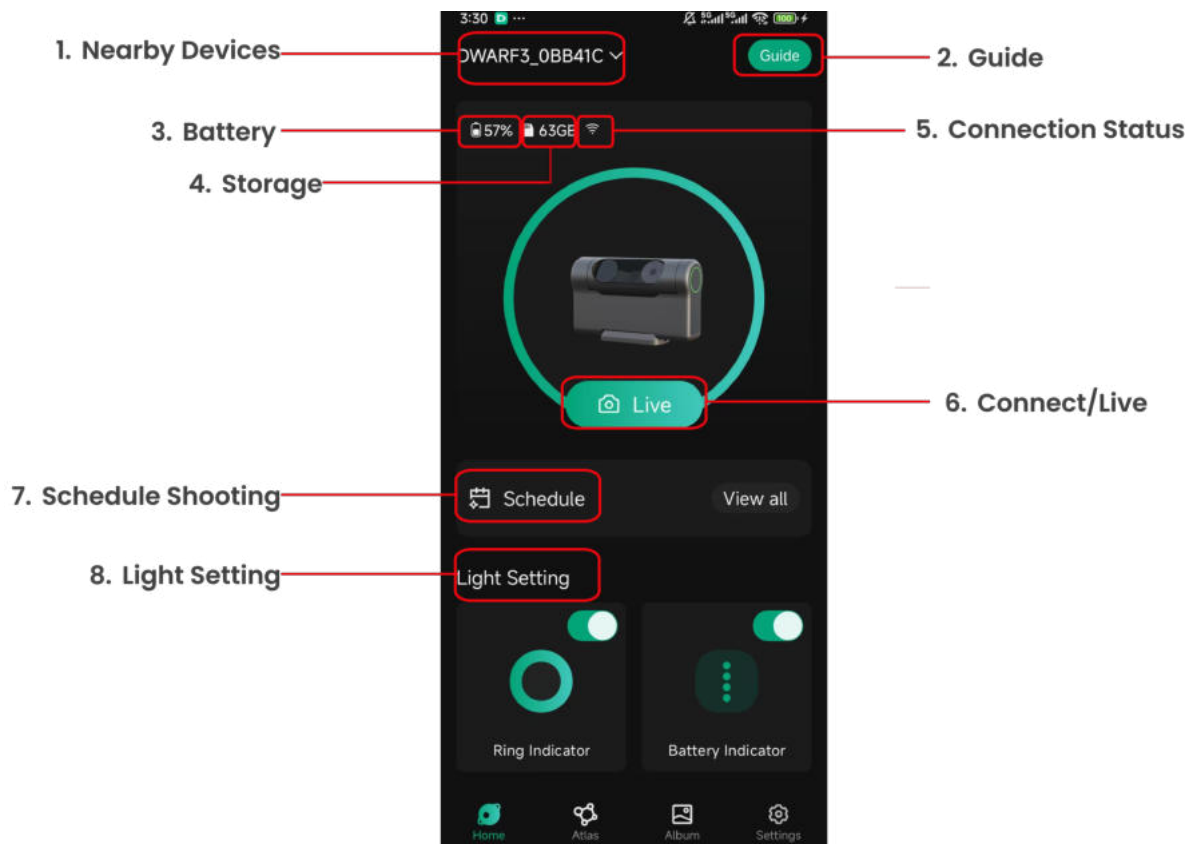


1. Application Interface Introduction

1.1 Home



1.1.1 Nearby Devices

Shows the currently connected device name. Tap to quickly disconnect or switch to another available device. [Section 1.1.6, Connect](#) will explain more in detail.



1.1.2 Guide

Click to browse *tutorials* in the help center (like this one you are looking at). Bestseller when you are using the bathroom, but not recommended before bedtime as it might inspire a sudden urge to stargaze. Note that a *internet connection* is required to browse the help center.

1.1.3 Battery

The LED indicators show the remaining battery level. Keeping enough charge is important for normal operation:

- **Firmware updates require at least 20% battery** and will not start below that level.
- **Astronomical shooting automatically stops at 8% battery** to prevent an unexpected shutdown.

Battery indicator lights:

- **1 light:** 0–25%; **2 lights:** 25–50%; **3 lights:** 50–75% ; **4 lights:** 75–100%

Charging information:

- **Fast charging:** USB-A or USB-C to USB-C cable using a **9V or 12V** power source
- **Slow charging:** USB-A or USB-C to USB-C cable using **5V** power
- The device **can be used while charging** and works with **portable power banks**
- We recommend using a USB-A or USB-C to USB-C power & data cable that supports PD2.0/PD3.0, with fast charging capabilities of 12V/2A (24W). With fast charging, the battery icon shows double lightning. Always remember to charge your device for your stargazing plans fully.

Recommended charging temperature:

Charge the device in environments between **0°C and 45°C (32°F–113°F)** for safe and efficient charging.

Operating and Charging Temperature Explained

The DWARF is designed to operate safely in temperatures between **-10°C (14°F) and 60°C (140°F)**.

- **Cold conditions:**

When temperatures drop **below 0°C (32°F)**, the device can still be used normally. However, **battery charging may slow down significantly or pause altogether** until the temperature rises. This is normal behavior and protects the battery.

- **Hot conditions:**

If the **battery temperature exceeds 45°C (113°F)**, charging is automatically disabled to prevent overheating. You can still use the device, but it will not charge until it cools down.

- **Overheat protection:**

If the **internal temperature reaches 60°C (140°F)**, the DWARF will **automatically shut down** to protect its internal components and sensors.

In short: the DWARF is built to protect itself. Cold affects charging speed, heat can stop charging, and extreme heat will trigger a shutdown to prevent damage.

1.1.4 Remaining Storage

For your convenience, this is displayed similarly to the battery level, showing "**remaining space**".

1.1.5 Connection Status Indicator

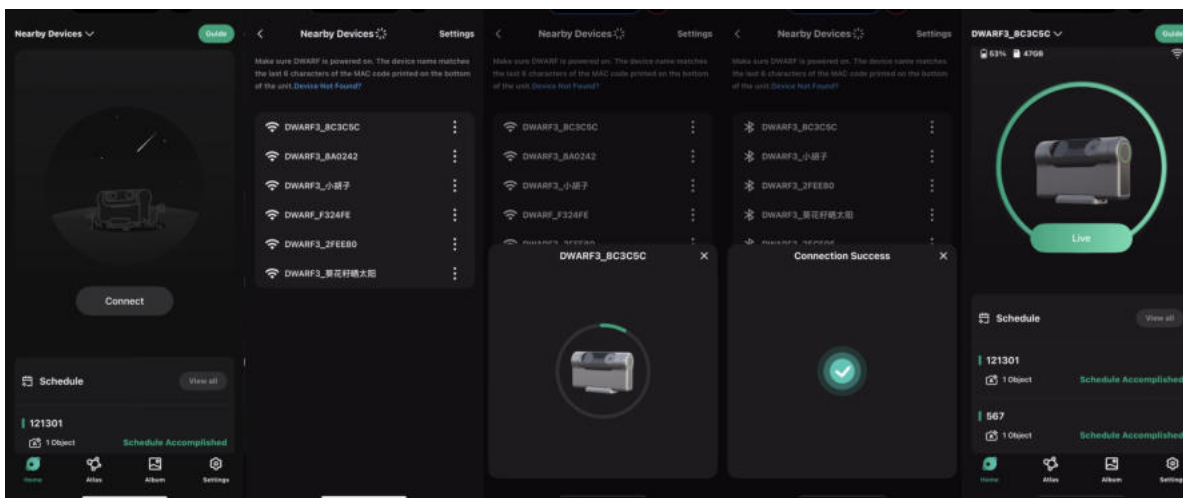
Helps you tell whether you are in good connection with DWARF 3.

1.1.6 Connect

1.1.6.1 App Connection

Before connecting, it displays "Connect". Click on "Connect" and follow the prompts to connect to DWARF 3. After connecting, it will display "**Live**".

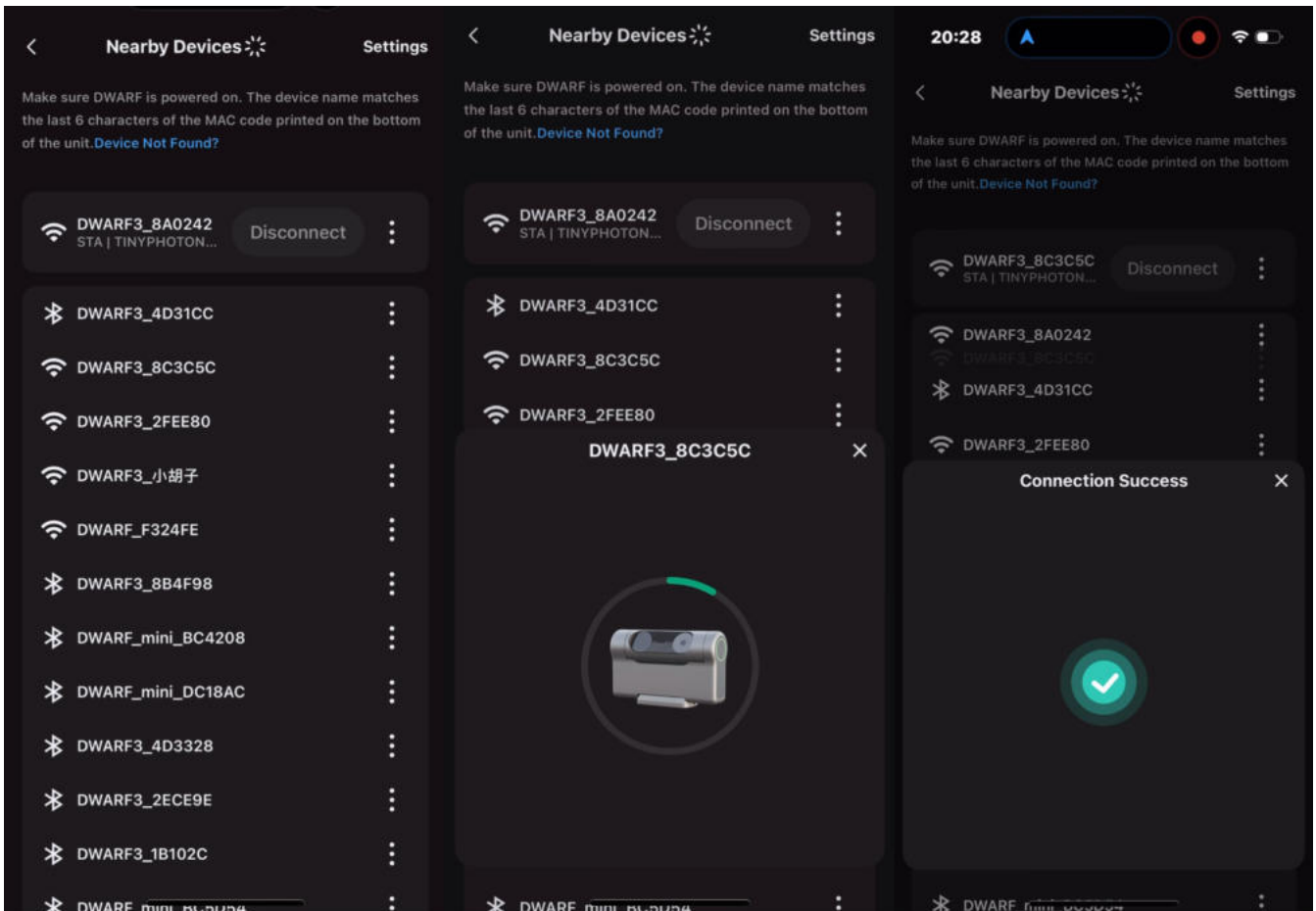
- When connected, your mobile devices still support using cellular data / internet access
- Some specific mobile phones or cellular enabled tablets may need to "[enable mobile data](#)" in their permissions settings or sub settings - [this usually applies to Android devices](#)
- When connected, your devices still support using cellular data or internet access (need to enable mobile data).



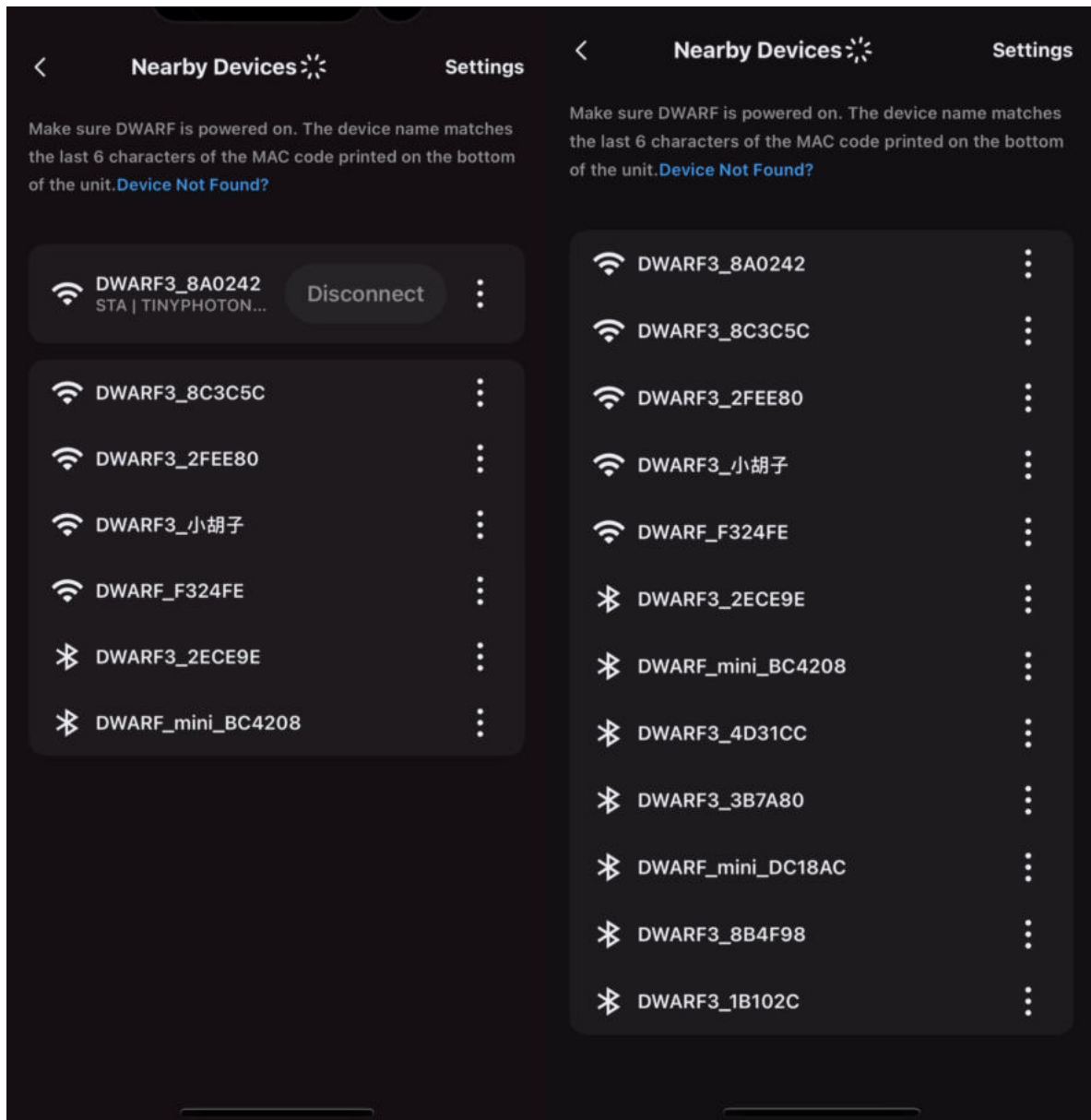
1.1.6.2 Quickly disconnect or switch devices

In the **Nearby Devices list**, you can simply tap on another DWARF device to **switch the connection instantly**, without needing to manually disconnect from the current device

first.

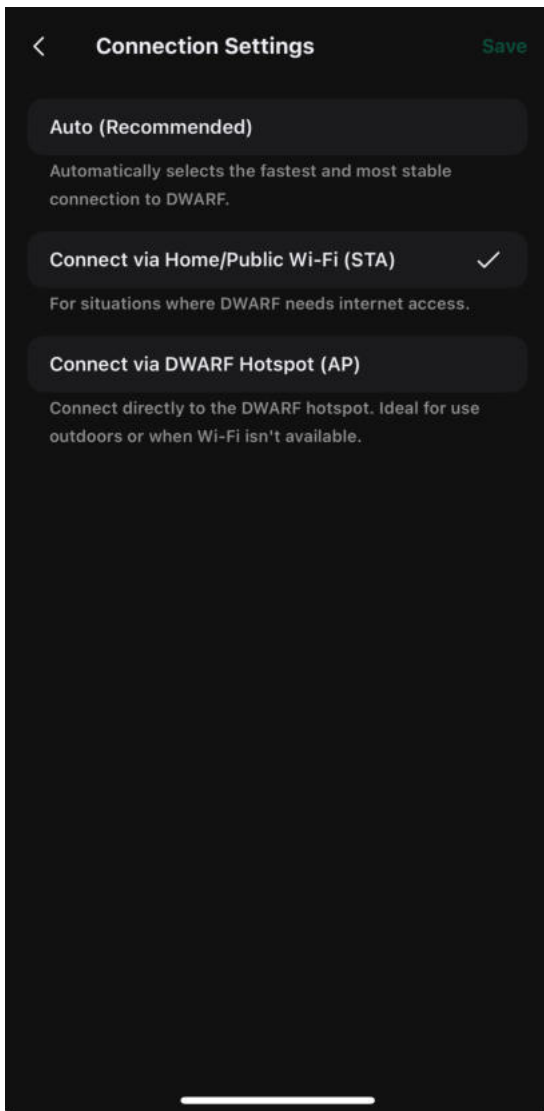


If you only want to disconnect from the current device, you can tap **Disconnect** to **immediately end the connection**, making it easy to reconnect later or switch to a different usage scenario.



1.1.6.3 Connection Methods Overview

You can connect your mobile device to DWARF in **3 different modes**:



1.1.6.4 Auto Mode (Recommended)

Auto mode automatically detects your current network environment and selects the **most stable connection method** without manual configuration. For most users and situations, this is the **simplest and most reliable option**.

Note: If you experience random or sudden disconnects, Auto Mode may be switching between AP and STA based on **signal strength, DWARF' s position, and your network setup**.

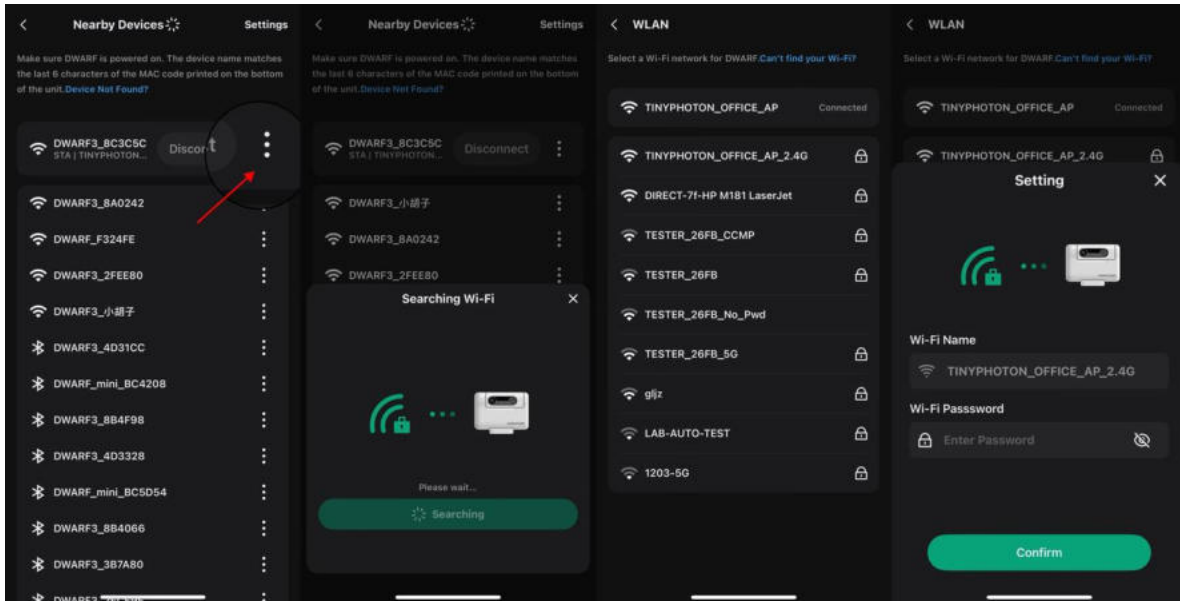
If this happens repeatedly, you can **manually select either AP or STA mode** in the settings to stabilize the connection.

Please use the **Support reporting feature** to share your experience with DWARFLAB. This helps the team analyze the devices data and improve connection handling in future updates.

1.1.6.5 STA Mode

DWARF connects to a **home or public Wi-Fi router**, which acts as an intermediary between the device and your phone or tablet.

This allows your mobile device to **remain connected to the internet** while controlling DWARF, enabling features such as online services, syncing, and uploads.



Note:

- Connection stability in STA mode depends on your router's range, configuration, and Wi-Fi band. If you experience connection issues, verify that your router meets the recommended settings and that required features are enabled.
- STA mode allows for a longer control distance, approximately 10 meters. If you're using a LAN-Node (mesh network) setup over a large spatial range, the STA connection might malfunction.

To fix that, ensure that both DWARF and your mobile/tablet device connect to the same SSID that covers DWARF's sitting location (if using a mesh network, connect to the closest node). Then, when moving to a different SSID's coverage area, manually switch your mobile/tablet device's network in the settings to another preferred SSID, if the naming is different or your nodes are not set to handle auto-negotiation (automatically connects your DWARF or devices to another node). You may need to research the guide or instructions for the specific model of your home wi-fi device.

- For networks that have been previously configured, DWARF will remember the password, so you won't need to re-enter it. Also, remember to turn off STA mode if you take DWARF 3 to a new place without an available WiFi

access. You may need to reconfigure your STA mode connections after an application or firmware update.

- If you plan on traveling away from your home network and have **STA** manually set, remember to change it to **AP** or **Auto Mode** before you head out on your adventure. When in STA connection mode, tap the “:” button on the right side of the DWARF device to reconfigure or update the network connection.

1.1.6.6 Auto Mode (Recommended)

Your phone or tablet connects **directly** to DWARF’s built-in Wi-Fi hotspot. This mode does **not require an internet connection** and is best suited for outdoor use or locations without reliable Wi-Fi access.

Note: If your device lacks a cellular network (e.g., a Wi-Fi-only tablet), using AP mode will disable internet-dependent features such as **activation, Sky Atlas downloads, firmware updates, and log uploads**. In this case, please switch to STA mode in a Wi-Fi environment to access these features.

Note: If your device lacks a cellular network (e.g., a Wi-Fi-only tablet), using AP mode will disable internet-dependent features such as **activation, Sky Atlas downloads, firmware updates, and log uploads**. In this case, please switch to STA mode in a Wi-Fi environment to access these features.

1.1.6.7 Near Field Communication (NFC) Connection

1. Unlock your phone.
2. Place your phone's **NFC module** under the ring light until the NFC notice prompts.
3. Tap the **prompt** to open the DWARFLAB App. DWARF 3 will connect to your phone automatically.



Android

Apple

Prompt

- The NFC module on the iPhone is located at the **top** of the device. To initiate the connection, align the **top** of your phone vertically with the **side** of the DWARF and hold it in close for approximately 2 seconds to trigger the

connection prompt. If necessary, remove your phone case before attempting NFC connection.

- You can check if your phone supports NFC (Near Field Communication) by searching for "**NFC**" in the phone system settings.
- NFC connection will build a connection based on your current setting, so it could be either STA or AP.

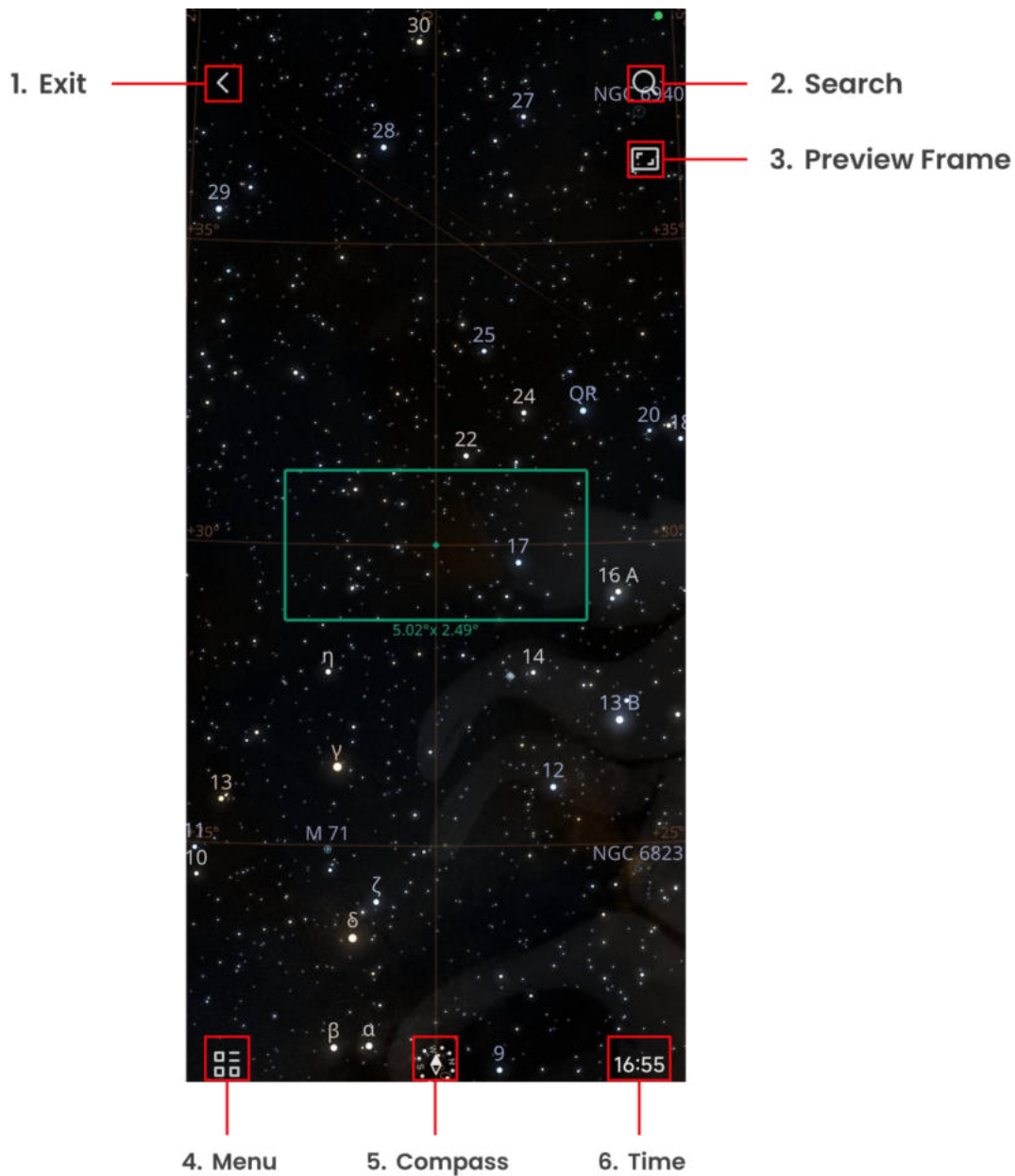
1.1.7 Schedule Shooting

Tap here to create your shooting plan, currently limited to deep-sky objects. For detailed instructions, refer to the [3.8 Schedule Shooting](#) tutorial.

1.1.8 Light Setting

Turning off the DWARF's lights can reduce potential light disruptions while you take Astrophotography.

1.2 Sky Atlas



First-time use:

- When opening the Sky Atlas feature for the first time, make sure your mobile or tablet device is **connected to the internet or cellular data first**. Download the catalog database if prompted.
- **Device storage requirement:** Your phone or tablet must have **at least 2 GB of free storage** to download the Atlas database. If you receive an error, free up space and try again.
- **Other settings:** Make sure **Airplane Mode and VPN are turned off** during the download to avoid interruptions.

1.2.1 Exit

Tap to return to the homepage.

1.2.2 Search Your Target & Shoot

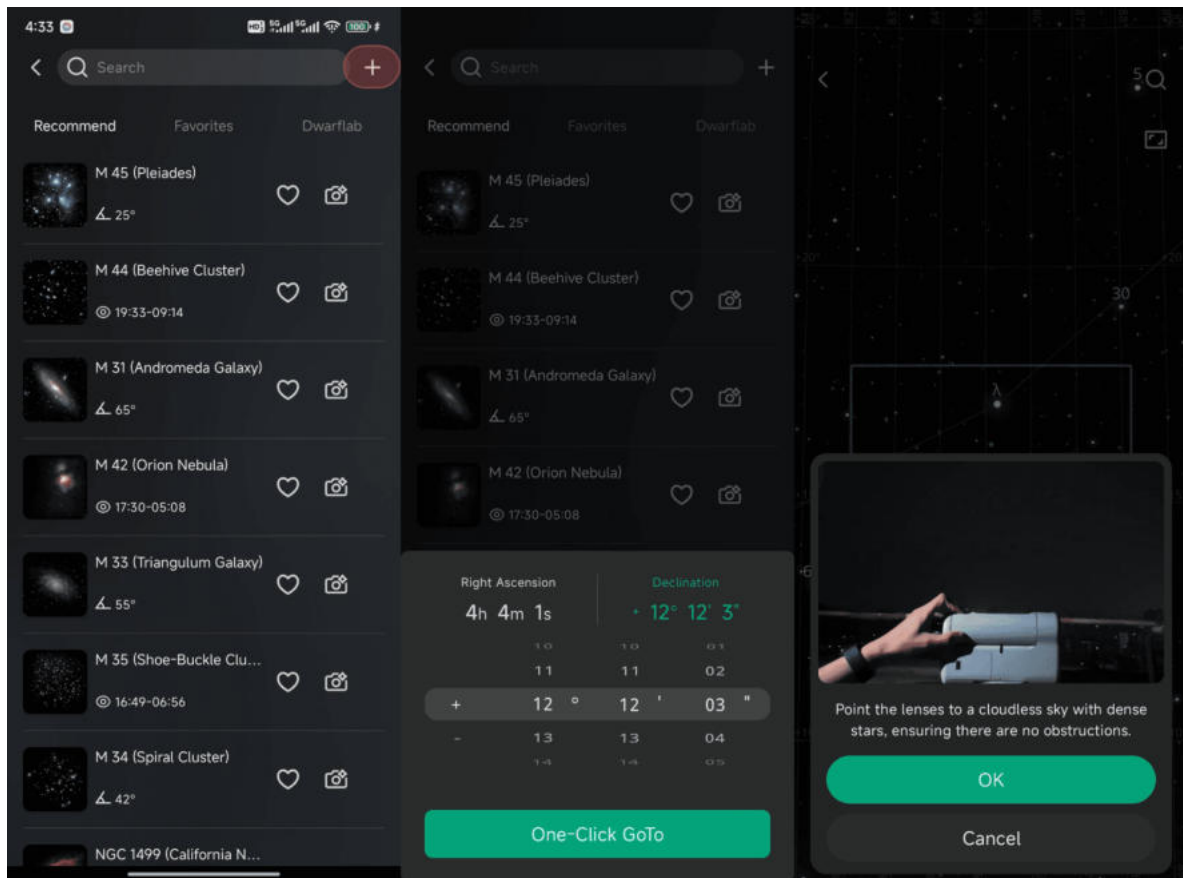
Enter the **Name or Alias** of a celestial in the search box to quickly find the target.

Note: Some name variations or identifiers may not be exact. If you have trouble finding a target, please reference outside sources (via the internet) to find alternate naming.

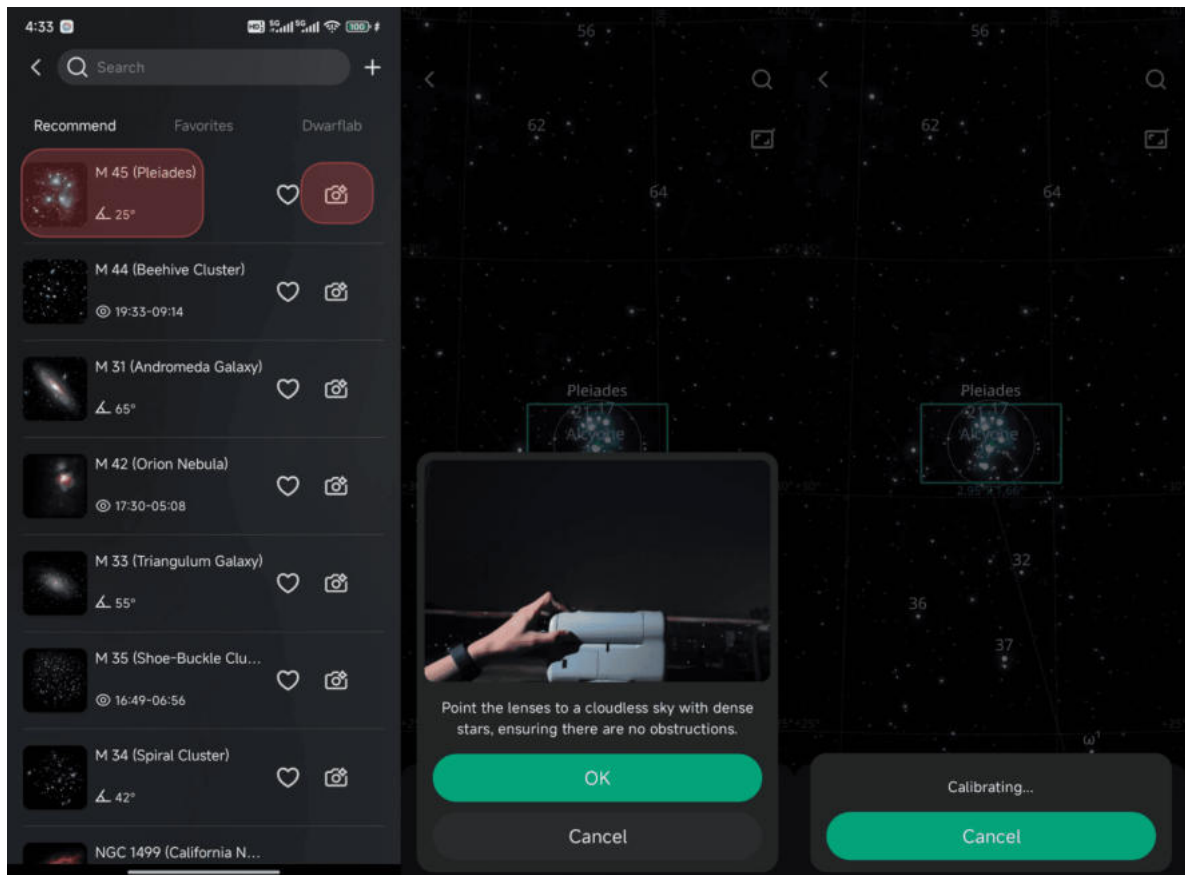


☒ **Enter Coordinates:** If a target's name is not available in the search, you have the ability to manually input the **RA** and **DEC** of the target. (Right Ascension and Declination are coordinates on the sky that correspond to longitude and

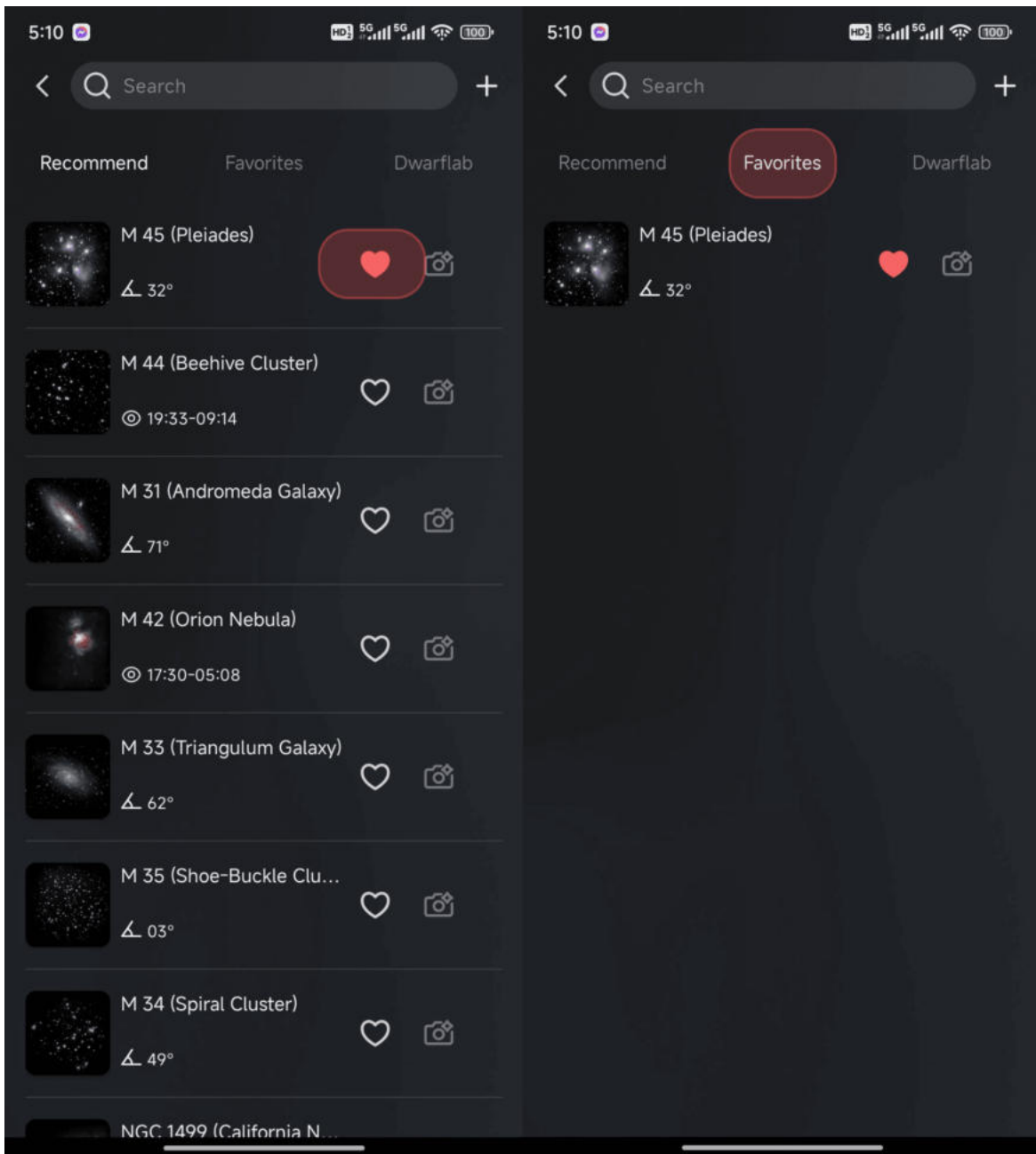
latitude on Earth) Tap "+" and enter the RA and DEC of a celestial to quickly find the target.



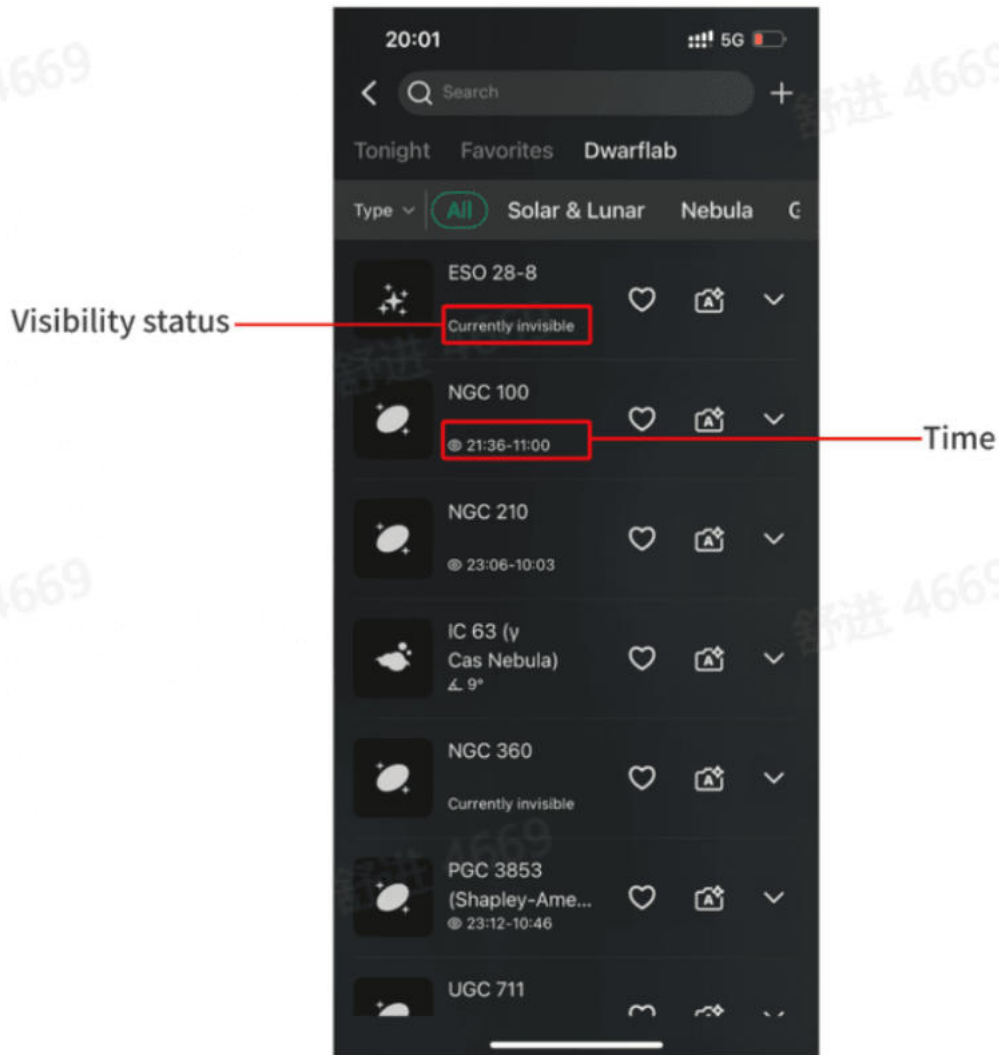
☒ **Tonight:** Recommend the best targets based on your time and location. Click the little camera on the right to track the target, manually set parameters and then start the shooting automatically.



☒ **Favorites:** Click the "Heart" to add your favorite targets to this list.



☒ **Dwarflab:** This is the Dwarflab celestial database, which contains many **celestial objects** suitable for DWARF observation and their **visibility status**; "currently invisible" means that this target is never visible at your location.



