for a slight mis-polar alignment or atmospheric refraction.

The other buttons indicate preset rates that allow the telescope to track the Moon (Lunar) or Sun (Solar). Custom rates can also be inputted for other solar system objects.

Superimpose Solar System Rates

Telescope | Center CCD



This tool helps a user quickly move the telescope to precisely center a target in the field of view (FOV). The FOV is determined by the detector being used and the (current) focal length of the optical system. Thus, it is necessary to specify the camera that is being used as well as the plate scale. In addition, the camera orientation must also be specified so that the telescope will be commanded to move in the correct direction.

First indicate the camera that is being used under Select Detector. Specify the Orientation of the camera using the combination of directional and mirroring operations. The flips/mirrors may be necessary if there is a flat mirror in front of the camera. Note that this tool can only be used if the chip is aligned with the directional axis of the telescope.

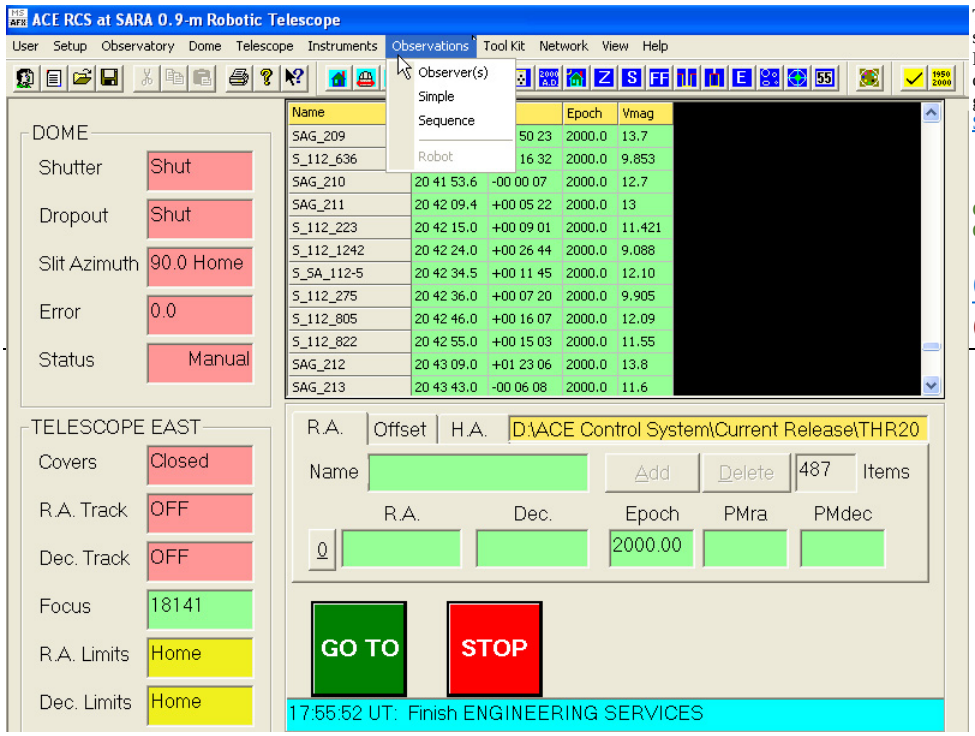
Next indicate the Binning Factor and input the plate scale in arcseconds per *unbinned* pixel (ACE will internally multiply by the binning factor when computing the plate scale). The plate scale can be calculated with the following formula:

P("/mm) = 206265"/FL(mm)

Where P is the plate scale and FL is the focal length of the system in millimeters. To convert to arcseconds per pixel multiply the plate scale by the size of a pixel in millimeters. As an example the SARA telescope has a focal length of 6750 mm and the U55 camera has 22.5 micron pixels. Thus P = 206265/6750 = 30.56"/mm or 30.56 x .0225 = 0.68755 "/pixel

Once these parameters are determined, input the coordinates of the star (pixel) into the X and Y fields. Press the Center Star button to move the telescope. Checking the Slew without prompting button will instantly perform the slew once the button is pressed.

