Astrid Introduction, Initial Setup and Operation

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Version date: June 17, 2024

Congratulations on your purchase of an Astrid! Astrid is a Raspberry Pi-based, self-contained GPS-equipped astronomy imaging device with features that make it a complete, all-in-one device for recording and accurately timing occultation events. Using a tablet or laptop to connect to Astrid (via its Wi-Fi hotspot) the user can plate-solve, pre-point a telescope, control a computerized mount (if desired), schedule a recording, confirm in advance that the exposure and gain chosen are sufficient to record the target star, automatically record an event, and play back the recording.

Frequently asked questions are answered at
https://github.com/ChasinSpin/astrid/blob/main/docs/FAQ.md

Astrid requires a quality power supply. Please read the documentation on power requirements at https://github.com/ChasinSpin/astrid/blob/main/docs/PowerSupply.md

A series of video documents on using Astrid can be found at
https://github.com/ChasinSpin/astrid/blob/main/docs/README.md

Astrid both broadcasts a Wi-Fi hotspot (an SSID) and also runs a copy of RealVNC server which will allow you to connect to it from a tablet or laptop running the RealVNC Viewer, also called a Client (free version).

To prepare to connect to Astrid, install the free RealVNC Viewer client on your tablet or laptop. The VNC Client we recommend is the free [RealVNC VNC Viewer](#) (note you may be prompted for a free trial, but it's not necessary). Other VNC clients may or may not work.

IMPORTANT: There are 2 versions of RealVNC; RealVNC Viewer and RealVNC Connect. RealVNC Connect is a paid-for product, and the website and product itself are designed to pull you into purchasing the paid product by mistake. Be sure to download RealVNC Viewer using the link above.

After installing you'll be presented with a screen asking you to sign in and send anonymous usage data. Uncheck the send anonymous usage data checkbox, and click "Use RealVNC Viewer without signing in". Never click the "Sign In" button.

There are several steps required to make the first connection to your Astrid device.

Power on Astrid by plugging in your power supply and wait 1-2 minutes for it to boot. (There is no on-off switch on Astrid).

From your laptop or tablet Wi-Fi menu, search for and connect to the Astrid hotspot SSID, which will be **astrid-xxxx** (all lowercase with a dash) where xxxx are the four digits of your Astrid serial number, which can be found on the label on the side of your device. The Wi-Fi password for all Astrid devices is **iotaiota** (8 characters, again all lower case). Once connected, the status will be "No Internet, Secured". This is normal.

Once connected to Astrid's Wi-Fi hotspot, start RealVNC Viewer on your laptop or tablet and create a RealVNC connection (File->New Connection) with the following properties. Replace **xxxx** with the 4-digit serial number of your Astrid on both lines.
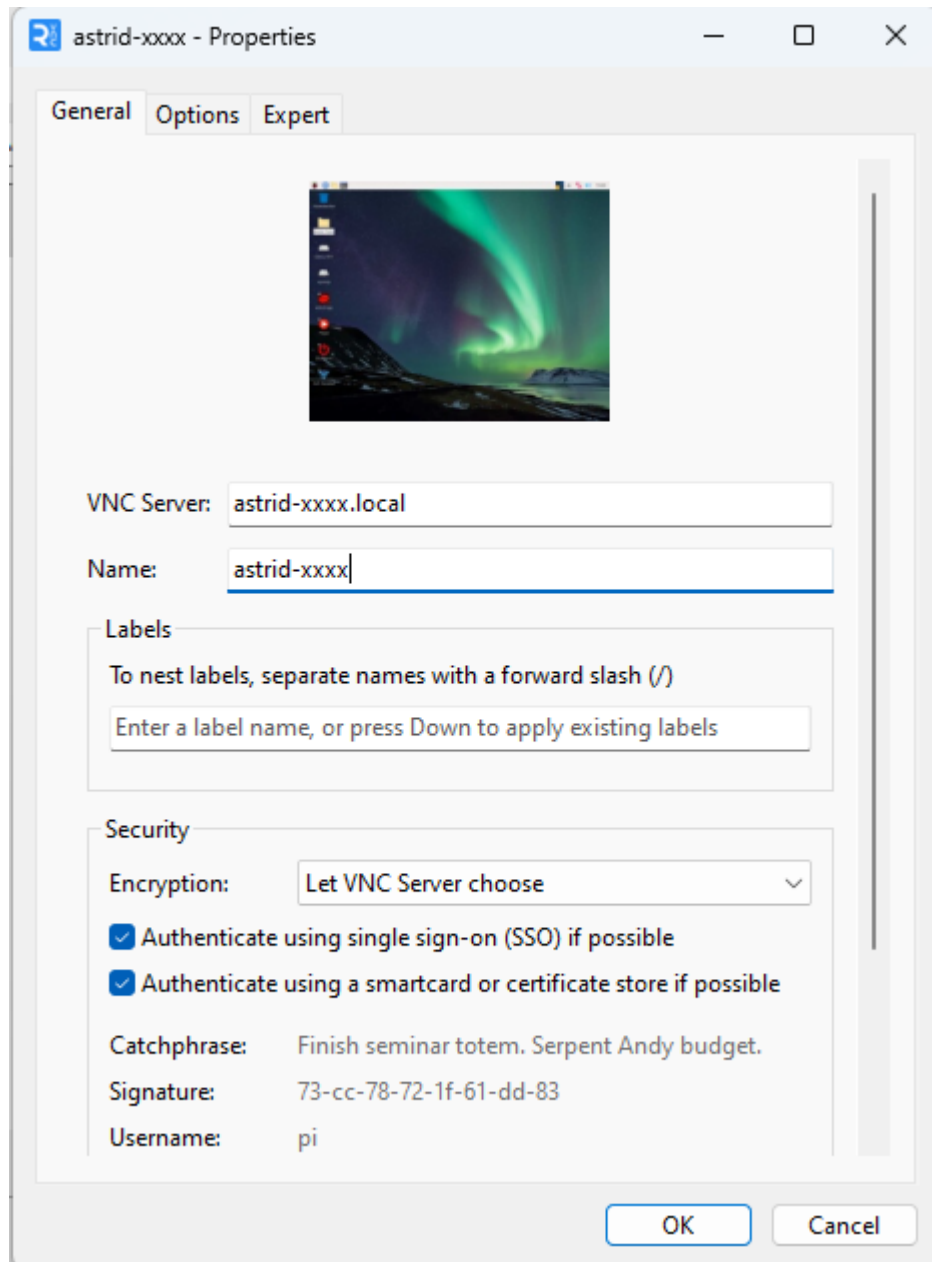
Click OK. When prompted for a userid and password, enter information below, username "pi" password "iota". Click "Remember Password" and "OK".
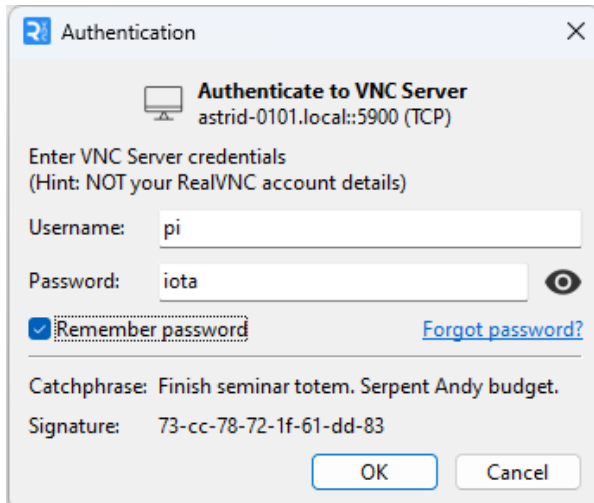
Double click on the square connection icon you just created to connect the VNC Viewer client on your laptop or tablet to the VNC Server running in your Astrid device.