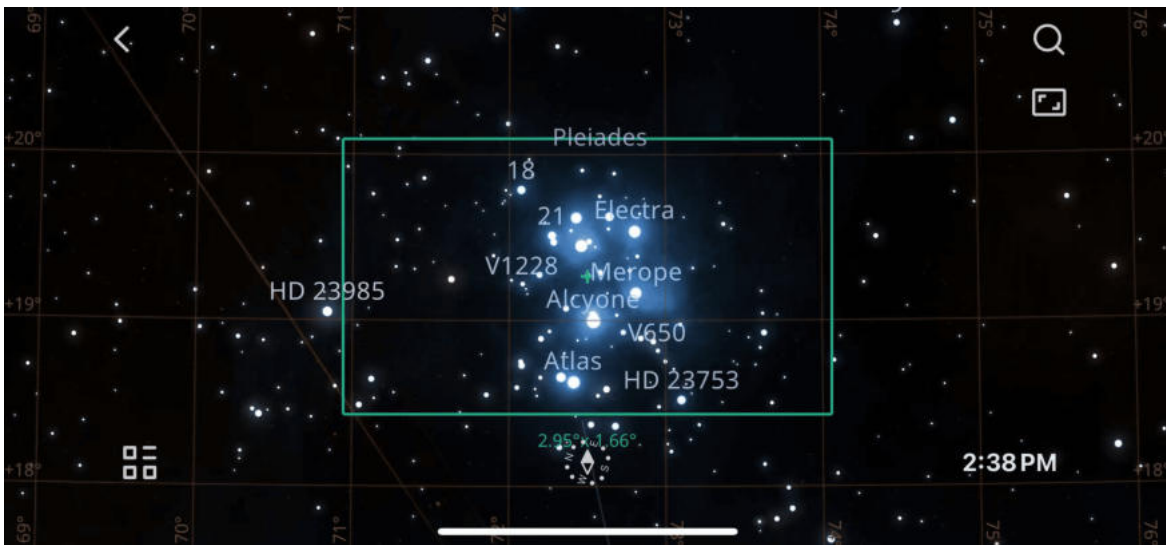
☒ **Celestial Categories:**

By type: **Nebulae, Galaxies, Planets, etc.**

By common catalogs: **Messier, NGC, IC.**

1.2.3 Preview Frame (Astro Mosaic)

In addition to the shooting targets mentioned above, you can now freely compose your astronomical images within the preview frame of the DWARF 3! For detailed information on Astro Mosaic, please refer to **Section 3.9 Astro Mosaic.**



On posing the frame, the **coordinates** at its **center** will be used in later actual capture. These coordinates may not correspond to the original target selected in the Atlas, and it will display as "**Unknown.**"

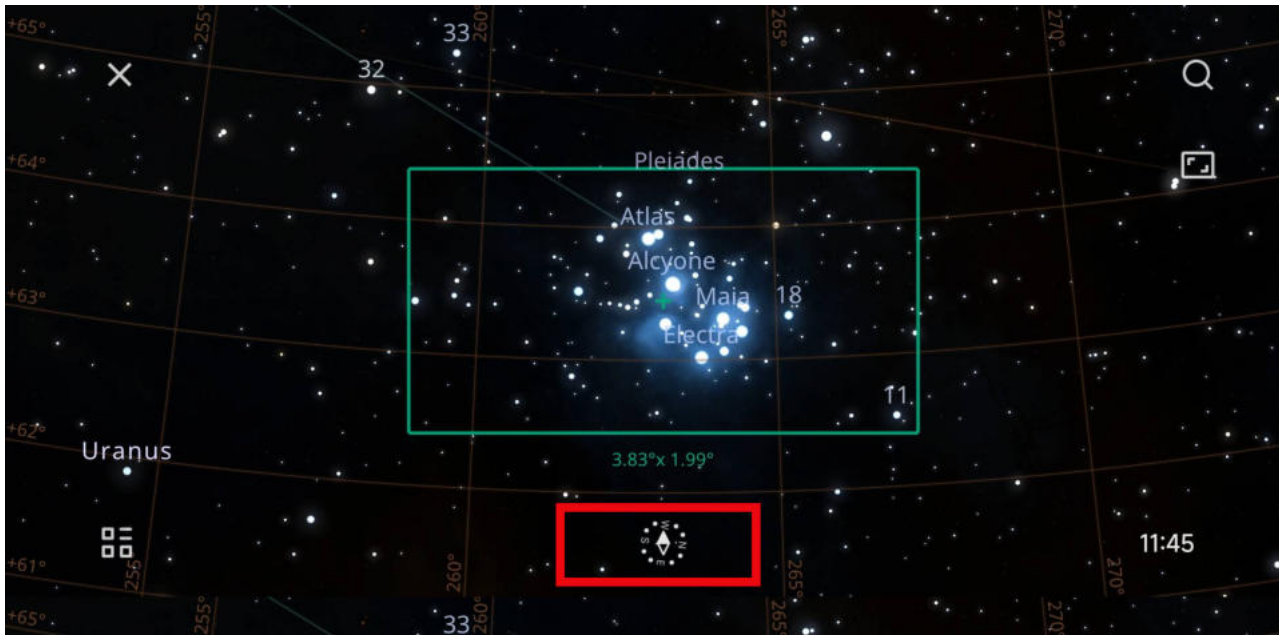


1.2.4 Compass

Helps you know the actual direction the phone is pointing at.

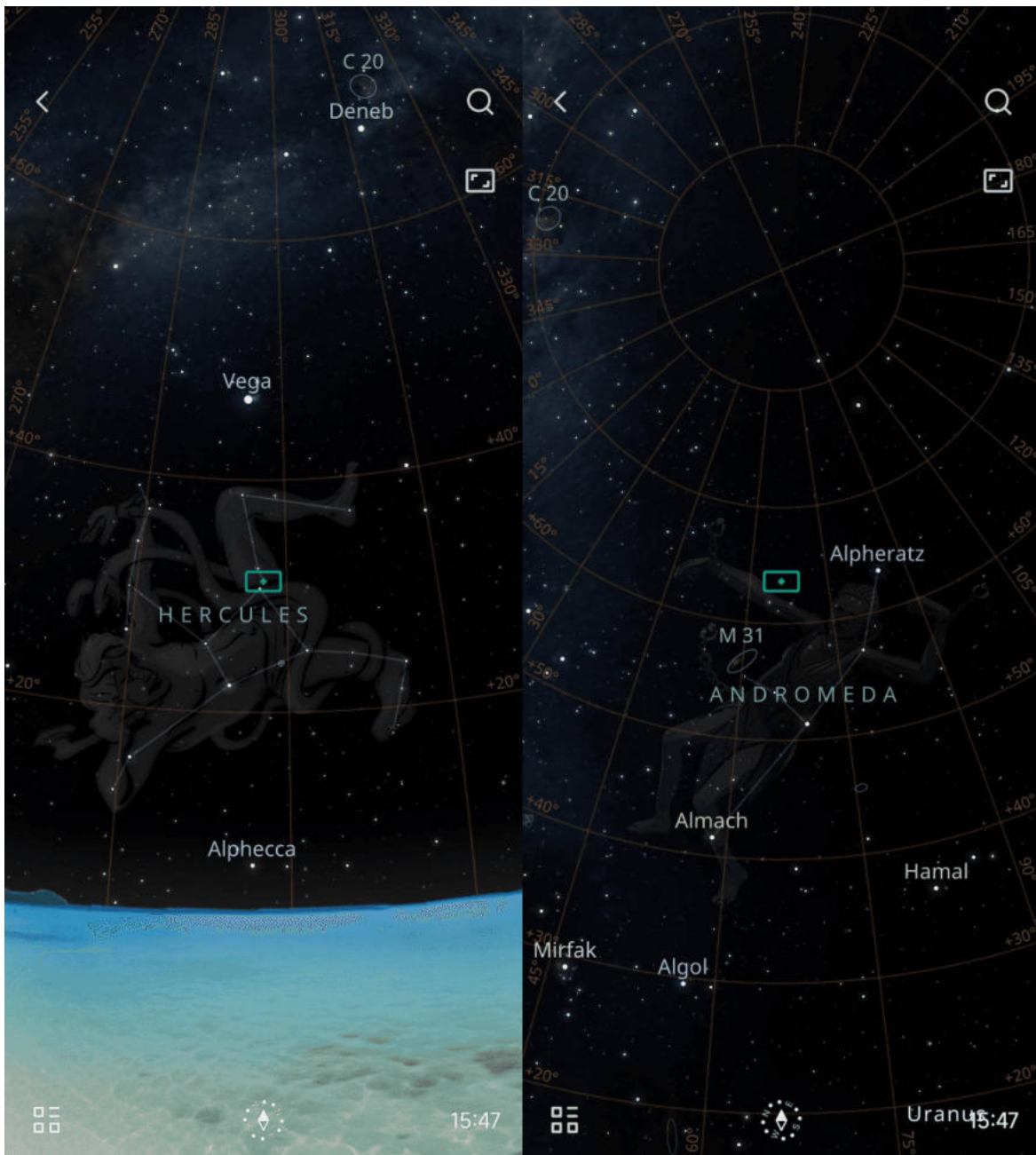
Pick up your phone or click the little compass icon, the atlas will enter **auto-follow** mode.

Lay the phone **flat** to use as a guide tool.

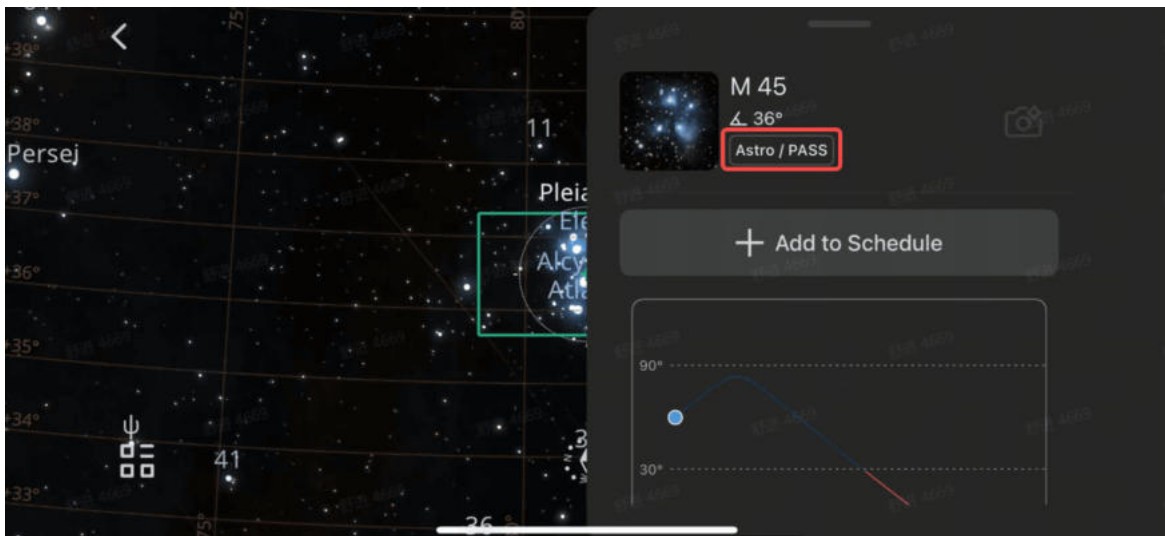


1.2.5 Sky Atlas Menu & More

View various celestials and constellations in the Sky Atlas.



Click on the name of a celestial and swipe upon the pop up page to display its detailed information (type, alias, coordinates, and the suitable filter for imaging it, etc.).

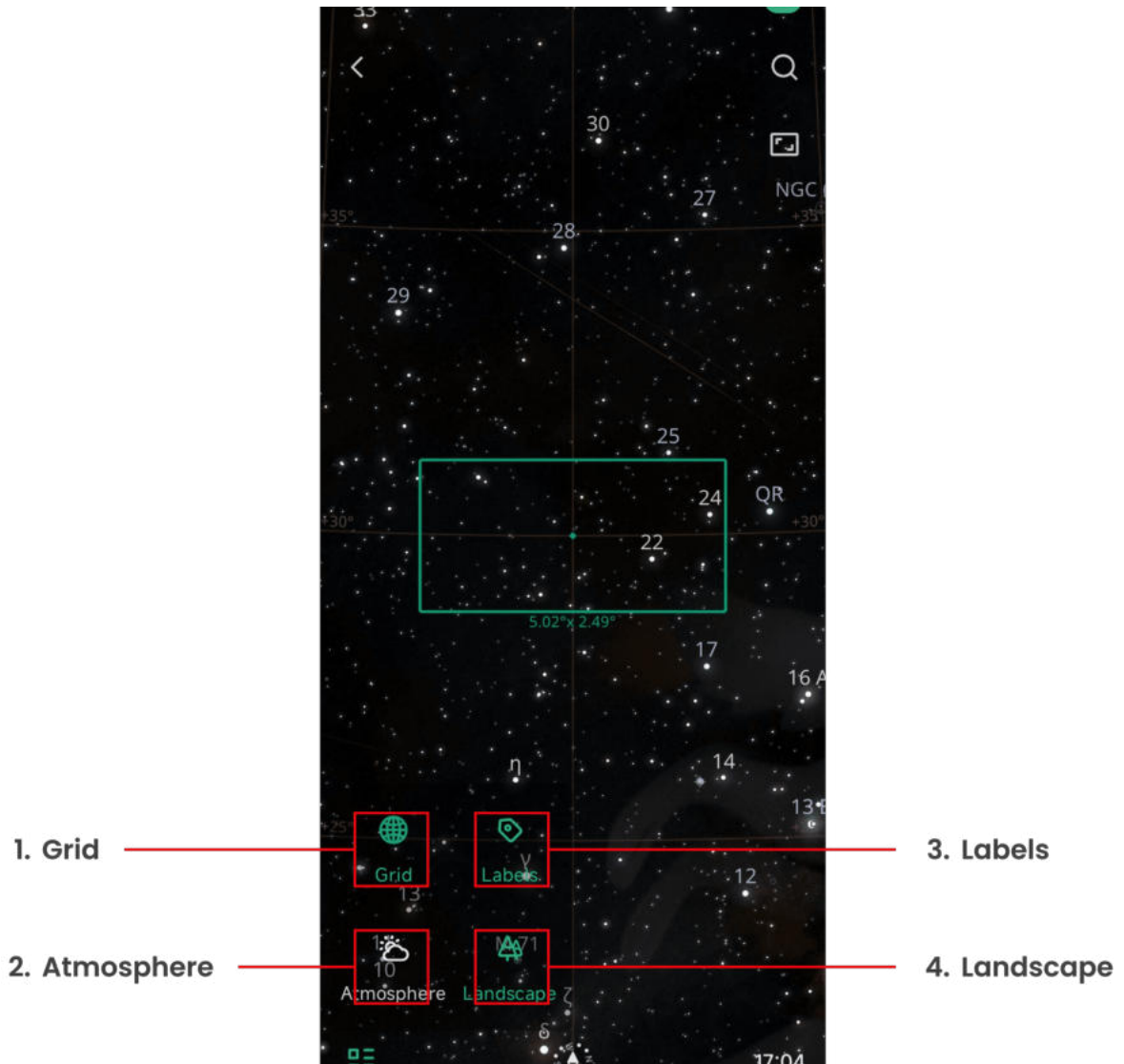


Grid: Turn on to display the positioning grid.

Labels: Turn on to display the names or labels of celestials.

Atmosphere: Turning it on displays the state of celestial bodies under current weather conditions.

Landscape: Turn on to display a simulated landscape, making the horizon position clearer.



1.2.6 Time

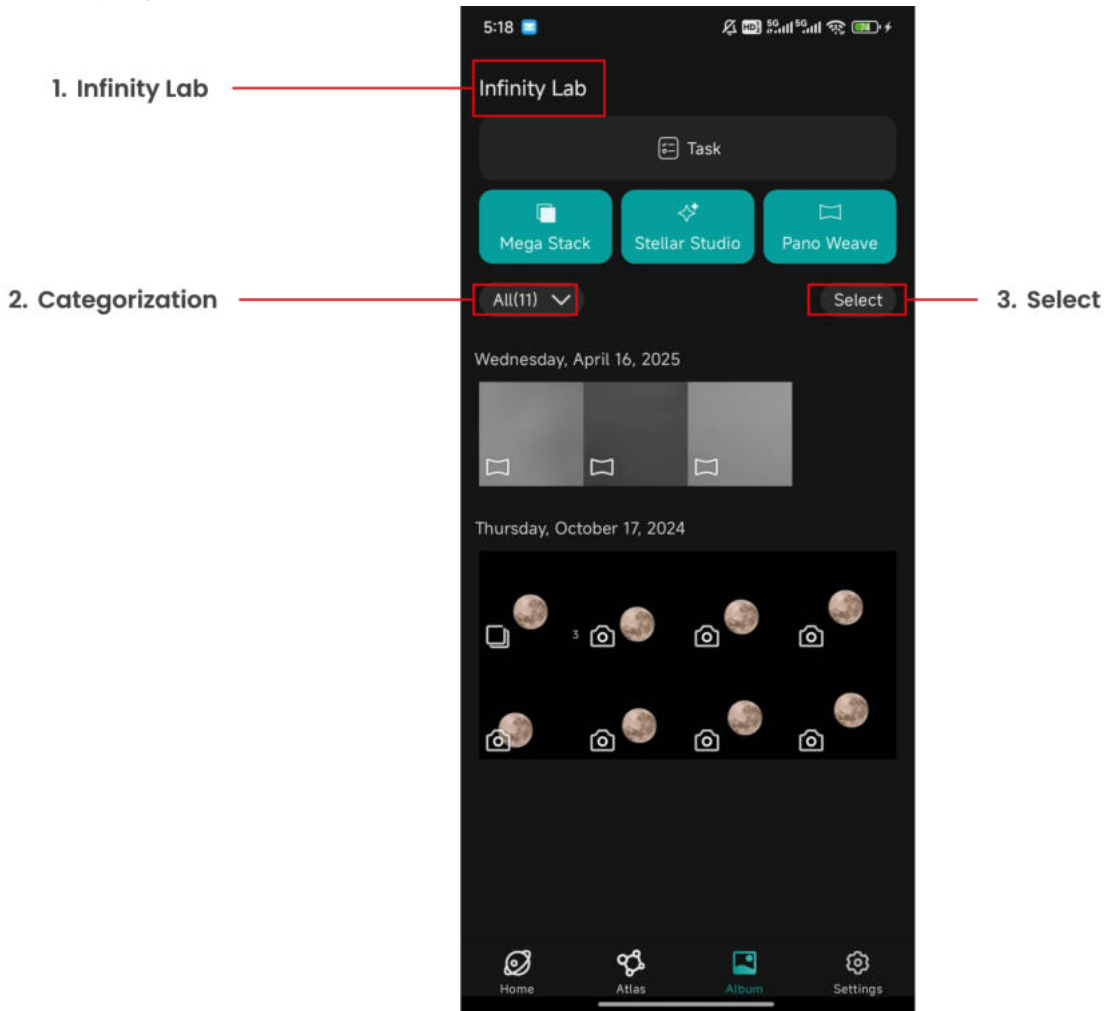
Display the current local time. Clicking on the time allows you to adjust it, and the Atlas will display the celestial objects status based on the set time.



1.3 Album

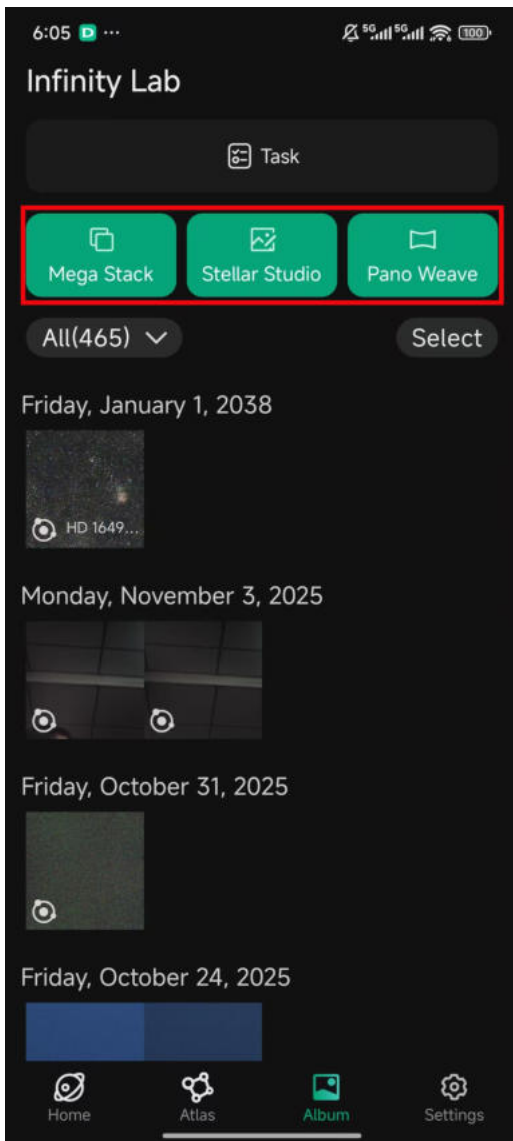
The photos in the album are categorized and displayed in chronological order, with the date and time of the photo indicated. For photos taken in different modes, different icons

are displayed in the corners.



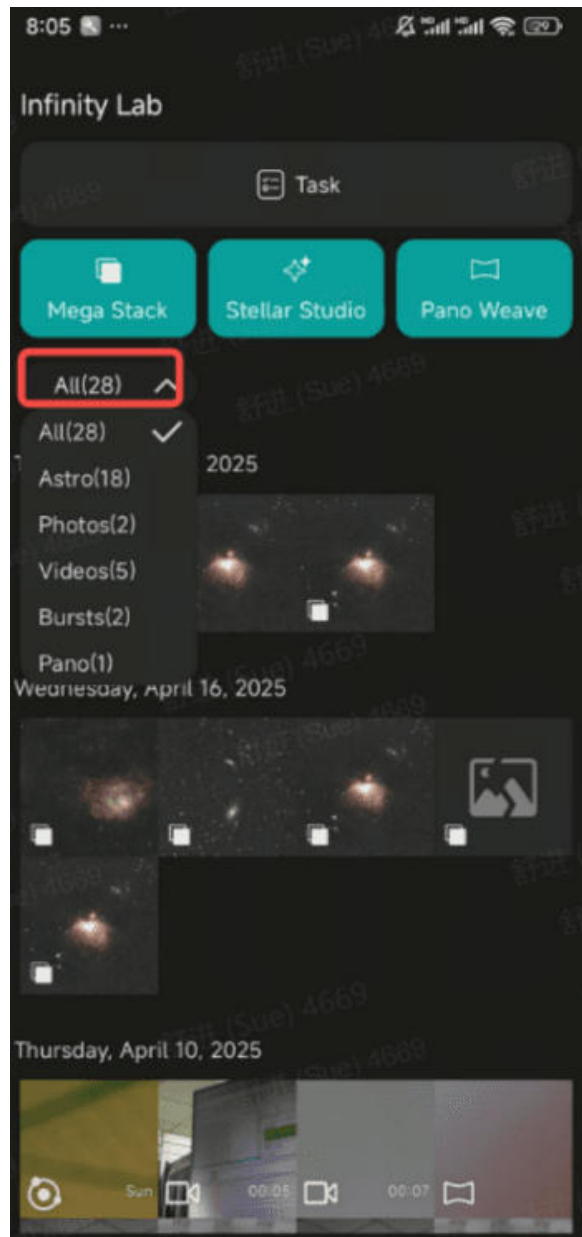
1.3.1 Infinity Lab

In the topmost part of the album, you can find the Infinity Lab. This feature includes **Mega Stack**, **Stellar Studio**, and **Pano Weave** — three powerful tools that let you process your captured images in amazing ways. It's like magic for your photos! For detailed instructions, refer to: **Section 3.6 Stellar Studio**, **Section 3.7 Mega Stack**, and **3.5.4 Pano Weave**.



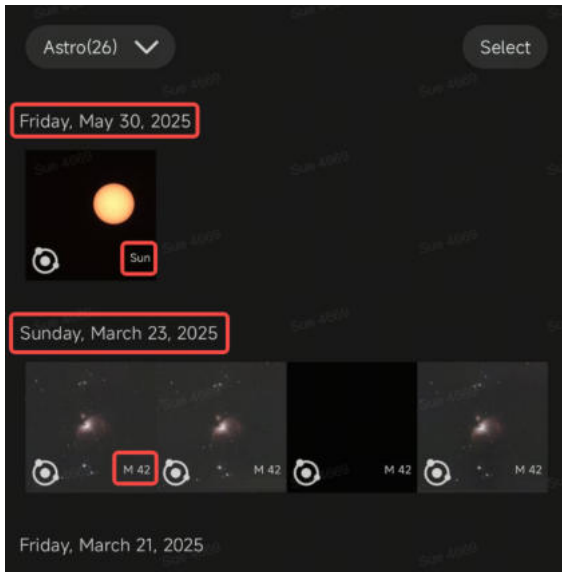
1.3.2 Categorization

This is where all album categories are listed. Click to access photo libraries in different modes, including: Photos, Videos, Bursts, Panoramas and Astro photos.

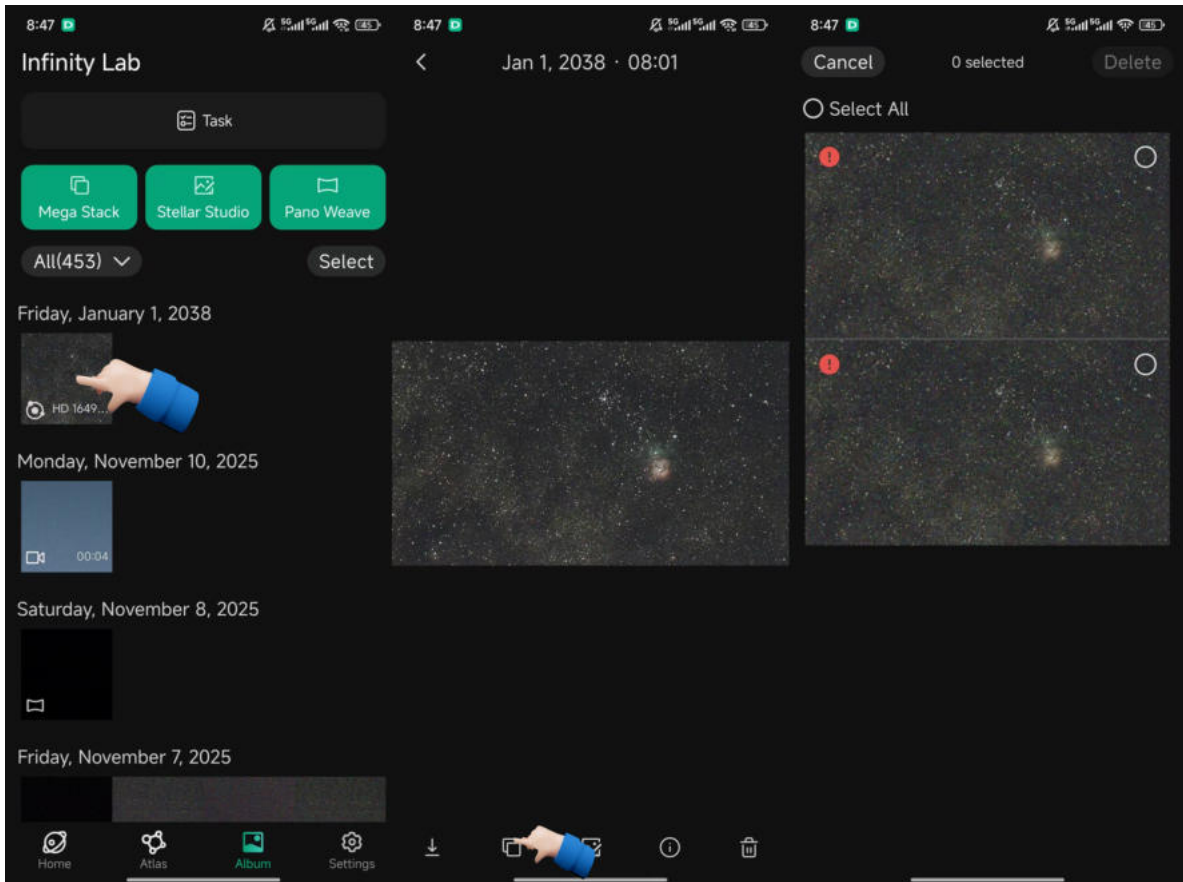


- Bursts & Panoramas: The Album will only display the first image and the number of shots taken (for burst), but these cannot be downloaded to your phone.
- **Astro** Photos: For astronomical targets, in addition to the date and time, the name of the target is also displayed.

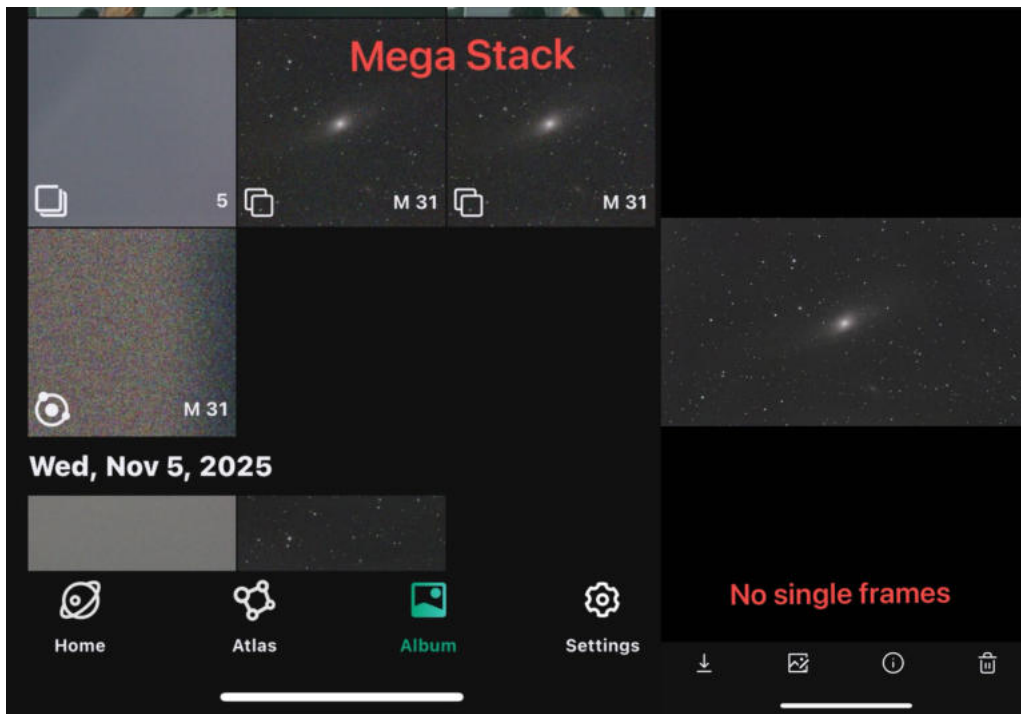
☒ Astro sessions generate many individual sub-frames saved inside the telescope, so storage usage can grow quickly (couple gigabytes/GB).



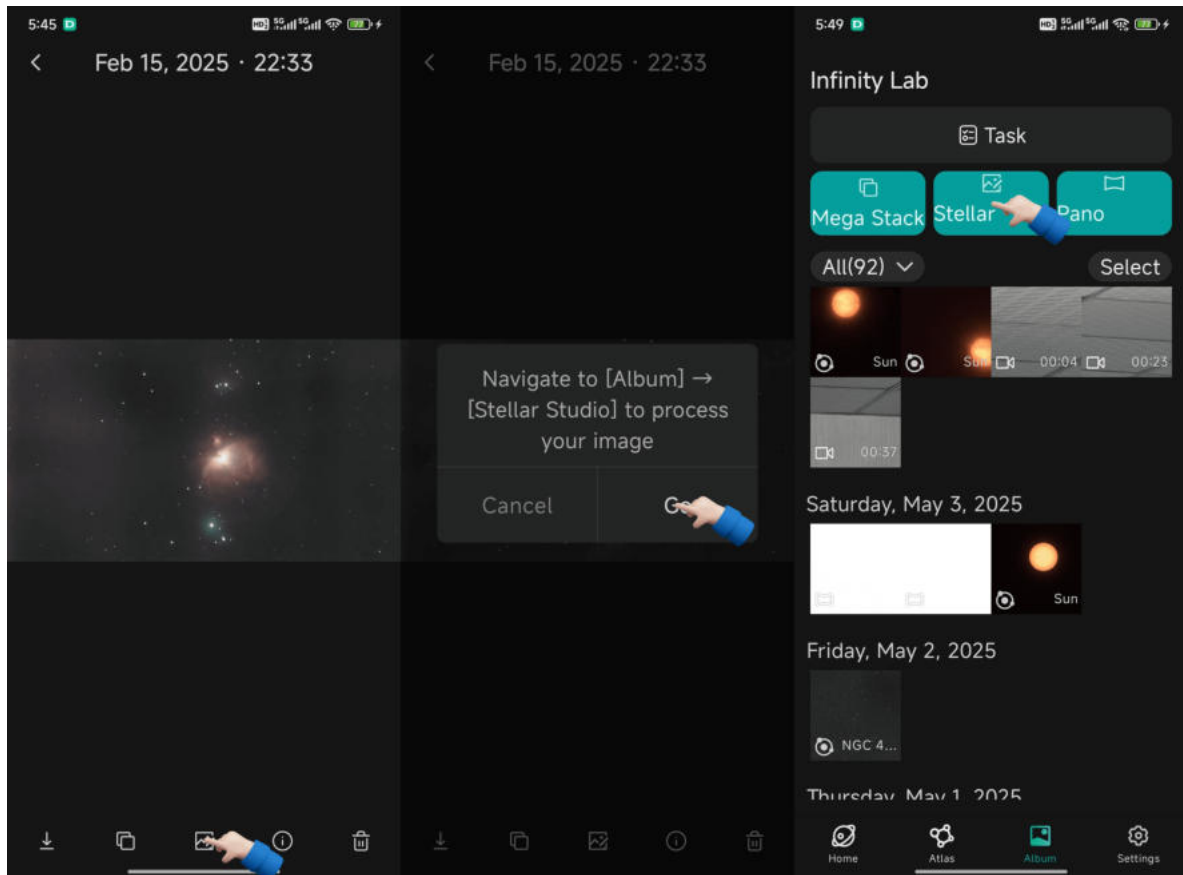
1. If you notice any issues in the stacked result, **you can manage individual frames — delete unwanted ones and re-stack using Mega Stack.**



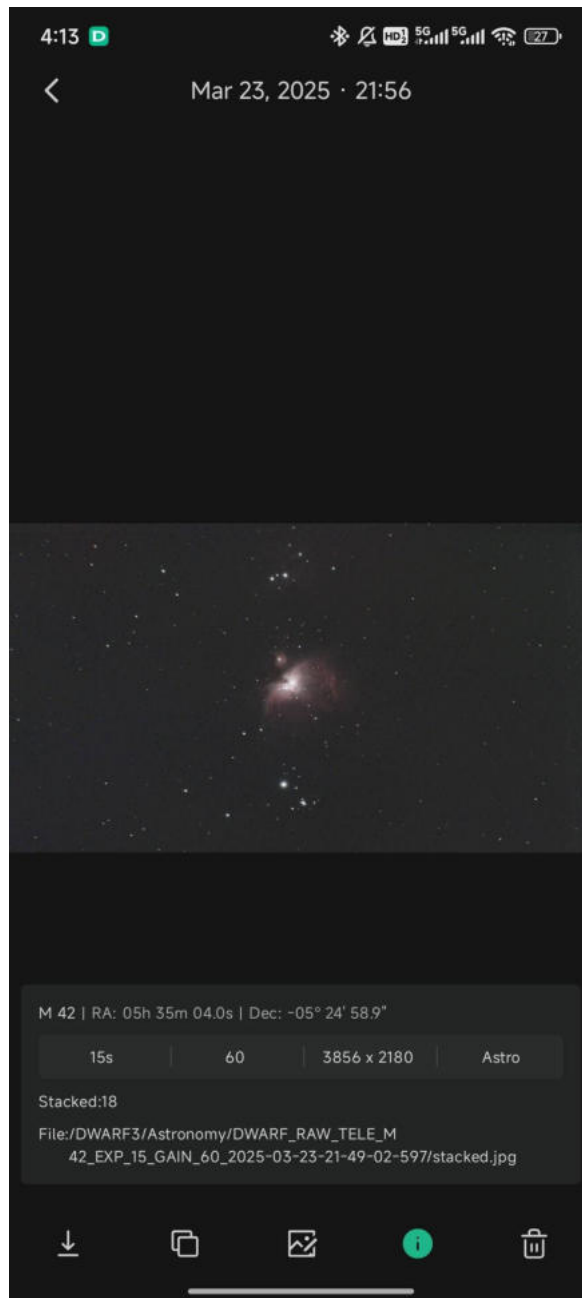
The stacked image generated by MegaStack does not retain individual frames, so single-frame management is not available.



2. Tap the Edit button to start post-processing your astronomy image.

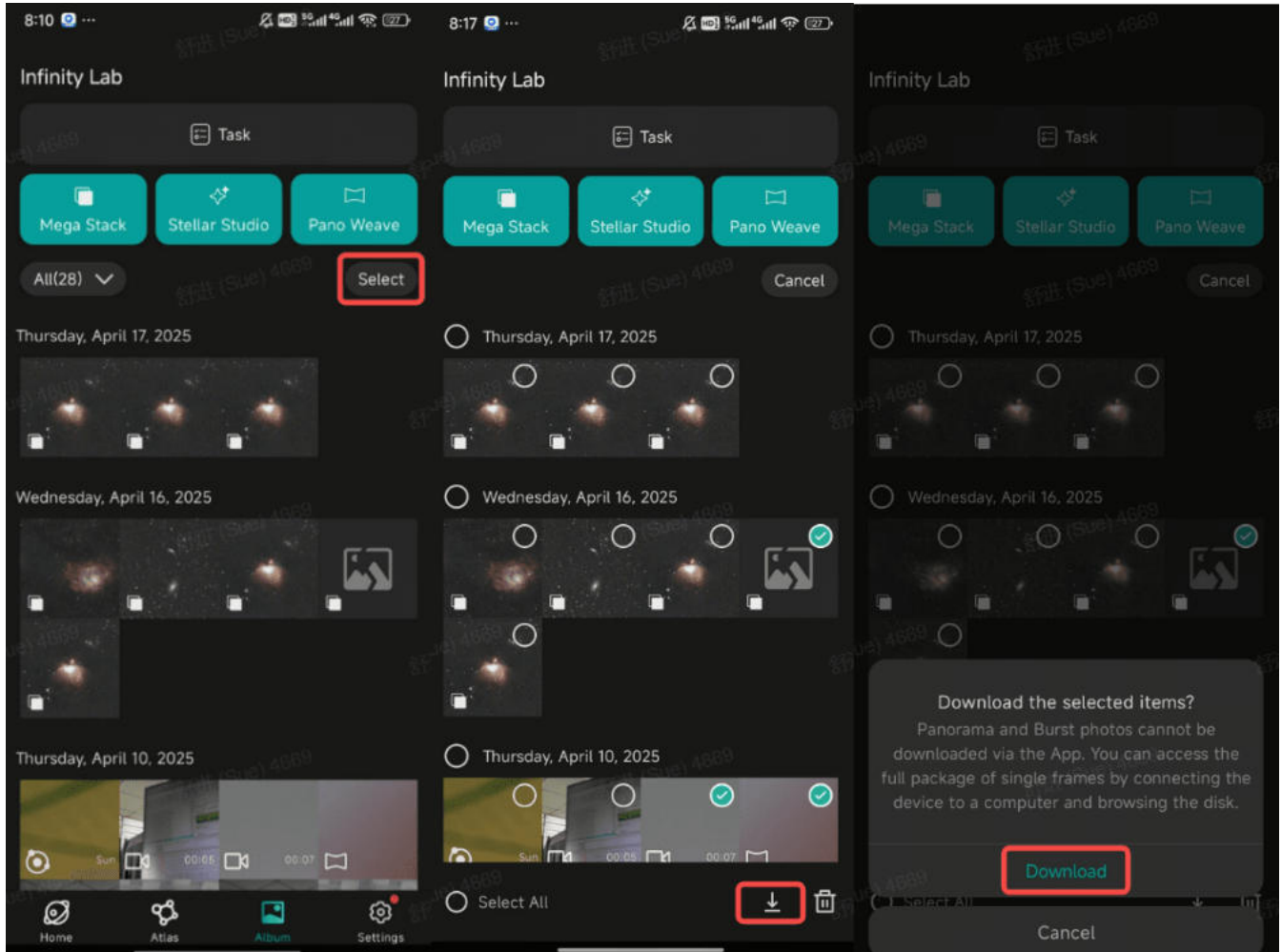


3. In the details page of an astronomy photo, you can now view target information, image parameters, file location.



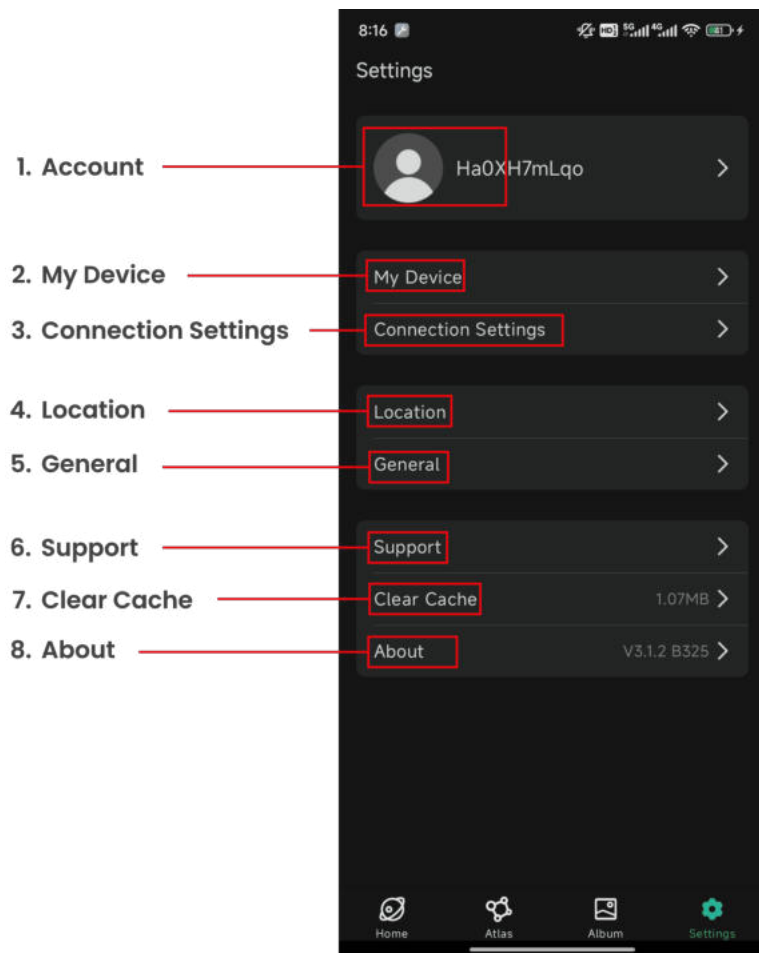
1.3.3 Select / Edit Album

Tap to select photos then you can save or delete photos in batches.



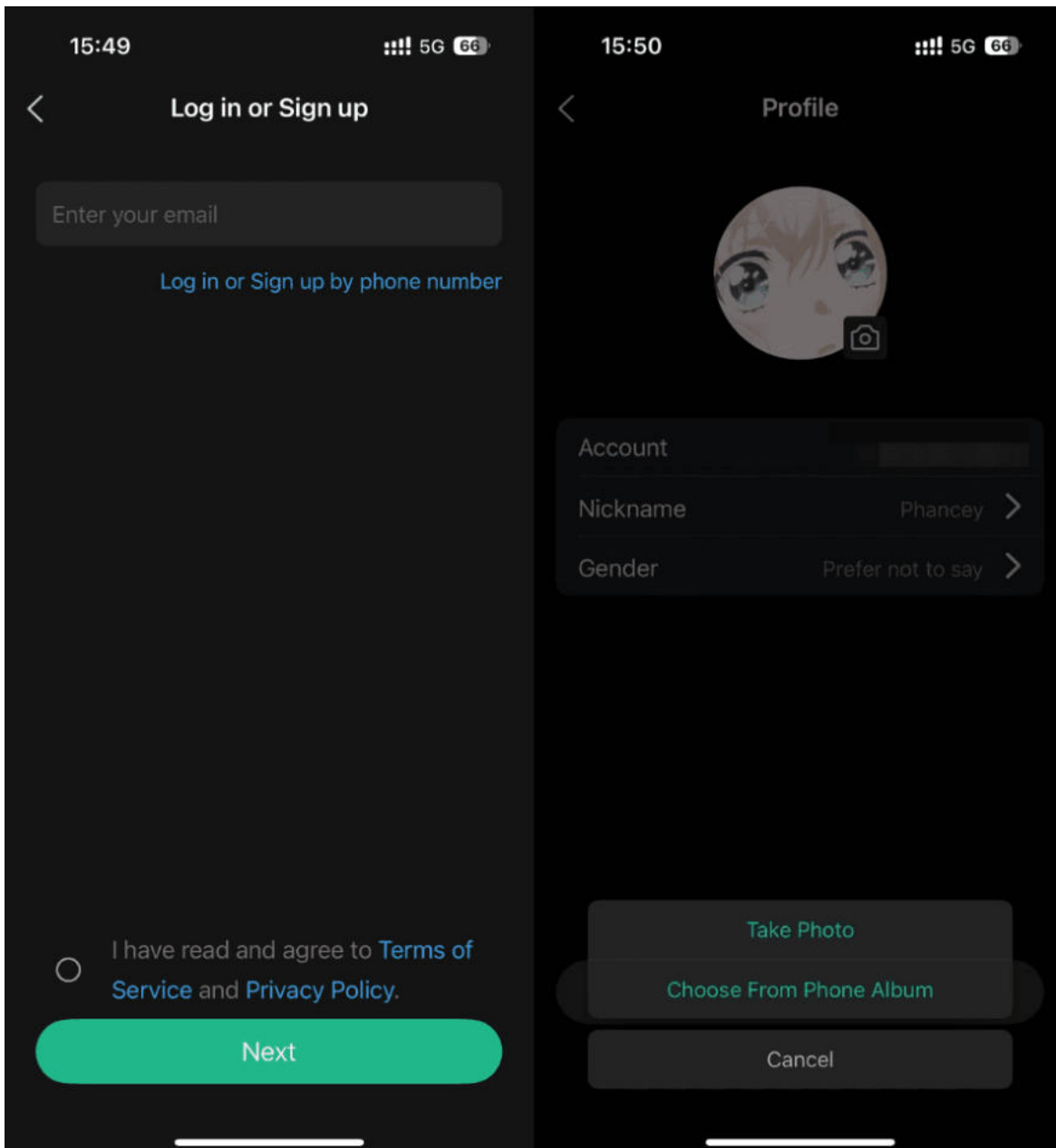
- In case of poor network conditions, loading photos might take a few seconds, and videos may also require some time to be refreshed.
- When you delete your photos in the **Album**, files in your Dwarf's **storage** are also **wiped**.
- Deleting a certain Astro/Panorama/Burst photo will result in deleting **the whole package** under it. As saying, all the single frames of the stacked Astro photo or all panorama puzzles.