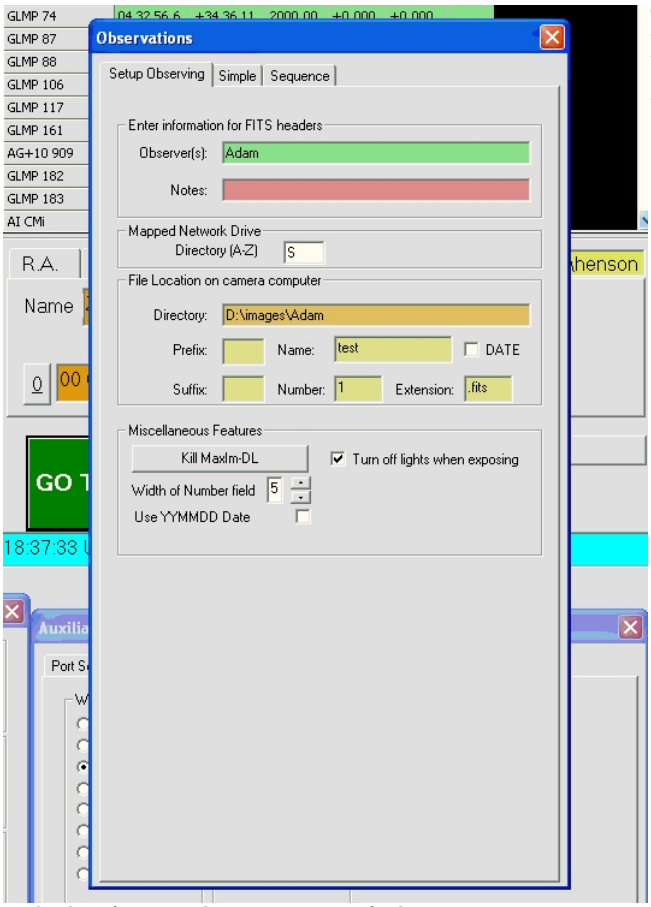
Menu | Observations



The Observations menu permits an Observer to specify information that will be saved to the FITS files' headers of images. This menu also controls the acquisition images that are generated singly (Simple) or programmed in a Sequence. .

Click on the image to choose a selection under Observations or navigate to another menu.

Observations | Observers)



The three tabs of the Observations window allow the user to input information that will be written to the FITS headers of images and to setup parameters for data acquisition.

Setup Observing

Enter the name of the observer and any notes that are to be appended to the FITS header of images.

Specify the Mapped Network Drive that images may be saved to.

Input the directory that images are to be saved in. If the directory is located on a mapped drive, be certain to have specified it above.

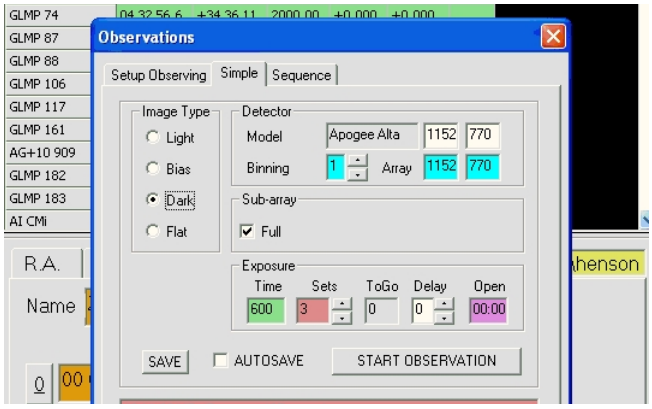
The Prefix adds a set of characters before the file Name and the Suffix puts characters immediately after the file Name. If the DATE box is checked the file Name will be the date as recorded as YYYYMMDD. Checking the Use YYMMDD option will force the format of the date to be six digits representing the year, month and day. All dates and times are UT in ACE.

The Number field specifies the starting number for observations. This value is written after the suffix and incremented automatically after each exposure/observation. The number portion of a file name can be formatted to include as many digits as desired by modifying the Width of Number field.

ACE can command that remote switches/lights be off during a exposure.

The Kill Maxim-Dl button will close the program (on the camera acquisition computer) and terminate the link with ACE.

Observations | Simple



The Simple tab is a concise image acquisition tool that allows a set of observations to be taken through the currently selected filter.

Image Type

Light frame: Shutter opens and an exposure is taken.

Bias frame: A zero second exposure. Chip is read instantly to measure voltage offsets (pedestal values) and any consistent behavior of the ADU convertors.

Dark frame: Shutter is closed during exposure. Records dark current and hot pixel population.