At this point your VNC Viewer window should be showing you the Astrid Raspberry Pi desktop, similar to the image below.
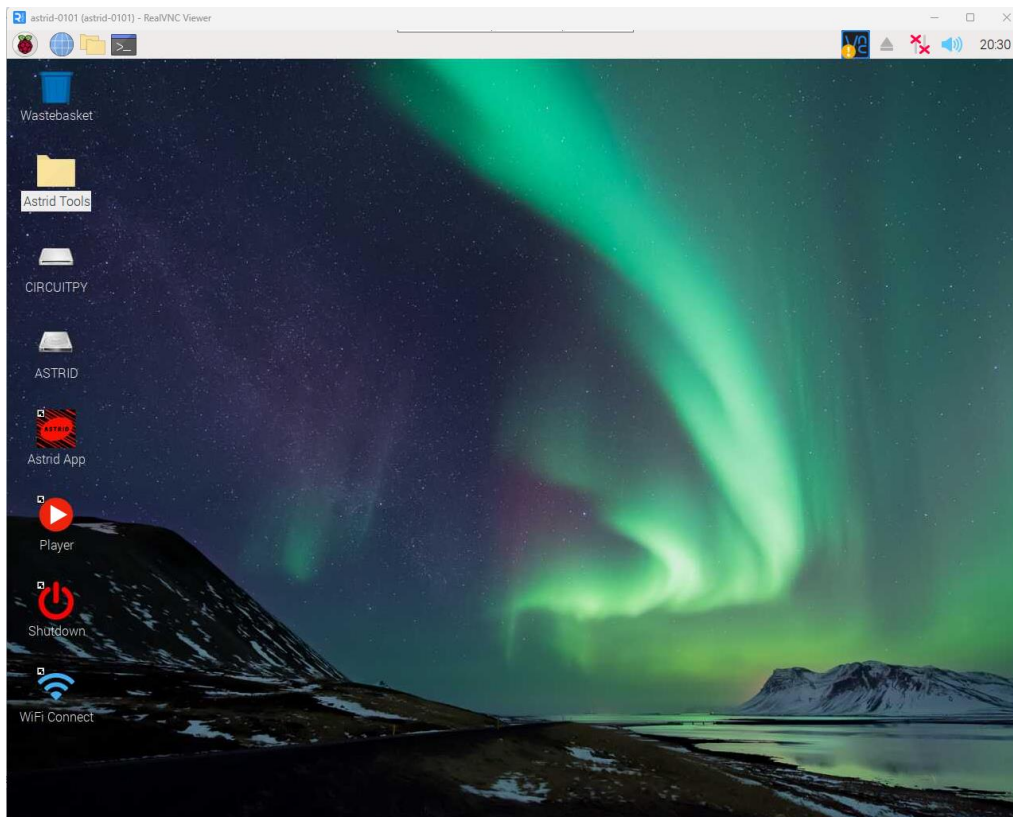
Connecting Astrid to your home Wi-Fi network

At times, Astrid requires access to the internet to download event information from OW Cloud for events you have registered for, and for updates to its software (less frequent).

Double click on the "Astrid Tools" icon and select Wi-Fi Setup. You will then be presented with the following screen:
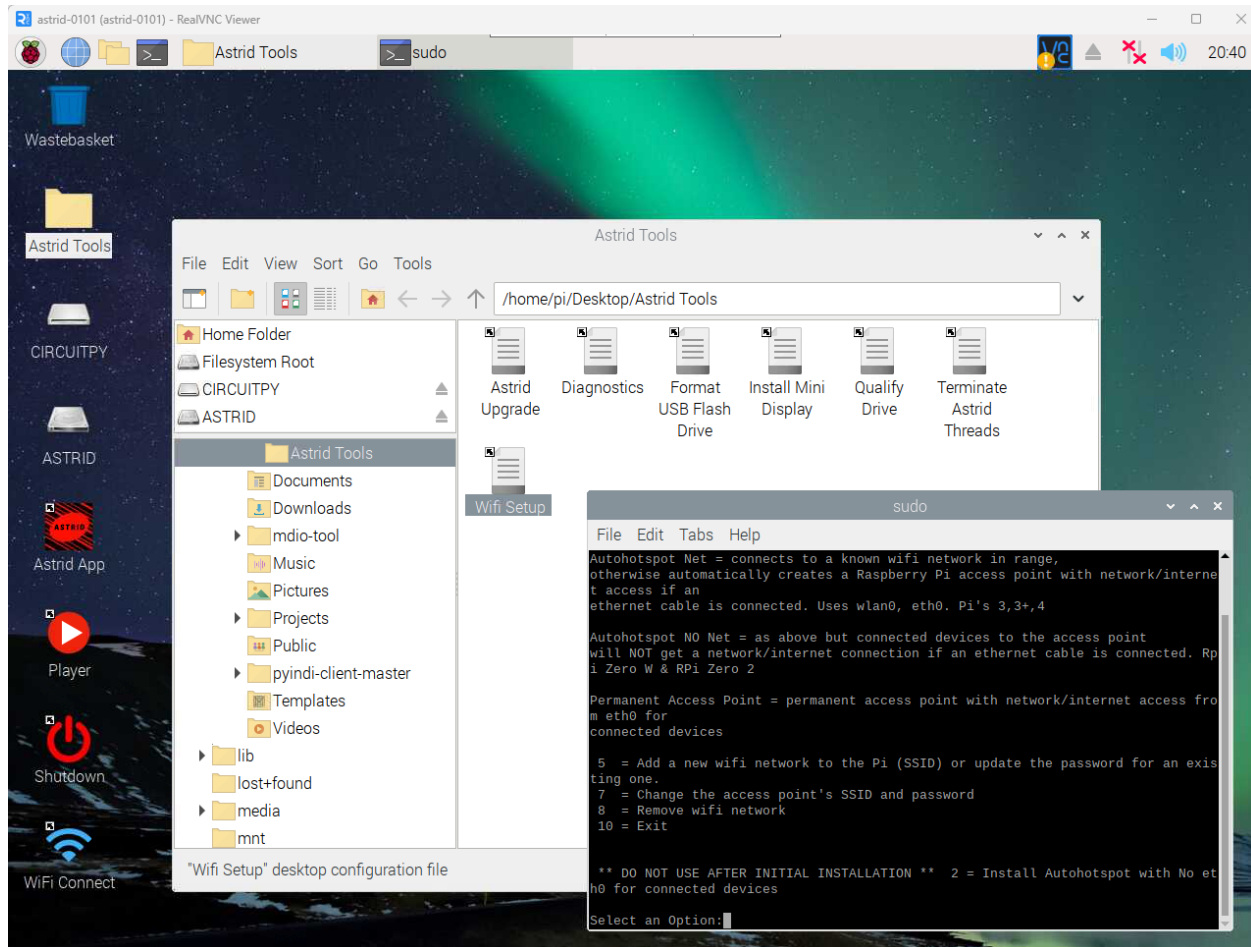
The Wi-Fi Setup screen looks like this:

```
                                    sudo                        ∨  ∧  ✕

 File  Edit  Tabs  Help

Autohotspot Net = connects to a known wifi network in range,
otherwise automatically creates a Raspberry Pi access point with network/interne
t access if an
ethernet cable is connected. Uses wlan0, eth0. Pi's 3,3+,4

Autohotspot NO Net = as above but connected devices to the access point
will NOT get a network/internet connection if an ethernet cable is connected. Rp
i Zero W & RPi Zero 2

Permanent Access Point = permanent access point with network/internet access fro
m eth0 for
connected devices

 5  = Add a new wifi network to the Pi (SSID) or update the password for an exis
ting one.
 7  = Change the access point's SSID and password
 8  = Remove wifi network
 10 = Exit


 ** DO NOT USE AFTER INITIAL INSTALLATION **  2 = Install Autohotspot with No et
h0 for connected devices

Select an Option:█
```

Select option 5 and press Enter. After a moment you will be presented with a list of all available hotspots that Astrid can find. Enter the number corresponding to your home Wi-Fi hotspot name and press Enter. Now enter the password for that hotspot. *Be very careful entering this information – no typos allowed!* Astrid will remember this information and will be able to connect to your home Wi-Fi network and the internet when you tell it to.

Connecting Astrid to your Home Wi-Fi network

Astrid is always in one of two states, either (A) broadcasting its own Wi-Fi hotspot, or (B) connected to a Wi-Fi network for which it knows the password, typically your home network with internet access. It is never in both states at the same time.

Upon initial power-up, it always begins in state (A), broadcasting its own Wi-Fi hotspot name (astrid-xxxx with password iotaiota) for you to connect to. The mini-display will show either the name of the hotspot that Astrid is broadcasting or the name of the external Wi-Fi network to which it is connected.

Assuming you have previously entered your home Wi-Fi network name and password into Astrid via the Wi-Fi Setup menu, you can switch Astrid from broadcasting its own Wi-Fi hotspot (state A) to connecting to your home Wi-Fi (state B) by pressing any of the 3 buttons on the mini-Display. After a few moments, the mini-display will change and will show that Astrid has now stopped broadcasting its own Wi-Fi hotspot and has connected to your home Wi-Fi network. The display will also show the IP address Astrid has received from your home network.   (Pressing any of the 3

buttons again will tell Astrid to switch back and forth between these two states. Be patient – it takes some time for the mini-display to update.)

Mini-display showing Astrid broadcasting its own hotspot SSID

Mini display during network switching

Mini-display showing Astrid connected to a home network

During the process of switching from broadcasting its own hotspot to connecting to your home Wi-Fi, the VNC Viewer client on your laptop or tablet will temporarily lose connectivity to the VNC server software running in Astrid. However once Astrid has joined your home network (the same one your laptop or tablet is connected to) the VNC connection should be recovered. Your laptop or tablet should still "see" the Astrid device on the home network and be able to connect to it, and you should be able to continue to work on the Astrid desktop as before.