1.4 Settings



1.4.1 Log In/Account

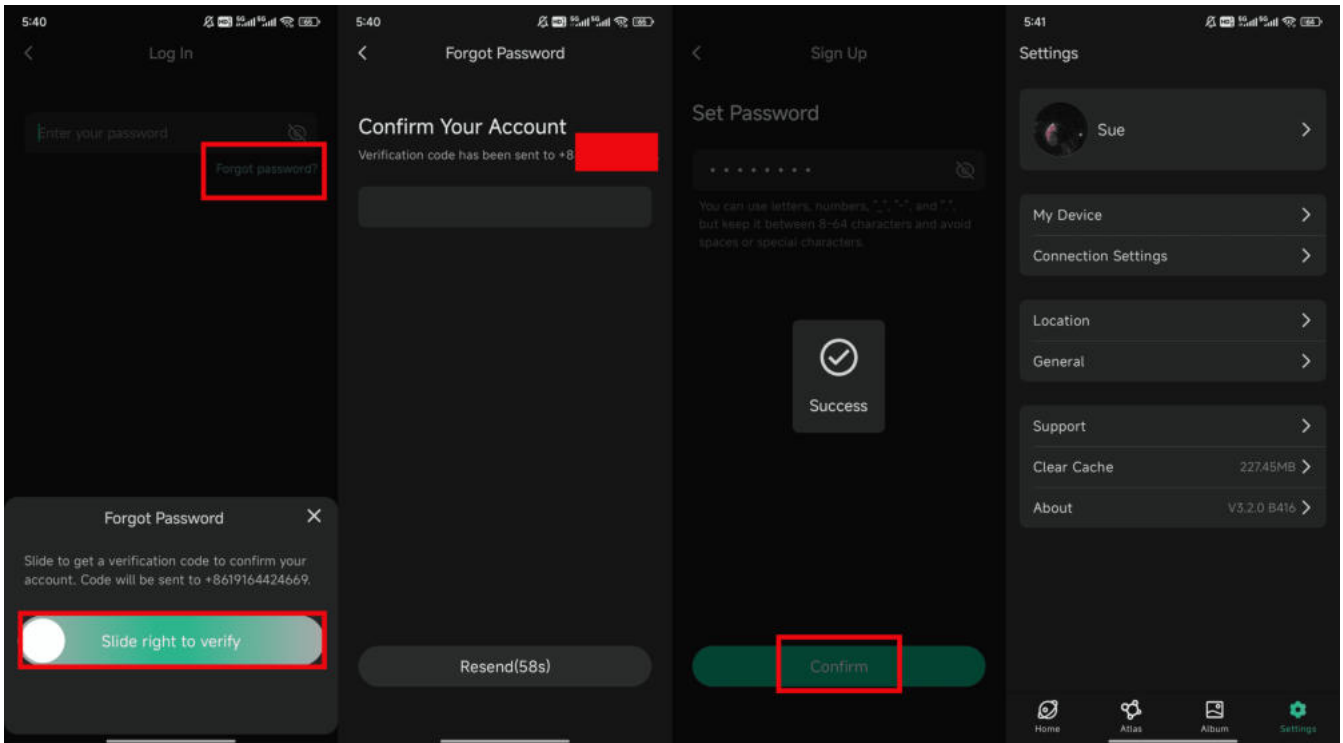
Tap "**Log In**" to create your account. Many upcoming interesting features will require your account. You can register and log in using your phone number or email. Feel free to update your profile picture, nickname, and other personal information.



1.4.1.1 Password Requirements / Reset Password

Passwords must be between **8–64** characters. They can include letters and numbers, but **no spaces or special characters**.

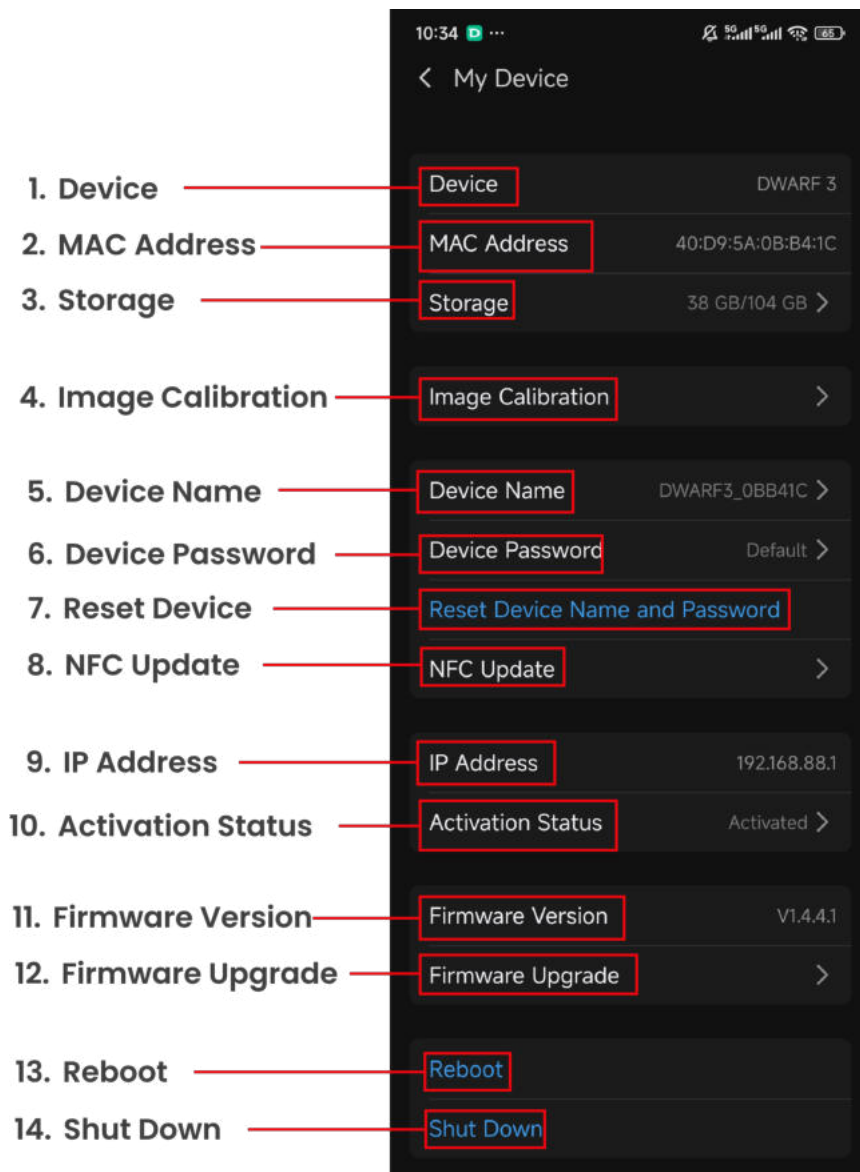
To reset your login password, at the Login screen, enter your email or phone number assigned to the account (⚠️If you have already logged on, **you need to log out first**), on the next screen, select “Reset Password” located under the password entry block. Follow the prompts to reset your password.



Please note that the account systems for the beta and official versions of the app are not connected. **You will need to register a new account when joining the test program and using the beta version.**

If you are having difficulty signing in or resetting your account password, please contact **DWARFLAB** for assistance.

1.4.2 My Device



1. **Device:** Displays your DWARF's model (Yes there will be more).
2. **Mac Address**
3. **Storage:** Displayed as used/total memory, following standard convention.

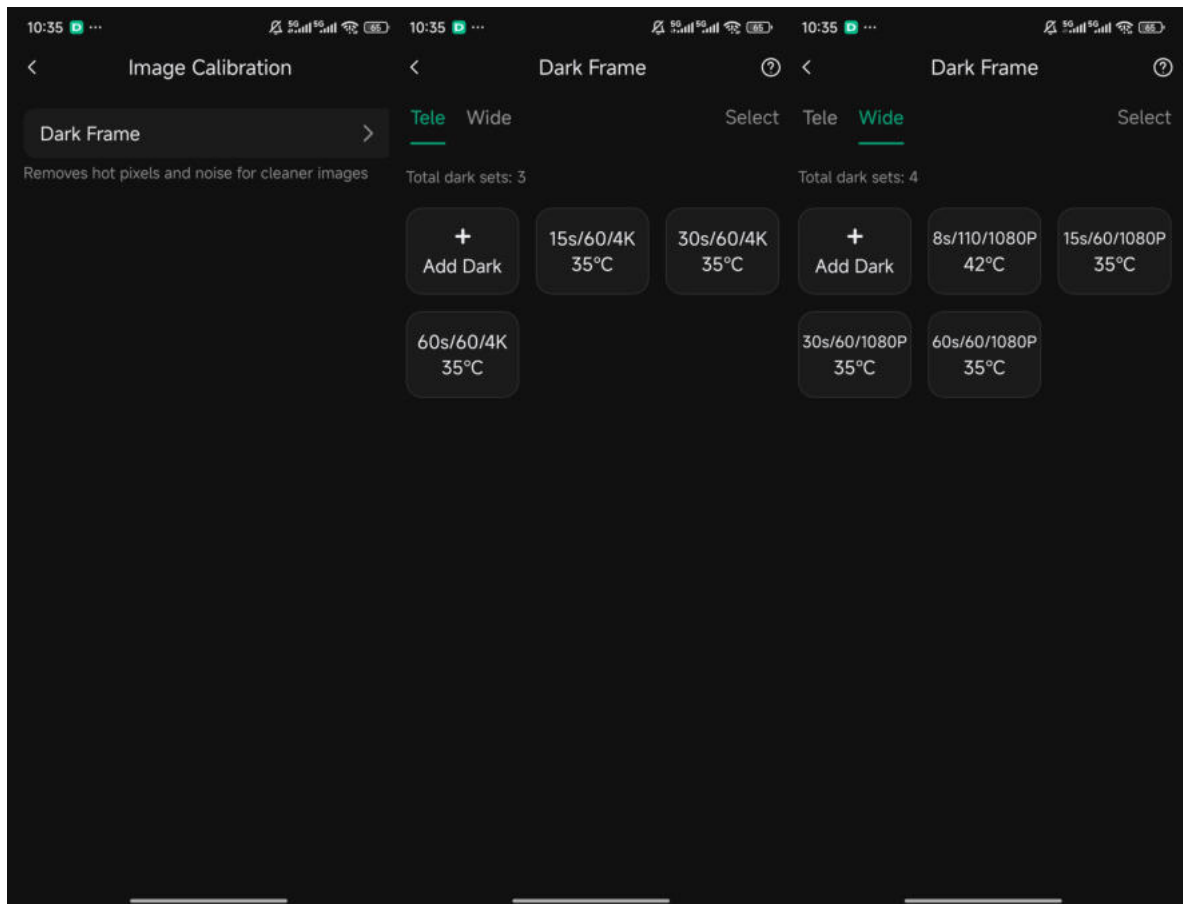
The system is equipped with 128GB eMMC storage.

Please note: the operating system and essential files for the DWARF 3 will utilize a portion of this storage space, resulting in slightly less available total storage for use.

4. Image Calibration

Dark frames used to reduce noise in astronomical images for both tele and wide imaging are listed here. You can add, delete, or manage dark frames from this interface.

For more details about **Dark Frames**, please refer to section [3.2.3 - Dark Frames & Quick Apply](#), in the tutorial.



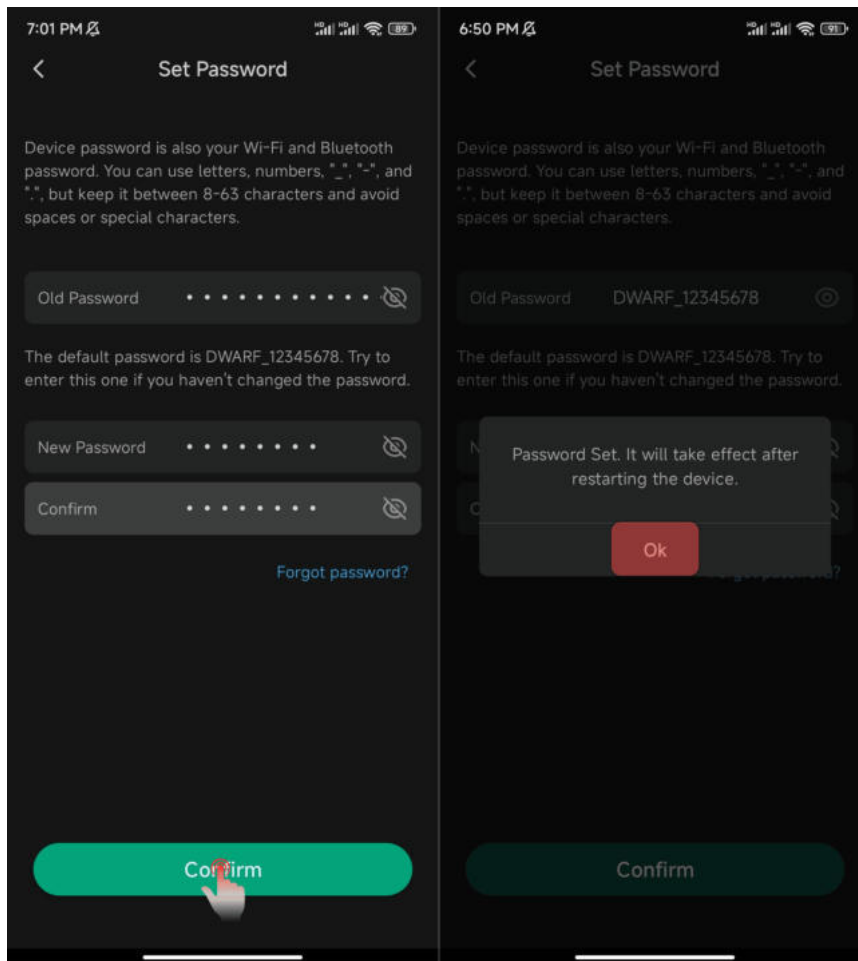
Currently, only **dark frame management** is available for management. Other types of calibration frames, such as **flat frames** and **bias frames**, are under development and will be added in future updates.

☒ **BIAS** and **FLAT** frames

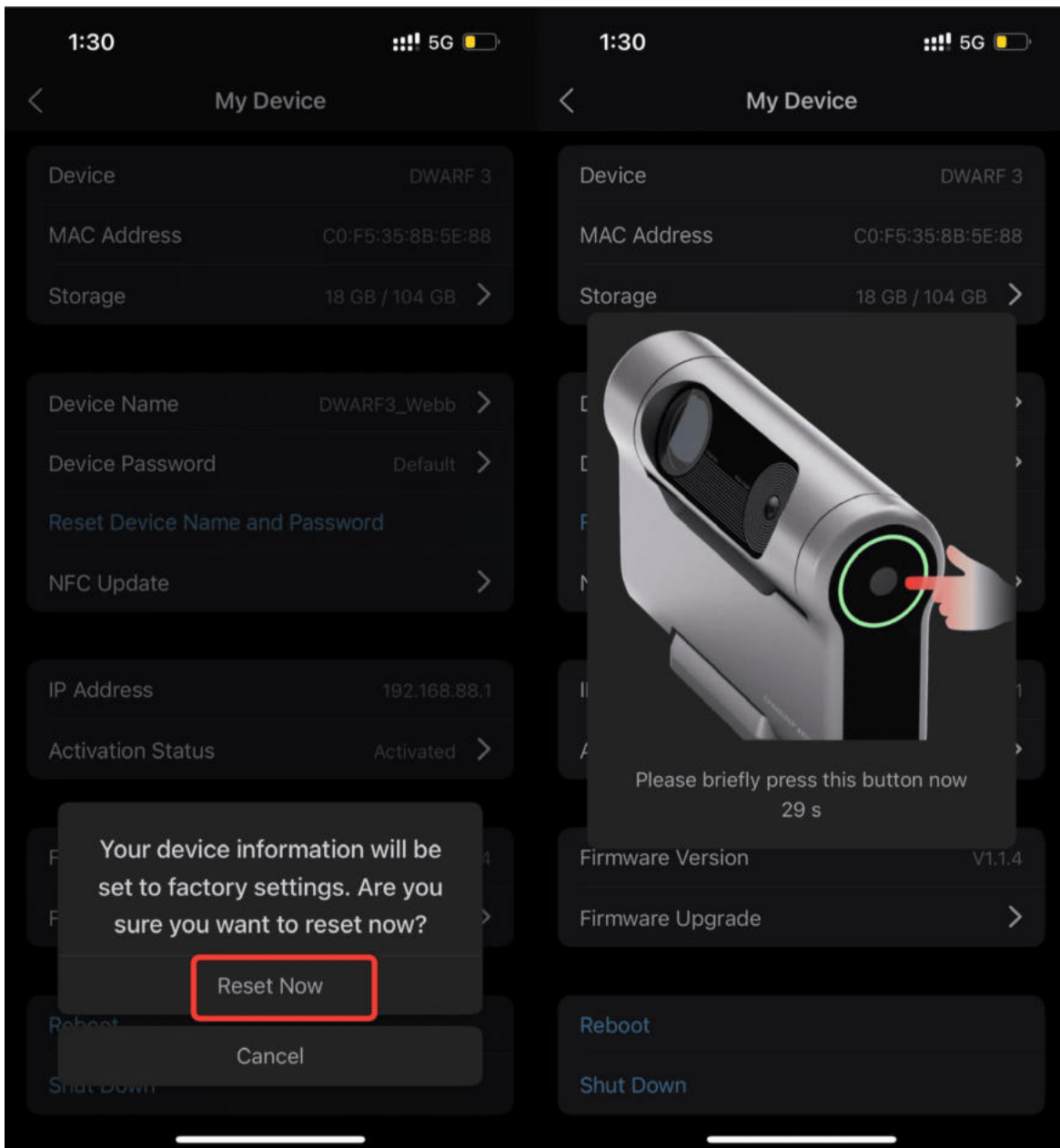
- Bias frames are used to correct sensor readout noise. Flat frames are used to correct uneven illumination and dust shadows (dust motes) in the optical path.
- DWARF 3 comes pre-loaded with BIAS and Flat frames calibrated for each individual device. Since the DWARF 3 uses a fixed optical system, factory provided Flat data remains valid over time. There is no need for users to capture new BIAS frames manually in common cases.
- For those who have specific post-processing work flows that may require the use of those files, you can always use the calibration files (CALI_FRAME) stored in the DWARF 3. Please reference the ["How to View and Edit Files in DWARF 3"](#) document on where to find them.

5. **Device Name:** Here get your DWARF a great new name. (Default name is the last six digits of the Mac number showing on the bottom base). I call mine Webb. Changes take effect after a restart.

6. **Device Password:** Change the password here; changes take effect after a restart. The default password is DWARF_12345678.



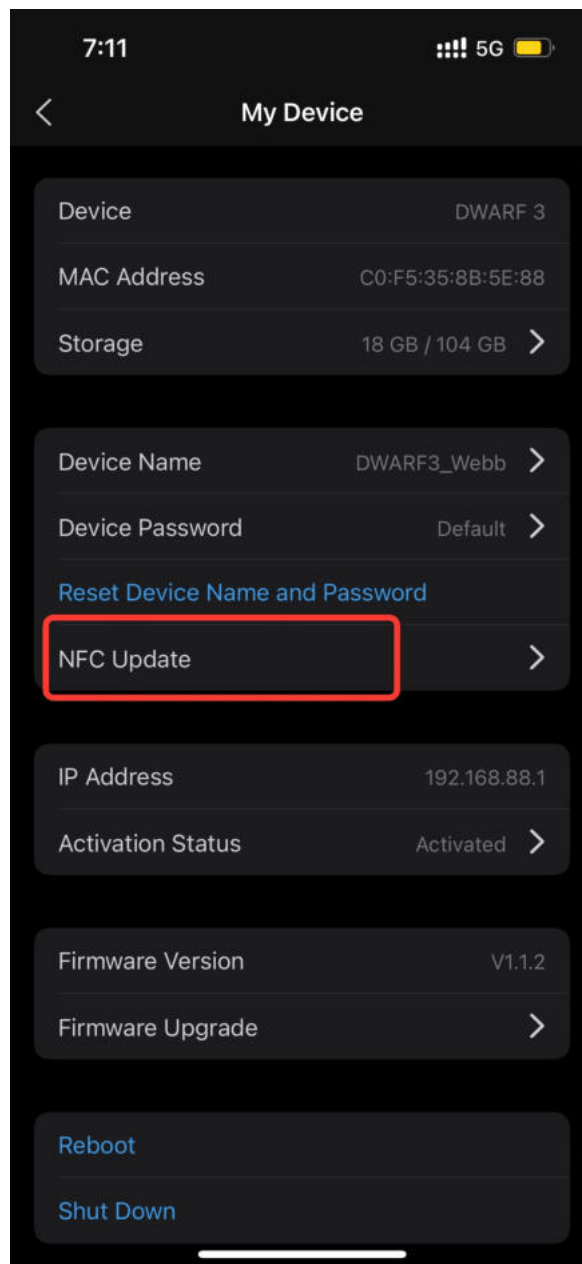
7. **Reset Device Name and Password:** In case you forget your password, reset it at any time. After confirming the reset, press the power button briefly within 30 seconds—just once! The reset takes effect after a restart.



☒ **Note:** Everytime you change the name of your DWARF, an update with the NFC information is required, you need to tell the NFC connector what name it should submit when pairing with your phone.

8. NFC Update

Here is where you can update your NFC info.



9. Activation Status:



☒ **Activation Time:** Date of activation

Warranty Status: If you are in the warranty period, it'll take a few seconds for the status to show up after entering this page.

Official Warranty Period: The expiration date of your warranty time.

10. **IP Address:** displays the devices current IP address. It will update when connected to a wireless network when STA mode is configured. Check this when you require an IP for FTP access, or other functions that specifically need it.

11. **Firmware Version:** The firmware version of DWARF 3. What is Firmware you might ask, Firmware is the built-in system of the DWARF Telescope, requiring regular updates like your app, adding new features.

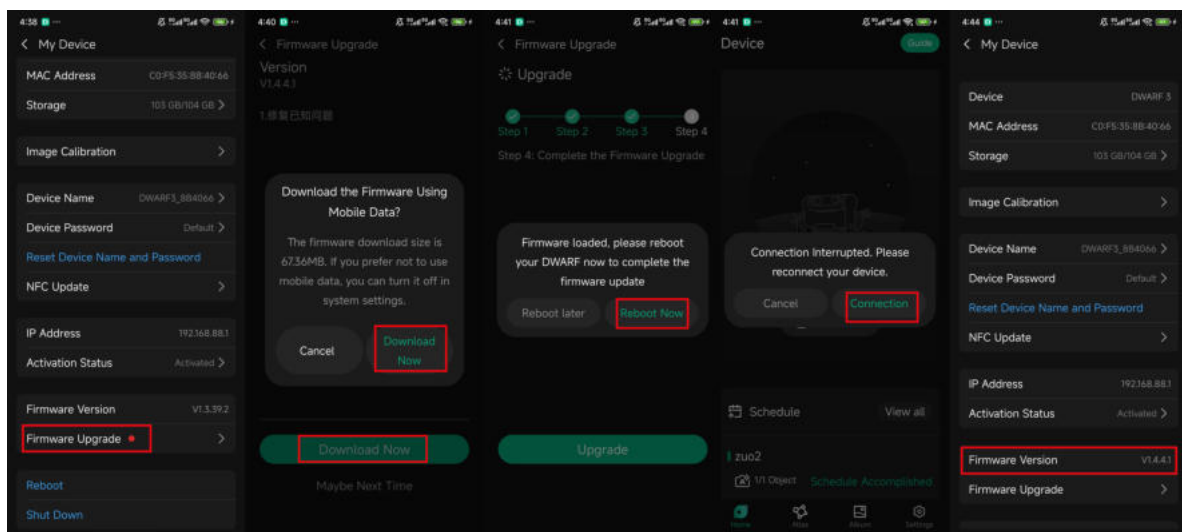
12. Firmware Upgrade: Access the firmware upgrade process here. Follow the prompts to complete the upgrade.

When your DWARF device is connected to the internet, a red dot will indicate if an update is needed. Follow the guided prompts to completed firmware updates when required.

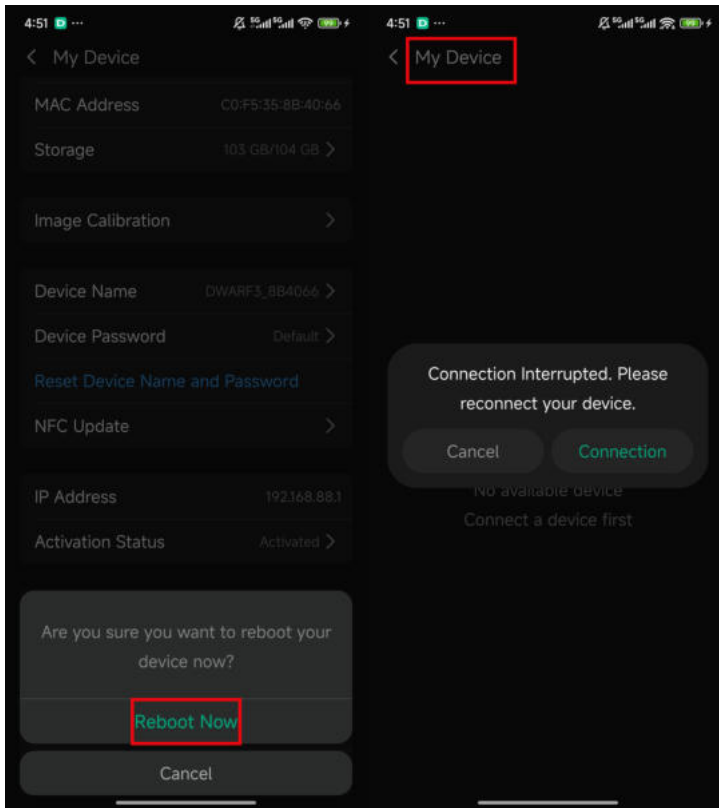
Remember to REBOOT your device upon completion. There may be a mandatory update notification displayed when the DWARFLAB application has a specific feature of functional update. Mandatory updates ensure the user is reminded to download the required firmware or they may find specific features will not work as intended until the update is applied.

☒ **Firmware Update Note:**

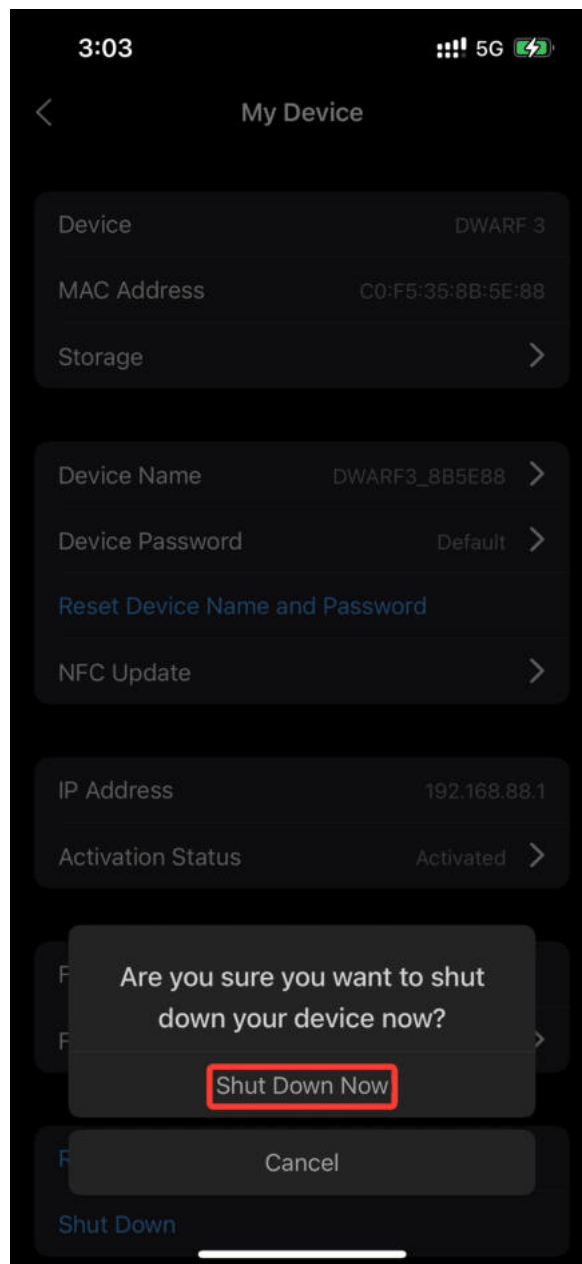
- You can not "re-install" a firmware update
- You can not roll back an update to a previous firmware
- If you are having problems upgrading the firmware, or problems after the firmware update is applied, kindly contact our team via support@dwarflab.com



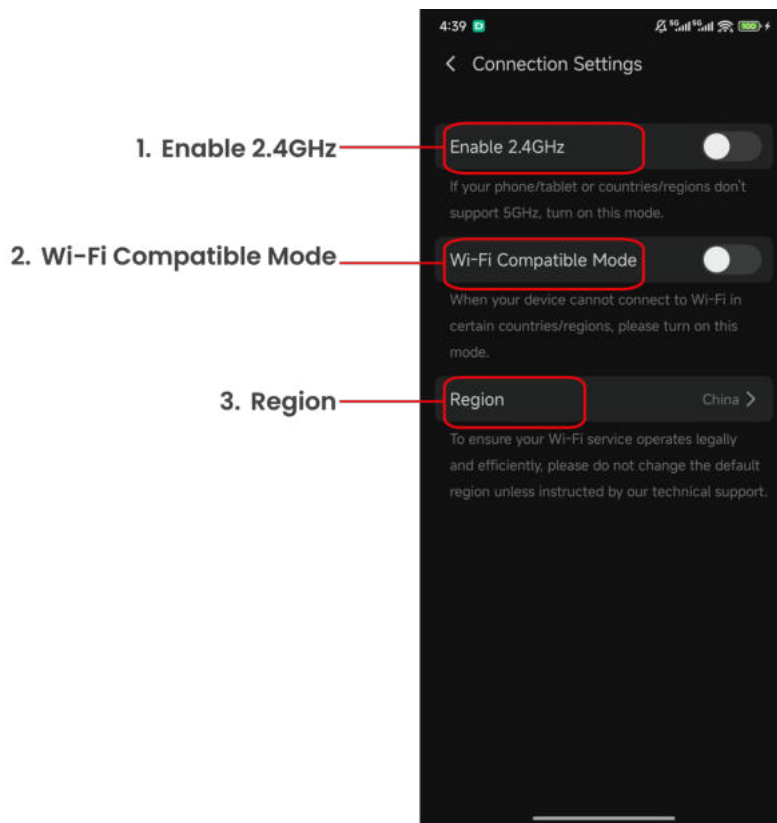
13. Reboot: Restart DWARF 3.



14. **Shut Down:** Allows you to remotely shut down DWARF 3 when it is not at hand. The shutdown mode will **rotate the cylinder (lens) down to a closed position**. It will not rotate the base back to a default position. You can manually move the base on your own.



1.4.3 Connection Settings



- 1. Enable 2.4 GHz:** Normally, DWARF 3 defaults to send out a 5 GHz band signal. This setting allows DWARF 3 to emit a 2.4 GHz band signal, supporting connections to tablets or mobile devices that may not have a 5 GHz band available.

2.4GHz transmission will cause certain lag due to lower transmission speeds and possible interference from other electronic or household devices in your home.

- 2. Wi-Fi Compatible Mode:** Tailored for users in special regions where Bluetooth can't activate DWARF 3's hotspot, this mode can be a solution. For most users with free access to the Internet, skip this part.
- 3. Region:** To comply with network communication standards, please select your current locating country/region.

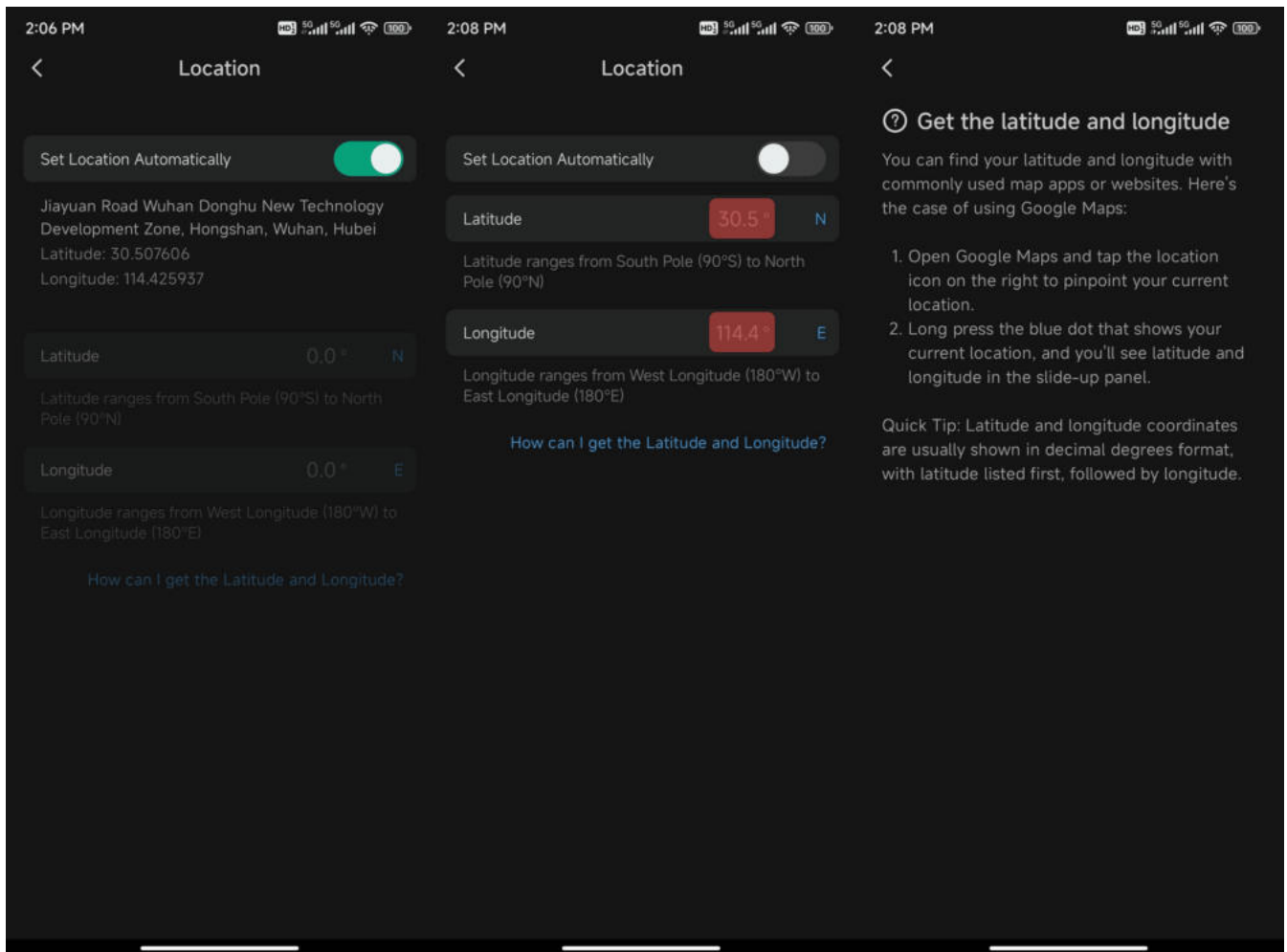
1.4.4 Location

1. Set Location Automatically

Automatically retrieves your geographical location. Ensure your phone's GPS is on and DWARF 3 has permission to access your location.

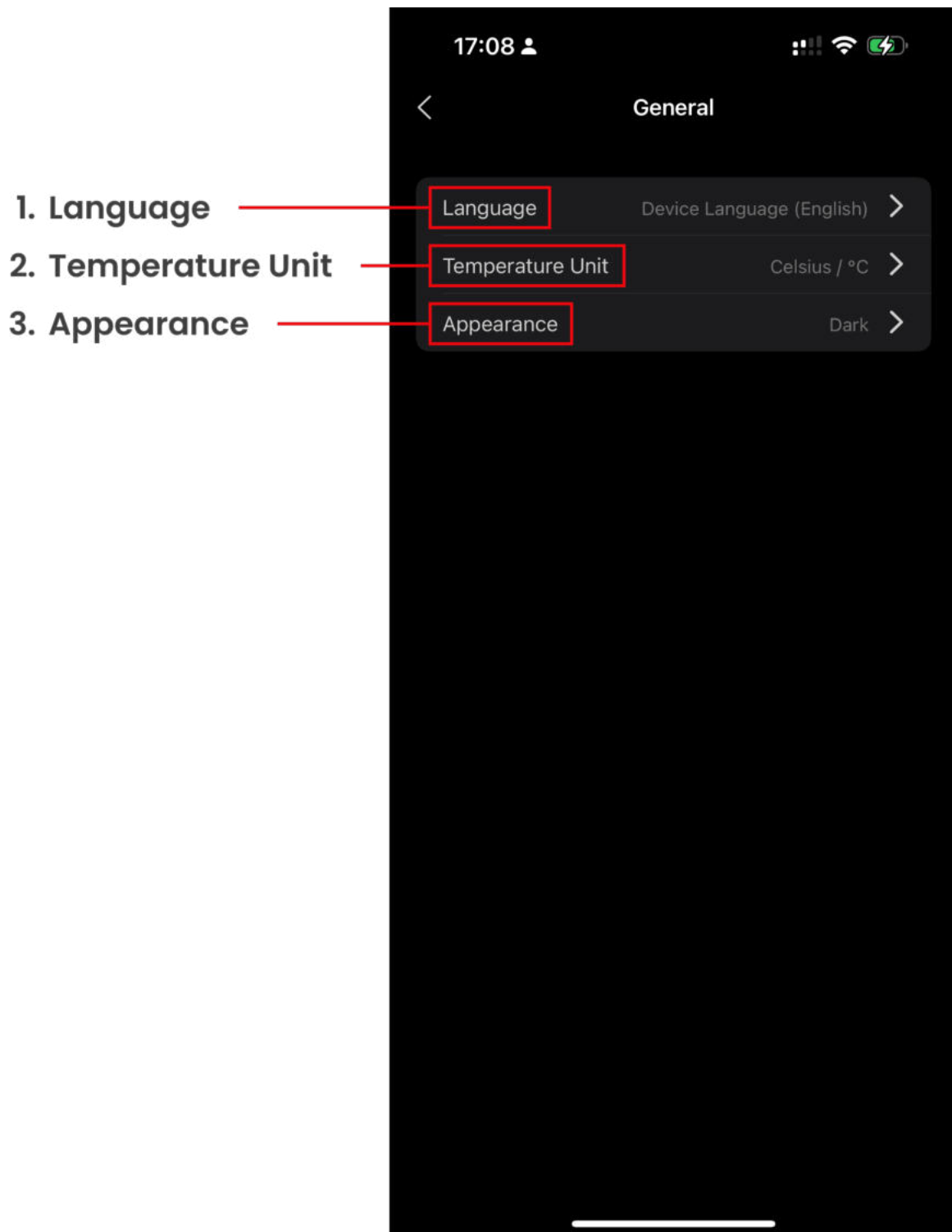
2. Set Location Manually

In areas without GPS signal, no access to a mobile network, or using a tablet with no GPS reception, turn off automatic location and enter coordinates manually.

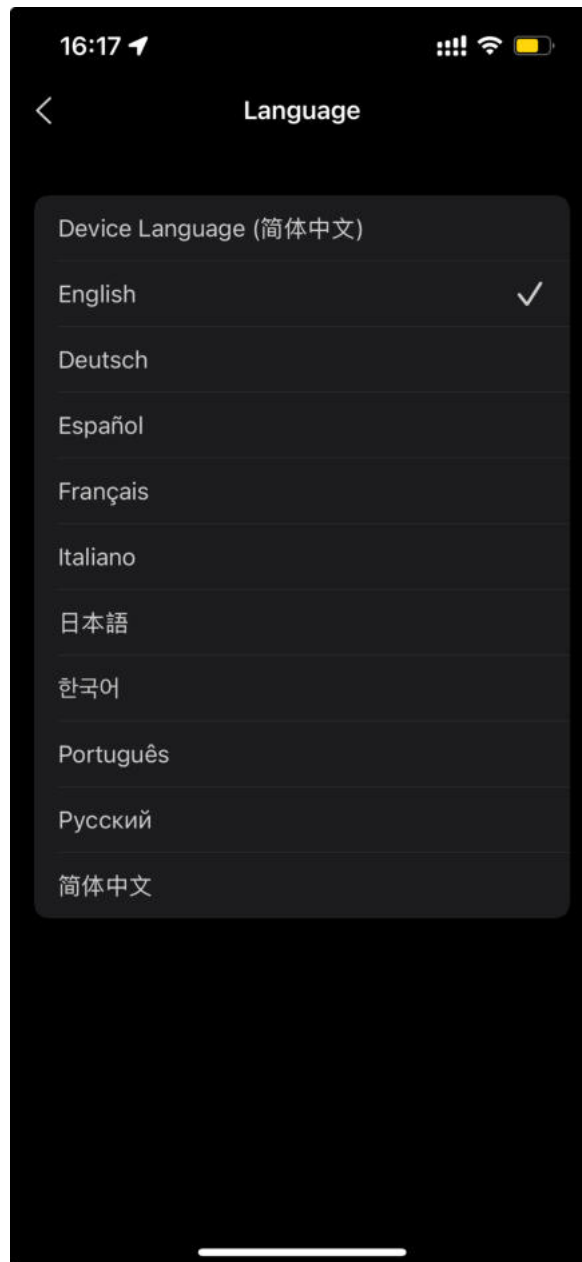


☒ **Location Note:** Correct coordinates are essential for accurate calibration and object locating with the DWARF 3. If you're traveling to remote locations without mobile service—or using a tablet that can't get a GPS fix—plan ahead. Locate your observing site on a map in advance and record the latitude and longitude. Having this information ready will save time and prevent headaches during setup and calibration.