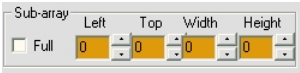
Flat frame: Same as a light frame above, except the keyword "Flat" is written to the FITS header. Flat frames are generated by illuminating the chip evenly. The image records any non-uniform illumination the system introduces (vignetting for example) as well as any pixel to pixel variations in response.

Detector

Specifies the camera model and total number of pixels. If the on-chip Binning field is changed, the new array of pixels is displayed.

Sub-array

When Full is checked, the entire array of pixels is used. Un-checking the box will reveal options that control the position and size of the sub-array on the chip (see below).

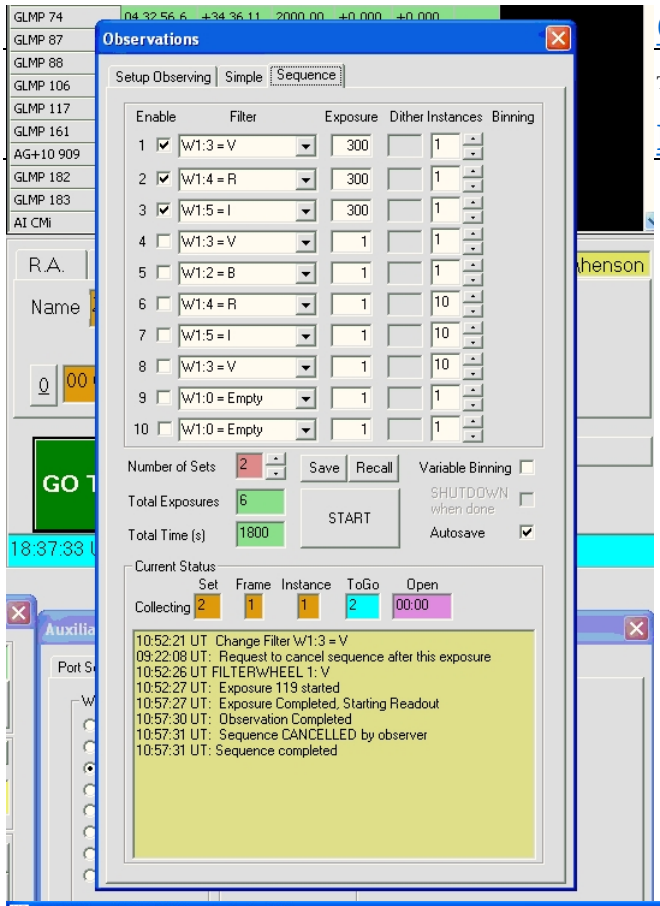


Exposure

Time is in seconds. If more than one exposure is desired, increment the number of Sets needed. The ToGo field will display the number of exposures remaining to complete a set while imaging. A Delay (in seconds) can be inserted between exposures during a set. The Open field shows... something.

Check the AUTOSAVE box to save the images to disk as they are acquired. Press the START OBSERVATION button to begin exposing. Messages concerning the current camera state and file archiving are displayed in the bottom window.

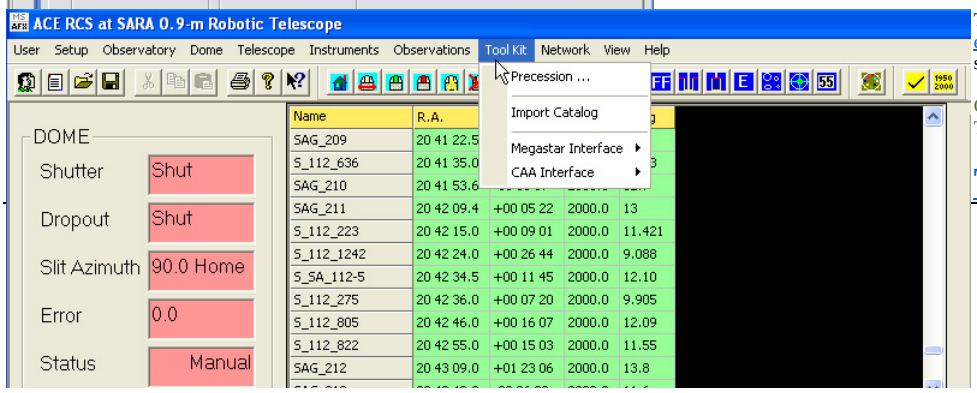
Observations | Sequence



Observations | Robot

Type topic text here.