Instead of pressing a button on the mini-display, you can also switch Astrid from broadcasting its own hotspot to connecting to a network it knows about by double clicking on the "Wi-Fi Connect" icon on the RPi desktop.

This will cause Astrid to search for a network it knows about and attempt to connect to that network with its stored userid and password. However, this icon only goes in one direction. To

switch back to having Astrid broadcast its own hotspot you will need to press one of the buttons on the mini-display.

NOTE: Any time you cause Astrid to switch from being connected to a Wi-Fi network to broadcasting its own hotspot, either by pressing a button on the mini-display or by power-cycling the device, you will need to reconnect your laptop or tablet to the Astrid default hotspot (astrid-xxxx) before your VNC Viewer client will be able to "see" and connect to the VNC Server running on Astrid. This may happen automatically if you have the "Connect Automatically" option selected for that connection but if not you will have to connect manually.

Troubleshooting connectivity

There has been one case where a user could not connect to Astrid over VNC even though Astrid and his laptop were both on the same home network. The solution in that case was to connect the laptop to the network via a CAT5 cable from the laptop to his router/hub rather than over the laptop's Wi-Fi.

Also, if you have multiple network names (e.g. home-2.4 and home-5) be sure that both Astrid and your laptop or table at connected to the same network.

Shutting Down Astrid

Use the "Shutdown" icon on the RPi desktop to shut down Astrid safely.


ALWAYS REMEMBER TO SHUTDOWN ASTRID AND WAIT 15 SECONDS AFTER GREEN LIGHT STOPS FLASHING ON THE SIDE <u>BEFORE REMOVING POWER</u> TO AVOID SD CARD AND USB FLASH DRIVE CORRUPTION.

The Astrid App

The online documentation sometimes uses the term "Astrid" to refer to both the physical Astrid device and to the Astrid application which runs on the Raspberry Pi system in the device. This document will try to make it clear which is being referred to by using the term "Astrid" to refer to the physical device and "Astrid App" or just "App" to refer to the software.

To start the Astrid App, double click on the icon labelled "Astrid App" on the RPi desktop.
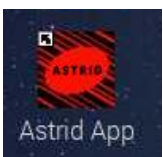
Operating the Astrid App

This section is an introductory manual for observing asteroidal occultations with the Astrid camera. I will assume you know the basics of observing occultations. In this document I will focus on the operation of Astrid.

Astrid Features:

- Imaging
    - Sony IMX-296 monochrome sensor
    - Photo exposures from 40 microseconds to X seconds
    - Maximum video frame rate = 30 frames per second (currently)
    - Single Photo mode
    - Highly accurate UTC timestamps based on PPS signal from GPS receiver
- User Interface
    - Raspberry Pi computer
    - Raspbian OS (Linux)
    - Remote connection over Wifi with VNC
    - Astrid application
        - Plate Solving
        - Mount Control/Automation
            - GoTo target
            - Prepoint with both manual and GoTo mounts
        - Video recording (RAVF format)
            - Manual and auto recording operation
        - Occultation data
            - Import occultation attributes from Occult occelmnt files
            - Import occultation attributes from OccultWatcherCloud
        - Configurations
            - User may define configurations for multiple combinations of scopes and mounts.
- Power
    - 12V @ 2amp via 5.5mm/2.1mm power jack

- !!! Astrid runs a Linux operating system. You should always SHUTDOWN the OS before turning off power to Astrid.

Initial Startup

Astrid does not have a power button or on/off switch. Astrid will power up, and boot the OS, when you apply 12V DC to the power input jack. Having connected with VNC you should see the Raspbian desktop UI in your VNC viewer app:
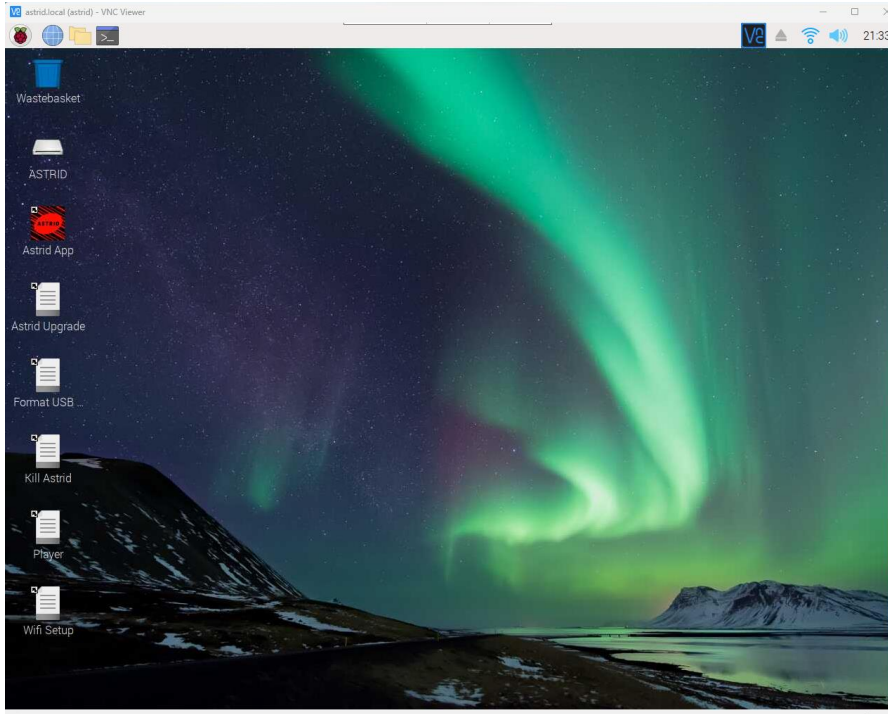
The desktop UI includes shortcut Icons for the Astrid App and other Astrid utility programs.

You can access the main menu of the Raspbian OS via the small berry icon in the upper left corner of the desktop UI. For normal operation, you will rarely access the Raspbian main menu. When Astrid powers on (boots) you may see messages from the Raspbian suggesting that you update the OS. DO NOT UPDATE Raspbian!
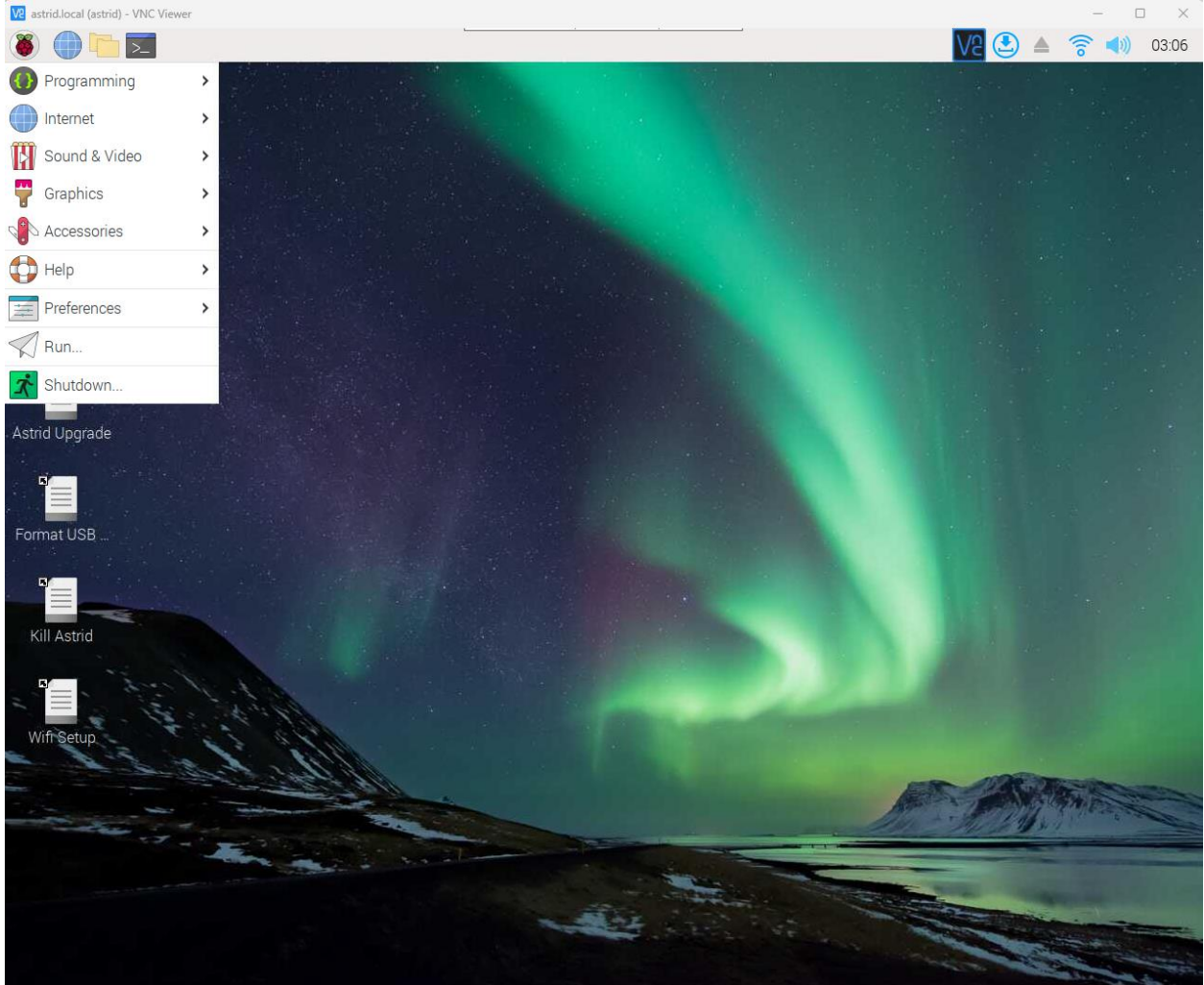
After running WiFi setup and connecting Astrid to a network with internet access (e.g. your home network), you should run the Upgrade Astrid app to make sure you have the latest release of the Astrid software.