1.4.5 General

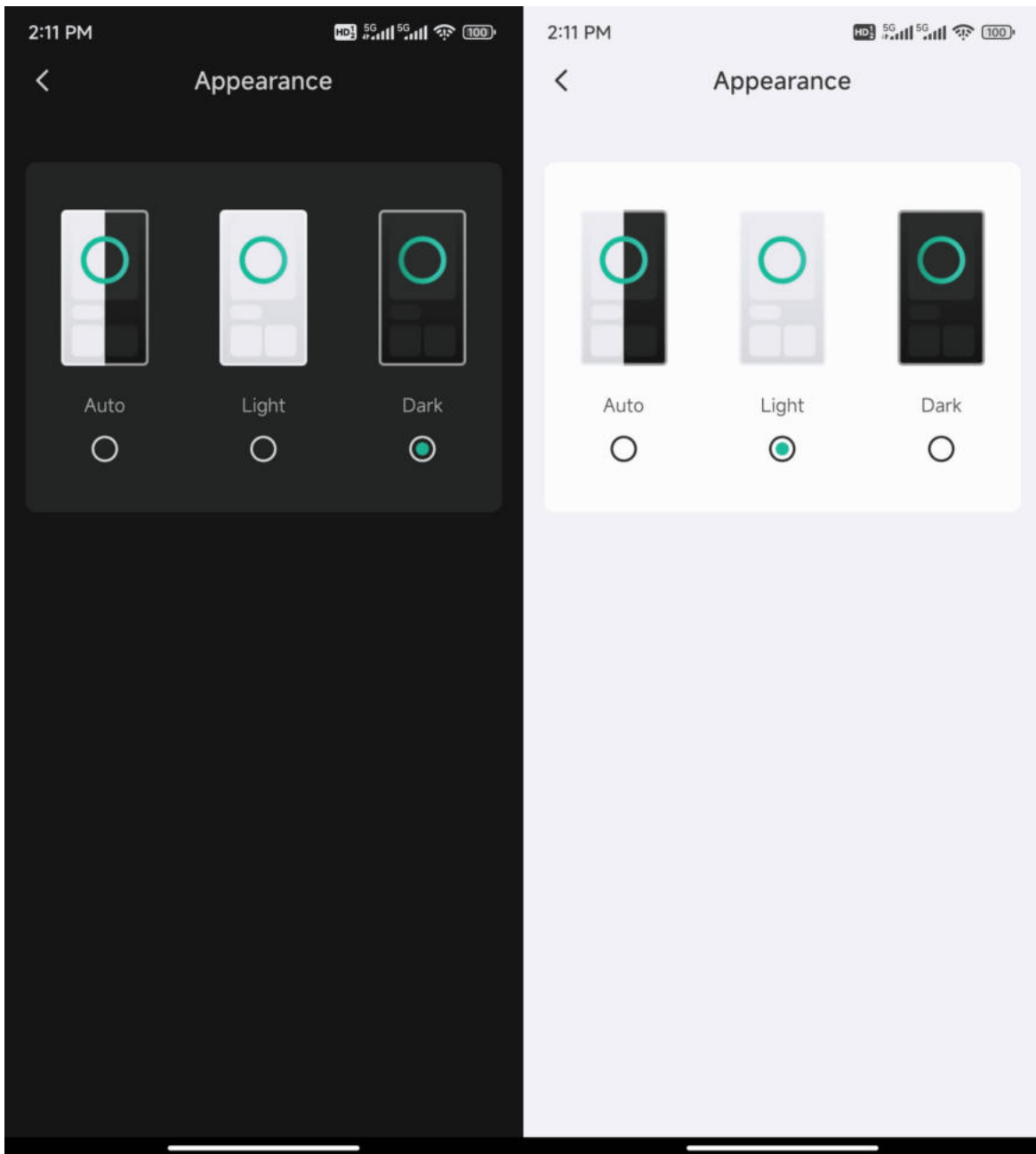


1. **Language:** Currently supports 10 languages, as shown in the image.



2. **Temperature Unit:** Switch between Celsius and Fahrenheit.

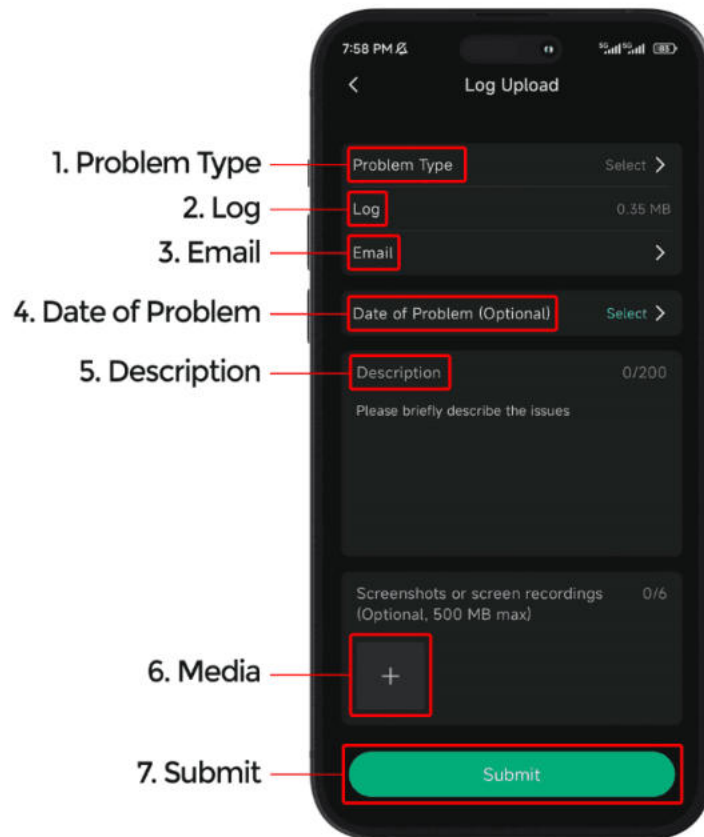
3. **Appearance:** Choose between Dark/Light mode or follow system settings.



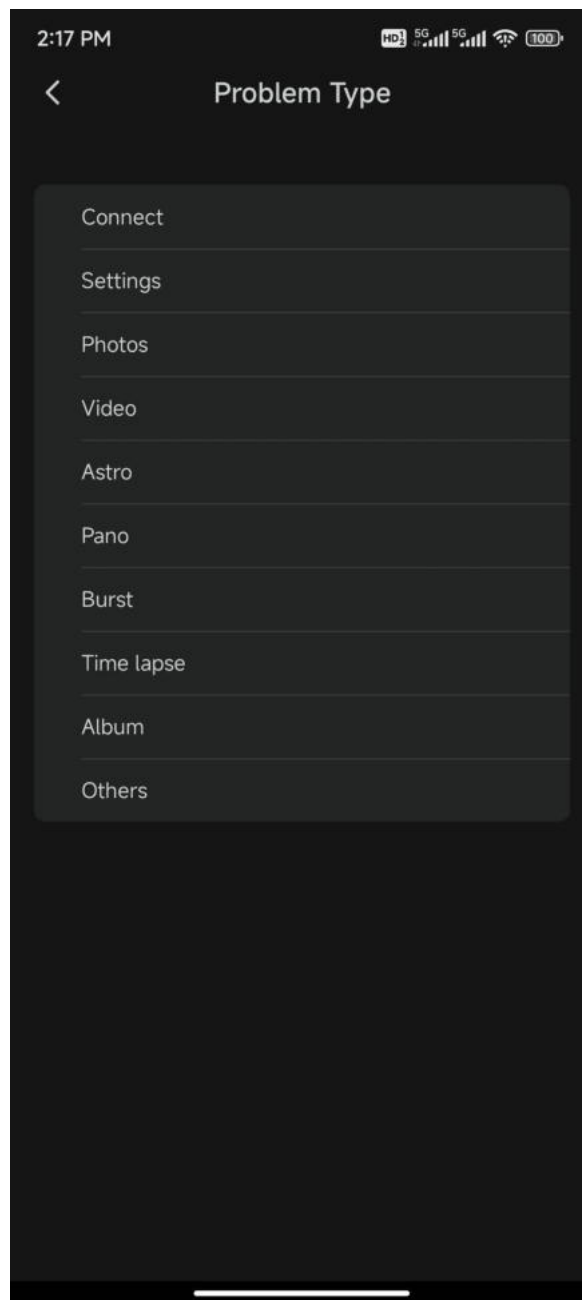
1.4.6 Support

In this part, you can upload the log for DWARF 3 if there is any problem.

Log Upload: DWARFLAB app automatically records DWARF 3 logs while you are using it. Upload the log and contact our support team when needed. Or contact our official after-sales support email at Support@DWARFLAB.com for expert advice.



1. **Problem Type:** Select the type of issue encountered.



2. **Log:** Logs are overwritten after reaching 10MB. Report errors promptly if you can.
3. **Email Address:** Provide your email for contact.
4. **Date of Problem:** Select the date when the issue occurred so that we locate the problem quicker.

2:18 PM

Log Upload

Problem Type Select >

Log 0.49 MB

Email >

Date of Problem (Optional) Select >

Description (Optional) 0/200

Please briefly describe the issues

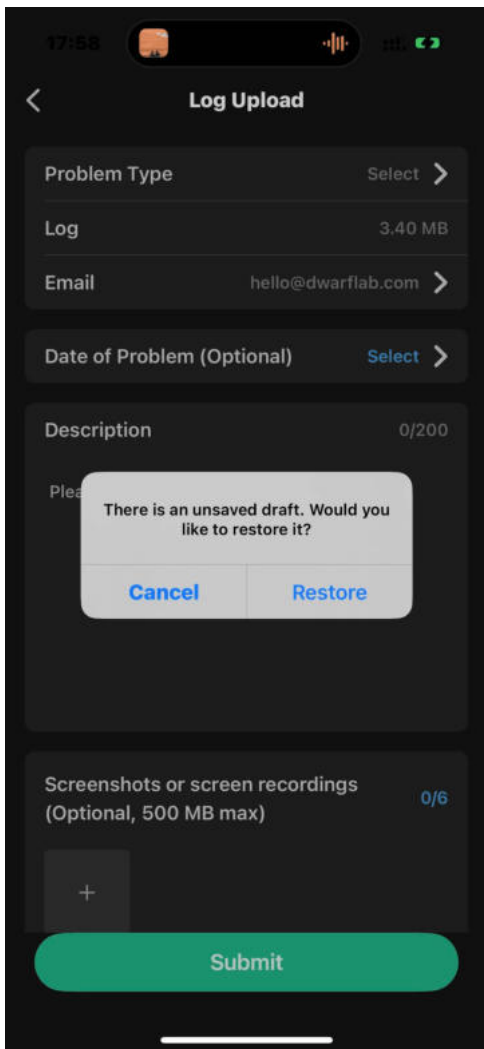
Cancel OK

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S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

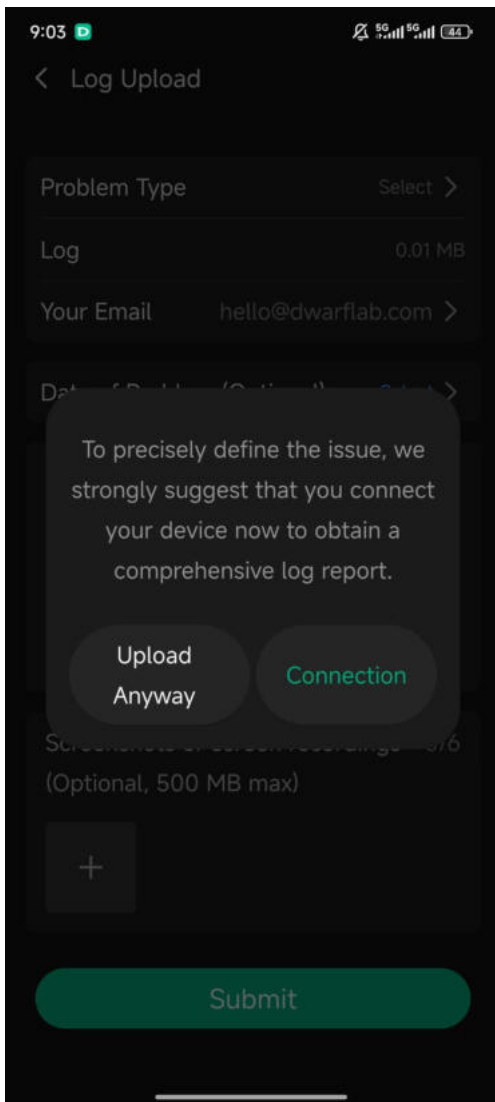
5. **Description:** Provide as detailed a description of the problem to help us better understand and solve it!

6. **Media:** Uploading screenshots or screen recordings is a very helpful and necessary step, as it greatly increases the chance of reproducing the issue you're experiencing for us.



You can **leave this page** at any time to take a screenshot/recording, then return. The system will record your input and provide a recovery option.

7. **Submit:** Submit and we will contact you within the next 48 hours.



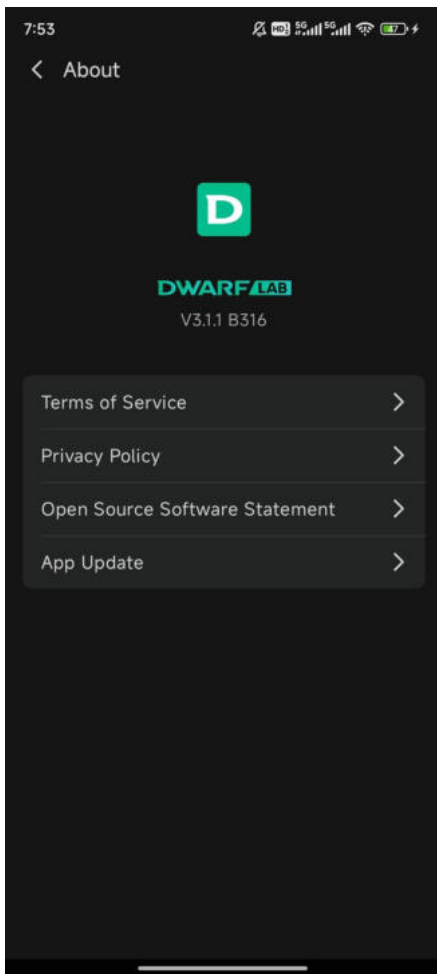
☒ If you encounter connection issues, you can also upload logs.

- After clicking "**Upload Anyway**", fill in the required information as usual. (When connected to the DWARF 3, logs from both the telescope and the mobile app will be uploaded. If not connected, only logs from the app will be uploaded.)
- Submitting logs does not require disconnecting DWARF 3 from the phone; but a mobile network or internet connection is needed.

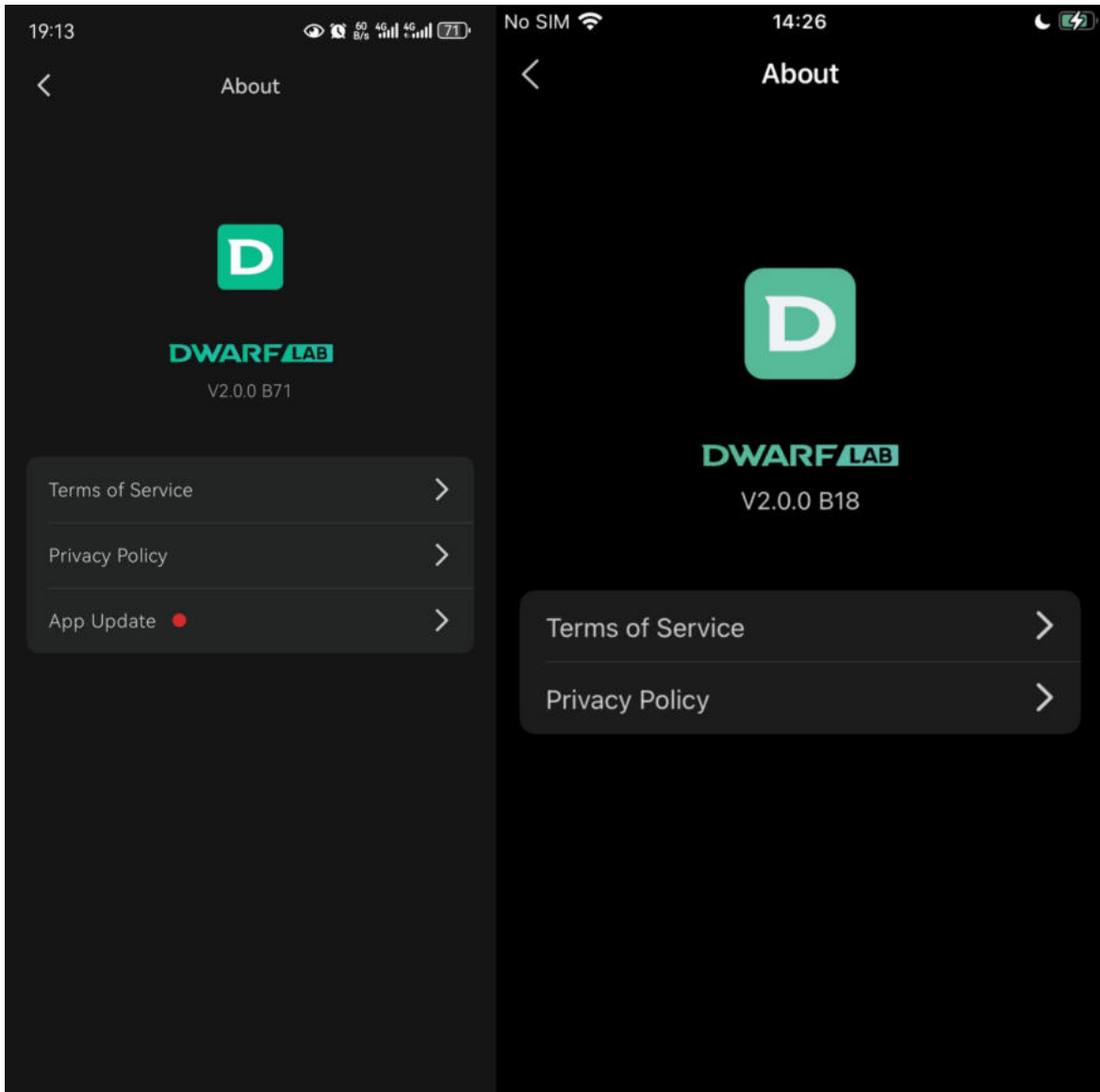
1.4.7 Clear Cache

Clear Cache: Allows you to clear the album thumbnail cache, Pano Weave upload cache (using mobile data) and half-downloaded firmware (useful for rescuing you from stuck mid-upgrade).

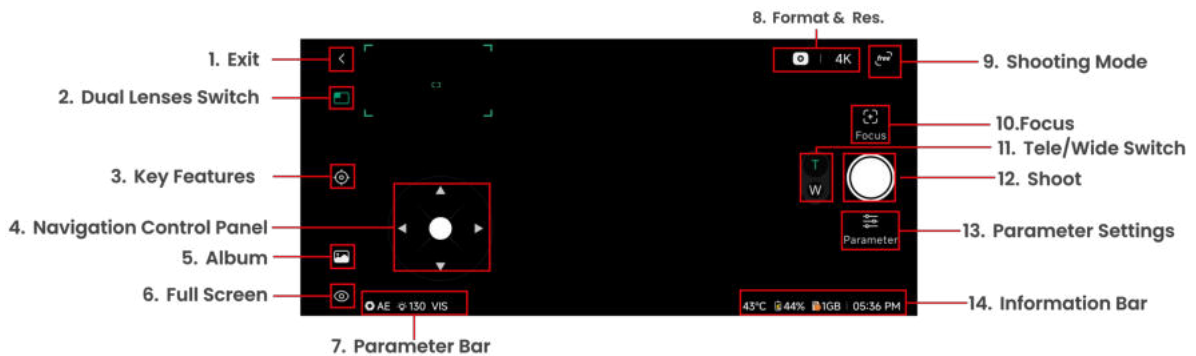
1.4.8 About



1. **Terms of Service:** View the service agreement.
2. **Privacy Policy:** View the privacy policy.
3. **Open Source Software Statement**
4. **App Update:** View the app version.



2. Shooting Interface Introduction



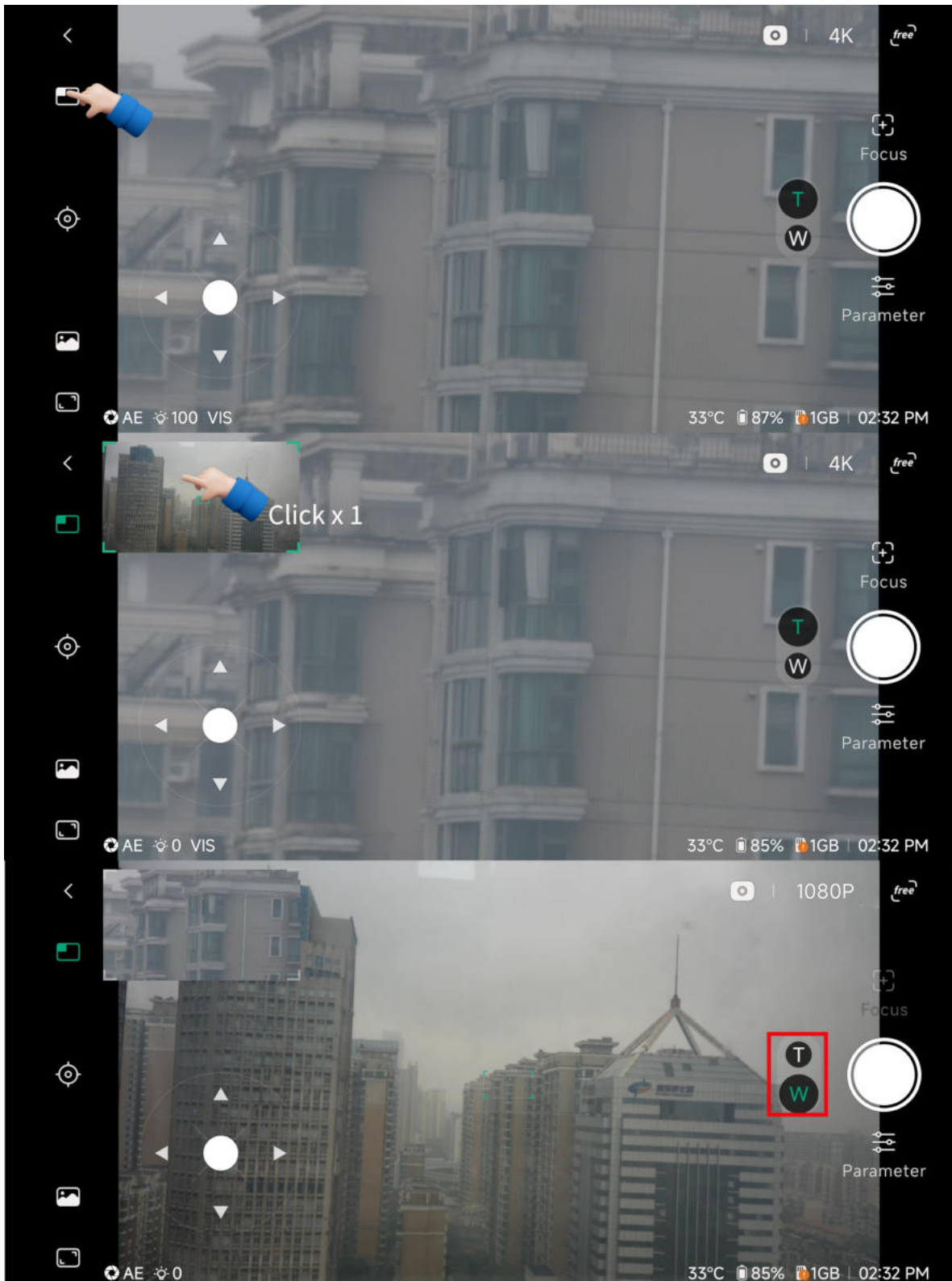
2.1 Exit

Click to exit the shooting interface and return to the homepage.

2.2 Dual Lenses Switch

The dual-lens system helps in quickly locating targets. Please read the following tutorial with devotion.

Open/Close Dual View: Click to open/close the dual views.



Switch View: Click the small rectangle or tap the **T/W** button on the right to switch between views.

View Indication: The telephoto view shows the content within the green frame in the wide-angle view.

☒ Double-clicking on the telephoto view enables auto-focus. Wide-angle is a fixed focal length. The Auto-Focus function does not apply, nor can you manually focus on the optic.



Dual Lenses Locating: Switch to the wide-angle view, then double-tap on the screen to move the green frame indicator (which represents the telephoto view) and easily put your target into the tele lens — for example, birds in the backyard or people walking on the street — and then quickly switch to the telephoto view for close-up observation.



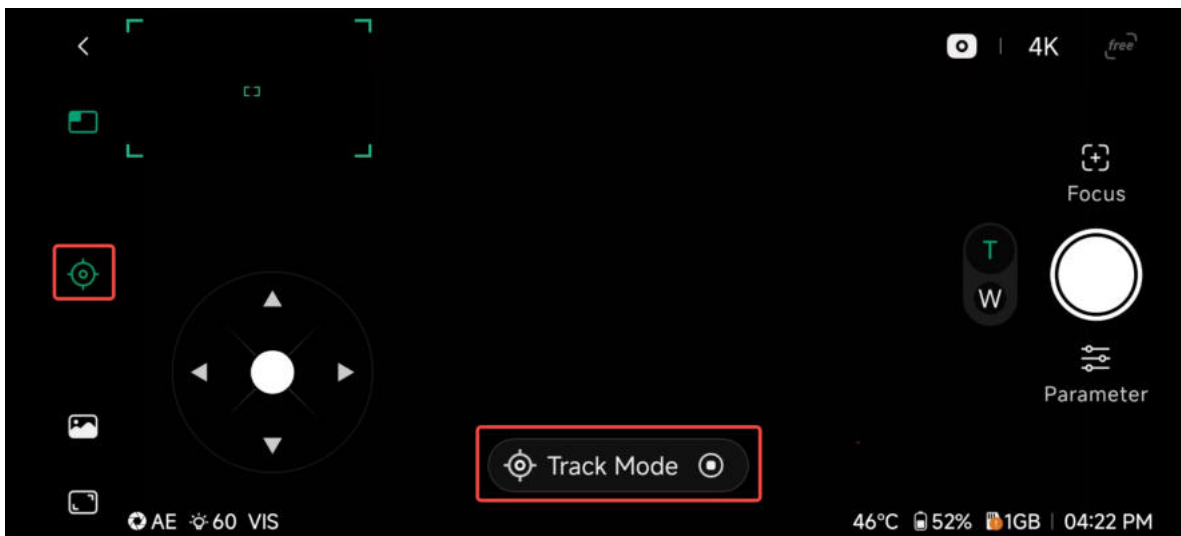
- The dual-lens system may occasionally become out of sync when switching between targets at different distances. Performing auto-focus will restore

alignment. It's recommended to run auto-focus in a bright environment while aiming at a distant object for the best results.

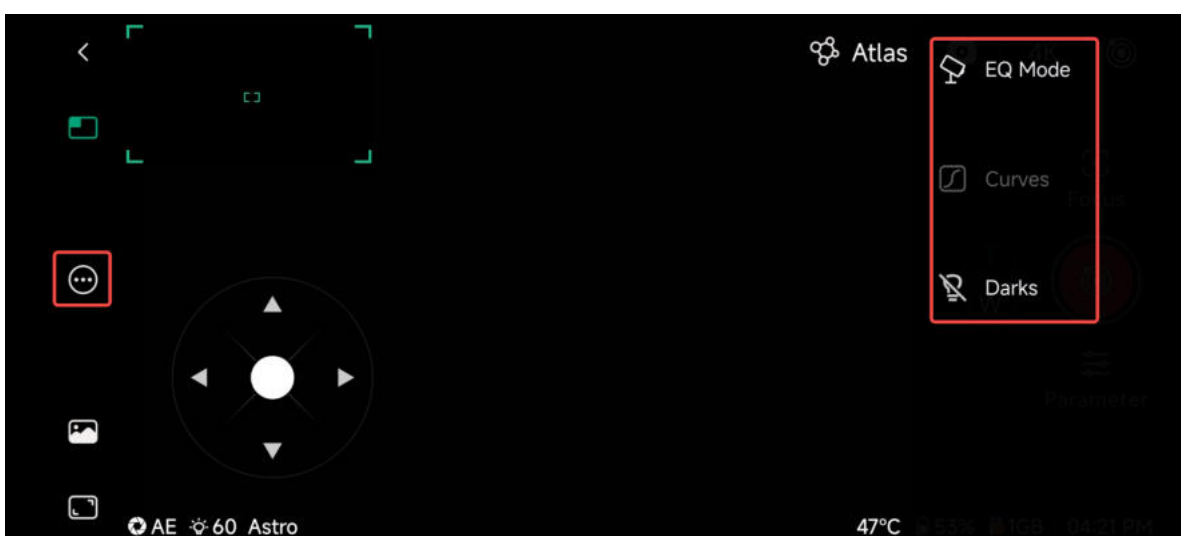
You cannot use double-click to auto-focus in Astro Mode, as we want to avoid accidentally disrupting the perfect focus you've carefully achieved.

2.3 Key Features

This button serves as a key feature button in each mode. For example, in **General Mode**, tapping this button activates **object tracking**.



In **Deep Sky Mode**, you can tap here to access features such as **EQ settings**, **dark frame management**, and **curve color adjustment**. For detailed information, please refer to the [Section 3.2 Deep Sky Mode](#) later in this manual.



2.4 Navigation Control Panel

Move the joystick to navigate the lenses. The farther the virtual **ball moves from the center**, the faster the movement speed.

You can also use the surrounding arrow buttons to control movement. Press and hold for steady **medium-speed motion**, or tap briefly for **precise fine adjustments**.



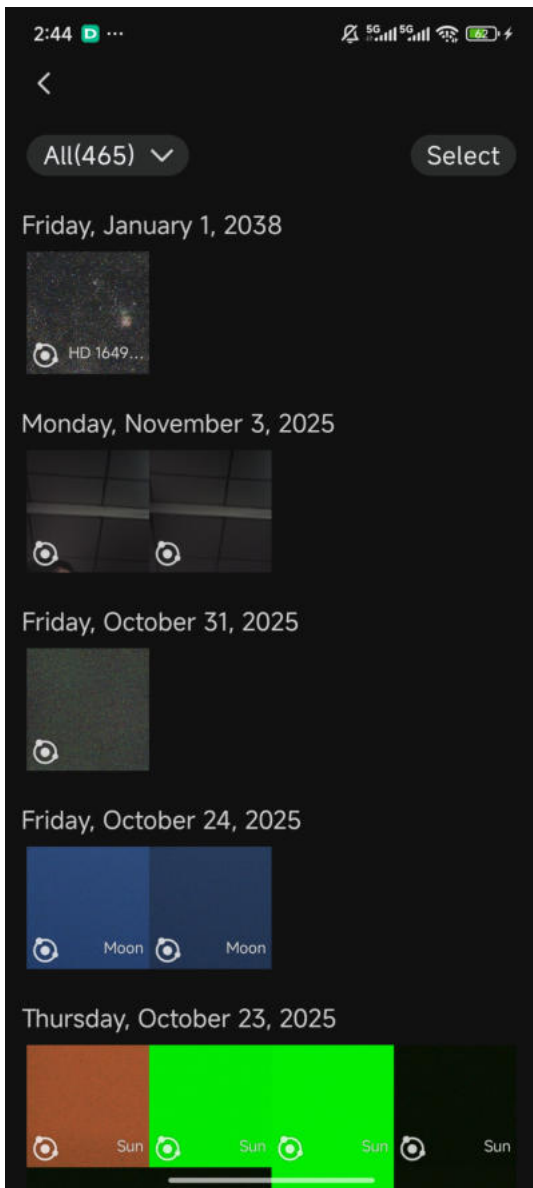
☒ **Navigation Tips:**

You can quickly and precisely locate your target by combining the following three methods:

- Manually rotate the lenses to roughly align with the target.
- Use dual-lenses (picture in picture) locating to align the target.
- Adjust the lens position finely with the joystick/arrow.

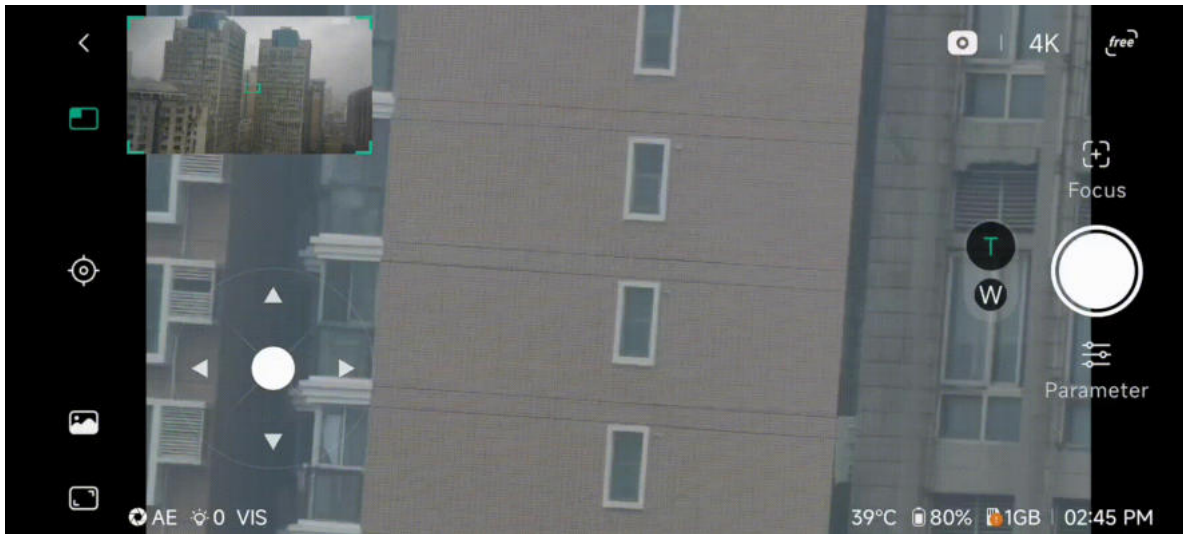
2.5 Album

Quick visit for photos.



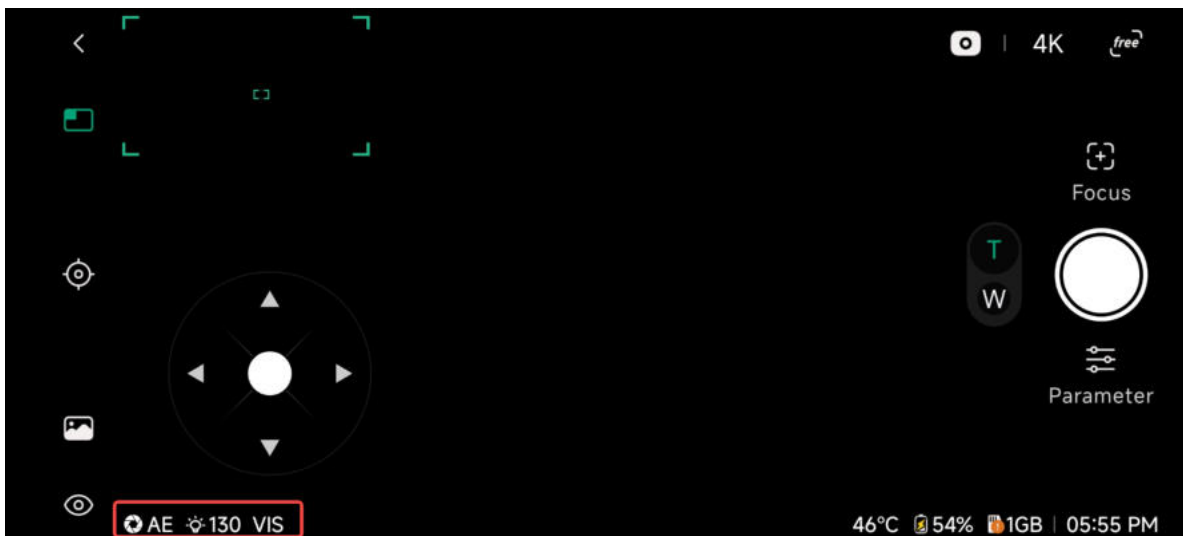
2.6 Full Screen (Hide All Controls)

Tap this button or **long press the screen to hide** all on-screen controls and enjoy an **immersive viewing experience**. Press and hold to **restore** the controls.



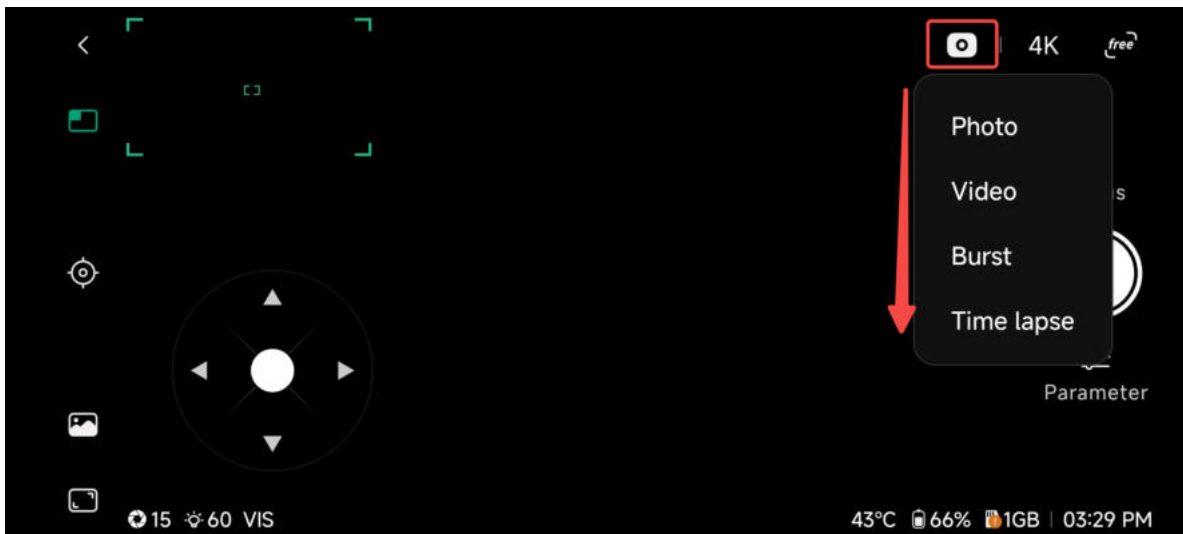
2.7 Key Parameter Bar

This bar area displays key imaging parameters such as **exposure**, **gain**, and **filter**, which affect the final image the most.

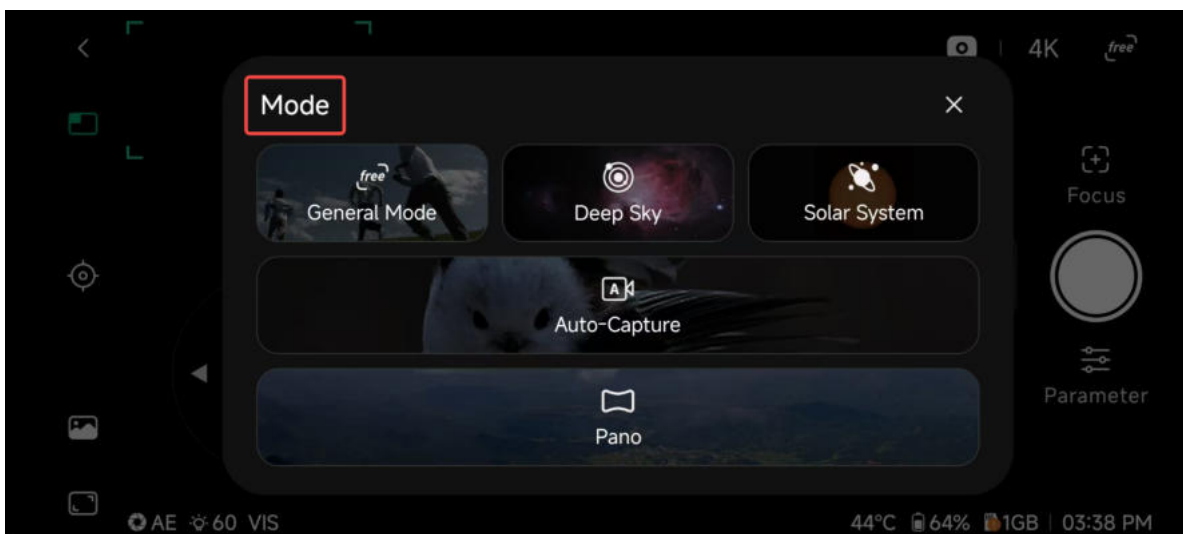


2.8 Format & Res.

Here, you can select the **shooting format** (such as **photo** or **video**), as well as adjust **resolution**, **frame rate**, and other related settings.



2.9 Shooting Mode Switching



2.10 Focus

Tap 'Focus-AF' for auto-focus. **Long press** or tap +/- to adjust the focus. The focus scale value helps you better confirm the appropriate focal point.

Focusing on targets at a distance of **5 meters** or more. Focusing on targets less than this may result in autofocus failure.



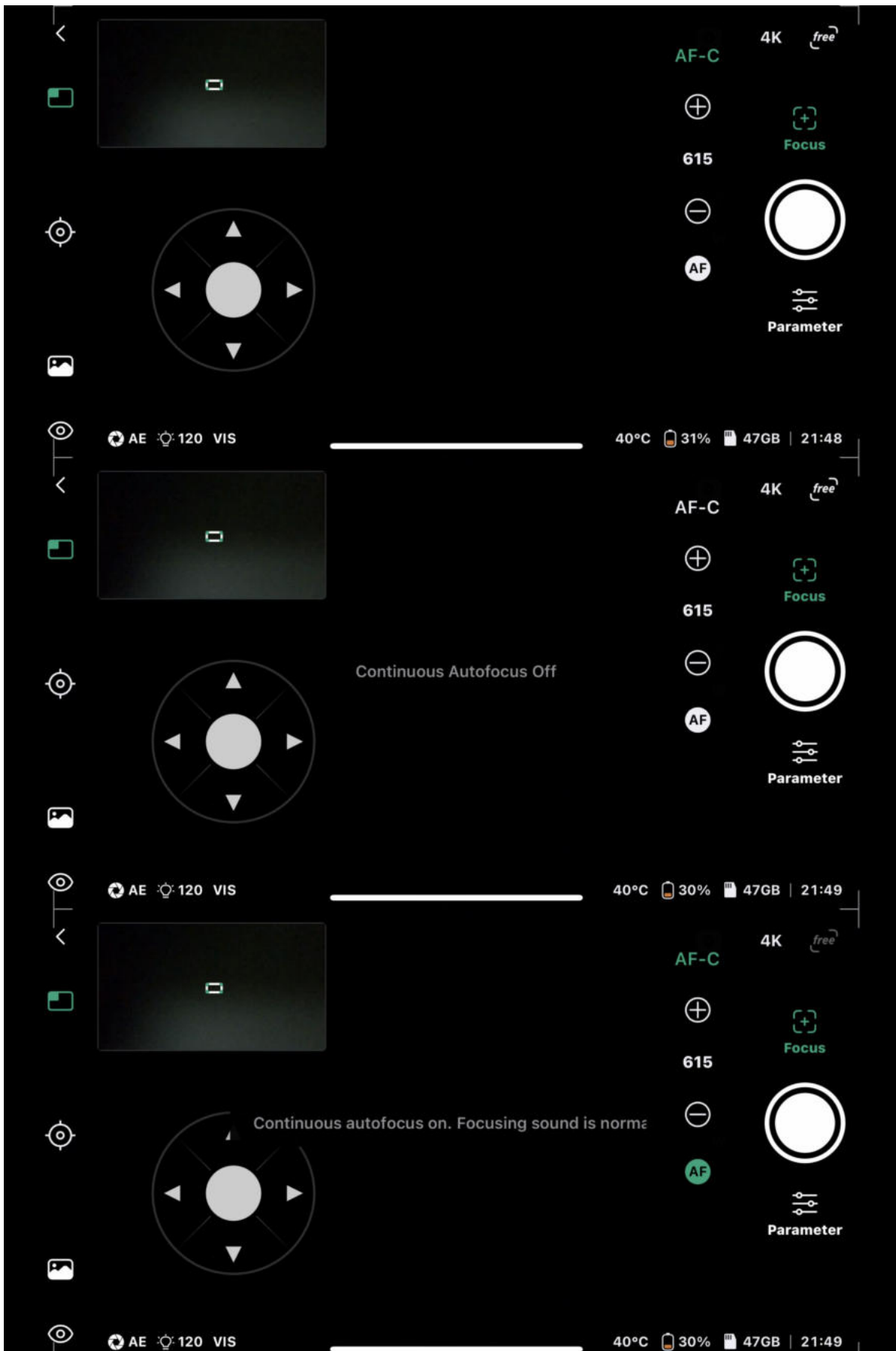
The Auto button turns green during focusing and reverts to white once focus is achieved.