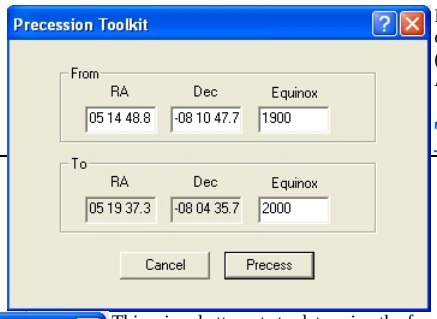
Menu | Tool Kit



The Tool Kit menu can be used to change the epoch the program is working in as well as load star Catalogues and other program Interfaces.

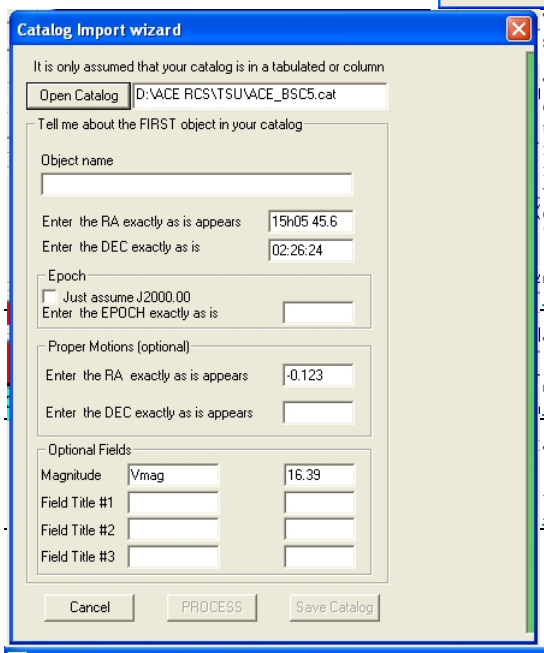
Click on the image to choose a selection under Tool Kit or navigate to another menu.

Tool Kit | Precession



Input values in the From fields for a referenced pair of coordinates and the associated Equinox. Then input the new (desired) Equinox in the To field. Press the Precess button and ACE will calculate the coordinates for the new Equinox.

Tool Kit | Import Catalogue



This wizard attempts to determine the format structure of an imported catalogue and after processing it, saves a new version in an ACE friendly format to be loaded in the normal way.

The imported catalogue needs to be delimited by white space with the first "row" containing the first entry in the catalogue (strip any headers from the file). The first element of the first row (this will make up the first column) is allocated 24 characters for name specification. Enter the RA and DEC in the fields as the appear in the file for the FIRST entry/object. ACE will analyze the line to understand the format convention. The Epoch and Proper Motion columns can also be constructed or forced to be zero values. The user can also create additional fields (whose elements can be inputted through the ACE catalogue management functions later). When saving the newly translated catalogue, ACE will append a ".cat" extension to the file.