After updating Astrid you are ready for observing. All observing tasks are handled from the Astrid App which is started via an icon on the Raspbian desktop. The subsequent sections of this primer will focus on using the Astrid App for observing.

Astrid App Configurations

When you start the Astrid App, by double clicking the Astrid App icon on the Raspbian desktop, the Astrid app will first display the "Choose Config" dialog shown below.
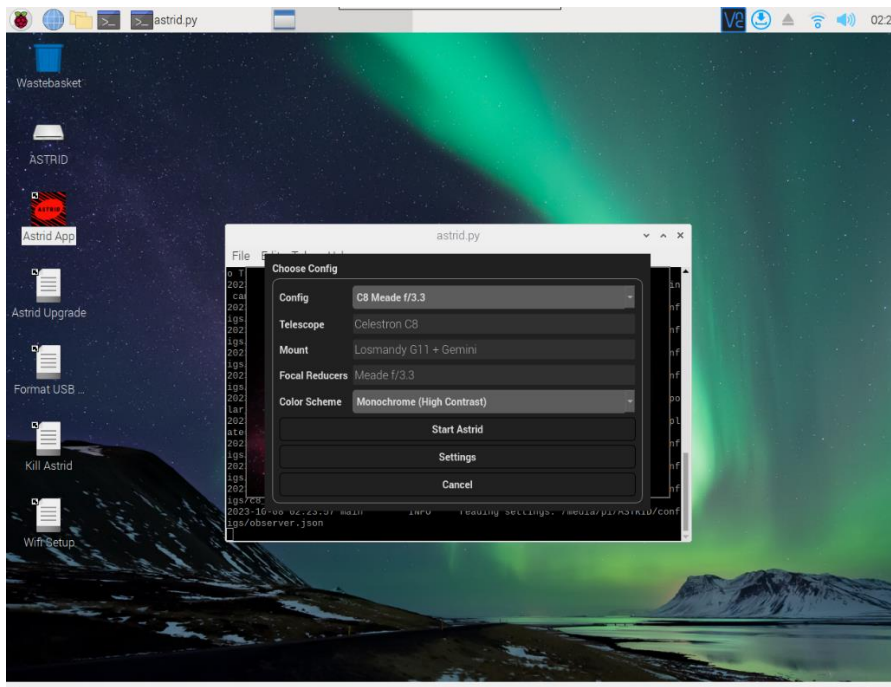
The user may select a configuration from a list of available configurations, then "Start Astrid". Or the user may select the "Settings" option to add new configurations and edit existing configurations. Each configuration specifies attributes of the mount and optics which the Astrid app uses for controlling the mount and other aspects of the observing session. When you first receive the Astrid camera it will likely include some example configurations. Before observing with your equipment, you must create new Astrid configurations to match your equipment. To create new configurations, select the "Setting" option to access the Settings dialog shown below.
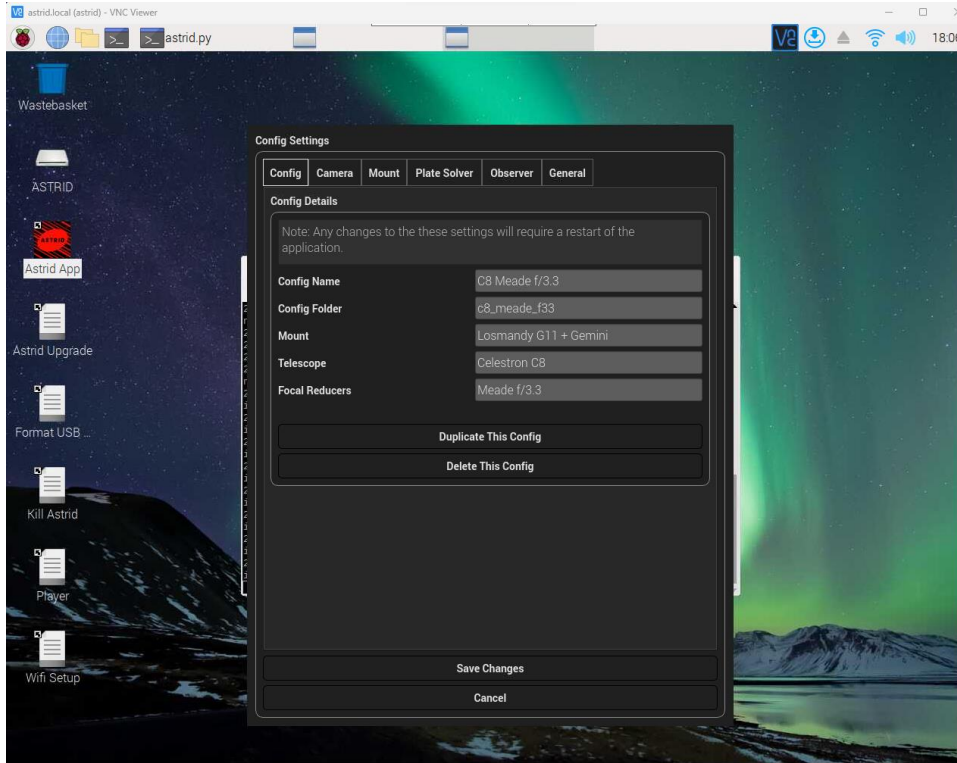
Each configuration is organized into the following sections: Config, Camera, Mount, Plate Solver, Observer and General.

Configuration: Config Details Section

Except for "Config Folder", each of these attributes is just a label to make it easier for you to identify the configuration. "Config Folder" is the name of the folder (directory) where the configuration is stored on Astrid's USB Flash Drive. I suggest you AVOID spaces for the "Config Folder" name – use underscore instead.

Configuration: Camera Section

For most observers, the "Horizontal Flip" attribute is the only interesting option in the camera section. If you enable this attribute, Astrid will flip the display image horizontally (left/right). Most observers will choose to orient Astrid such that the display image will have North Up (either NCP or the Zenith). However, with some configurations you may need to enable "Horizontal Flip" option to ensure that East is toward the left in the display.

Configuration: Mount Section

Atrid communicates with mounts via the INDIlib library. The INDIlib library supports many types of mounts and you will find more details on mount support at the Astrid github documentation pages. If your configuration is for a "manual" mount (no communications), you will use the INDIlib telescope simulator driver.

Configuration: Plate Solver Section

Most observers will only set the Focal Length in the Plate Solver section. Astrid can handle some inaccuracy in the Focal Length but this is a very important setting. If you can't figure out the focal length of your optical system, I suggest you take a picture and plate solve the image using the free service at nova.astrometry.net. You should be able to use this information to determine the actual focal length of your optics.
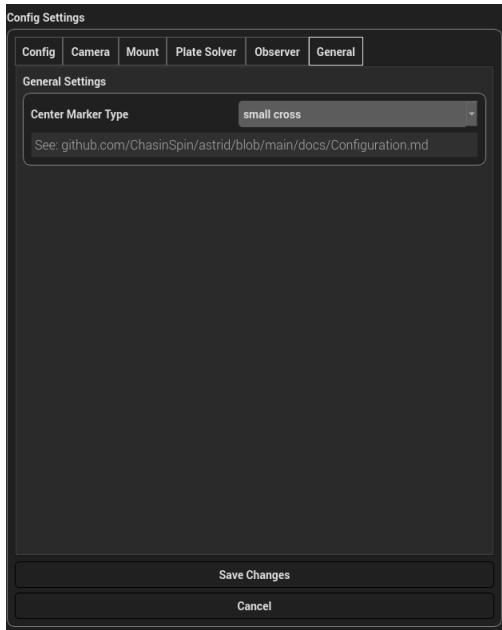
Configuration: Observer Section

Enter your name, contact details and OccultWatcher login.