Focus Feature Update (2025.12.30) Continuous Autofocus for Daytime Scenes (AF-C)

We've added **Continuous Autofocus (AF-C)** for daytime use. When enabled, you no longer need to manually focus when shooting your target or refocus while viewing subjects at different distances. The telephoto lens will **automatically maintain image sharpness continuously while the device is moving**, making daytime observation much smoother and more convenient.

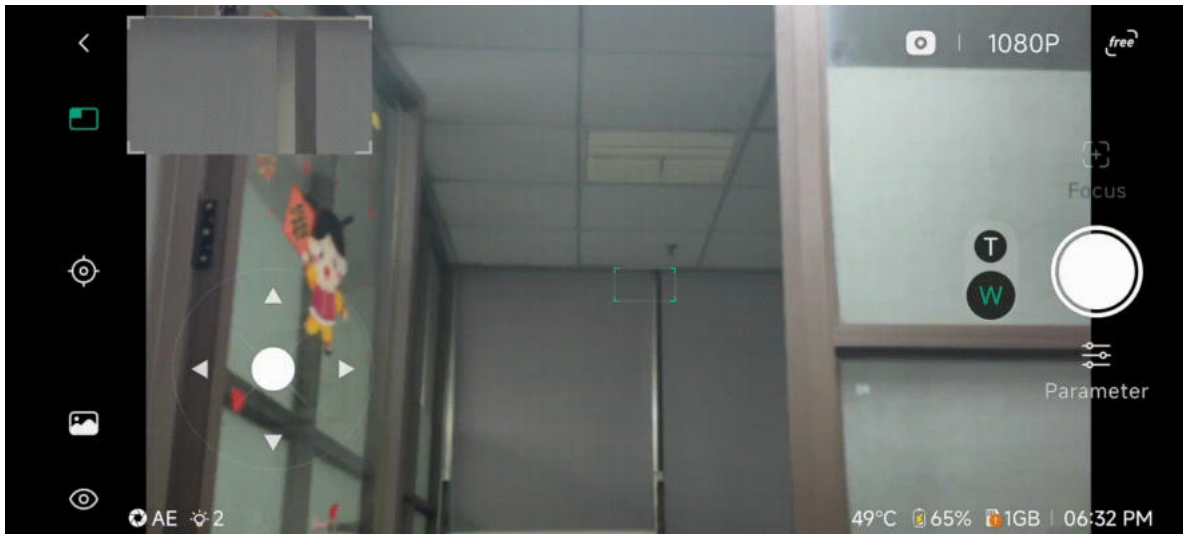
*Notes:

- This feature is available **only in General Mode, Panorama and Auto Capture** modes. It is **not supported at night**. In Panorama, AF-C works only before shooting starts. Focus remains locked during capture.
- During autofocus, you may hear a **grinding-like focusing sound**. This is the normal sound of the motor operating and **does not indicate a malfunction**.



2.11 Tele/Wide Switch

Tap this button to switch between the **telephoto** and **wide-angle** lenses as the **main view**. The lens you intend to use for shooting must be set as the **main view** before capturing photos or videos.



2.12 Shoot

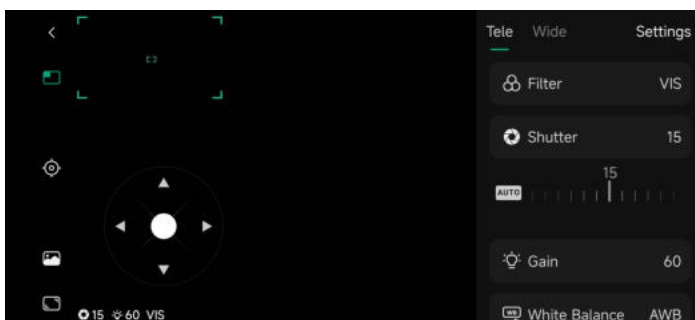
The shooting button, tap to start shooting.

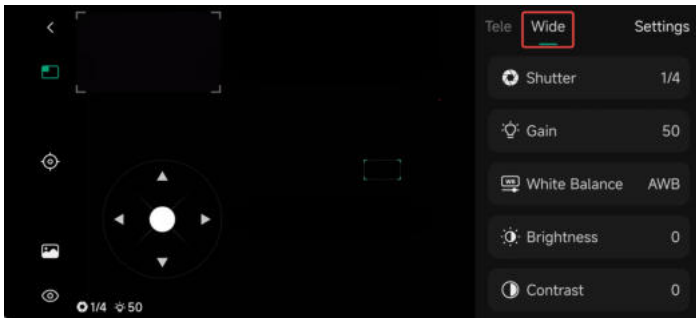
2.13 Parameter Settings

Here, you can freely adjust the **shooting parameters** for both the **wide-angle** and **telephoto** lenses.

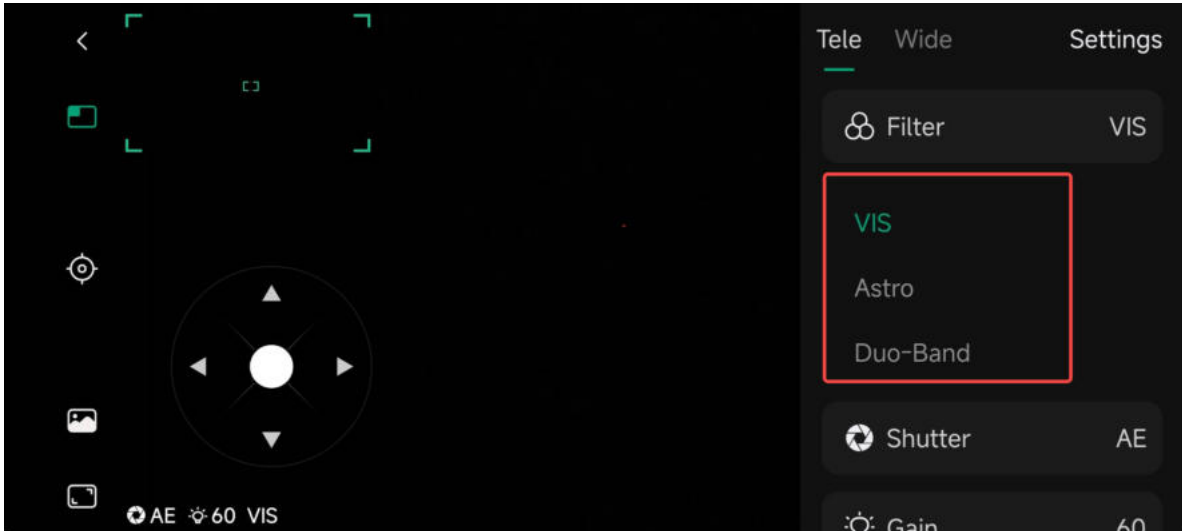
2.13.1 Shooting Parameter Settings

You can adjust the shooting parameters such as Filter/Shutter/Gain.

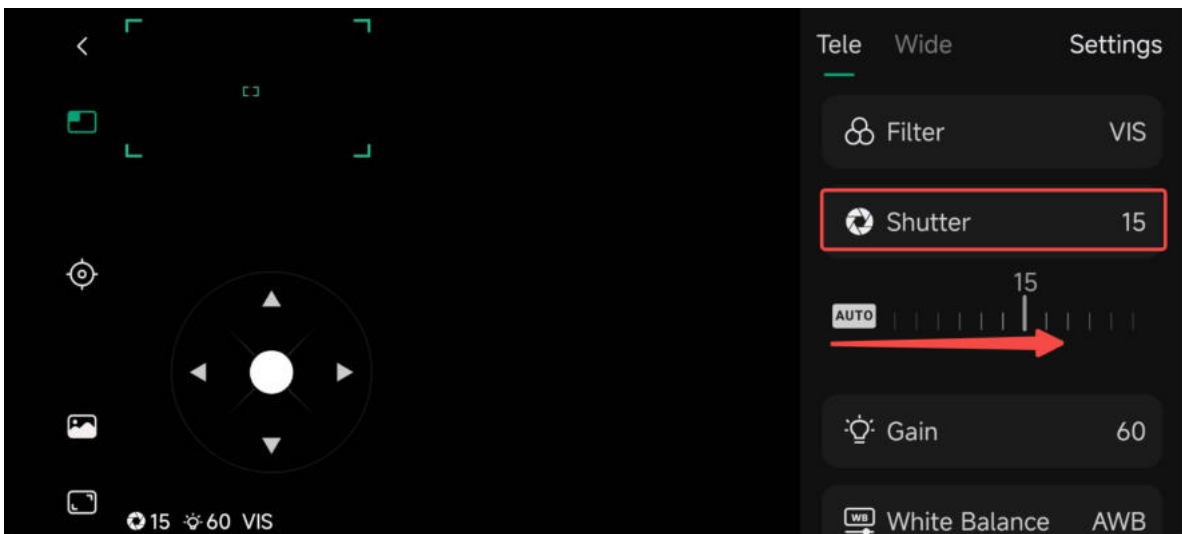




Filter: DWARF 3 has 3 built-in filters. See details in [Section 3.2 Deep Sky Mode](#).

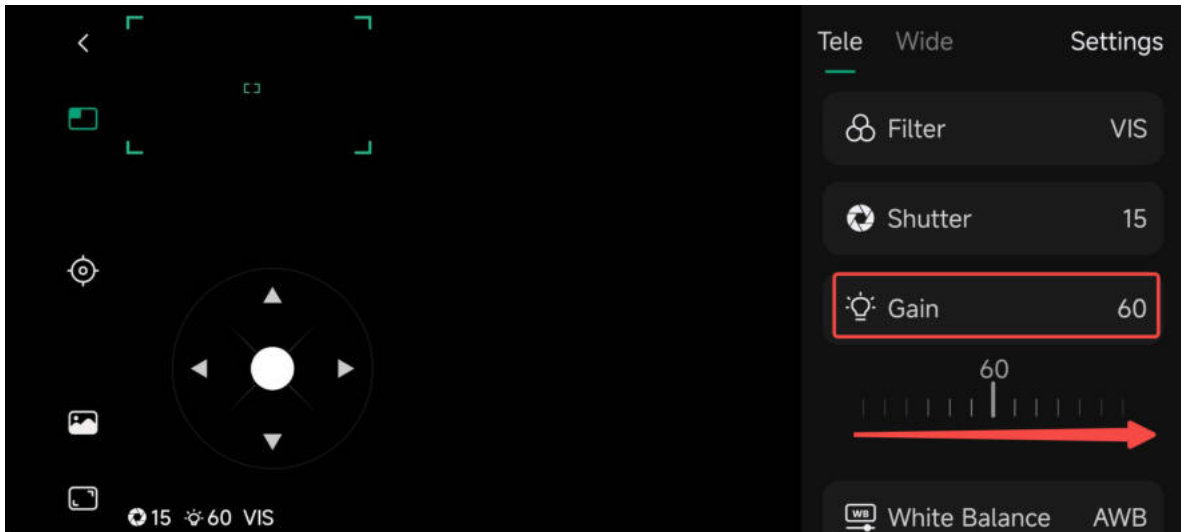


Exposure/Shutter: Adjust shutter time. Automatic shutter setting is always recommended for daytime. More to be introduced for astrophotography exposure in the next section tutorial.



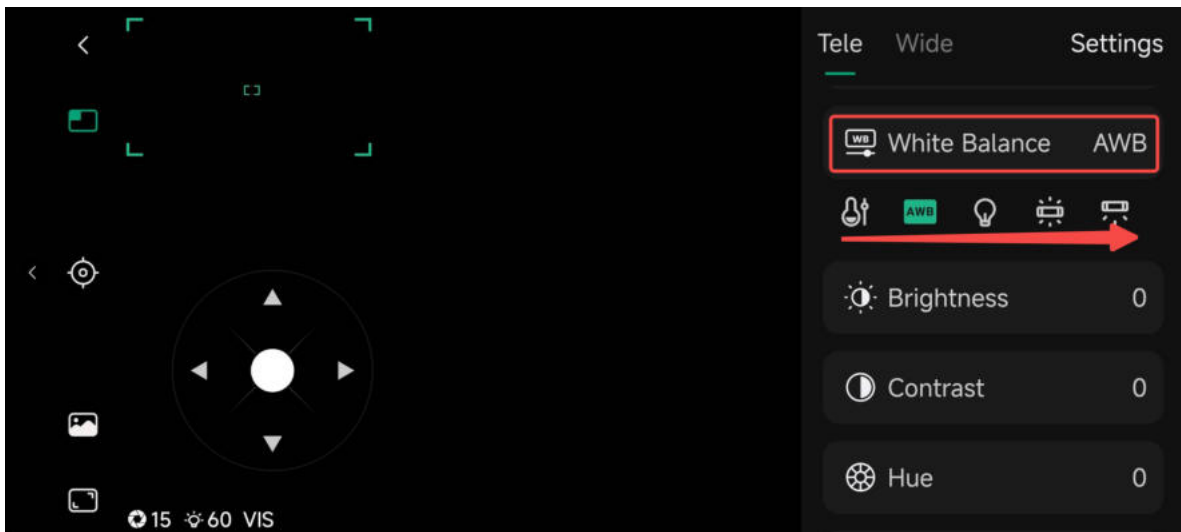
For Astrophotography, set shutter longer than 15s.

Gain: Adjust the gain setting. Keep between 0-30 for daytime normally. More to be introduced for astrophotography gain in the next section tutorial.



For Astrophotography, set gain to 60 or above.

White Balance: Usually set to Auto. Adjust to warmer temp. when you feel like getting a yellow or orange sun/moon.

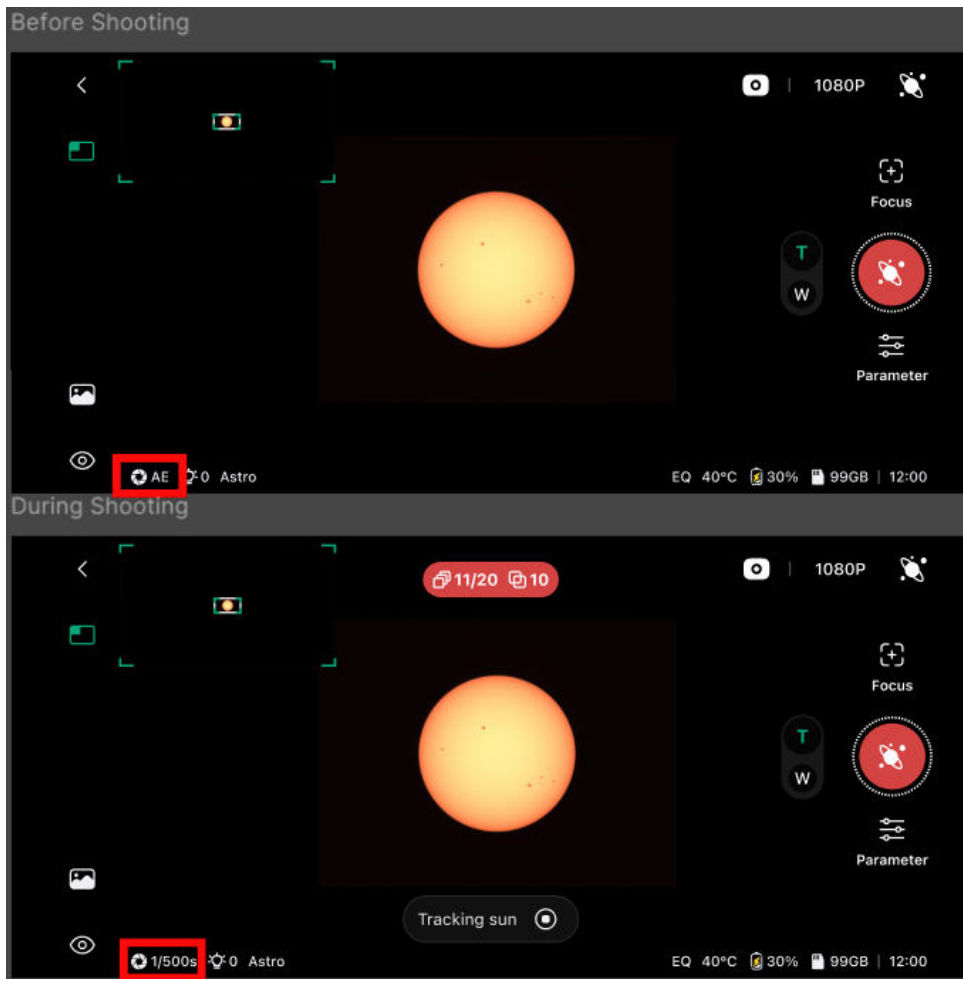


Other Settings: Feel free to experiment with different parameter adjustments.



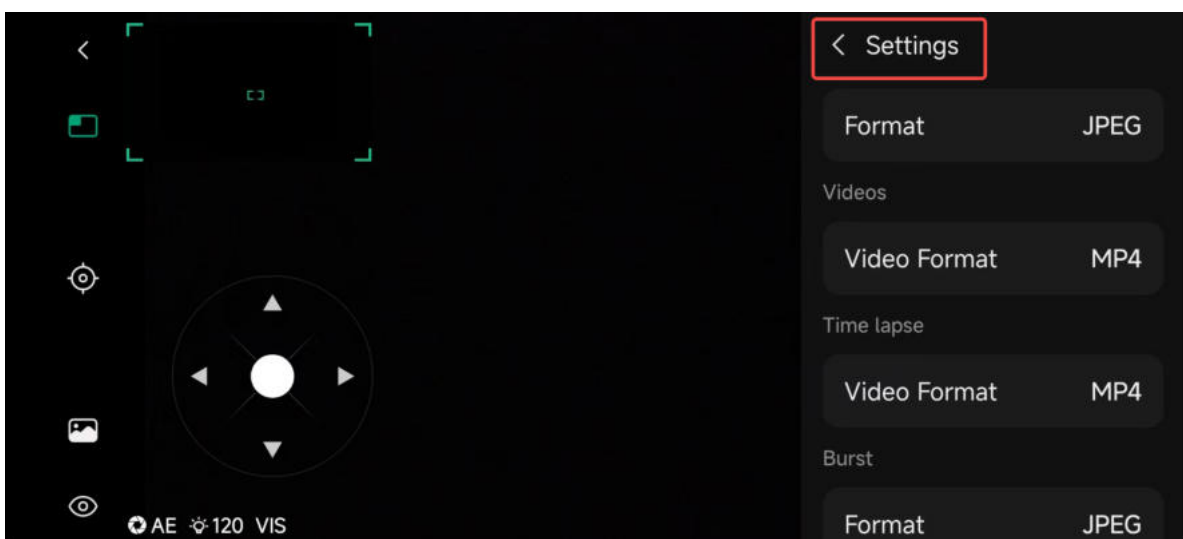
☒ Important Note on Parameters:

- When switching modes, you may notice that the **exposure** and **gain** values change automatically based on ambient brightness. At all other times, these parameters will remain fixed to your manual settings and will not change unless you adjust them yourself.
- To ensure the best imaging results, when shooting **deep-sky objects (DSOs)** or **the Sun and Moon**, if you haven't manually set your parameters, pressing the **shoot** button will automatically switch the **exposure** and **gain** from *AE (auto exposure)* to a set of **recommended fixed values**. (Because during astrophotography, parameters are not expected to change with environmental variations, keeping them within a fixed range ensures image stability and consistent capture quality.)

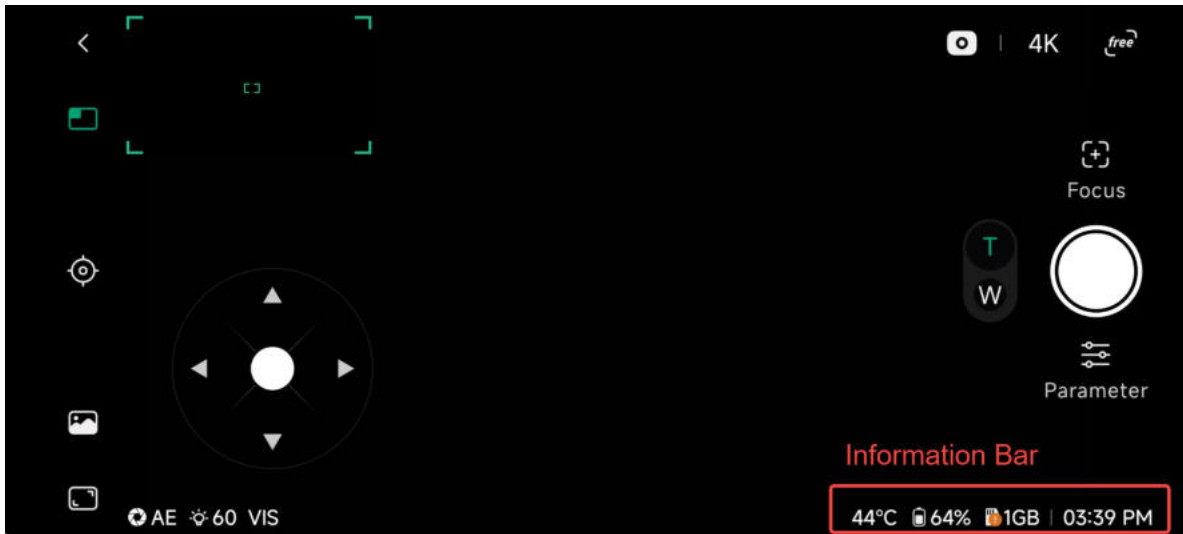


2.13.2 Image Format Settings

Here, you can set the **format** of your works (JPG/PNG/FITS/TIFF etc.) and adjust **other related settings**.



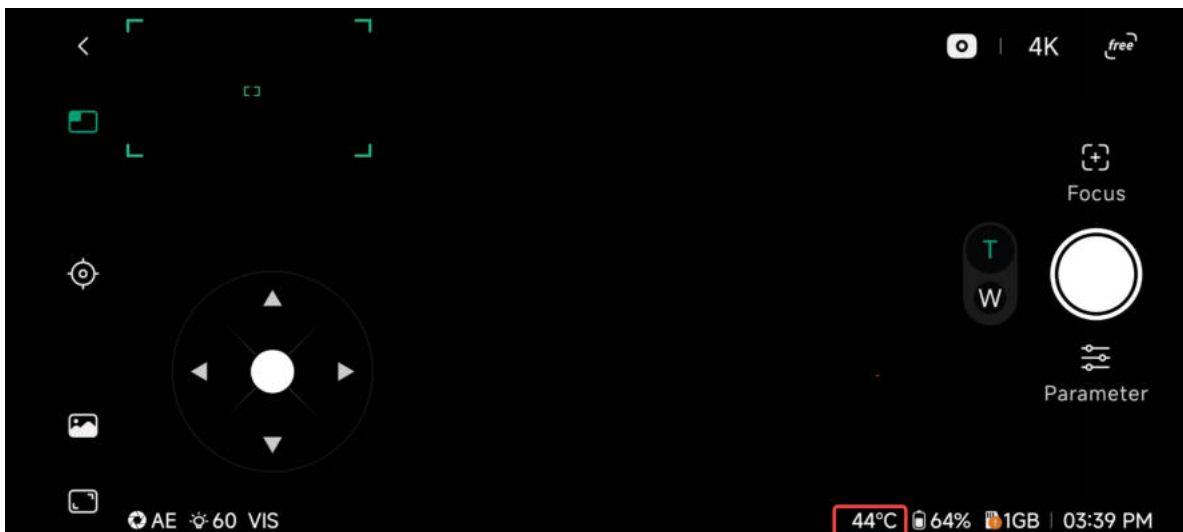
2.14 Information Bar



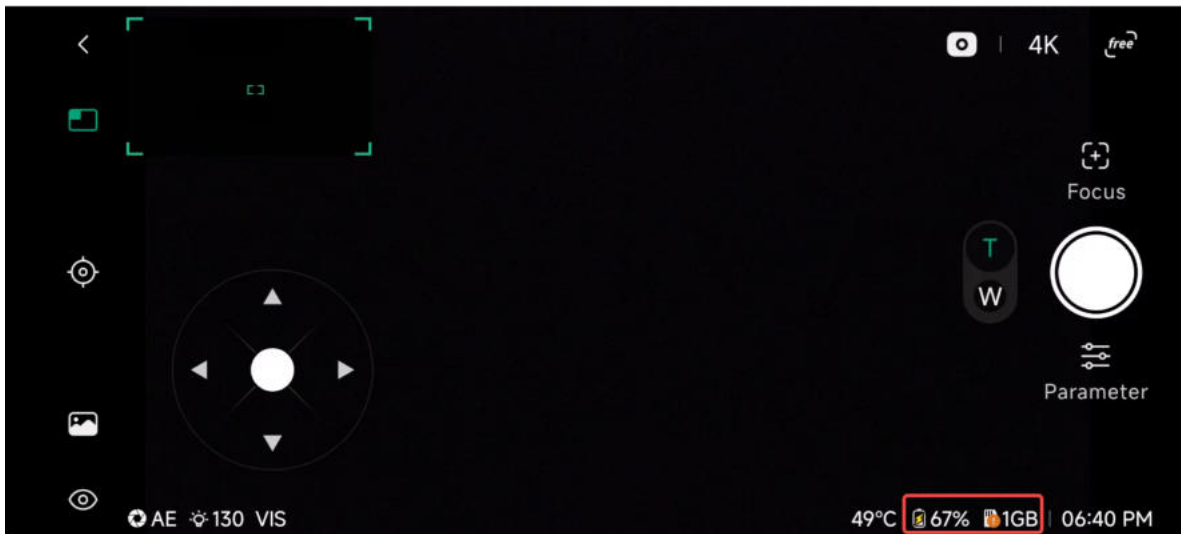
2.14.1 Temperature

Display the **temperature of the sensor**.

This data assists in assessing whether the temperature of your existing dark frames matches the current conditions. If there's a **significant discrepancy** ($\pm 8^{\circ}\text{C}$), **retaking dark frames may improve your results**. For detailed information, please refer to [Section 3.2 Deep Sky Mode](#)



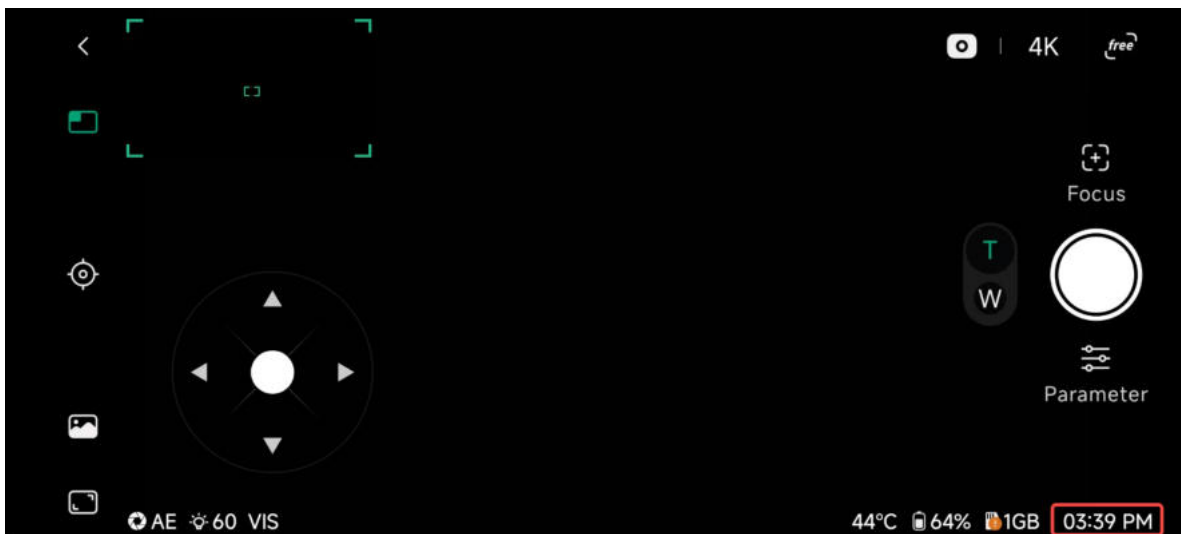
2.14.2 Battery & Storage



Storage & Battery Indicates the remaining memory space & battery level of DWARF.

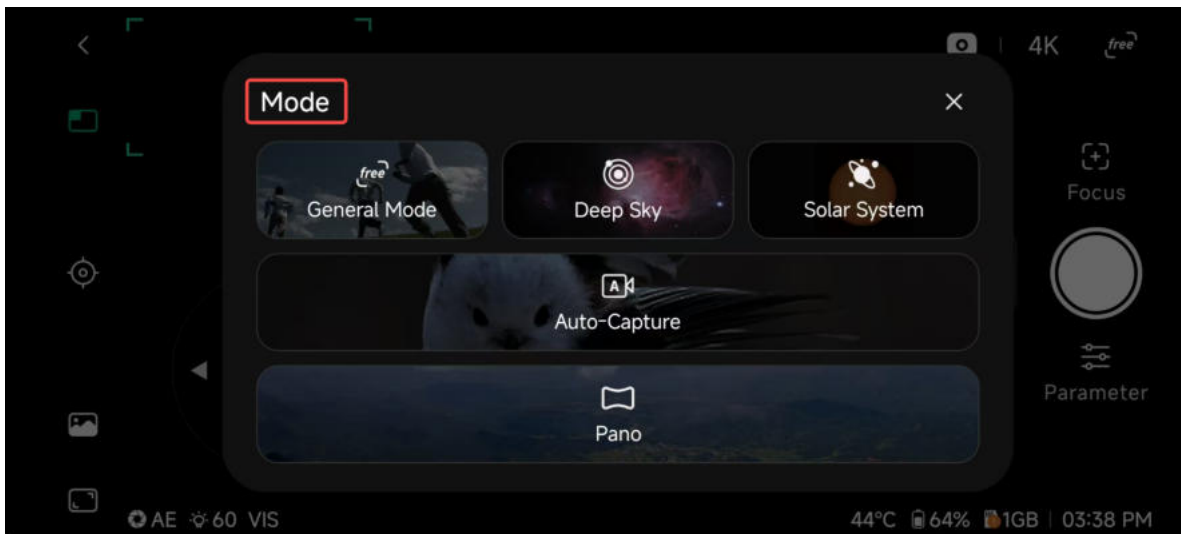
2.14.3 Time

Display the current time.



3. Instruction for Different Modes

DWARF 3 offers **five shooting modes**, allowing you to choose freely based on your desired target. The following sections provide an introduction to each shooting mode.



3.1 General Mode (Free)

As an astronomical telescope, **DWARF 3** also offers exceptional **landscape photography** capabilities.

The **General Mode** is designed specifically for **daytime photography**, allowing you to choose either the **telephoto** or **wide-angle** lens for shooting.

Wide camera: suitable for wide scenery, sunrise or sunset views Tele Camera: designed for **close-up and detailed observations**, such as **distant mountains, birds, or wildlife**.

Each lens supports four shooting options — **photo, video, burst, and time-lapse**.

This mode also features a unique **object tracking** function.

By freely switching between the two, DWARF 3 allows you to capture everything from vast landscapes to tiny, faraway details with ease.

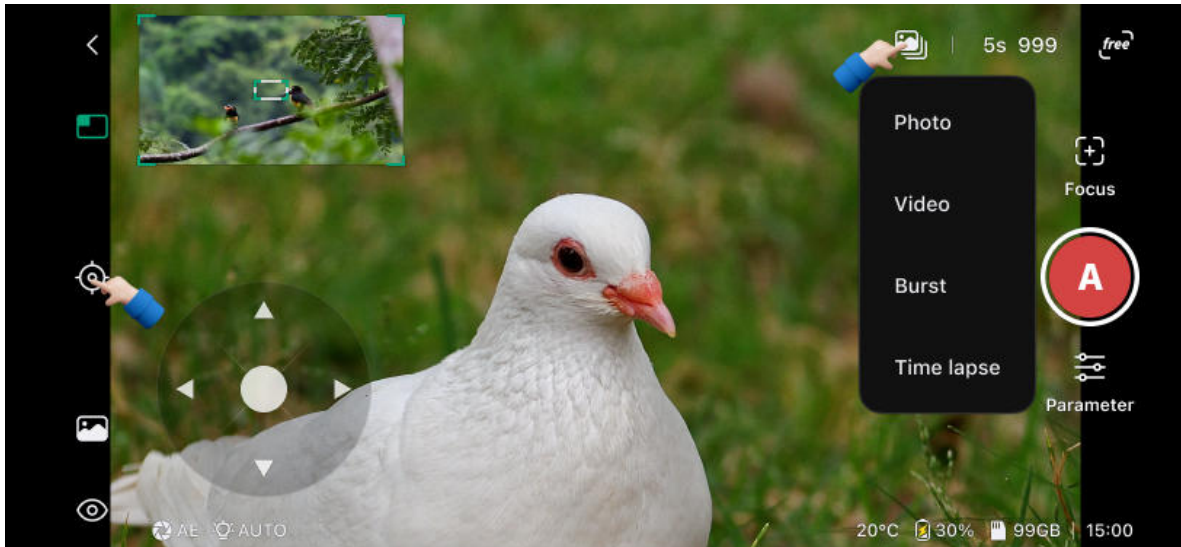
Below are some example use scenarios.



3.1.1 Bird Observation

Use the **telephoto lens** to observe birds in detail – their feathers, movements, and behavior.

The **object tracking** feature keeps them center and precisely in focus all the time, allowing you to follow their motion smoothly and effortlessly.

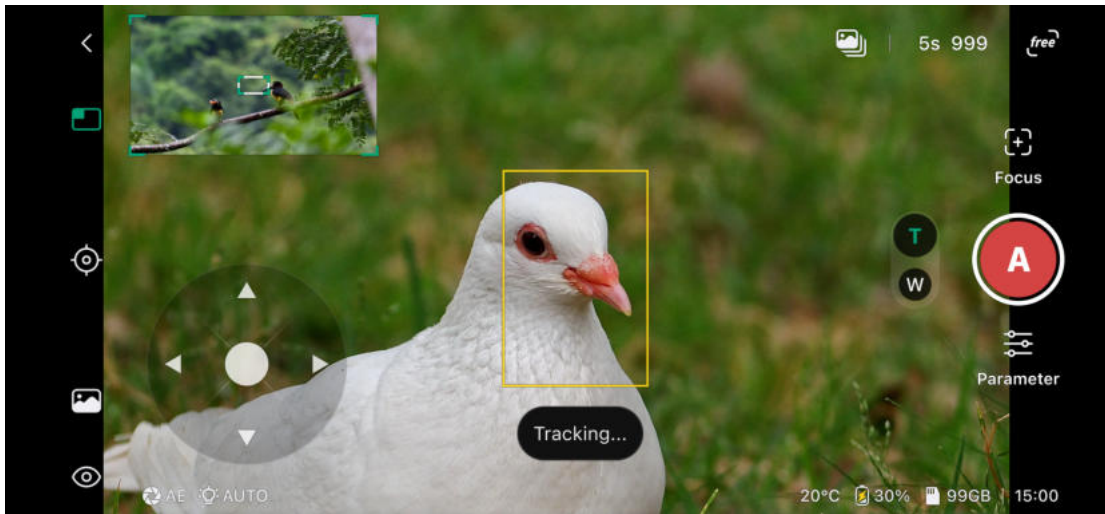


Steps

1. **Point the lens toward the direction of the bird.**
2. Make sure the bird is visible in either the wide-angle or telephoto view.
3. Tap **“Target Tracking Button”** on the left side to enter tracking mode.



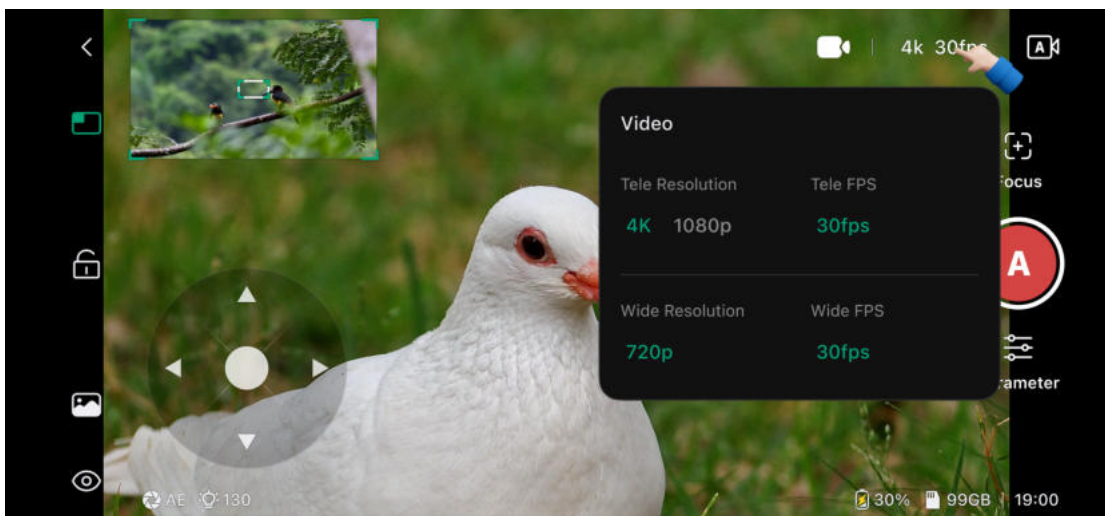
4. **Draw a box around the bird in the wide-angle or telephoto view.**



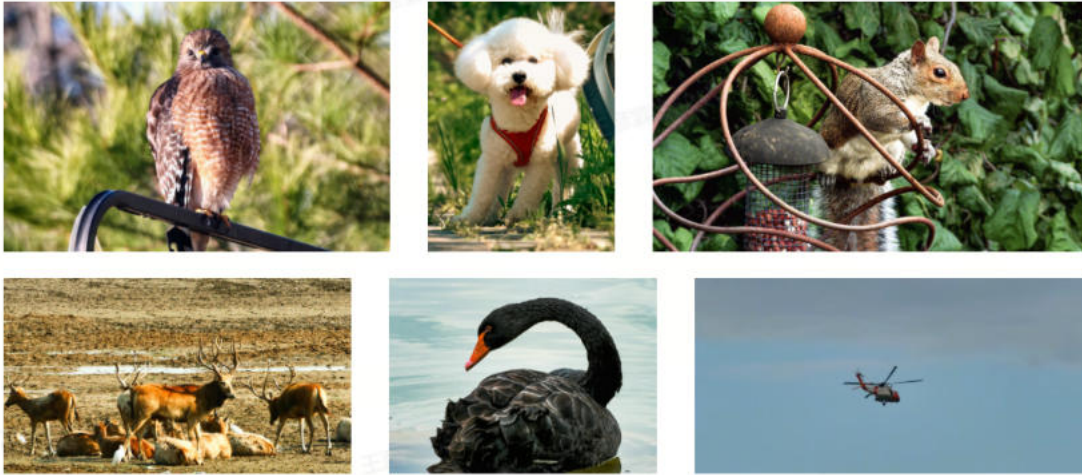
5. DWARF 3 will start synchronized tracking across both lenses automatically.
6. Use the function panel on the right to fine-tune focus, exposure, or gain as desired.
7. **DWARF 3 automatically maintains (follow) focus while the bird moves (AF-C Enabled).**

**If focus becomes unclear during movement, try tapping Auto Focus at several distances to help DWARF 3 learn and refine focus accuracy.*

8. **Choose your preferred lens to capture photos or videos.**
9. For example, to record detailed bird footage, set the telephoto lens as the main view, switch to **Video Mode**, select your resolution and frame rate (e.g., **4K 30 FPS**), and start recording.



10. **Try tracking other moving subjects.** The same method works perfectly for **airplanes, rockets, athletes, boats, or even your pets** — give it a try!

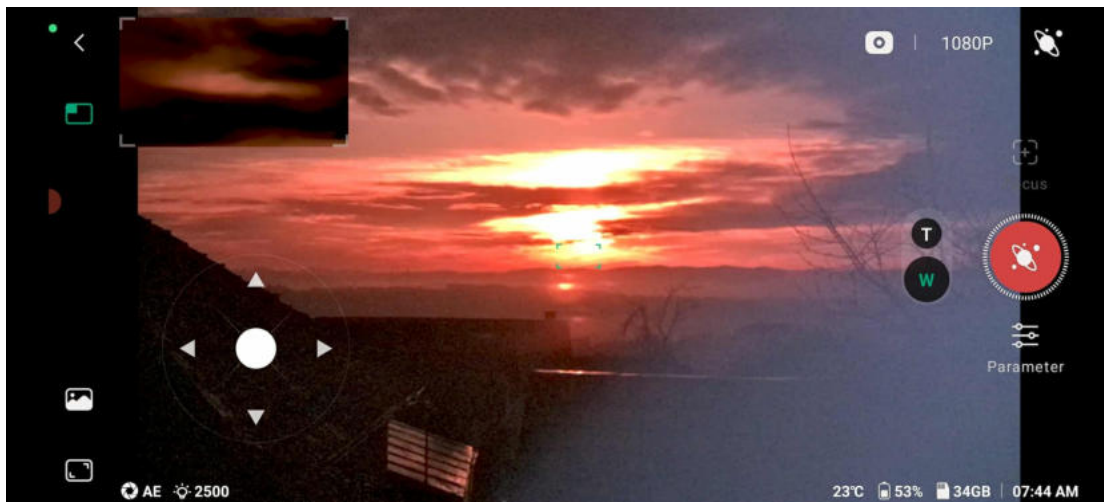


3.1.2 Wide View Time-Lapse

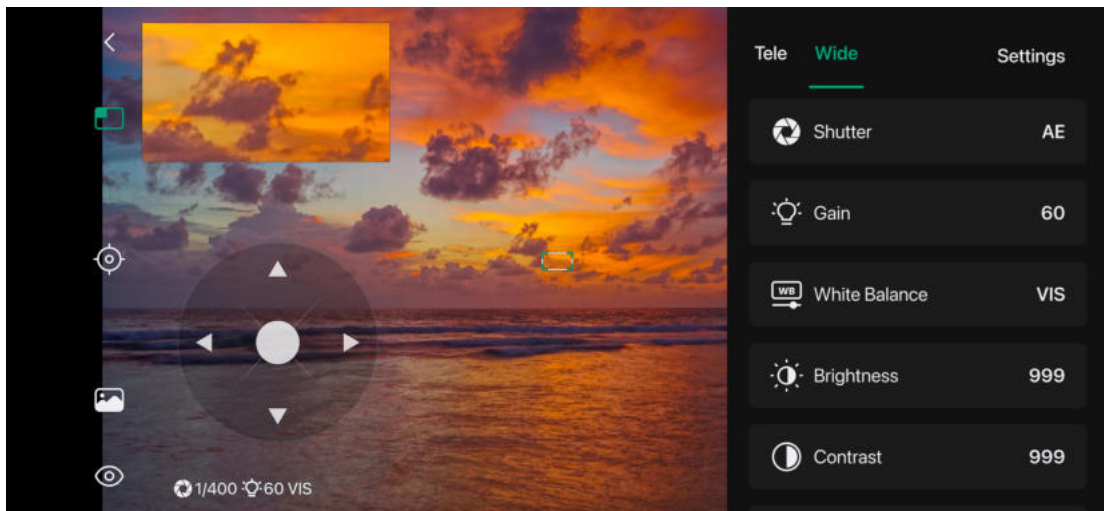
Use the **wide-angle lens** to capture the ever-changing clouds across the sky, from drifting patterns to stunning fiery sunsets.