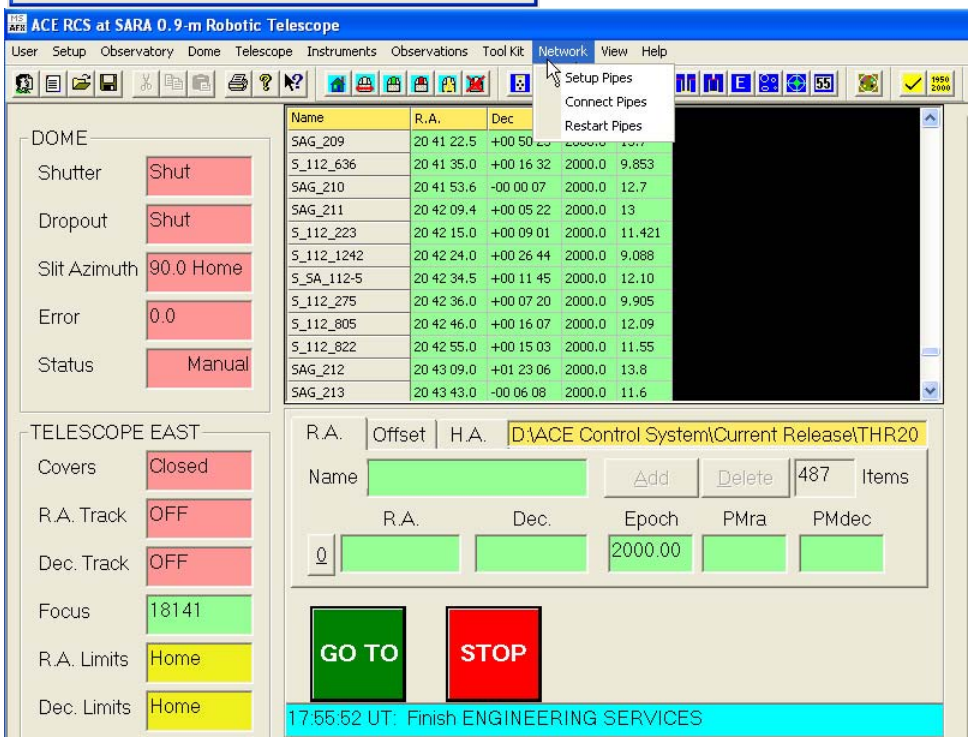
Tool Kit | Megastar Interface

Type topic text here.

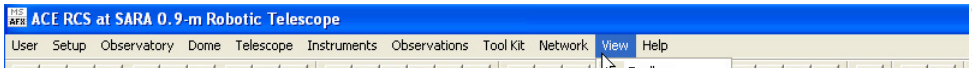
Tool Kit | CAA Interface

Type topic text here.

Menu | Network



Menu | View



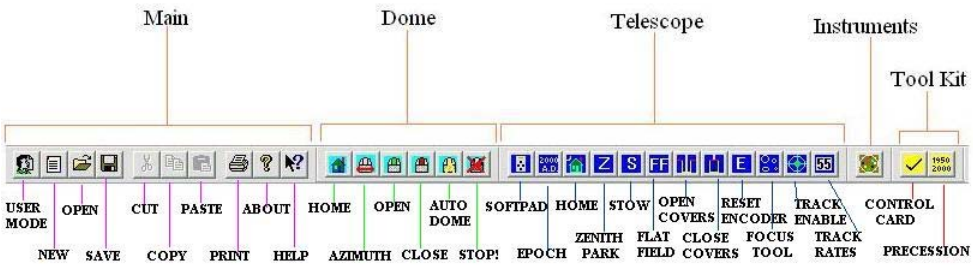
The View menu controls the various Toolbars (buttons) that are displayed beneath the main menus. The Status Bar option displays

information at the bottom right fields of the ACE software.

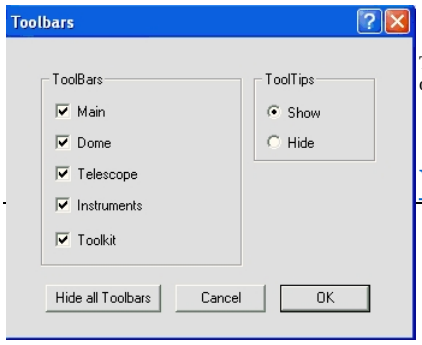
Click on the image to choose a selection under View or navigate to another menu.

View | Toolbars

The Toolbars are named and sectioned as shown below.



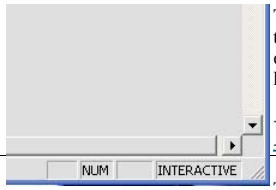
Turn these on and off by the dialog below:



Tool Tips turns on/off the screen tips that are displayed (

) when a mouse cursor hovers over a button or object.

View | Status Bar



The Status bar is located at the bottom right corner of the ACE window. It displays the current User Mode as well as whether the <Num Lock> key is engaged. Be certain this is on as it will make data entry considerably easier when using the keypad on keyboards.

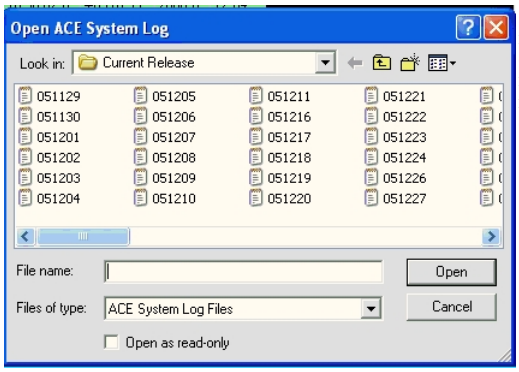
Help | Help Topics

Type topic text here.