Configuration: General Section


Creating your Configurations

To create a new configuration, you must Duplicate an existing configuration, open the duplicate configuration, make changes to the duplicate configuration, then save this new configuration. I suggest that you start by duplicating a configuration which uses the same Mount as your desired configuration. Before starting the process of creating a new configuration, ensure that Astrid has internet access (e.g. Astrid is connected to your home network). Astrid should include several sample configurations (including at least one "manual mount" configuration). Assuming you start with a "sample" configuration, follow these steps.

- Start the Astrid App
- In the "Choose Config" dialog, choose the desired sample configuration and select the "Settings" option.
- Choose "Duplicate this Config" in the "Config Details" section. The Astrid app will terminate. Wait until the process command window closes.
- Start the Astrid App again.
- Now Choose the duplicated configuration. If the original sample configuration was called "Sample", the duplicated configuration will be called "Sample Copy".
- Choose Settings and change all sections of this "Sample Copy" configuration (including the config name and config_folder in the config details section).
- After making all changes, select "Save Changes". The Astrid app will check the current plate solving database files against your selected focal length. If necessary, the Astrid app will attempt to download any missing database files. These files can be very large and the download may take significant time. After downloading any missing plate solve file, the Astrid app will terminate. Wait until the process command window closes.

Your new configuration is now available and you can select this configuration when using the Astrid App.

Overview of Astrid App

When you first start the Astrid App, you choose a configuration based on your current scope and mount setup. After choosing the configuration, the main Astrid User Interface appears:
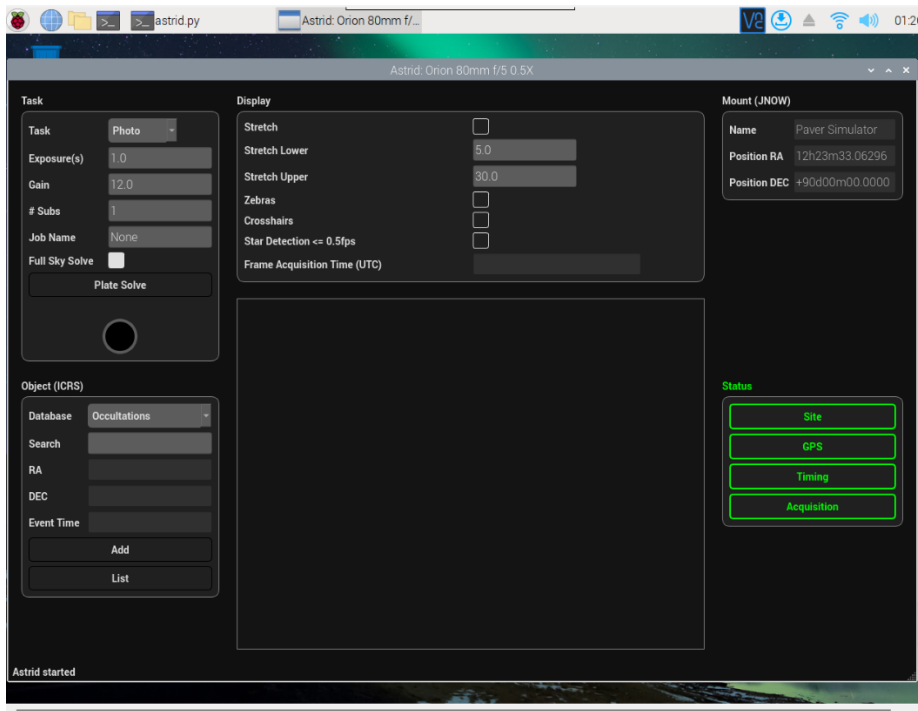
Astrid's UI is divided into six panes: Task, Display, Mount, Object, Image, and Status. The following sections of this primer provide a brief description of each section. Later sections provide more details in the context of observing an occultation.

Astrid UI: Task Pane

This pane controls Astrids two different imaging modes: Photo and OTE Video. Astrid starts in the Photo as shown in the screenshot above. After selecting either Photo or Video mode, you can adjust various settings for that mode and capture a Photo or Video via the round "button" at the bottom of the Task pane.

Photo Mode settings:

- Exposure: 0.0001 seconds to X seconds
- Gain: 0.0 to 16.0.
- Job Name: Astrid will include this name as part of the filename for photos.
- Full sky solve: Tells the plate solver to include the entire sky as a possibility for the image location when plate solving. You should enable this option when using a "manual" mount.

When using a GoTo mount under Astrid's control, you can normally disable this option for faster plate solves.

- Plate Solve button: After taking a photo, selecting this button asks Astrid to do a plate solve with the photo to determine the RA/Dec of the photo. If the plate solve succeeds, you will see an option to Sync the mount to the solved location.

Video Mode settings:

- Frame rate: 30fps to 0.X frames per second
- Gain
- Job Name

When you select video mode, Astrid starts displaying current images in the Image Pane. If you make changes to the video mode settings, these changes will appear in the Image Pane. Note: Astrid employs a 12 frame buffer as part of the timing synchronization logic. Therefore, any changes to settings will appear in the Image pane after 12 images have been exposed. When running slow frame rates, this delay will be noticeable (e.g. At a frame rate of 1 fps, changes will appear after 12 seconds).

Astrid UI: Display Pane

The display pane provides options for adjusting the images which appear in the Image pane. These adjustments apply ONLY to the image in the Image pane of the Astrid UI. The recorded image data is not affected by these settings.

Stretch:

Stretch is a very useful feature for most observations. When enabled, the displayed image will be adjusted to spread all input intensity values from Stretch Lower to Stretch Upper across the full range of output intensity values. Thus, intensity values below Stretch Lower will be full dark and intensity values above Stretch Upper will be full white. With Stretch enabled dim stars are much more apparent in the Image display. I only use this feature in OTE Video mode.

Zebras:

Enabling this option marks all saturated areas of the Image.

Star Detection:

This feature provides a focusing aid in OTE video mode. If you set the frame rate to a value less than or equal to 0.5 fps (2 second or longer exposures), Astrid will attempt to identify stars in the display and provide a numerical rating of the quality of focus. Smaller ratings imply better focus. Here is an example:
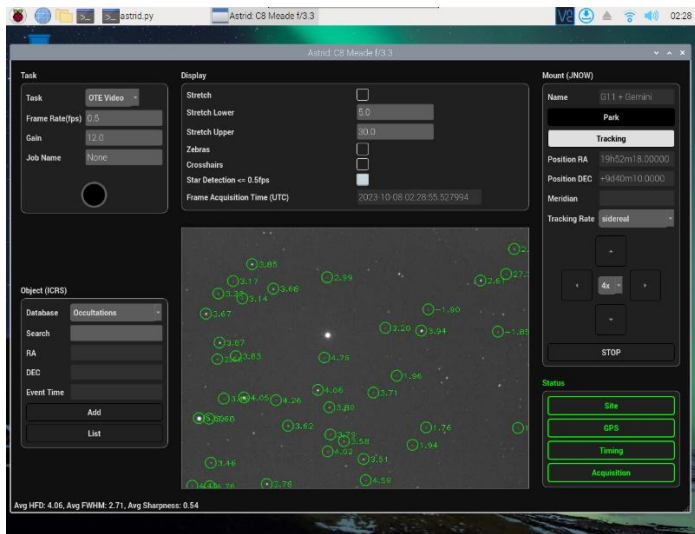
Astrid UI: Mount Pane

The Mount pane provides current status of mount and some ability to control the mount. You can enable/disable tracking or move the mount using this pane. There is a good chance you will never use the features on this pane while observing occultations.

Astrid UI: Object Pane

You will use the Object pane to select a target star or other object. In general, you will first specify a target object and save this object definition. Then you will select this object as a target for Astrid. Astrid contains two separate object lists: Occultations and Custom. Custom objects only specify and RA & Dec position. We are interested in Occultation objects which specify occultation timing information in addition to the target star position.

The Database option can be set to Occultations, Custom, or Simbad (online). Choose the Occultations database to create and select Occultation objects. Choose Custom to create and select Custom object. When Astrid is connected to the internet, the Simbad option enables a search of the Simbad online database. You can use this option to search for an object by name (e.g. Altair or M15) and save this object (position) as a Custom object. After choosing either Occultations or Custom objects, use the List button to select the object as the current object for Astrid.

Later sections of the primer will provide more details on creating an Occultation object.