Steps

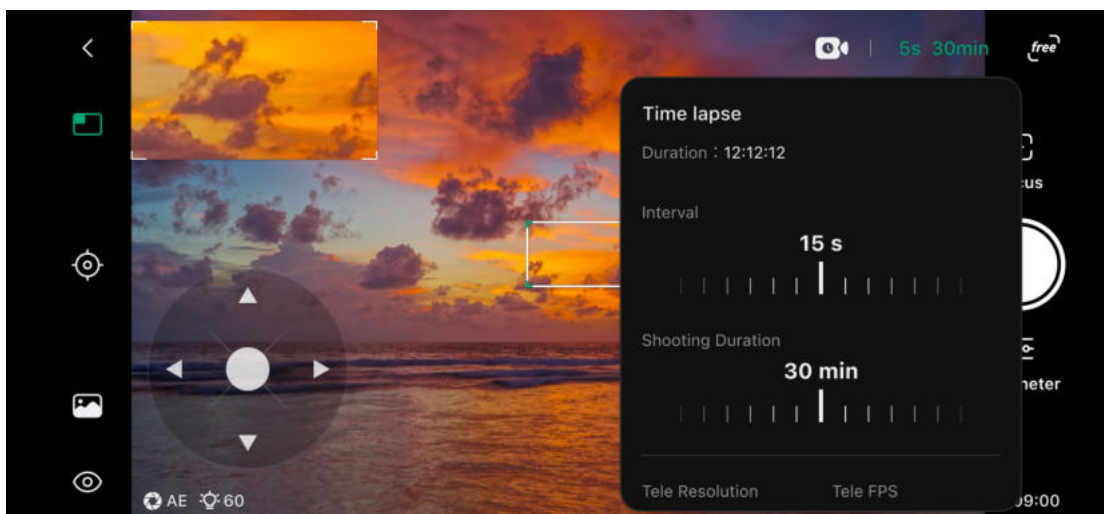
1. **Point the lens toward the sky.** Make sure the wide-angle view covers the cloudscape you want to capture.
2. **Tap “W” to set the wide-angle lens as the main view.** This ensures the camera records using the wide-angle perspective.



3. **Adjust image settings such as tone and saturation to your preference.** Fine-tuning these parameters helps bring out the color and texture of the clouds.



4. **Open the settings panel to configure the time-lapse options.** Set the **shooting interval, total duration, and resolution** — the final video length will be displayed at the top of the screen.



Recommended settings for different scenarios:

- **Clouds:** 2-5 second intervals for capturing dynamic cloud movements, aiming for a 20-30 minute duration.
- **City Traffic:** 1-3 second intervals to capture the hustle of city life, ideally for about an hour during peak times.
- **Blooming Flowers(Tele Photo):** Longer intervals, like 1 minute, for slower processes such as flowers blooming, extending over several hours or days.

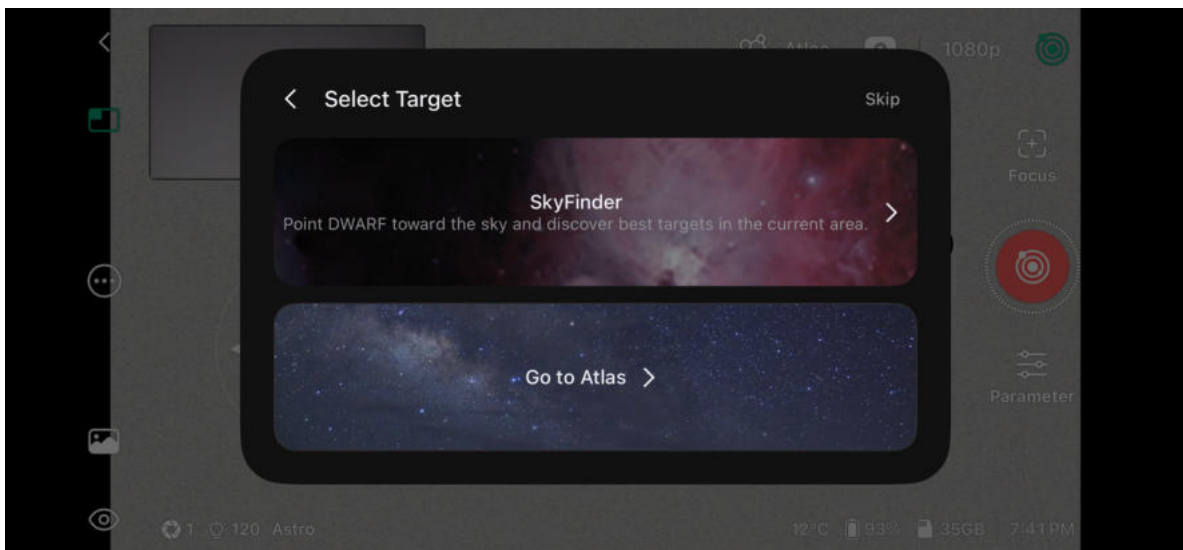
When you switch the app to the background or disconnect, the shooting process will still continue. Note that there's a brief delay in saving photos after hitting stop on taking the time-lapse video. So it might take some time for the photos to show up in the album.



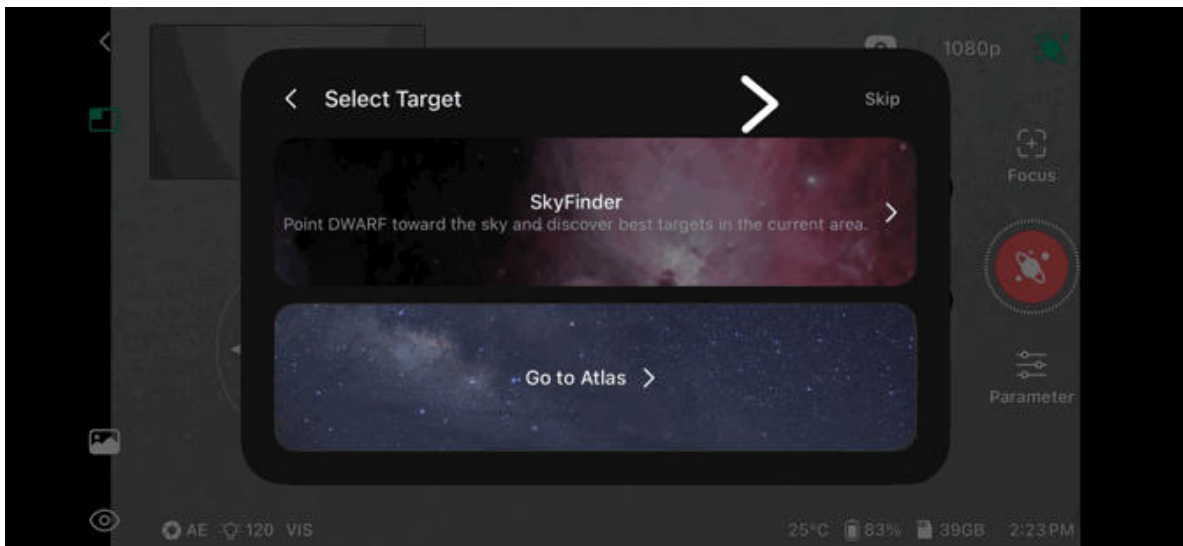
3.2 Deep Sky Mode

The **Deep Sky Mode** is designed for capturing faint celestial objects such as galaxies, nebulae, and star clusters. DWARF 3 automatically aligns, tracks, and stacks multiple long-exposure images to reveal details invisible to the naked eye, allowing you to explore the deep universe with ease.

When entering **Deep Sky Mode**, you'll first be prompted to select a target from the **Star Atlas** or the **Sky Finder for a quick stargazing**.



Or **skip this step** to explore and get familiar with the main shooting interface first.



3.2.1 Deep Sky Photography (Astro Imaging Walkthrough)

Let's take Claire's first deep-sky shooting experience as an example to learn how to capture a deep sky target using the **DWARF 3** in **Deep Sky Mode**.

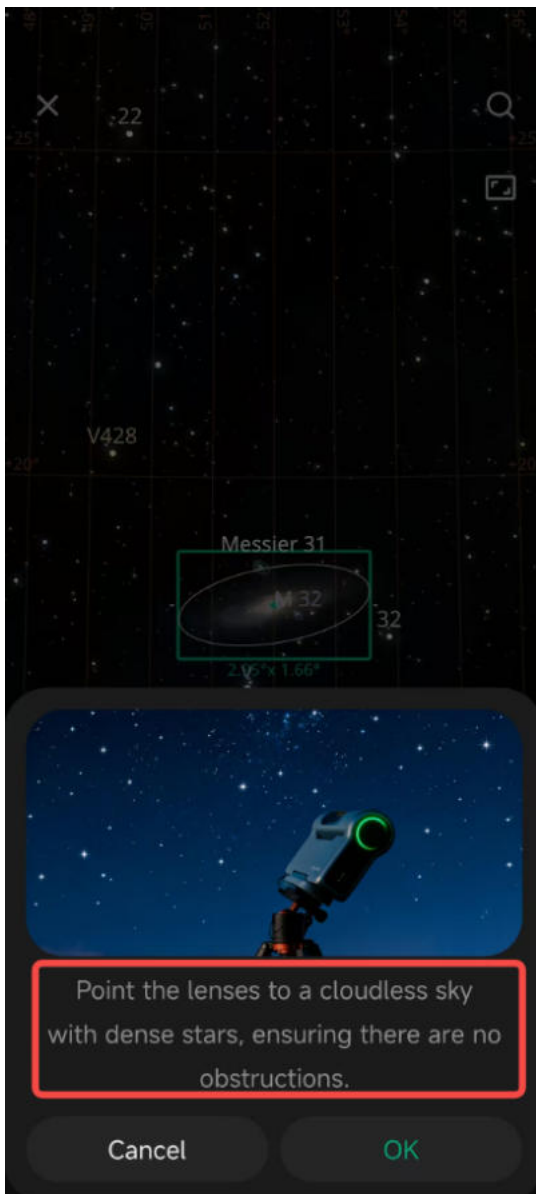
Goal: Capture a deep sky target with **DWARF 3**.

Preparation: DWARF 3 and a smartphone (or tablet)

3.2.1.1 Steps:

3.2.1.1.1 Setup DWARF (Alt-Az)

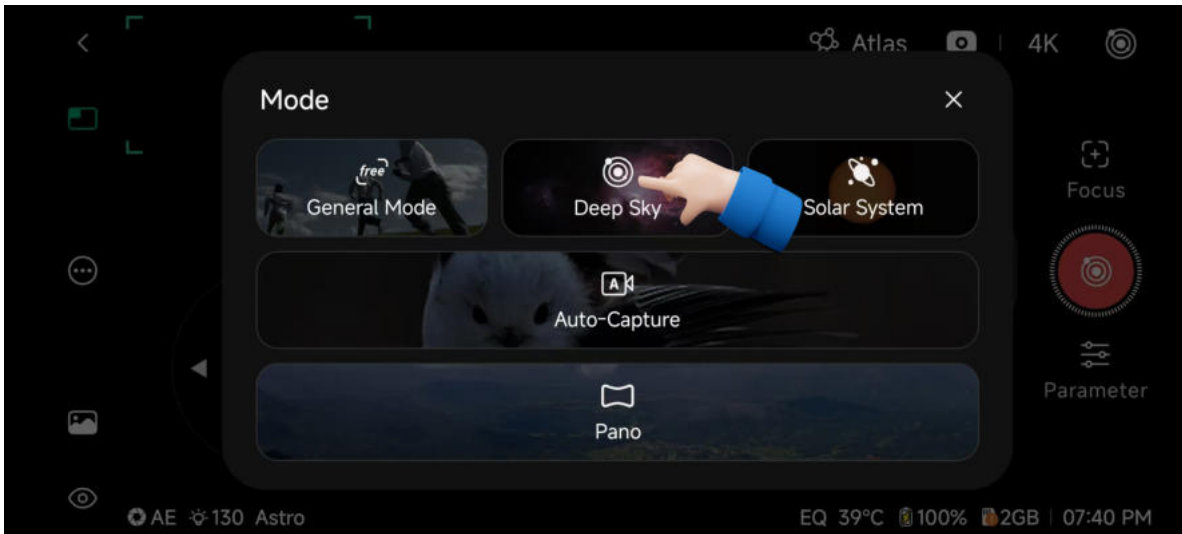
- On a clear, cloudless night, **power on the DWARF 3** and connect it to your phone.
- **Place DWARF 3 on a stable, level surface**, such as a flat piece of ground or a tripod.
- **Look up at the sky** and find an area where stars are visible to the naked eye. Rotate DWARF 3 so that the **lenses** face that direction so there are enough stars for later calibration.



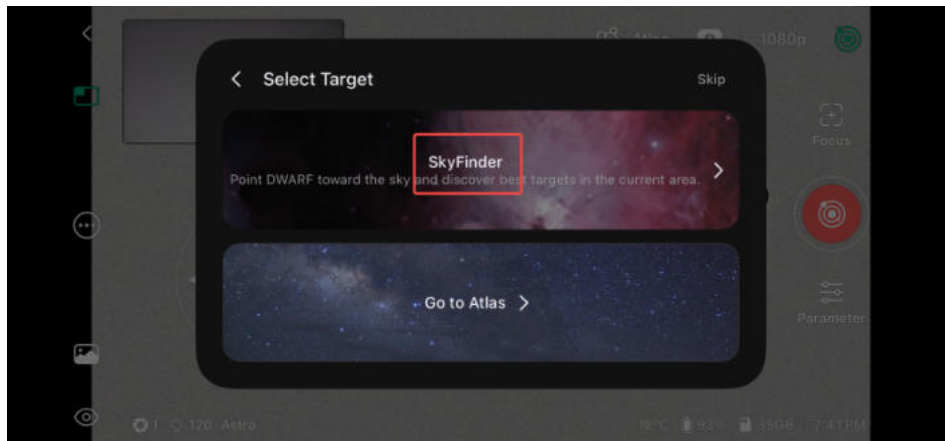
You may just see all black at first for the shutter is too short, stars will show up later.

3.2.1.1.2 Select A Target

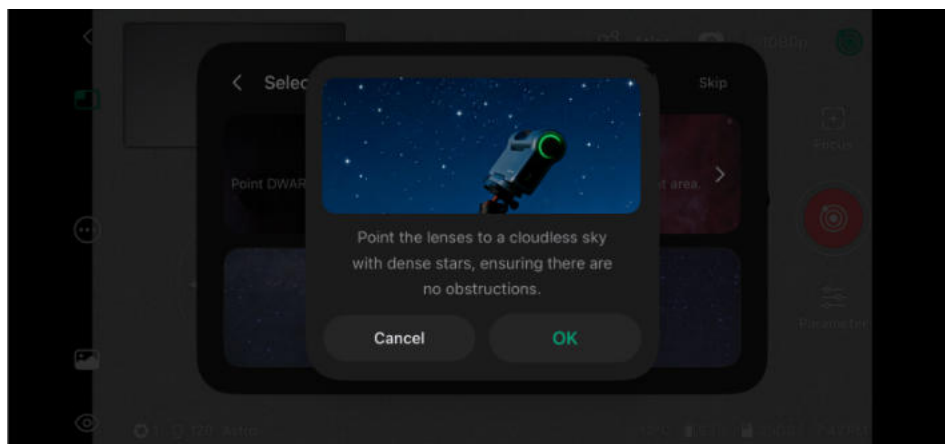
Now the setup is complete, enter Deep Sky Mode to begin!



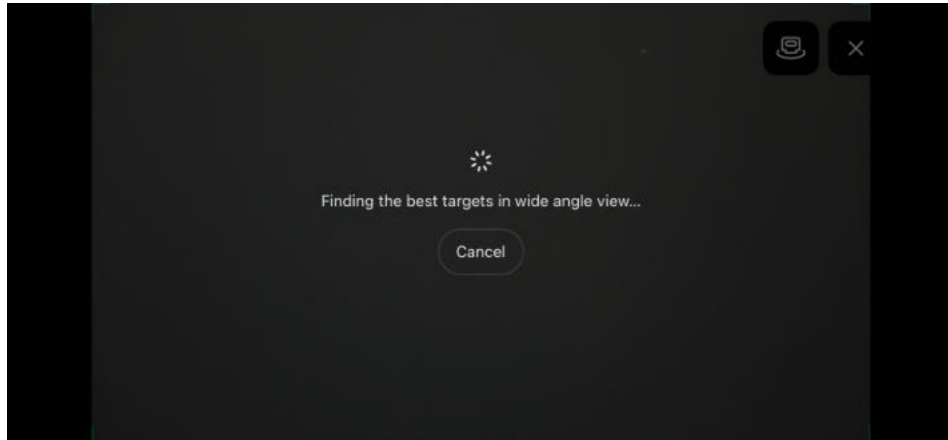
- In this mode, **first select your target**. Here are **2 ways** to select your target:
Option 1: Sky Finder



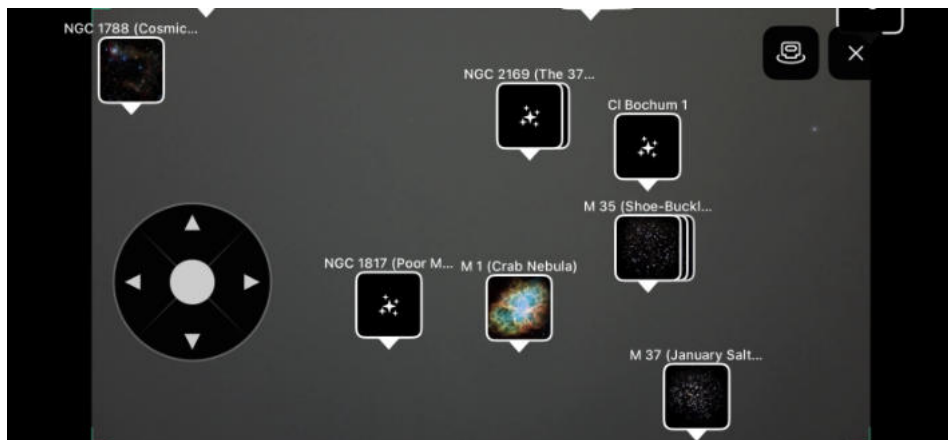
- Tap **Sky Finder** to discover shootable celestial targets within the wide-angle live view!
- Point your DWARF 3 toward an open area of the sky with visible stars, and tap "OK".



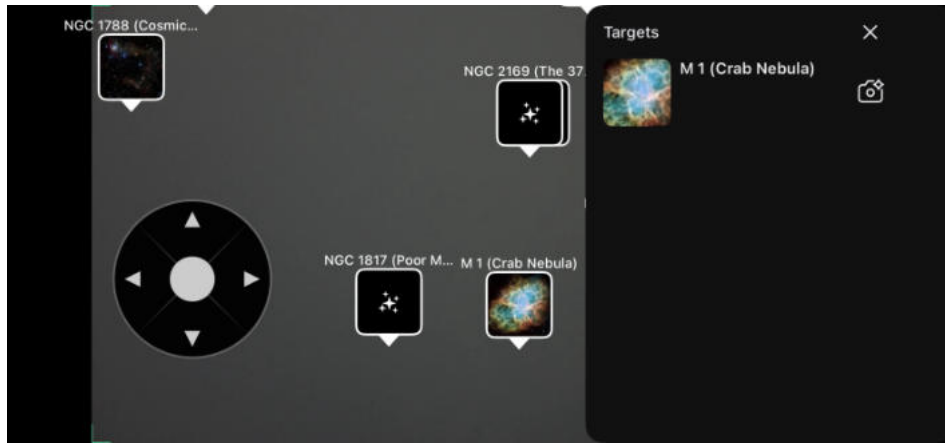
- It will take a moment to identify the celestial objects in the wide-angle view.



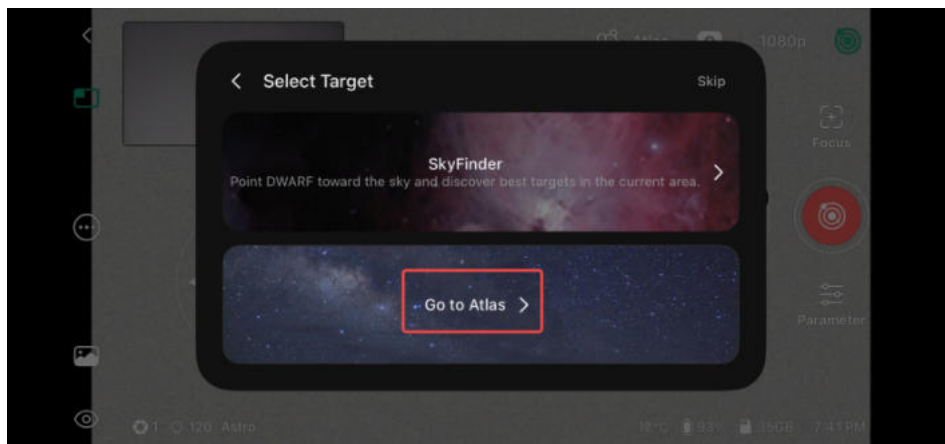
- After a moment, the celestial objects within the wide-angle view—including their names and positions—will be displayed.
- *Please note that manually moving the DWARF 3 will require a re-identification. However, if you use the virtual joystick in the bottom-left corner to move the device, the visible targets will update in real-time.



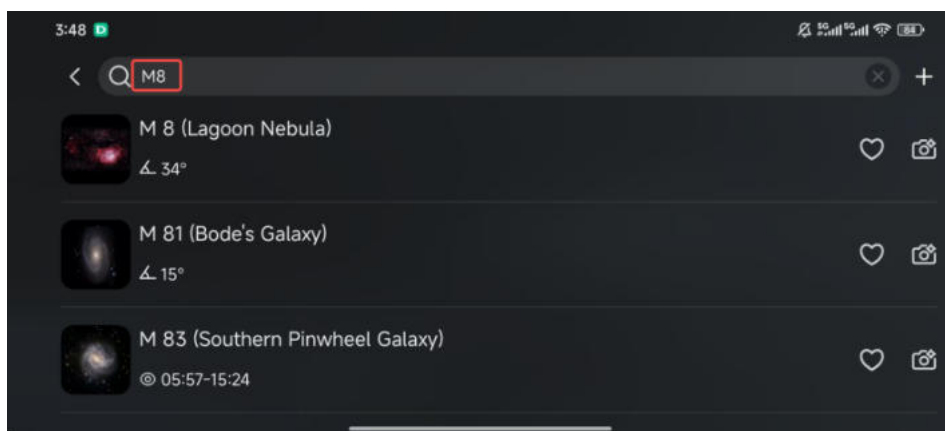
- Tap a target and select the camera icon on the right to start GoTo for that object. DWARF 3 will automatically perform **calibration, positioning, and tracking** all by itself. Sit back and let the telescope do its thing.



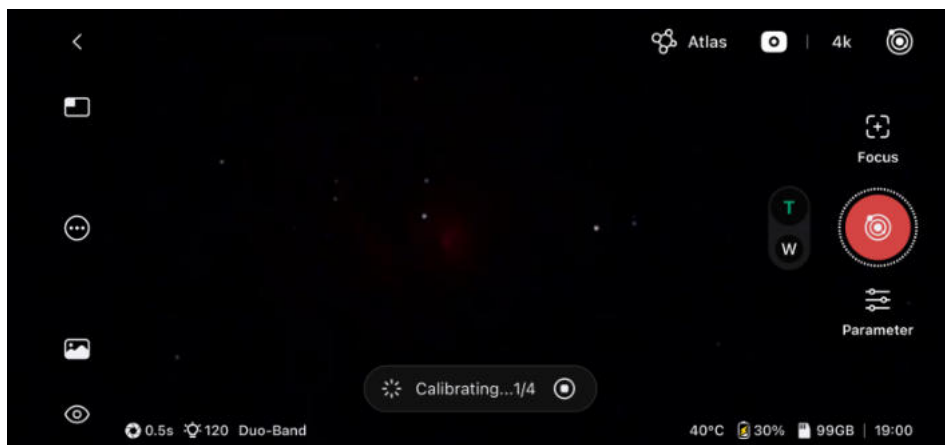
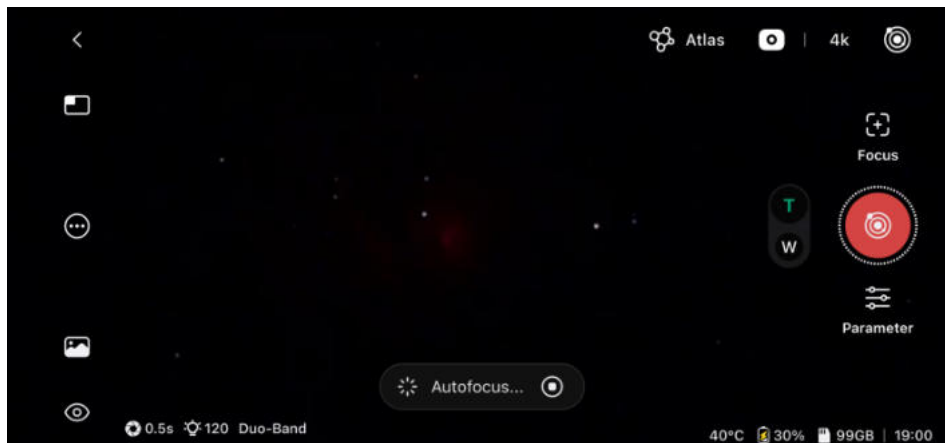
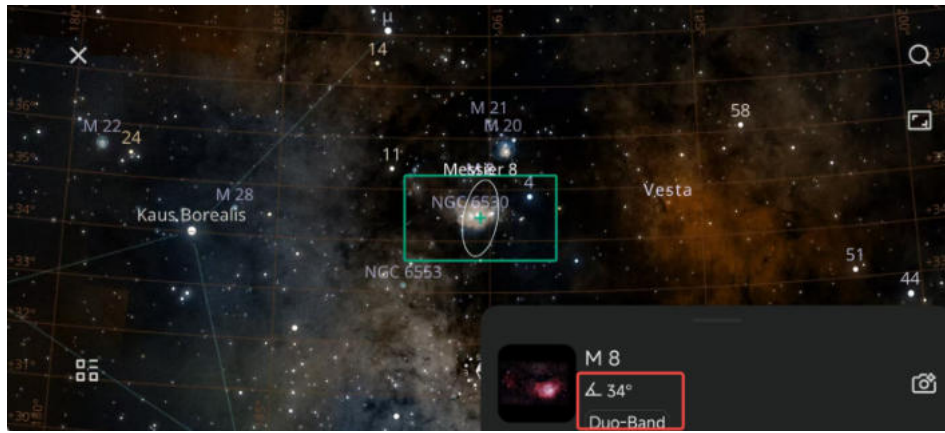
Option 2: Sky Atlas



- Tap the **Star Atlas**, then open **Search**. You’ ll see a list of celestial objects available for imaging. Since our goal tonight is Lagoon, simply choose **Lagoon** from the list.

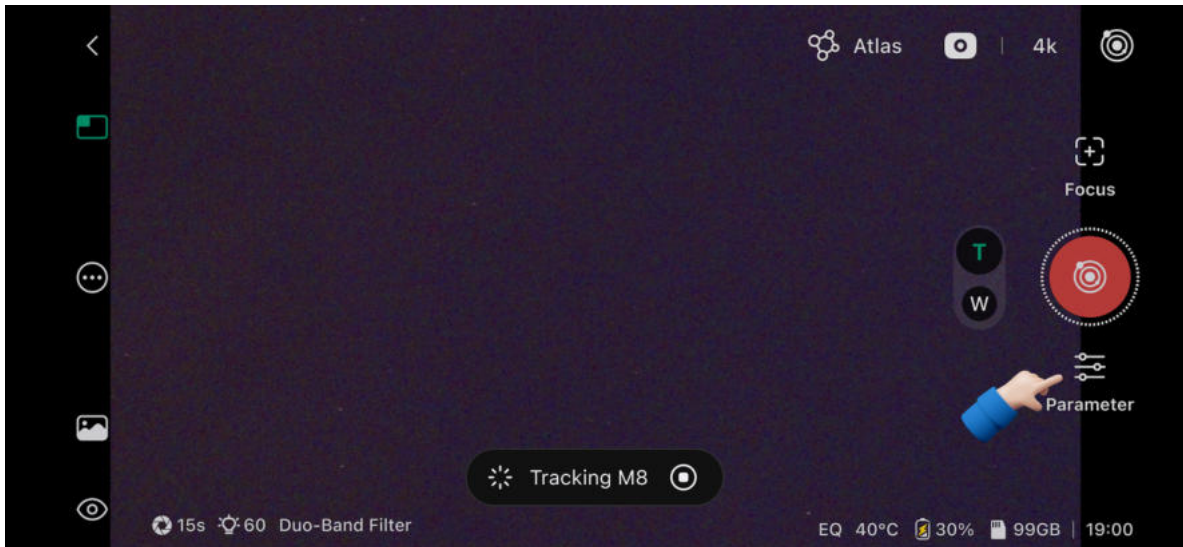


- Tap the **small camera icon** on the right. DWARF 3 will automatically perform calibration, positioning, and tracking all by itself. Sit back and let the telescope do its thing.

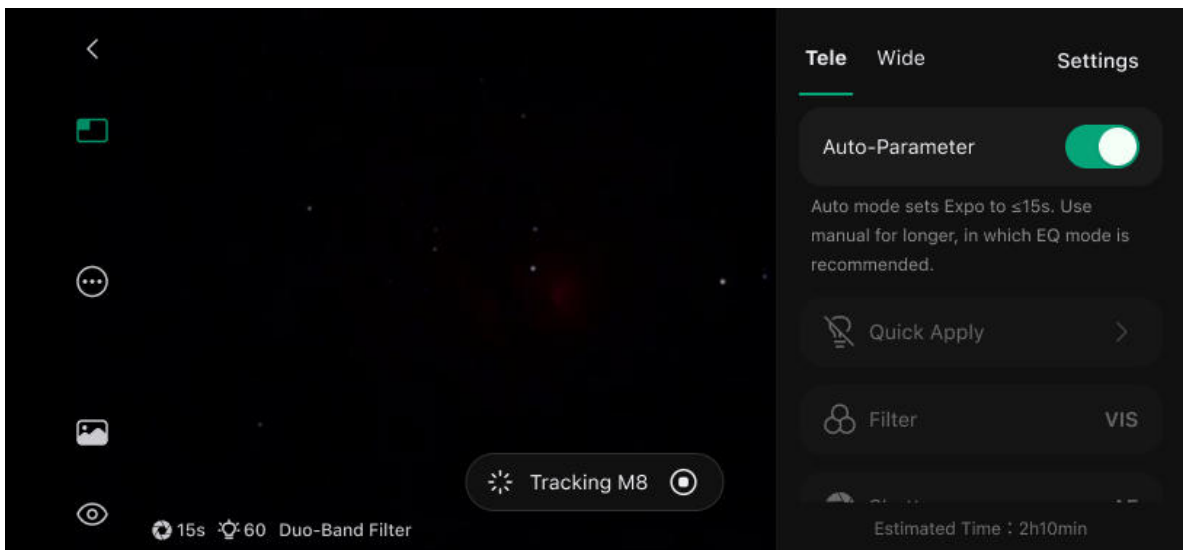


3.2.1.1.3 Adjusting Parameters

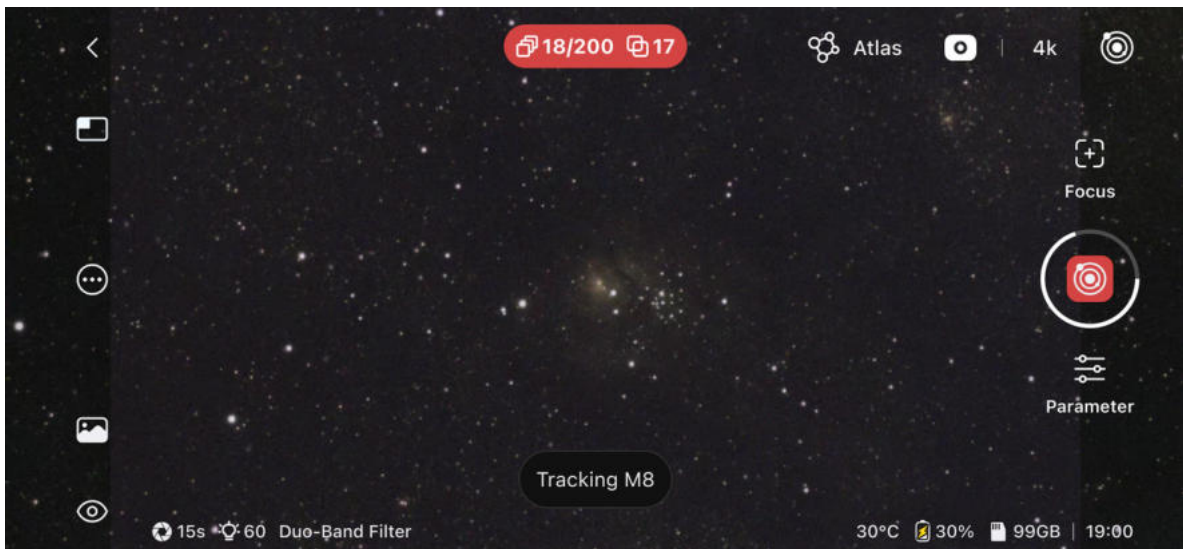
- Once DWARF 3 has locked on to the target, it's time to adjust the parameters for this session. Tap **Parameters** and open the **Telephoto Lens** settings.



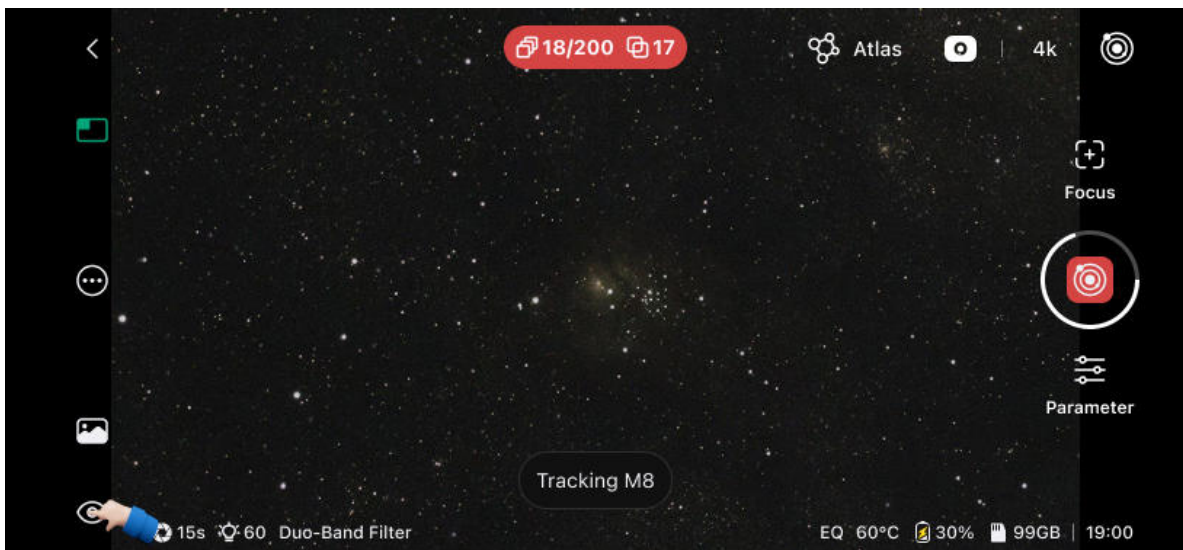
- You'll notice that **Auto Parameters** ③ are enabled, which means the system has already optimized exposure, gain, filter, and stacking numbers for you. It even estimates a total duration of **about 2 hours**. Perfect, no need to worry about all those options!

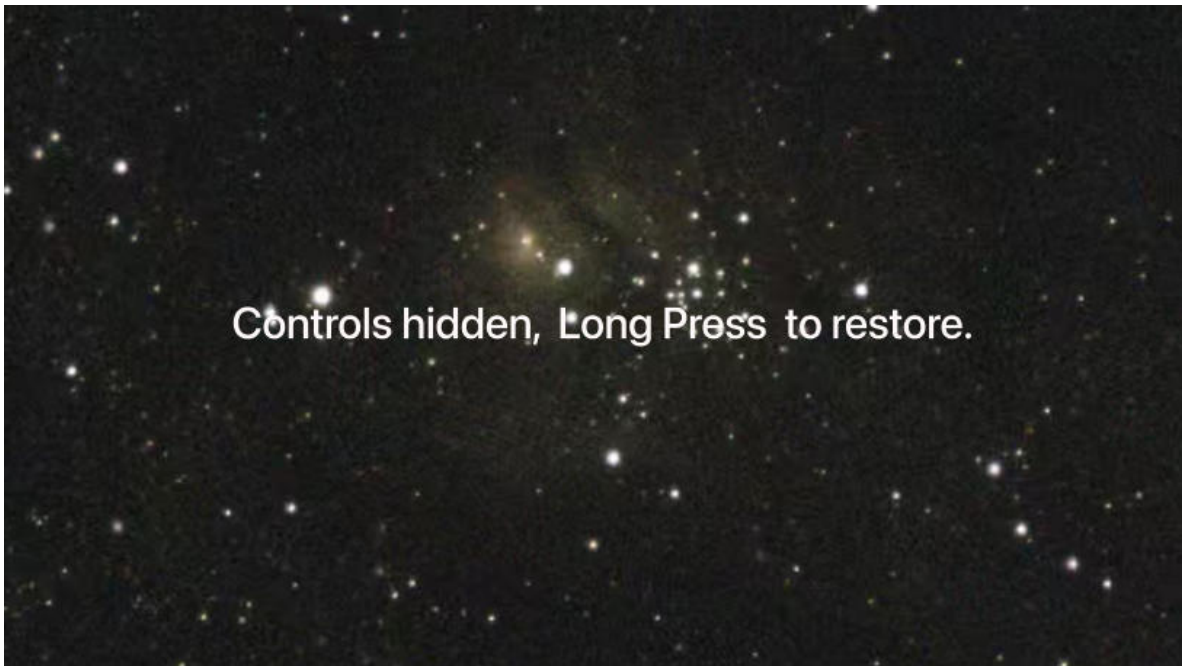


- 3.2.1.1.4 GoTo, Capture & Process**
 - Tap **“Shoot”** ! The **imaging and stacking** process begins automatically.

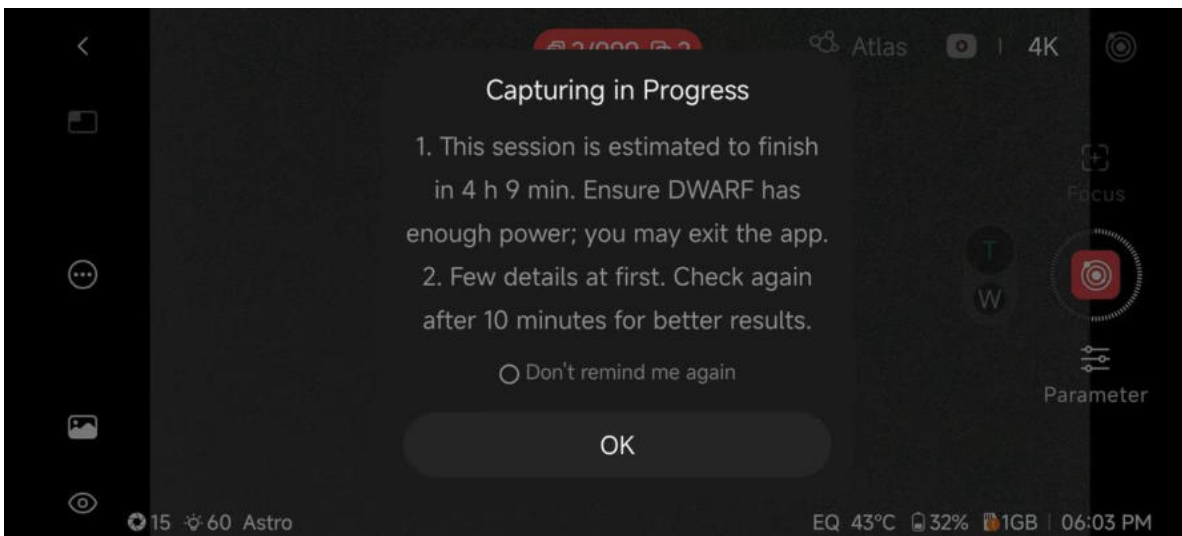


- Use **two fingers to zoom in** and explore more details. Tap the **Hide Controls** button or **press and hold the screen** for an immersive stargazing experience.

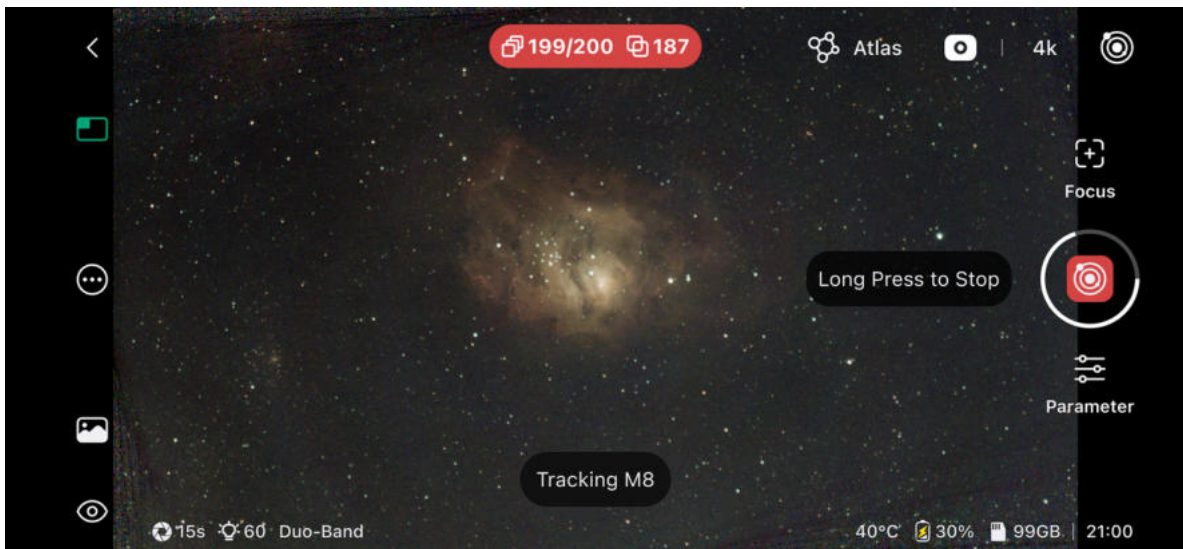




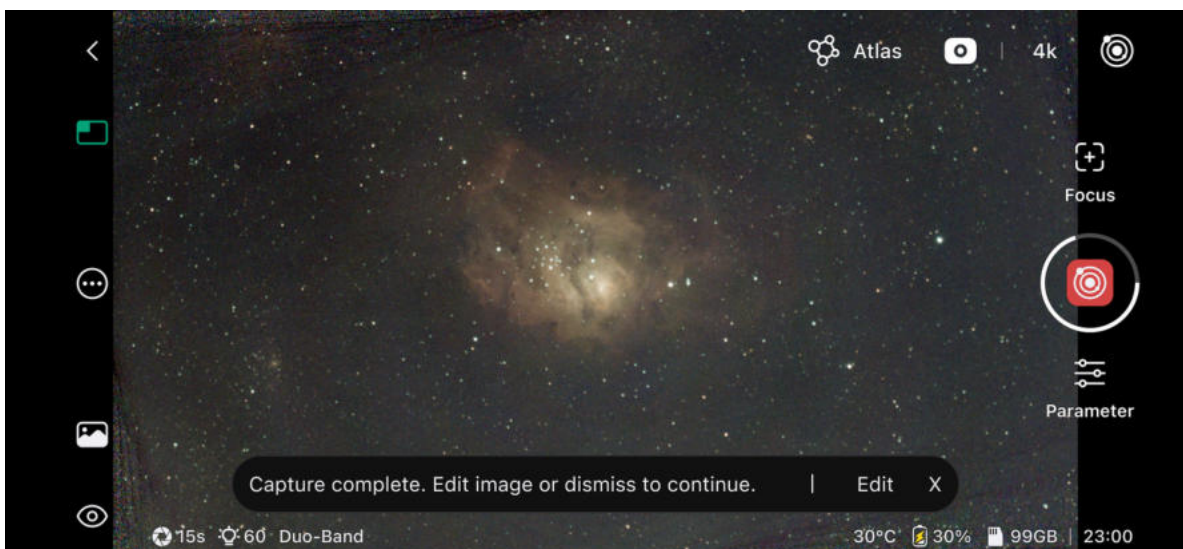
- You can safely **close the app or walk away during the imaging**, DWARF 3 will complete the session on its own.