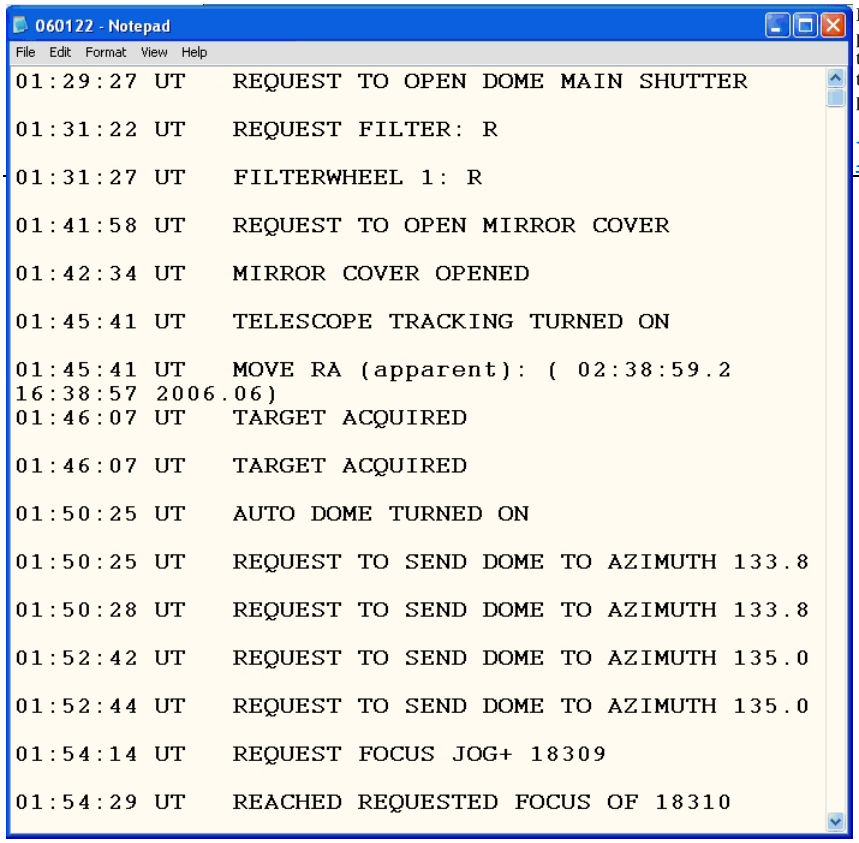
Help | About ACE

Shows the version of ACE software and the licensed users.

Help | Log File

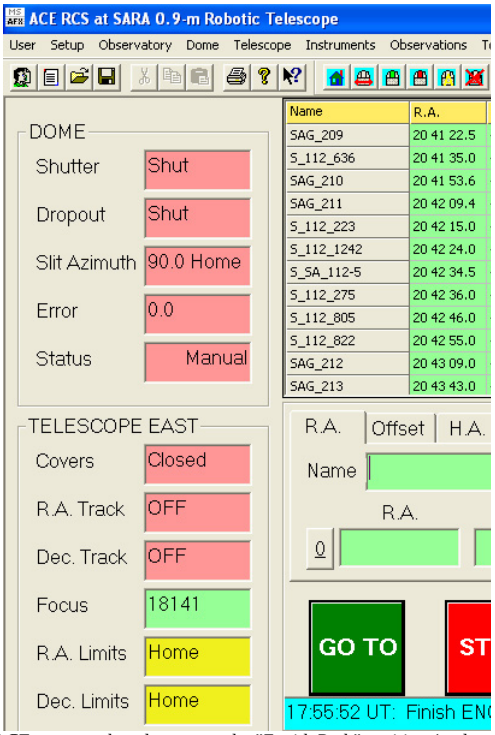


Select a Log File according to the date. The file naming convention is yymmdd so that files are listed chronologically when displayed by "name" (alpha-numerically). Also note the option to open the files as read-only so that they are not accidentally while being examined.



Here an example Log File is shown. Each line records actions performed by the ACE software. This file is useful for troubleshooting issues. A representative of ACE may ask for this file (or the creation this file) in the process of resolving problems.

Help | Astronomer Skill Level



In Normal mode, the program (ACE) will query the user to confirm actions. For example, if the user instructs ACE to move the telescope to the "Zenith Park" position (under the Telescope menu), ACE will ask "Zenith park telescope and turn drives off?" In the Expert mode, these kinds of confirmation requests are silenced.

Click on the image to navigate elsewhere in the program.