Astrid UI: Image Pane

The Image pane always shows the last image collected by Astrid. This image will include any adjustments specified in the Display Pane.

Astrid UI: Status Pane

The Status pane shows four buttons: Site, GPS, Timing, Acquisition. These buttons show the status of each of these subsystems of Astrid. When a button Green, the subsystem is operating as expected. When a button is Yellow, there is a minor issue. When a button is Red, there is a major

issue. If you click on one of these buttons, Astrid will display a dialog showing more status. For the Site button, the status dialog include an option to update the Mount. If the Site button is Yellow, select the Site button and select the option to Update the mount. This action should change the Site button to Green.

Observing with Astrid

In this section of the primer, I will describe the steps I follow to prepare for and observe an occultation with Astrid, from a mobile location.

At home: Define an Occultation Object

When planning to observe an occultation with Astrid, my first step is defining an occultation object. This occultation object tells Astrid the position of the star and when to record the star. I recommend gathering this information from OccultWatcher. For this reason, I find it much easier to define the occultation object at home (with Astrid connected to my home network). Here is the process I follow.

- Power On Astrid
- On my laptop: Find the occultation event information on OccultWatcher/OccultWatcherCloud
- On my laptop: Open VNC Viewer app and Connect to Astrid
- On Astrid: Start the Astrid App with a manual mount configuration
- On Astrid: Create Occultation Object
- On my laptop: Copy occelmnt data from OWC
- On Astrid: Paste occelmnt data into Occultation Object
- On Astrid: Review times and recording duration
- On Astrid: Save the occultation object
- On Astrid: Exit the Astrid App
- On Astrid: Shutdown Astrid
- Power OFF Astrid
- On my laptop: Close VNC

On Site: Connecting Astrid

After arriving at my observing site, I follow the process below to get ready for observing with Astrid. There are two cases: Manual mount and GoTo mount.

- Assemble Mount and Scope. If you are using a GoTo mount, try to get the polar/horizon alignment close. But the alignment does not need to be exact. If you are using a manual mount, start with the scope pointed to the region of the sky where the star will be at the time of the occultation.
- Attach Astrid (with focal reducer) to Scope
- Wrap Astrid's GPS antenna cable around finder mount of scope as a lanyard to protect against Astrid falling out. Place the GPS puck on the ground but leave enough slack to allow Astrid to move with the scope during slewing/pointing.
- GoTo Mount
    - Connect Astrid's UBS port to mount controller
    - Turn ON mount.
    - Align the Mount (for GoTo). A simple, approximate alignment is sufficient. With some mounts, the mount can be "aligned" by starting in a default Park position. With other mounts, you may have to do a "fake" one-star alignment. In the one-star alignment process, the mount will GoTo an alignment star, ask you to center the star and confirm. Because Astrid will use plate solving to sync the mount, you can skip the "centering" step and just confirm the alignment without centering the star.
- Connect Astrid to power and power ON Astrid. Again, leave enough slack in power cable to allow for slewing/pointing.
- Power up Laptop
- On Laptop: Connect to Astrid's Wifi (via Astrid Wifi hotspot when away from home)
- On Laptop: Connect to Astrid with VNC
    - Note: It may take a few minutes after powering Astrid to "find" Astrid with VNC. If VNC fails to find astrid.local, just wait a bit longer and try again.
- On Astrid (over VNC): on Raspbian Desktop, Run Astrid App
- On Astrid (over VNC): select the Astrid configuration which matches your scope+mount
- On Astrid (over VNC): select "Occultations" as the database in the Object pane
- After completing the steps above, it is time to Acquire the target star. The next section of this primer explains the options for acquiring the target star.

On Site: Acquiring the Target Star

Astrid provides multiple options for using plate solving to find the target star. If you are using a manual mount (no GoTo), Astrid will help you PrePoint the mount. In a PrePoint approach, you point the mount to the exact Altitude and Azimuth for the star's location at the predicted center time of the occultation. The mount is pointed at this location well before the predicted time of the occultation and NOT moved. Astrid records the star field during the interval before and after the expected timeframe of the occultation. If you are using a GoTo mount, you can choose either a PrePoint approach or a Direct GoTo approach. With the Direct GoTo approach, Astrid uses GoTo and plate solving to acquire the target star location immediately. Subsequently, the mount tracking must keep the star centered until the time of the occultation. When using the PrePoint approach with a GoTo mount, Astrid will acquire the target Alt/Az location and turn OFF tracking. Later Astrid will turn ON tracking at the start of recording and continue tracking during the recording. With a GoTo mount, PrePointing is often the best option. PrePointing with a GoTo mount avoids concerns with polar alignment and tracking accuracy AND works when the target star is still below the horizon (many hours prior to the occultation). If the event will happen soon after setup, Direct GoTo may be the best option. If the event time is more than an hour away, I recommend you use PrePoint. Although, if the star is already above the horizon, you could start with a Direct GoTo and verify your exposure and gain settings for the star first. Afterwards, you can switch to PrePointing for the actual recording setup.

The next few sections will explain how to use Astrid, over VNC, for the PrePoint and Direct GoTo options.

Manual Mount: Prepointing

- Step 1: Select the Occultation Object. In the Object pane, set the Database field to "Occultations". Choose "List" from the bottom of the Object pane.
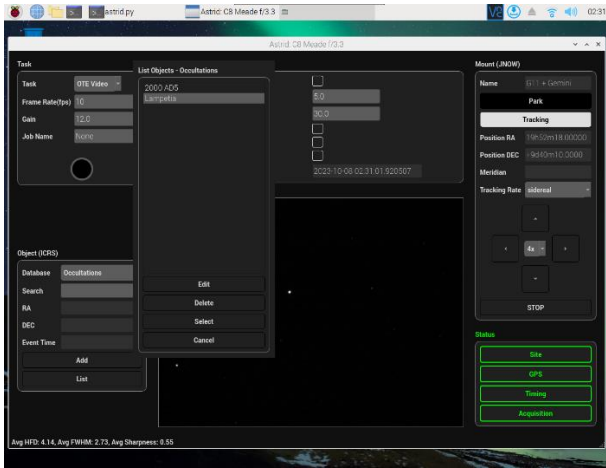

- Step 2: Select the Occultation, from the list, for this observing session (which you should have saved in Astrid earlier). This occultation is now selected. Astrid will confirm the selection, display the event time in the object pane, and enable the PrePoint and AutoRecord options in the Object pane.
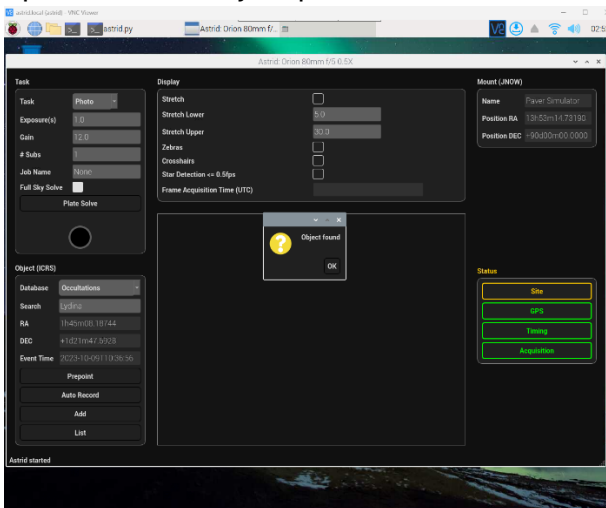

- Step 3: Verify Photo exposure for plate solving. In the Task pane, change to Photo mode and select an exposure and gain which is long enough to capture several stars but not long enough to cause significantly trailed star images (manual mount).