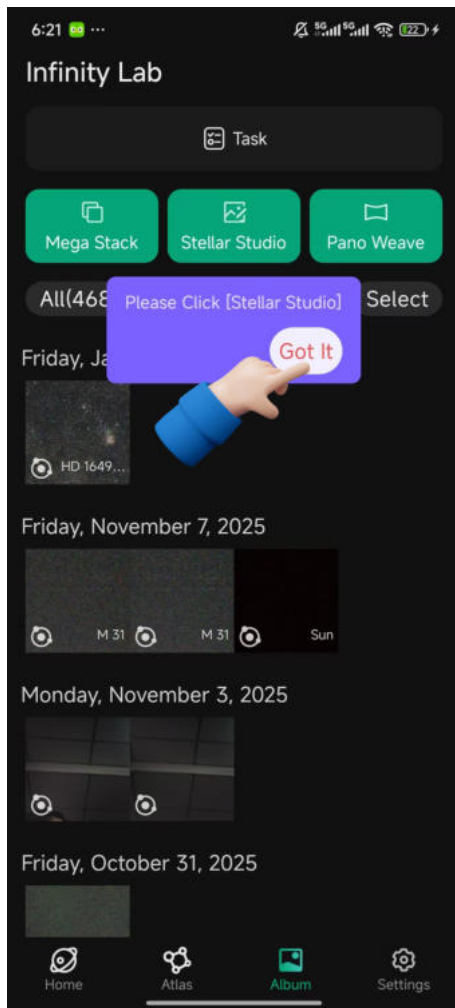


- After several stacked frames, you may think the result looks great enough. **Press and hold to stop the session.**

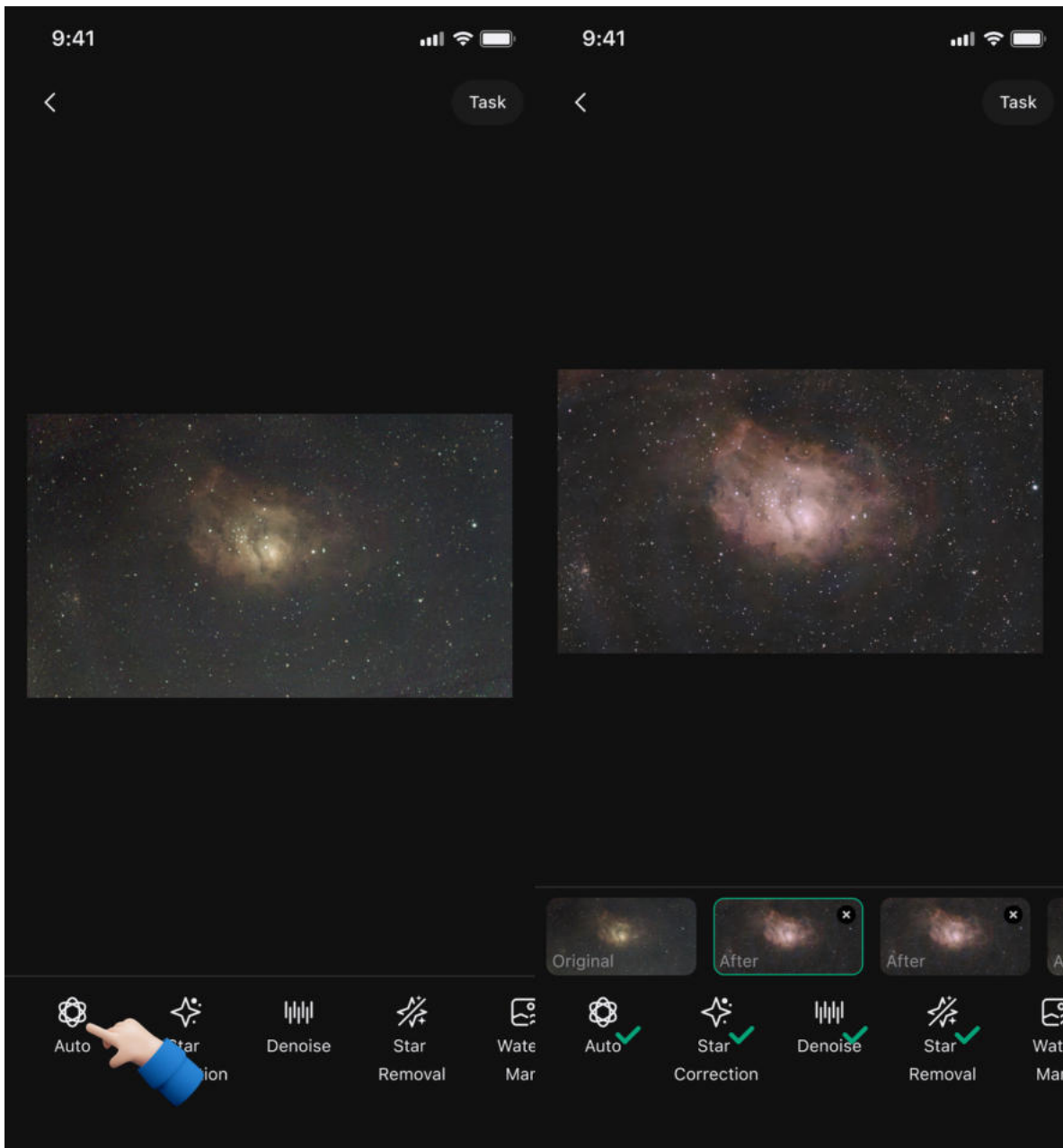


- A message will appear inviting you to begin **post-processing**. Tap it to continue.





- Upload your stacked image, select **Auto**, and wait for processing. Wow — the result looks amazing!



- Select **Watermark**, add the name, and share This masterpiece with friends!

3.2.1.2 Footnotes for (Alt-Az) Astro Imaging

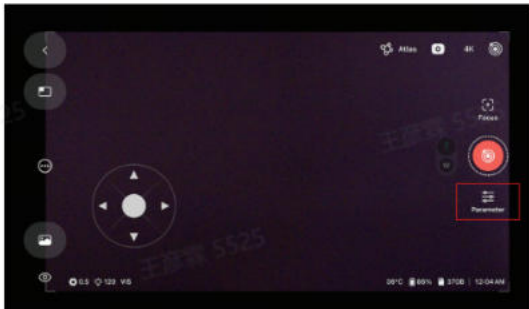
1. Calibration

Calibration is required before astrophotography can start with your DWARF device. During this process, DWARF 3 captures multiple images of the sky and analyzes star patterns. These are matched against the internal star catalog to determine the telescope's orientation and position, enabling accurate target alignment for subsequent observations.

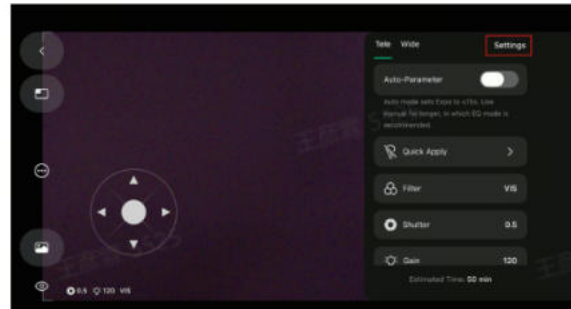
- Ensure the telephoto lens has a clear, unobstructed view of the sky during calibration. Any physical obstructions or thick cloud cover can cause calibration to fail. Always set

up the telescope under a clear sky with visible stars before starting the imaging process.

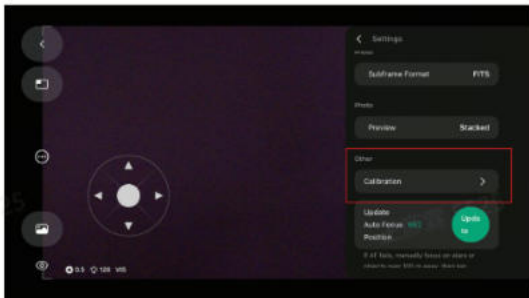
- If at any point you need to manually re-do your calibration, select 1. **Parameters** > 2. **Settings** > 3. **Calibration** > 4. press the "**Calibration**" button. Your DWARF device will start the calibration process and re-attempt to plate solve. Use this function for Alt/Az setups.



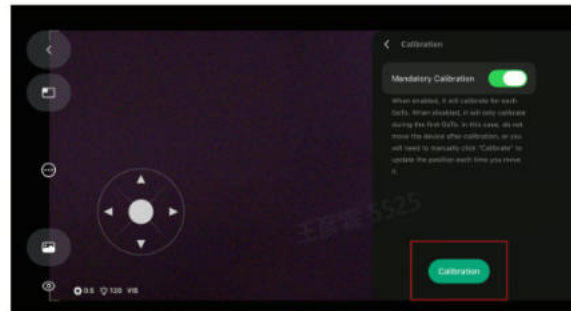
1. Parameters



2. Settings



3. Calibration



4. select "Calibration" to start it manually

2. One-tap GoTo

The **One-tap GoTo** function makes astrophotography effortless. With just a single tap, DWARF 3 completes a series of traditionally complex steps, creating a true **smart astrophotography experience**. The process includes:

- **Auto Focus** — The telescope automatically fine-tunes the lens to make stars as **small and sharp** as possible, locking focus at the optimal point.
- **Calibration** — DWARF 3 captures sky images, recognizes **star patterns**, and matches them with its **built-in star atlas** to determine its direction and attitude.
- **GoTo Target** — After you select a celestial target from the **Sky Atlas**, DWARF 3 calculates the path and **automatically slews to the object's position**. Thanks to calibration, it can point with high precision without manual correction.
- **Tracking** — Once the target is centered, DWARF 3 automatically **locks and tracks** it, continuously compensating for **Earth's rotation** so the object stays in frame during **long-exposure stacking**.

3. Auto Parameters

For first-time users, DWARF 3 provides **Auto Parameters** that automatically set the **filter, shutter speed, gain, and number of frames**.

In **Auto Mode**, the maximum exposure time is **15 seconds**.

If you need a longer exposure, switch to **Manual Mode** for full control of the parameters. (See details in section 3.2.2 “Going for Advanced Deep Sky Session.”)

4. Long Exposure & Stacking

Objects like nebulae and galaxies are extremely faint. To capture them, DWARF 3 combines **long exposure** and **multi-frame stacking** to enhance signal strength.

- **Long Exposure – collecting photons**

During long exposure, the image sensor continually gathers photons from the target. The longer the exposure, the more light is collected, revealing **nebulae and faint structures**.

- **Stacking – enhancing signal, reducing noise**

When multiple frames are stacked, **consistent signal is amplified** while **random noise is averaged out**, resulting in a brighter, cleaner, and more detailed image.

5. Stellar Studio Post-processing

With DWARFLAB’ s **Stellar Studio**, you can easily perform **post-processing** on your phone.

For detailed instructions, see section **3.6 Stellar Studio**.

3.2.2 Going for Advanced Deep Sky Session

Now that Claire’ s first session went smoothly, let’ s see how the experienced astrophotographer, **Sue**, approaches her observation.

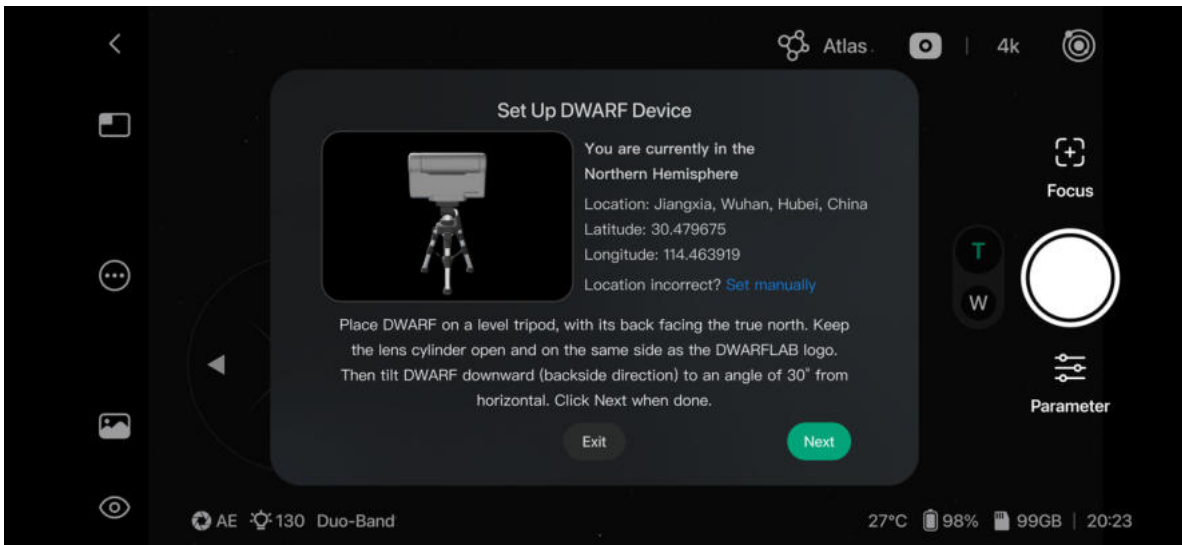
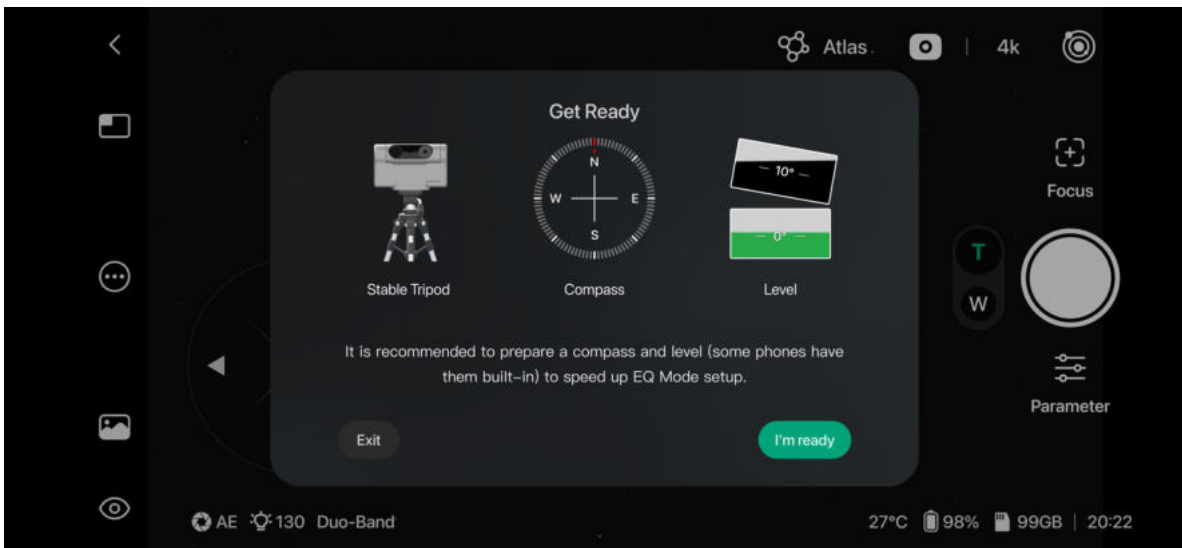
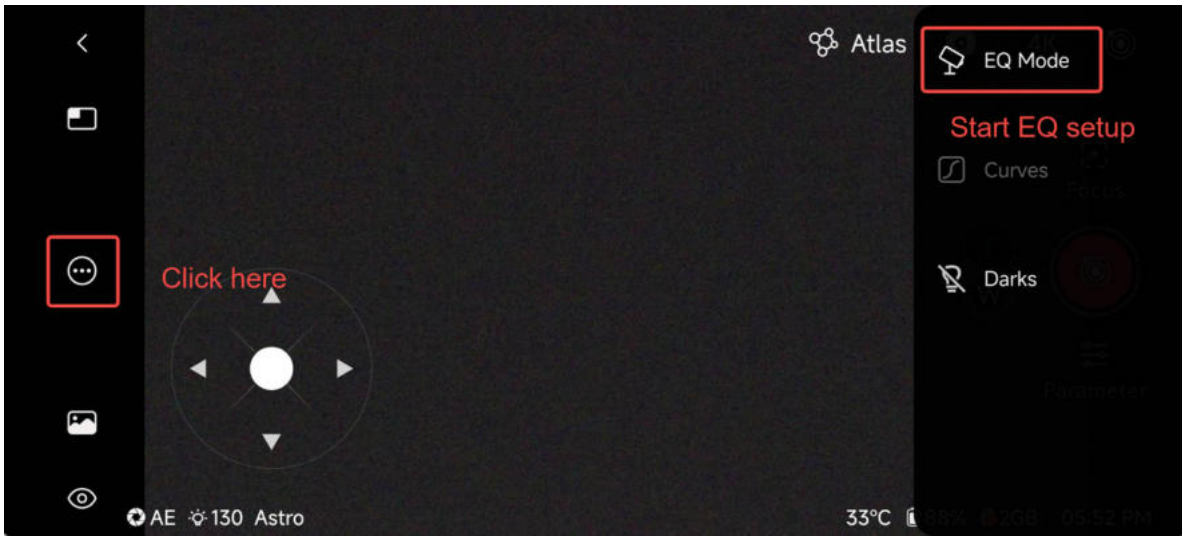
Goal: Complete a deep-sky imaging session

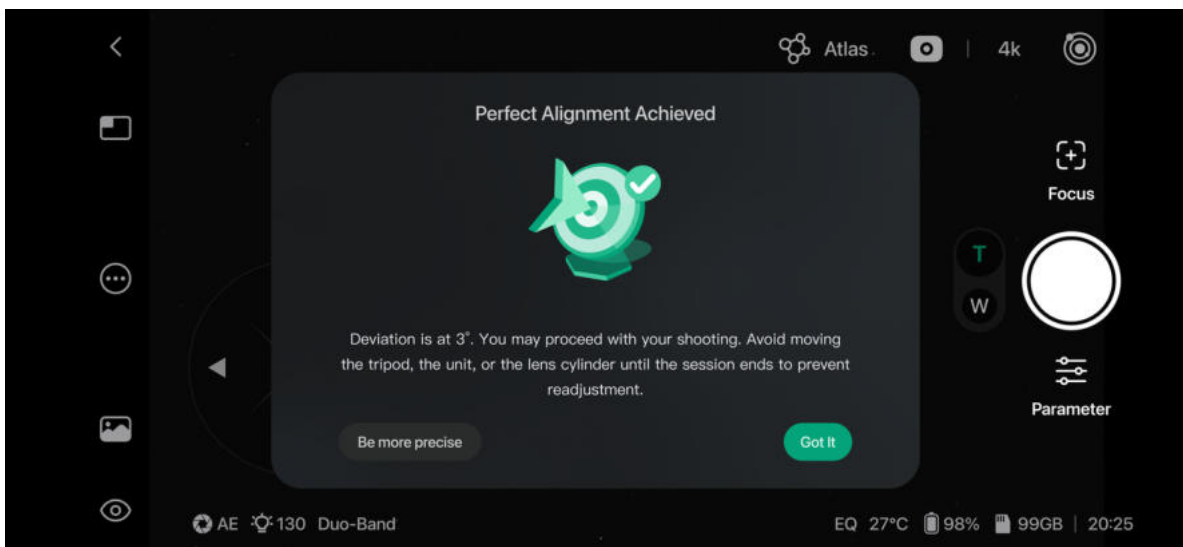
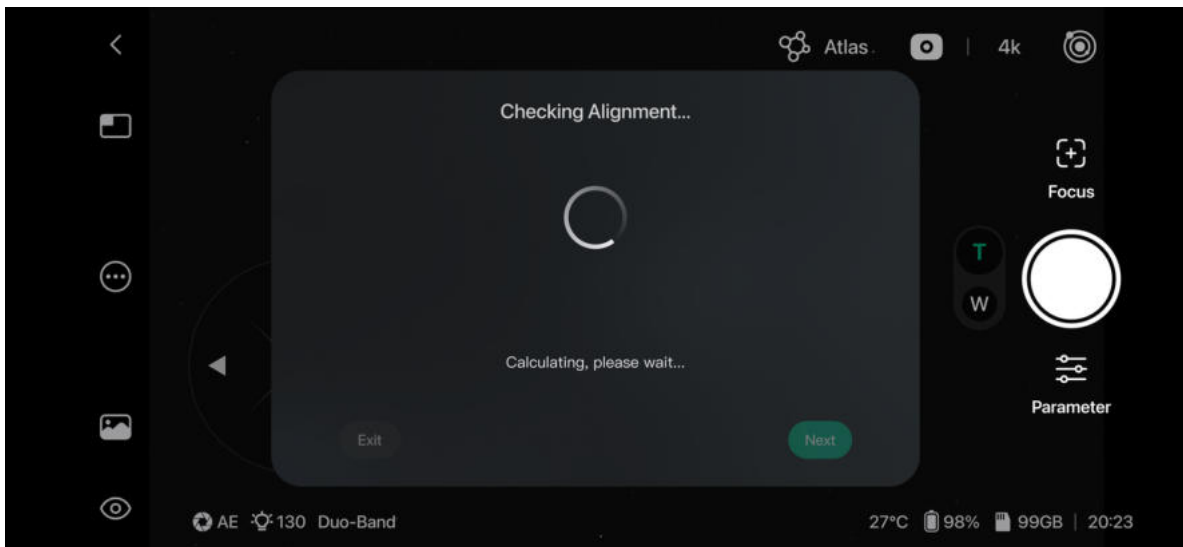
Preparation: DWARF 3, smartphone (or tablet), tripod (for EQ set up, optional), solar filter (for shooting darks; optional), power bank (for long term sessions, optional)

3.2.2.1 Steps:

3.2.2.1.1 Setup DWARF (EQ)

- As a seasoned user, **Sue sets up her DWARF 3 on a tripod** under a sky with plenty of visible stars. She powers it on, connects it to her phone, and enters **Deep Sky Mode**.
- Then she taps **EQ** on the left panel and, following the on-screen guide and animation, focus first, adjusts the mount & the scope until **the alignment** is properly configured.



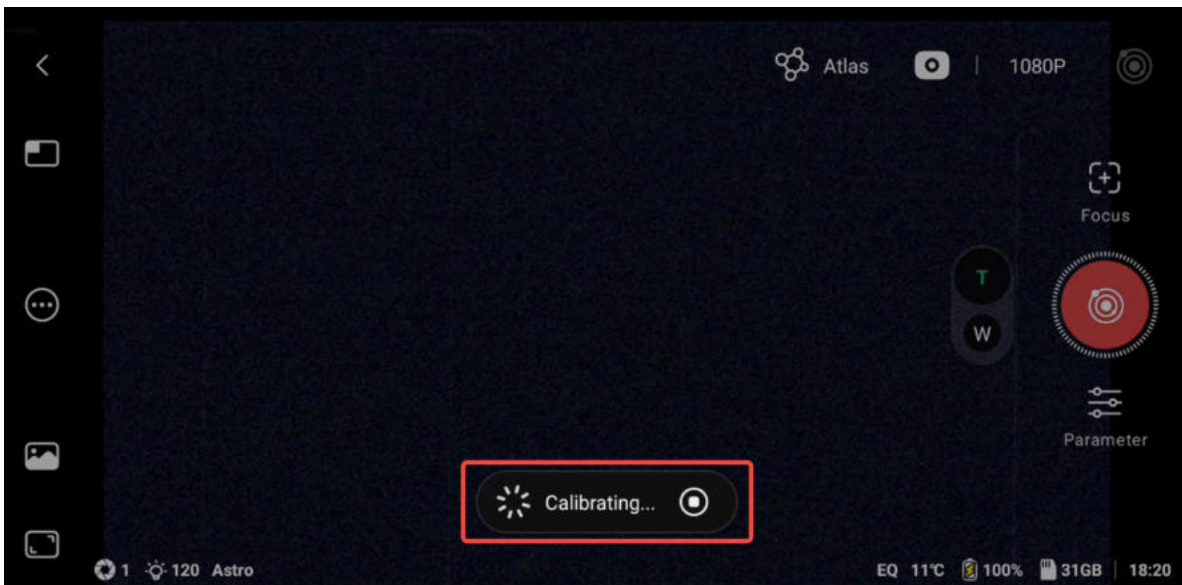


3.2.2.1.2 Set Target & Parameters

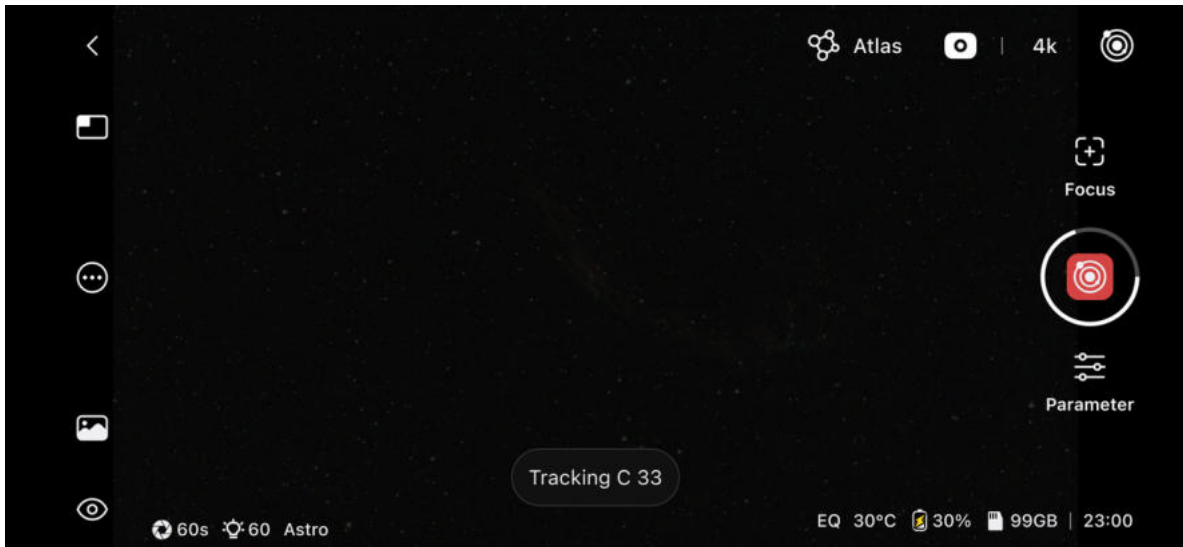
- Then she opens the **Sky Finder** or **Star Atlas** to browse potential targets for the night. Targets with an **altitude above 30°** are ideal. She selects her target — let's call it *Target X*. In Star Atlas, she notes that the **recommended filter** is *Filter Duo-Band*. She keeps that in mind for later when setting parameters. Then she taps the **small camera icon** to start GoTo.



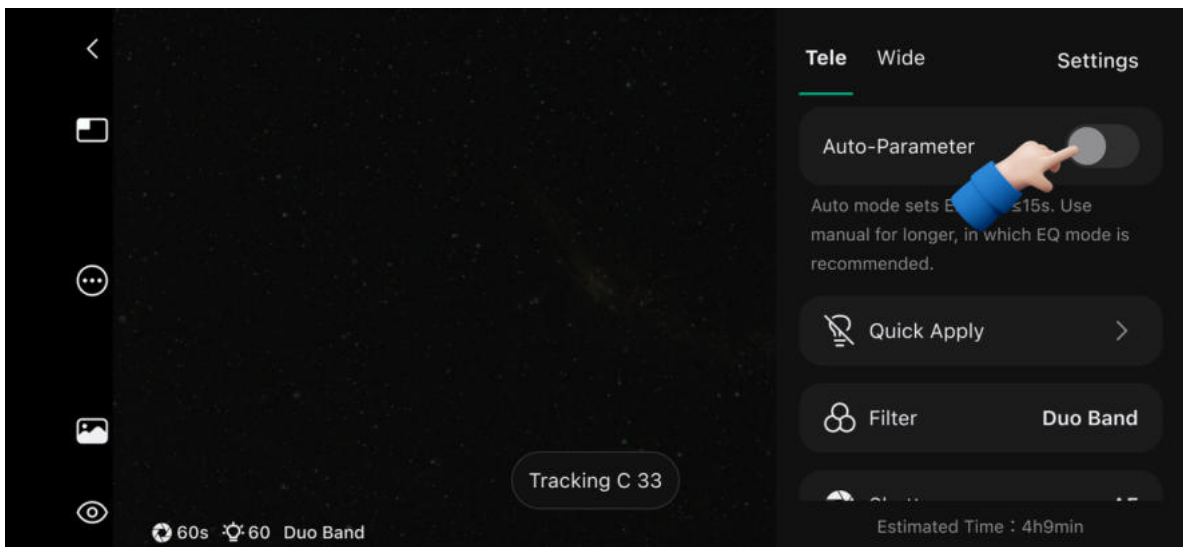
- DWARF 3 quickly calculates and locks on to *Target X*.

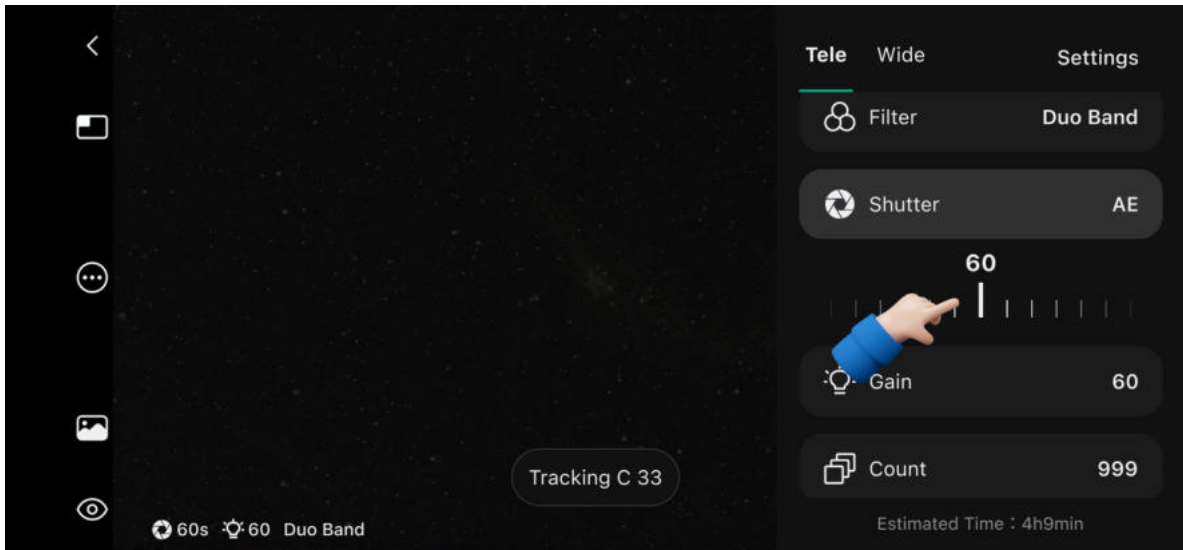


- On tracking X, Sue notices the stars look slightly soft, so she taps the **Focus** button to run **Auto Focus** again. After a few fine adjustments, the stars shrink to perfect points.

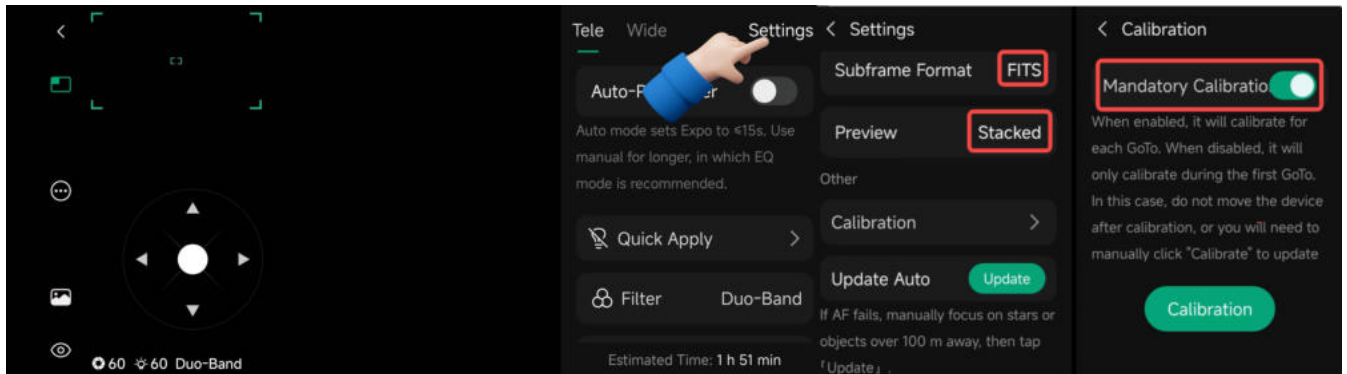


- She plans a **60-second long-exposure session** ③, so she turns off **Auto Parameters**, to perform **Manual Settings** ④, chooses the recommended Duo-Band **Filter**, sets **Exposure/Shutter = 60 s**, **Gain = 60**, and **200 frames** — a solid configuration for deep-sky imaging.





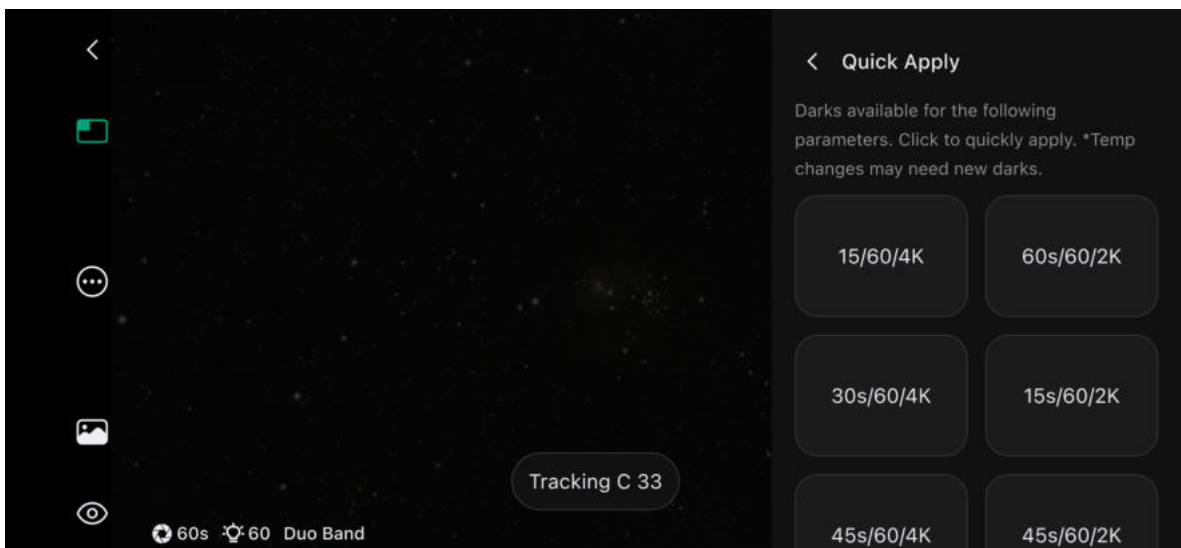
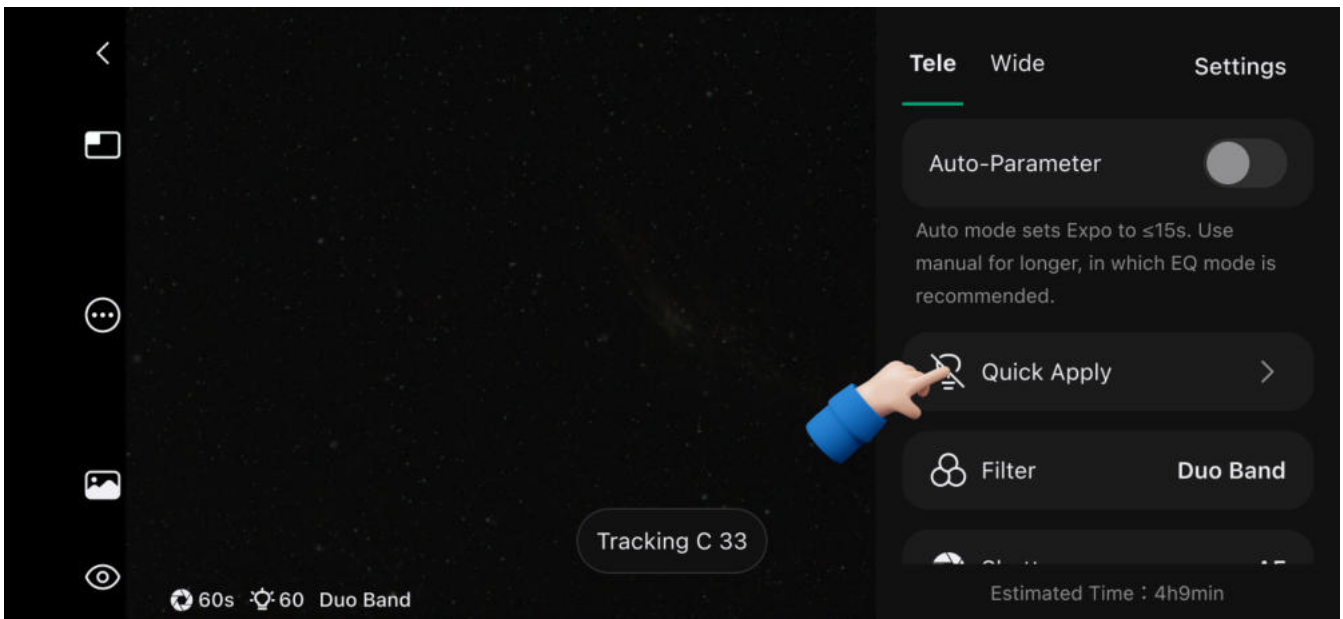
- Then in the **Settings** (top-right corner of the Parameters panel), she reviews the details of this session:



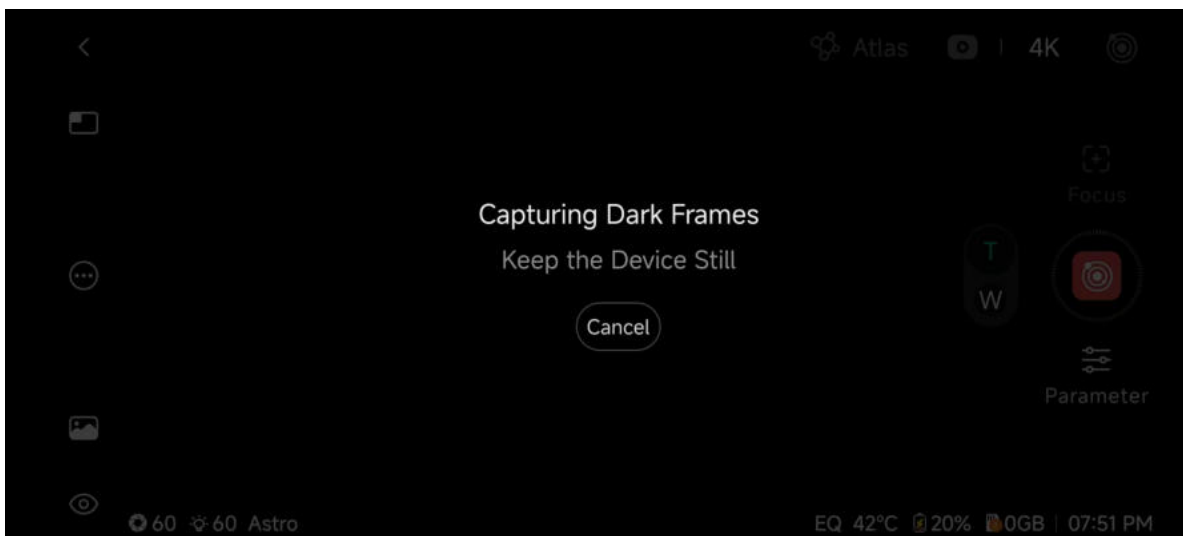
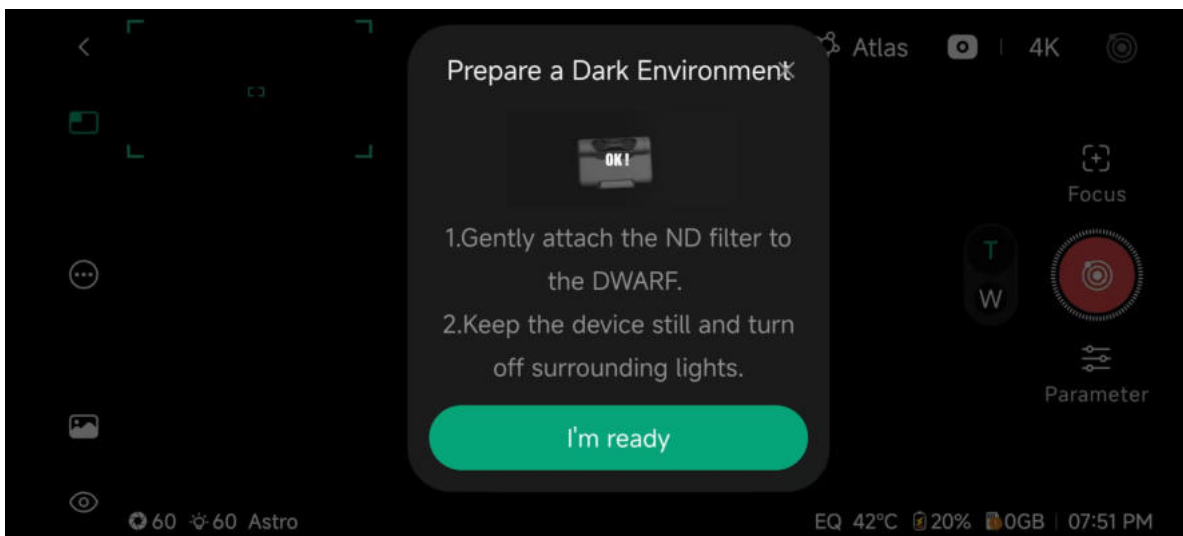
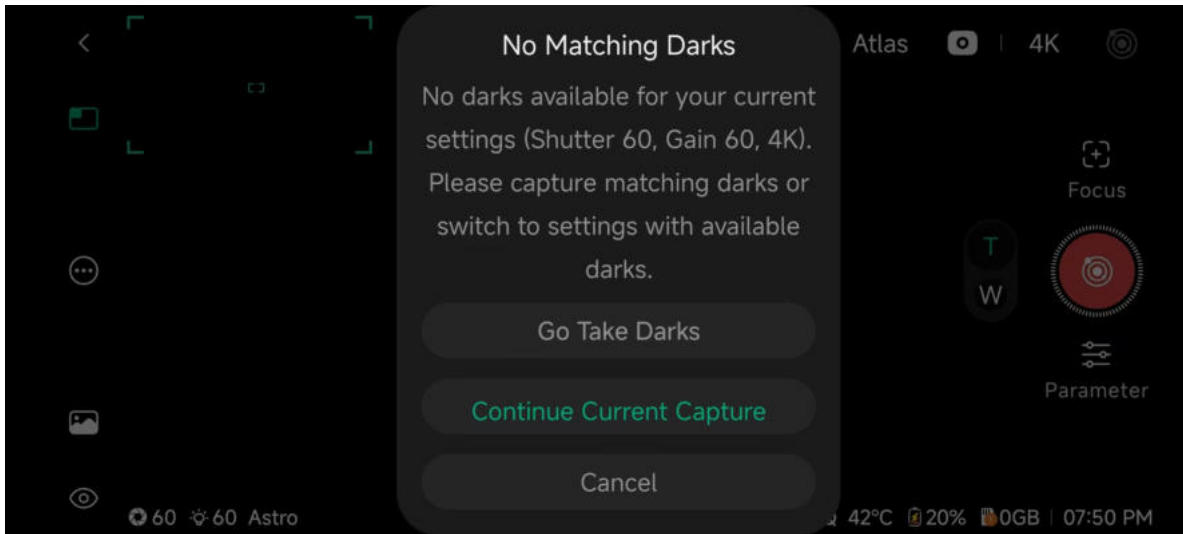
1. **Subframe Format:** FITS
2. **Display:** Stacked Image
3. **Mandatory Calibration:** On
4. **Update Focus Point:** (not needed this time)

3.2.2.1.3 Take Astro Darks

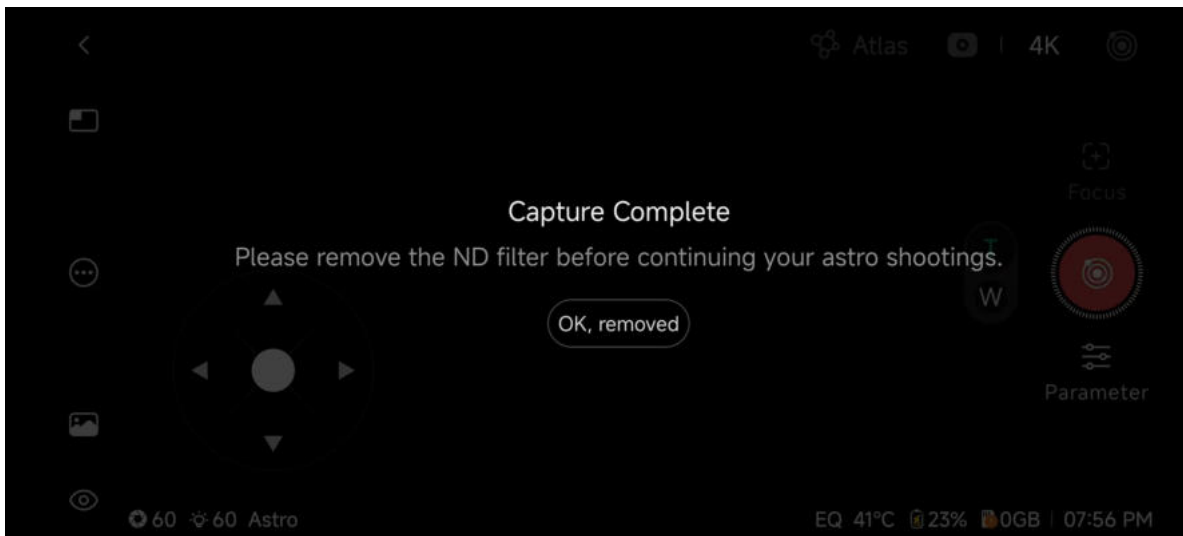
- Returning to the Parameter setting panel, she taps **Quick Apply** and finds that no dark frame matches her chosen parameters, so she'll need to take a new set later.