- Step 4: Start the PrePoint process. Select the Prepoint button in the Object pane. This begins the process of pointing to the Alt/Az position of the target star at the time of the occultation event. Astrid will display the PrePoint start dialog.
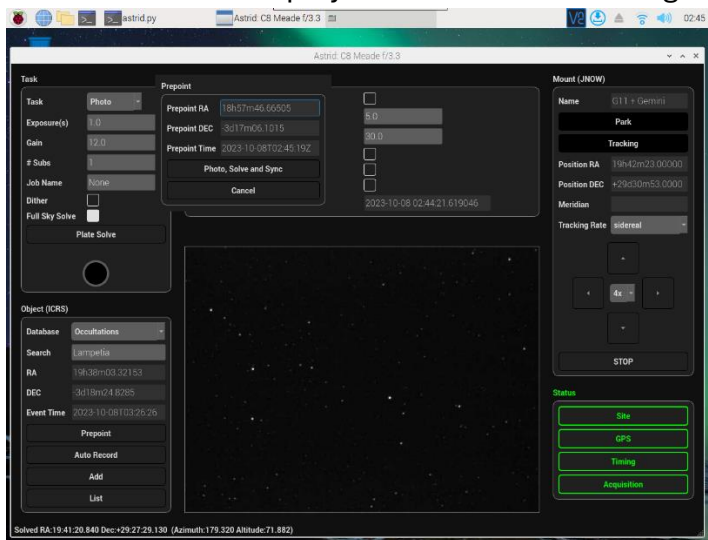
- Step 5: Select "Photo, Solve and Sync" to capture a photo and do the plate solve. After solving Astrid will display a dialog showing the current offset from the desired position.
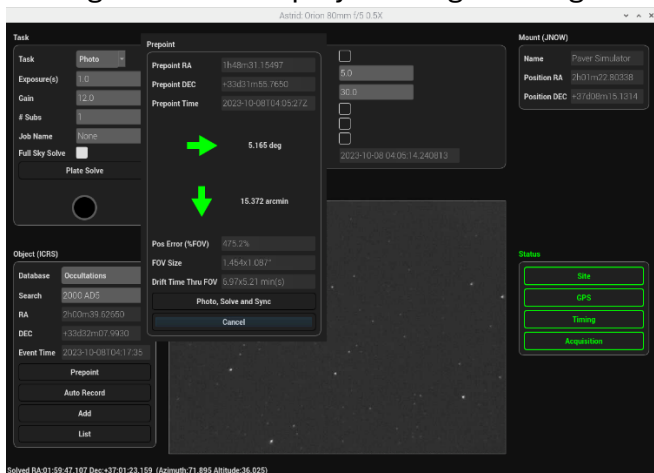

If the current offset is close enough, hit Cancel to exit this Prepoint dialog. Otherwise, move the mount in the direction indicated by the arrows and select "Photo, Solve, and Sync" again. Repeat this process (move mount, then solve) until the image field is close enough - within a few percent of the Field of View (FOV). At this stage the mount is pre-pointed and you can move to the Recording stage.

GoTo Mount: Prepointing

Prepointing with a GoTo mount operates similarly to Prepointing with a manual mount. The only difference is when adjusting the mount position toward the PrePoint location. With a GoTo mount, you will use a GoTo command rather than manually adjusting the mount.

- Step 1: Select the Occultation Object. In the Object pane, set the Database field to "Occultations". Choose "List" from the bottom of the Object pane.
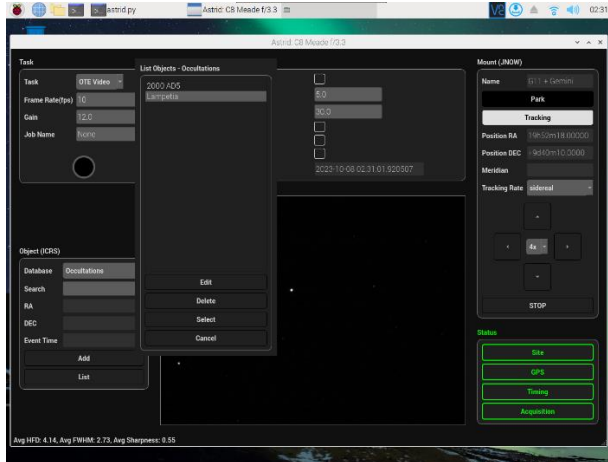

- Step 2: Select the Occultation, from the list, for this observing session (which you should have saved in Astrid earlier). This occultation is now selected. Astrid will ask if you want to GoTo the object. For PrePoint, answer NO to this dialog. Astrid will display the event time in the object pane, and enable the PrePoint and AutoRecord options in the Object pane.
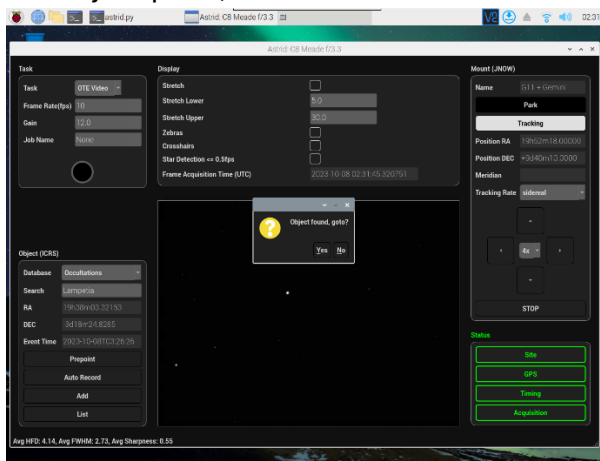

- Step 3: Verify Photo exposure for plate solving. In the Task pane, change to Photo mode and select an exposure and gain which is long enough to capture several stars but not long enough to cause significantly trailed star images (manual mount). Note: Although the GoTo mount has tracking, tracking will be disabled for prepointing.

- Step 4: Start the PrePoint process. Select the Prepoint button in the Object pane. This begins the process of pointing to the Alt/Az position of the target star at the time of the occultation event. Astrid will display the PrePoint start dialog.
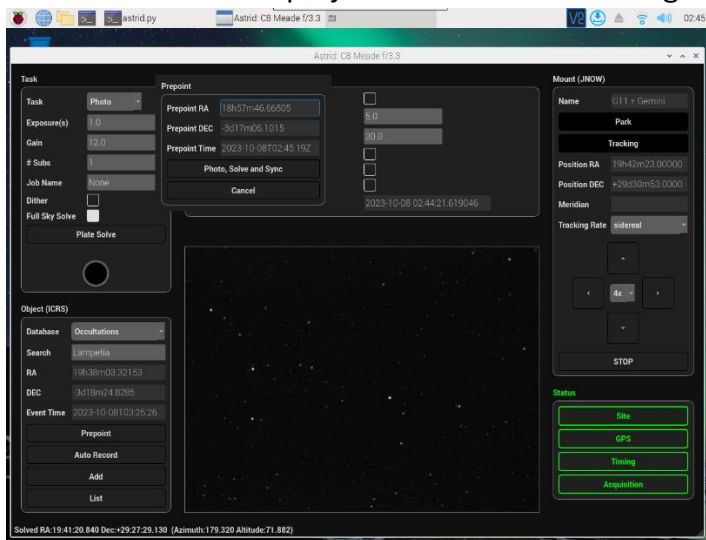
- Step 5: Select "Photo, Solve and Sync" to capture a photo and do the plate solve. After solving Astrid will display a dialog showing the current offset from the desired position.
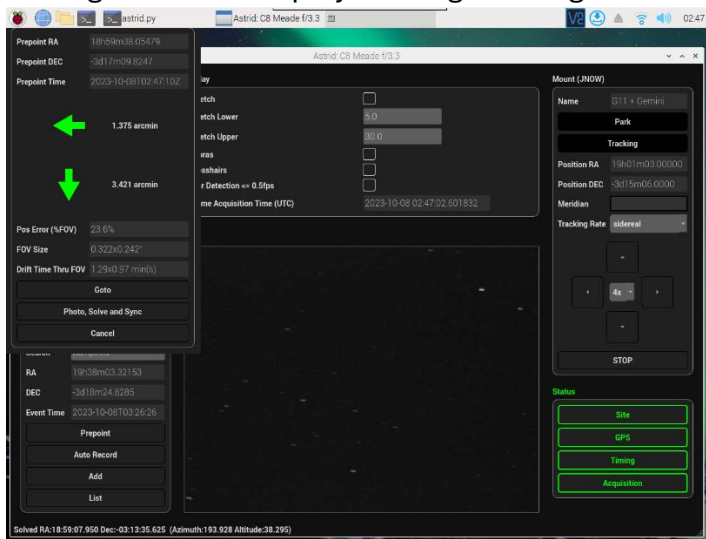

If the current offset is close enough, hit Cancel to exit this Prepoint dialog. Otherwise, select GoTo. After the mount finishes moving, select "Photo, Solve, and Sync" again. Repeat this process (move mount, then solve) until the image field is close enough - within a few percent of the Field of View (FOV). At this stage the mount is pre-pointed and you can move to the Recording stage.
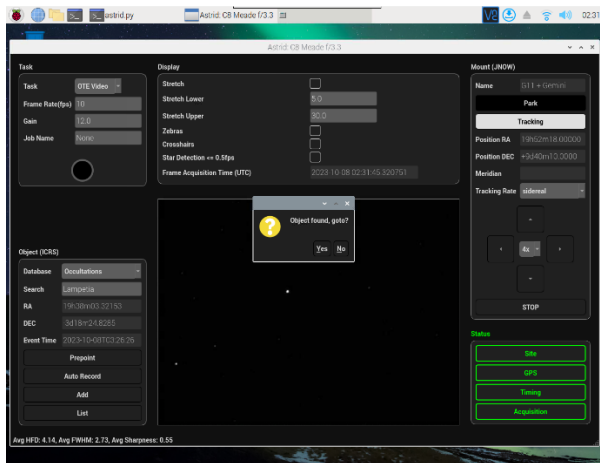
GoTo Mount: Direct GoTo

In the Direct GoTo approach, Astrid will use plate solving to accurately acquire the target star now.

- Step 1: Select the Occultation Object. In the Object pane, set the Database field to "Occultations". Choose "List" from the bottom of the Object pane.
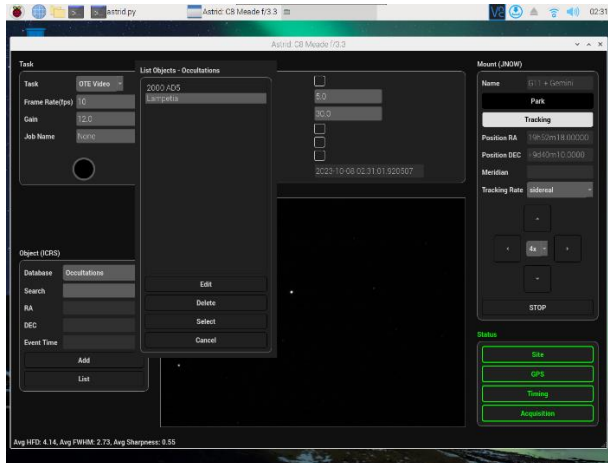
- Step 2: Select the Occultation, from the list, for this observing session (which you should have saved in Astrid earlier). This occultation is now selected. Astrid will ask if you want to GoTo the object. For Direct GoTo, answer YES to this dialog. Astrid will display the event time in the object pane, and enable the PrePoint and AutoRecord options in the Object pane. Astrid will command the mount to GoTo the location of the target star.

- Step 3: Verify Photo exposure for plate solving. After the mount stops slewing to the Target star, change to Photo mode and select an exposure and gain which is long enough to capture several stars. Note: With the Direct GoTo approach the mount tracking will be enabled and you can take longer exposures for plate solving.

- Step 4: Plate Solve, Sync and GoTo. In Photo mode, select the Photo button (round button). After the image appears in the Image pane, select the Plate Solve button. Astrid will do a plate solve using this image and display the Plate Solve Dialog.

## On Site: Recording

Set Video Exposure

Before recording you must verify that you have the correct exposure settings for recording the event. Your primary consideration should be adequate Signal-To-Noise (SNR) for the target star. Ensure that the Gain is high enough and the Frame Rate is slow enough to make the target star visible. When verifying the exposure settings, Astrid should be in OTE Video mode and you should enable the "Stretch" option in the Display Pane. Note: At higher frame rates, Astrid will only stretch the center portion of the Image pane. To ensure the best possible SNR, take time to achieve good focus.

Auto Record

I recommend always using Auto Record. Assuming you have already setup a good timeframe for recording when you setup the Occultation object, this approach avoids several possible errors. After acquiring a Prepoint Location (or Target Star) and verifying the video exposure settings, select the Auto Record button in the Object pane. Astrid will display you to verify:
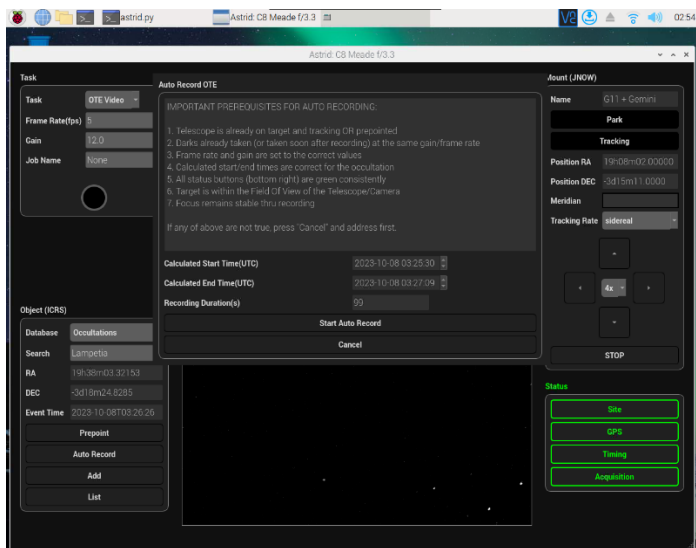
Assuming everything is OK, high "Start Auto Record" and Astrid will display the Auto Record Dialog. Note that you have the option to tell Astrid to Shutdown after recording (for unattended stations).
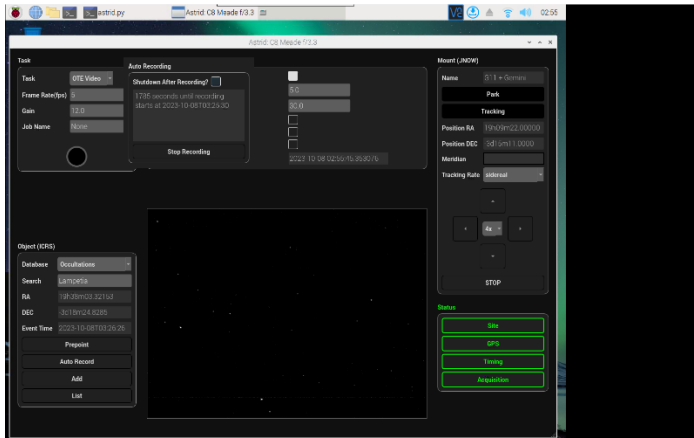
While recording Astrid will show the status of the recording. If you have setup PrePointing with a GoTo mount, Astrid will re-enable mount tracking at the start of the recording interval.
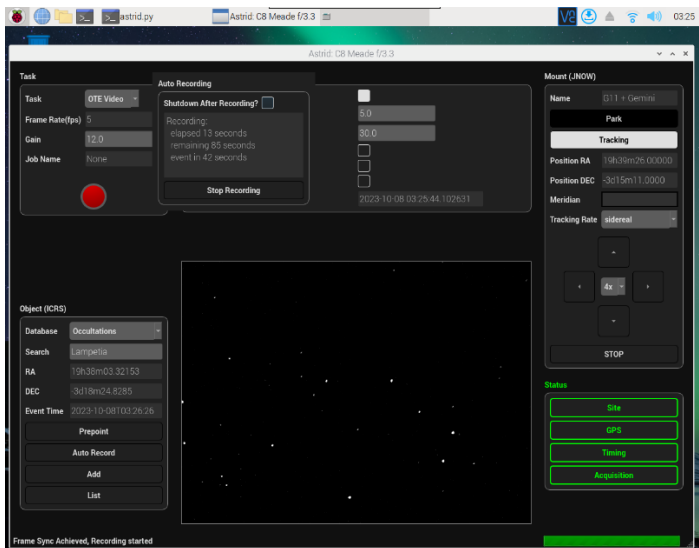
Recording Finished

After recording, if you did not select the option to Shutdown after recording, you can exit the Astrid app. Then you can Shutdown Astrid manually via the Raspbian Desktop main menu. Select Shutdown to bring up the Shutdown menu where you will select Shutdown to complete the process. Wait a minute for the Shutdown to complete (with no green light flickering on Astrid). Then you can remove power from Astrid.
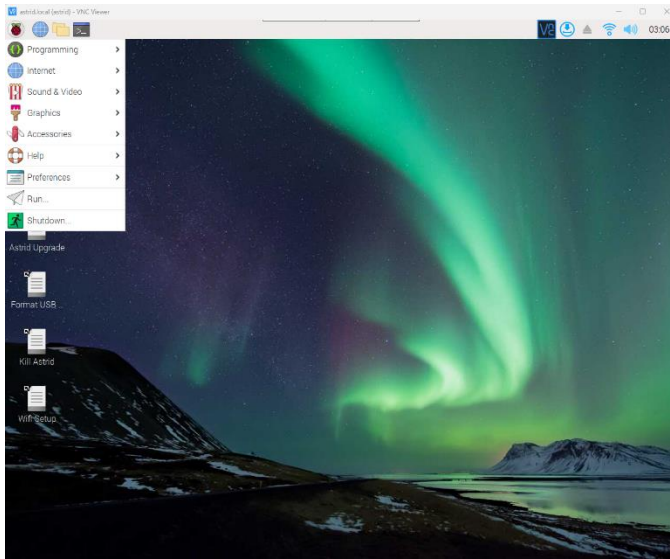
Reviewing Observations

Astrid records videos to the OTE Videos folder of the USB Flash drive using the RAVF file format. Each video file will have a unique name based on the Occultation object name and the Date/Time of the recording. With Astrid shutdown and powered off, remove the USB Flash drive from Astrid and insert it into your computer. Use the file browser on your computer to locate the relevant *.RAVF file on the USB Flash drive and copy this file to your computer. You can now review this video file with PyMovie.