- Everything's ready. Sue taps **Shoot**, as expected, a prompt appears asking her to **capture a dark frame** first. Following the instructions, she attaches the filter, turns off nearby lights, and keeps the telescope completely still.

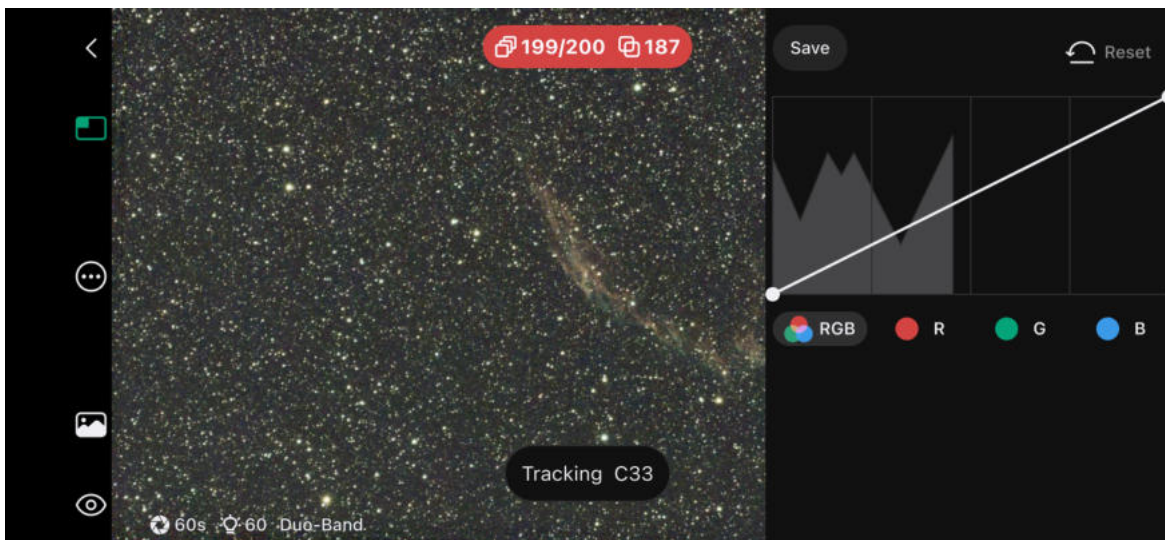


- The process finishes quickly. She removes the filter, hit the following "ok" button, and the scope just resumes to perform the previous shooting automatically, no need to tap shoot again.

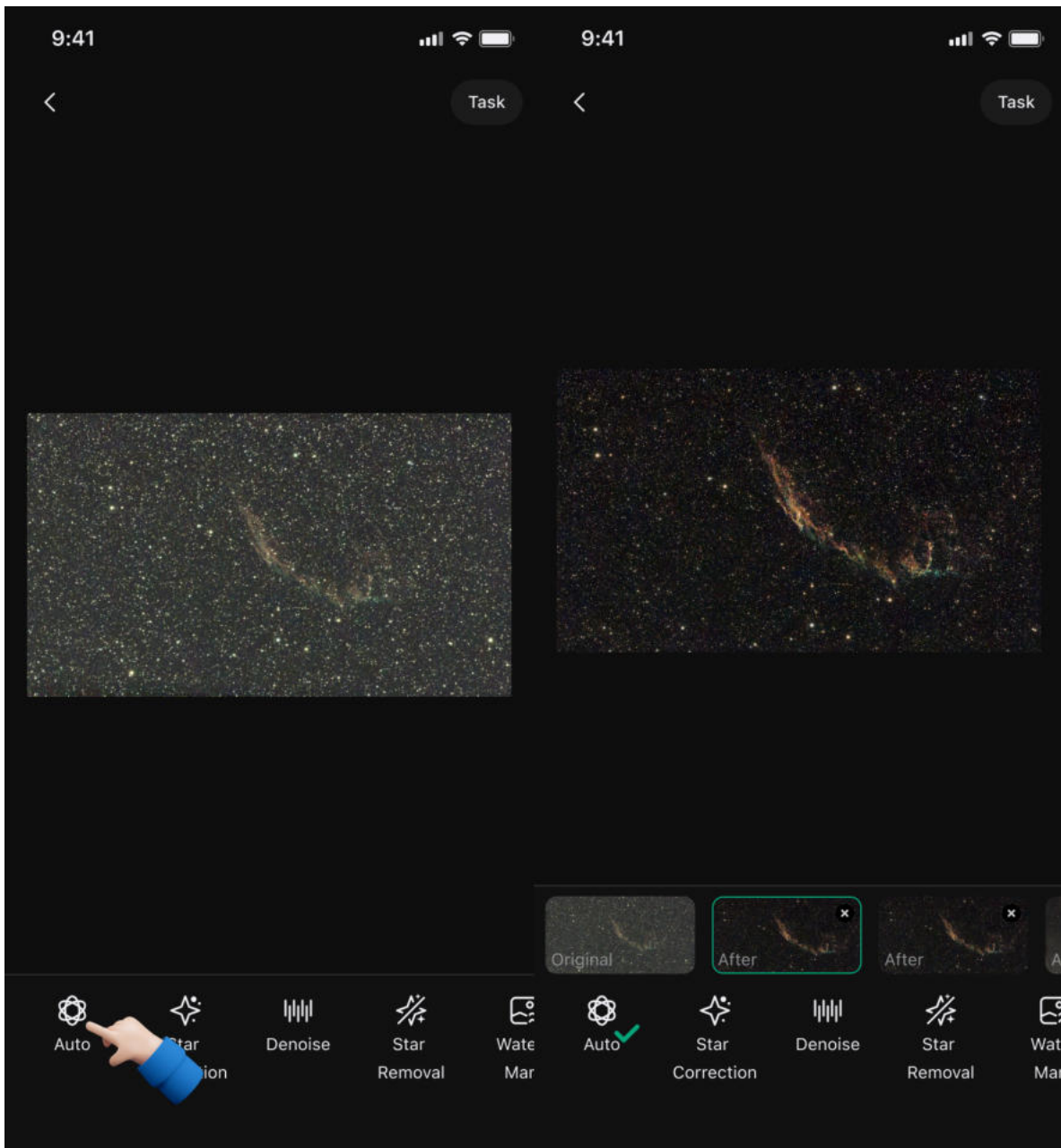


3.2.2.1.4 Processing Image

While the actual imaging & stacking going on, Sue adjusts the **curve** to refine brightness and raise clearness.

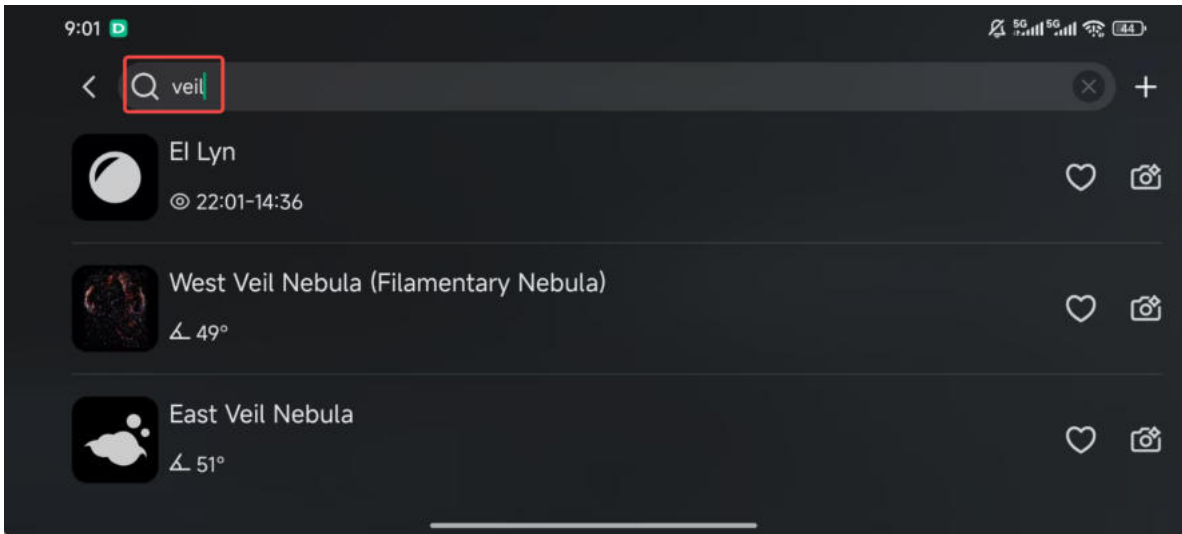


- Once stacking is complete, she proceeds to **post-processing in Stellar Studio**.

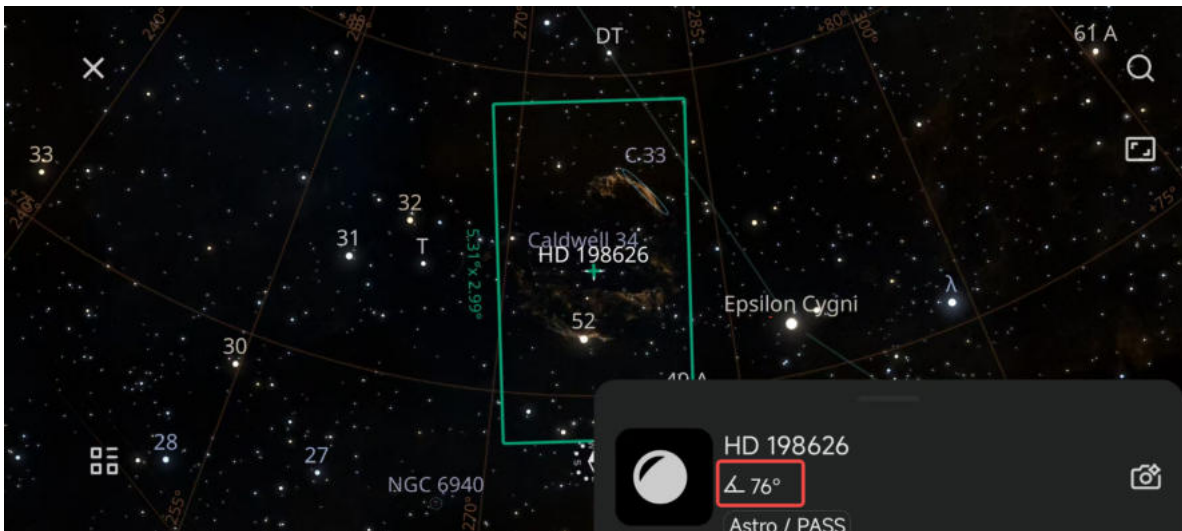


3.2.2.1.5 Take Astro Mosaic

Then Sue decides to capture another object, this time a with a larger view, so she returns to the **Star Atlas** and selects a new target.

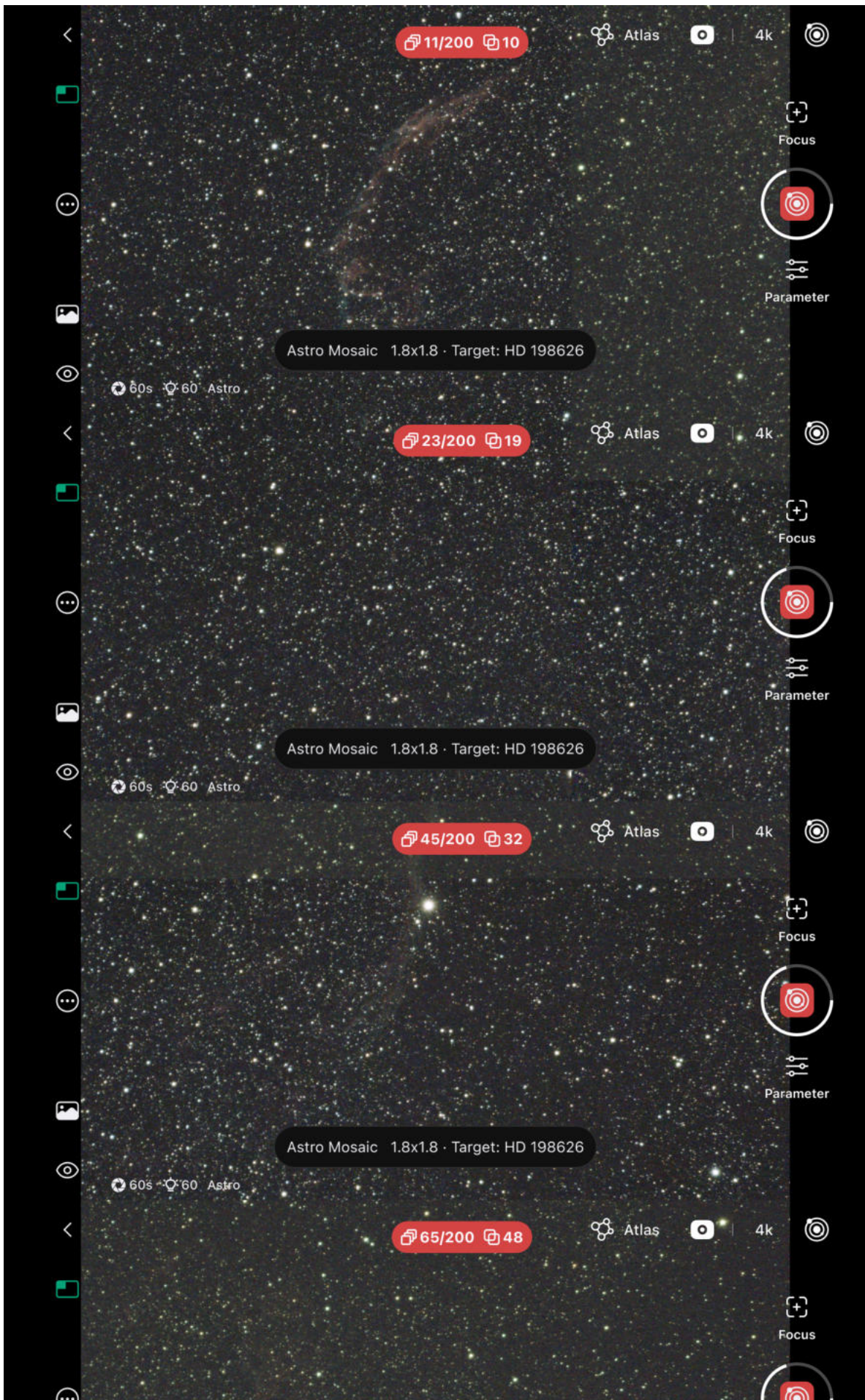


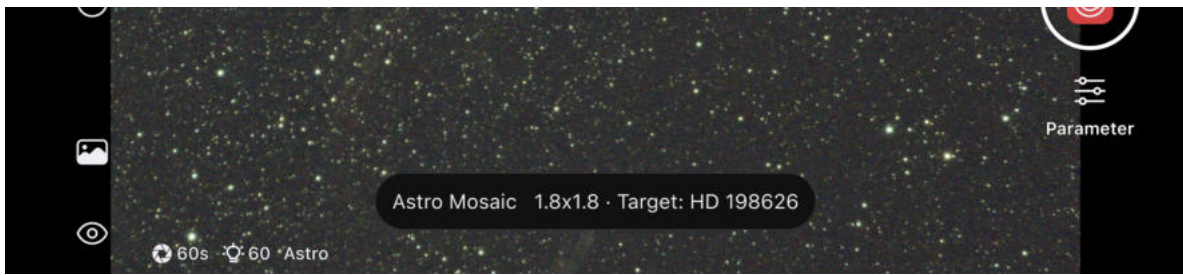
- This time, she attempts a **Veil Nebula mosaic**. She searches for the Veil Nebula, opens the preview frame and adjusts its size & position.



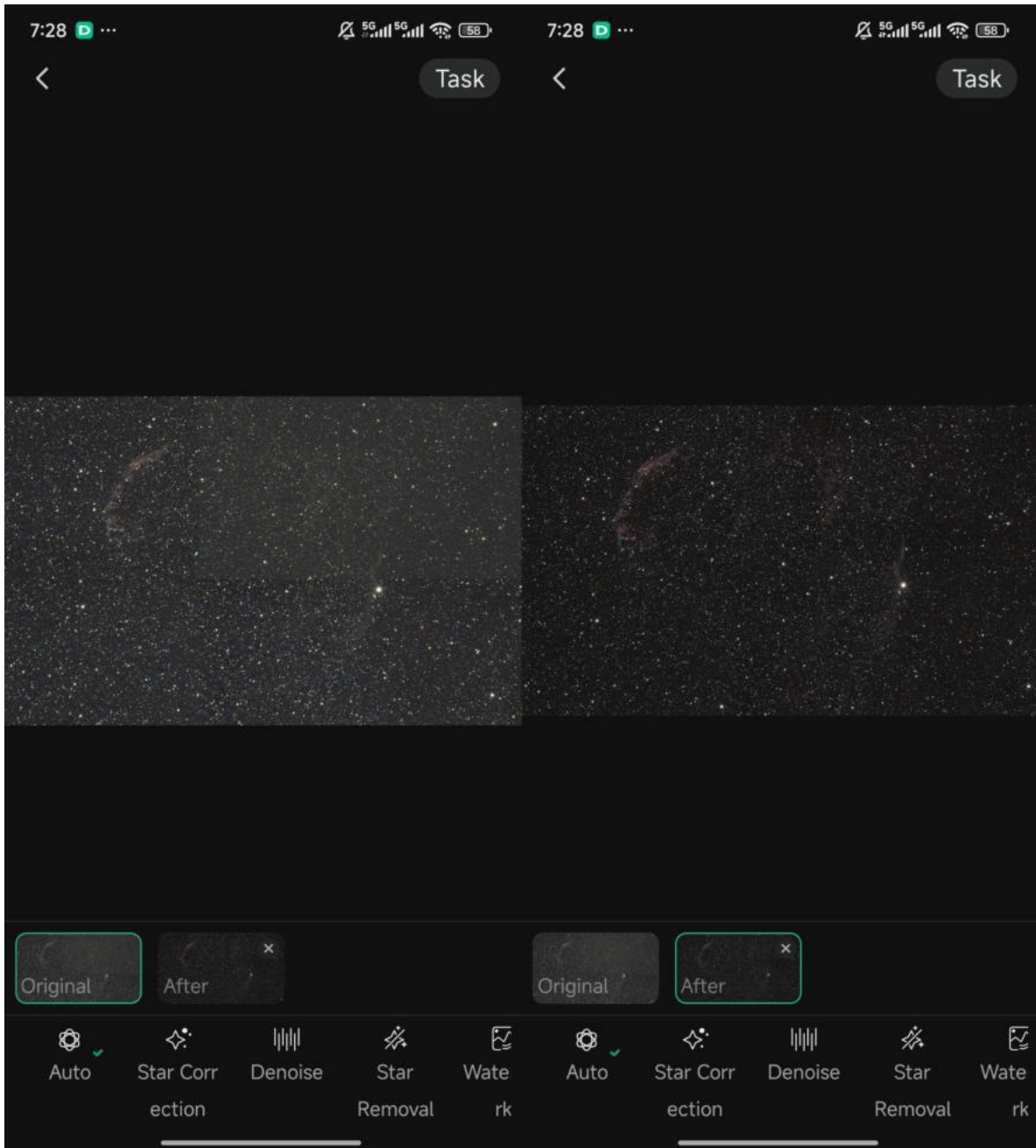
Due to framing adjustments, the final GoTo position may sometimes point to another target or unnamed object near your selected celestial target, which might be displayed as “**Unknown.**”

- She tunes parameters in the settings panel and taps **Shoot** to begin.
- During mosaic imaging, she notices **the view will automatically switches** among segments.

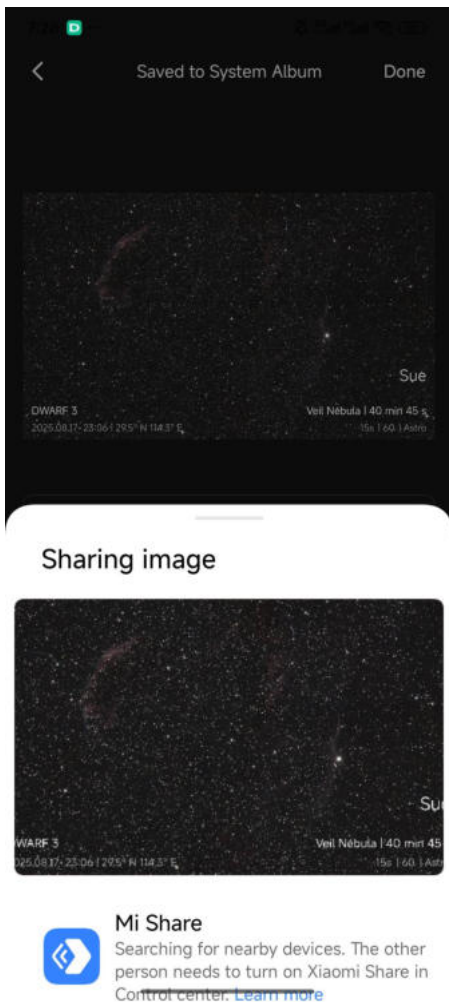




- When complete, she remembers that **mosaic images must be stitched in Stellar Studio** to form the final picture.



- The result looks fantastic, detailed and clean. She shares her masterpiece proudly.



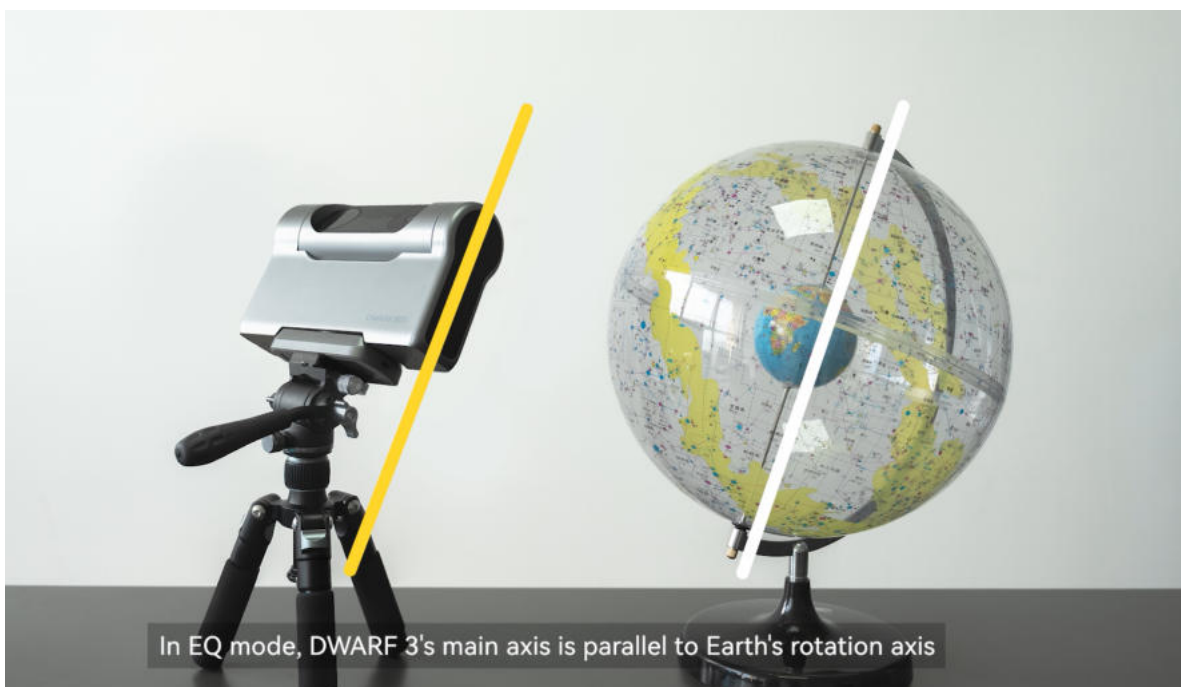
- Her 200 friends react with likes and cheers, what a wonderful night.



3.2.2.2 Footnotes for (EQ Mode) Advanced Session

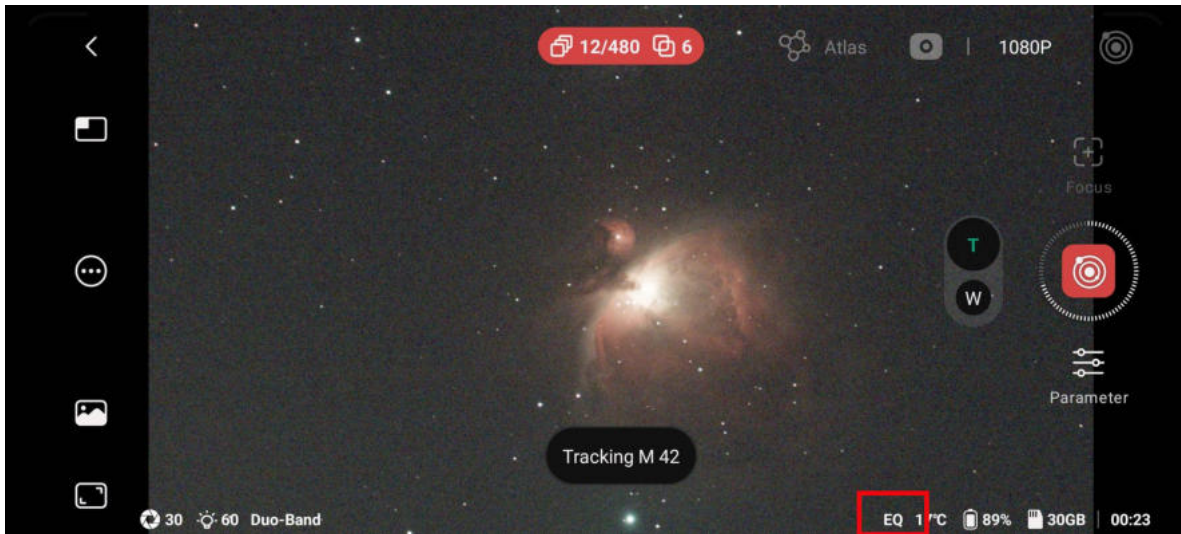
1. EQ Mode

EQ Mode - (Equatorial Mode) is a special tracking setup that lets the DWARF 3 tilt the whole mount so its rotation axis is aligned with Earth's axis, neutralizing the effect of Earth's rotation when tracking the target, ensuring stable tracking during long shutter time reducing field rotation on your stacked image.



Follow the in-App instructions to achieve perfect polar alignment! [Here](#) we also prepared a detailed **video tutorial** for EQ setup.

Once you've completed polar alignment, an **EQ icon** will appear on the screen.



Notes:

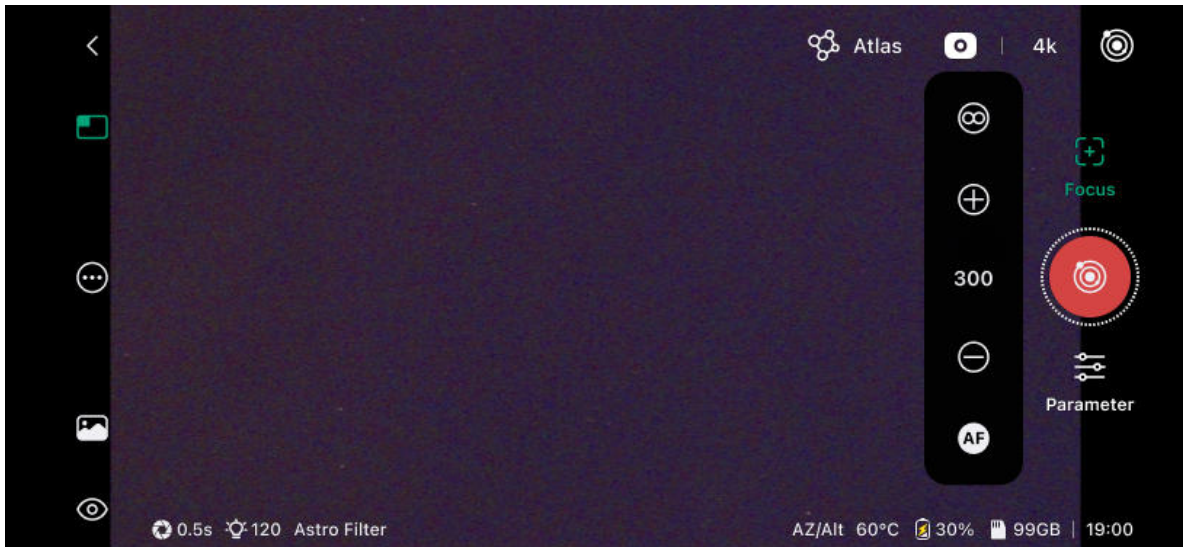
- We recommend setting your scope in EQ mode when you intend to set the exposure to 15 seconds and above. *A recent update has now made it mandatory to be in EQ mode for anything 30 seconds and higher.*
- Astro mosaic imaging (provides a **larger field of view / FOV**) also requires setting the **EQ mode**.
- DWARF 3 does not require you to "see" **Polaris** (Northern Hemisphere) or **Sigma Octantis** (Southern Hemisphere) for EQ (polar alignment) The key is the **axis aligning**, not **target aiming**. So if you don't see it, no worries.

2. Focus

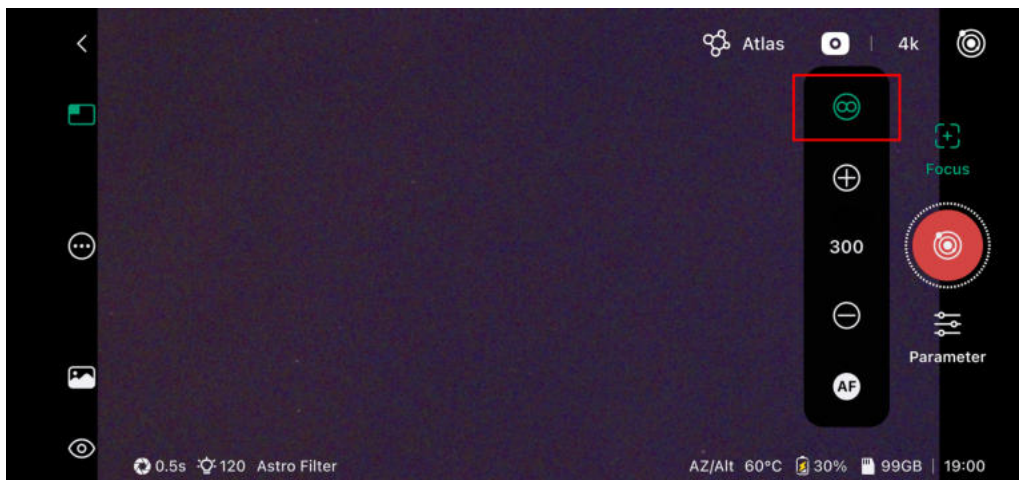
In astrophotography, achieving proper **focus** ensures sharp star points and crisp images, effectively avoiding issues such as blur, halos, distorted or elongated stars, and loss of detail caused by misfocus. **DWARF 3** features an intuitive **Focus Panel**, allowing users to easily perform precise **manual or automatic focusing**.

• Focus Panel

When you open the focus interface, the screen displays various focusing options and a **focus value** that represents the current lens position. You can fine-tune the focus by tapping the **“+” or “-” buttons**. DWARF 3 displays the sharpness of star points in real time to help you judge accuracy. When the stars appear **smallest and brightest**, the focus is correct.



A useful note for astrophotography: the **focal point for deep-sky objects is usually fixed**. The **Infinity Focus** represents this standard focus position for night-sky imaging. DWARF 3 provides a one-tap “**Infinity**” button to quickly return the lens to its preset starlight focus range.



Automatic focus also uses this reference value, and if you find autofocus slightly off, you can **update the infinity focus value** in *Parameters* → *Settings*. (See footnote ⑧ for details.)

3. Long Exposure

Long exposures greatly enhance the **signal-to-noise ratio (SNR)** of astrophotos, allowing faint celestial details to become visible. However, they can also **introduce challenges** in tracking celestial objects. Factors such as **tripod stability**, **light wind**, or even subtle ground vibrations may affect the tracking accuracy, causing **stars to appear elongated** or slightly blurred in the final image.

4. Manual Parameter Settings of DWARF 3

DWARF 3 allows users to freely adjust settings for different targets and environments. With manual exposure control, DWARF 3 is not just an *automatic* telescope, but a **fully adjustable astrophotography tool**. By properly setting exposure, gain, filter, and frame count, you can balance brightness and noise under various lighting conditions and capture your own ideal night sky.

- **Exposure/Shutter Time**

Exposure time determines how long the sensor collects light. Long exposures are ideal for nebulae and galaxies, allowing more light to accumulate.

Recommended exposure: **15 – 60 seconds**.

- **Gain**

Gain is similar to a camera's ISO. A higher value makes the image brighter but increases noise. **Low gain:** cleaner images and higher dynamic range, ideal for bright objects. **High gain:** stronger signal for faint targets, but requires noise control. Balancing exposure time and gain is key to achieving an optimal signal-to-noise ratio.

Recommended gain: **60 – 80**.

In **Deep Sky Mode**, the **minimum gain for tele photo lens is limited to 40**, as lower gains can cause **vertical banding** in stacked astro images.



- **Filters**

DWARF 3 supports multiple filter options.

VIS Filter

The VIS filter blocks ultraviolet and infrared light while allowing visible light to pass through. It is ideal for **daytime or landscape photography**, helping preserve accurate natural colors and image sharpness under sunlight.

- Spectral Range: 430–650 nm

Astro Filter

The Astro filter is designed for **deep-sky and wide-field astrophotography**, where you need to capture both visible and near-infrared light. It works best for **bright nebulae, galaxies, and star clusters**, helping reveal more structure and contrast in faint celestial objects.

- Spectral Range: 430–690 nm

Duo-Band Filter

The Duo-Band filter is specially optimized for **emission nebulae**, transmitting two specific wavelengths — **H α (656.3 nm)** and **OIII (500.7 nm)** — while blocking other light. This filter greatly increases nebular contrast and helps isolate fine gaseous details when the star field looks crowded or messy.

When selecting a target in **Sky Atlas**, the recommended filter will be automatically shown and applied under **Auto Parameters**.



If you find the image filled with too many star points or scattered background stars, try switching to the **Duo-Band filter** for a cleaner and more defined result.

• Frame Count

You can set the total number of frames to capture—100, 200, 500, or more. Each frame will be automatically stacked later. The more frames you take, the **cleaner the signal** and the **richer the final details**.

Recommended frame count: **200 – 400 frames**.

5. Subframe Format

DWARF 3 provides two **RAW image formats** for astrophotography — **TIFF** and **FITS**.

• TIFF Format

A TIFF file is a **high-quality raster image format** that uses lossless compression to preserve color and fine detail. It is widely used by photographers and graphic designers for **post-**

processing and visual editing, making it ideal when you want to adjust your photos in standard editing software.

- **FITS Format**

A FITS file (**Flexible Image Transport System**) is the **standard format used in astronomy**. It was specifically designed to store scientific imaging data, including **photometric calibration, spatial information, and metadata about image origin**. This makes it the best choice for **scientific image stacking, calibration, and analysis** in tools such as *Stellar Studio*, *PixInsight*, or *AstroPixelProcessor*.

Even if you select TIFF as the format, the final stacked image will be in FITS format, while the individual frames will be saved as TIFF.

6. Display Method

DWARF 3 offers two display modes during astrophotography: **Single-Frame Preview** and **Stacked Image View**.

- **Single-Frame Preview**

Shows the most recent frame being captured in real time. This view is useful for **checking focus, exposure, and tracking accuracy** while shooting.

- **Stacked Image View**

Displays the **combined stacking result** that continuously updates as more frames are captured. This mode lets you monitor the gradual improvement of image quality and brightness during long exposures.

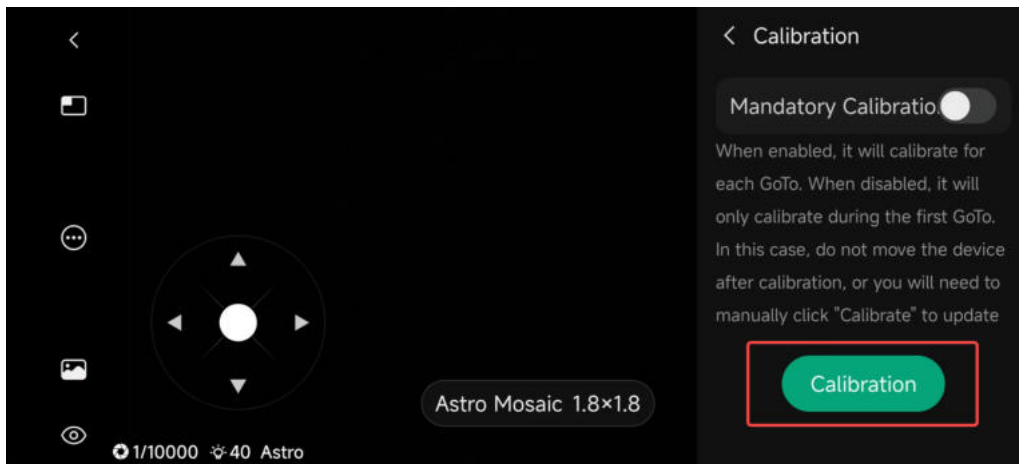
You can **switch between the two modes at any time** during shooting. If you notice the stars drifting or becoming elongated in the single-frame preview, it may indicate tracking instability or tripod movement.

7. Mandatory Calibration

The **Mandatory Calibration** option ensures that every GoTo operation is executed with the highest accuracy, making your astrophotography process **more reliable and precise**. When this setting is enabled, DWARF 3 performs a short calibration sequence before each GoTo to verify its orientation and positioning.

However, calibration takes additional time. If you are already confident that the previous alignment is accurate and the **scope won't be moved again**, you may **disable this option**.

In that case, there won't be another round of calibration **when switching targets**, and the **manual calibration button** will appear on screen whenever you find GoTo is failed and a recalibration is needed.



8. Update Infinity Focus

The **Update Auto Focus (∞) Position** feature allows you to manually redefine the telescope's infinity focus point used for astrophotography.

If **autofocus fails** or does not produce sharp stars, manually adjust the focus until stars appear as fine and sharp as possible, then tap update the position here.

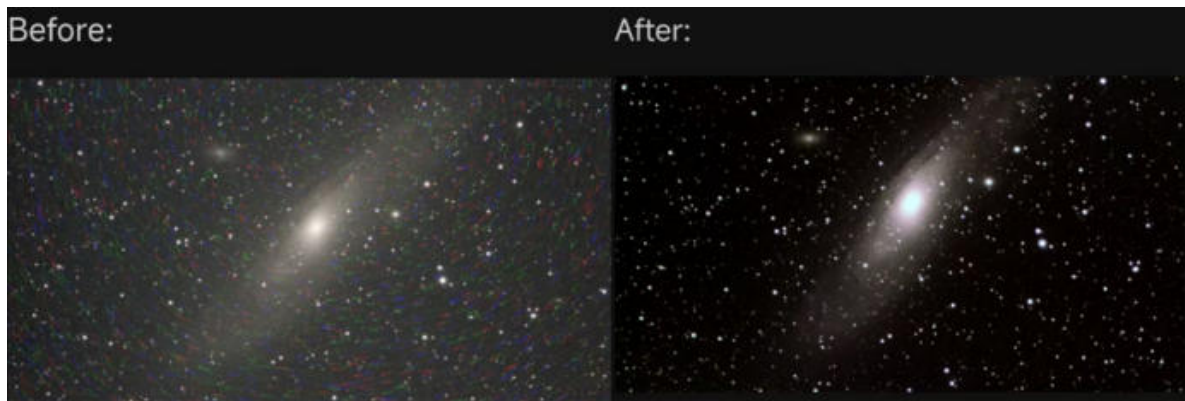
To do this:

- Go to **Focus** and manually adjust your **telephoto lens** on a star field or a **VERY** distant object.
- Return to **Parameter > Settings**, scroll down to **Update Auto Focus Position**, and press **Update**.
- The **three-digit value** displayed will change to your newly defined focus position, which will be used for future autofocus operations.

3.2.3 Dark Frames & Quick Apply

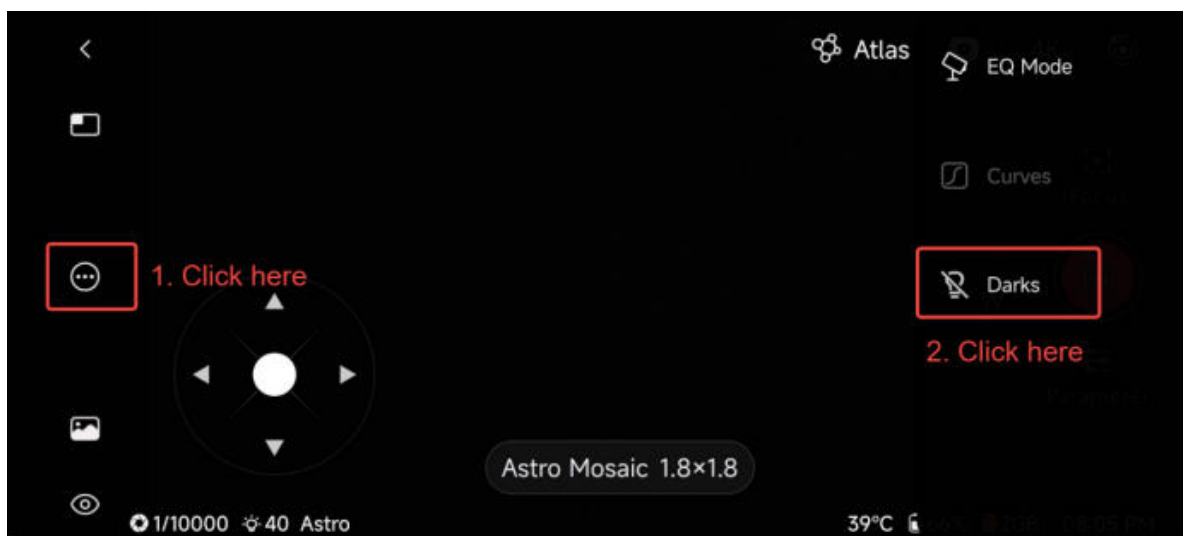
3.2.3.1 What Are Dark Frames

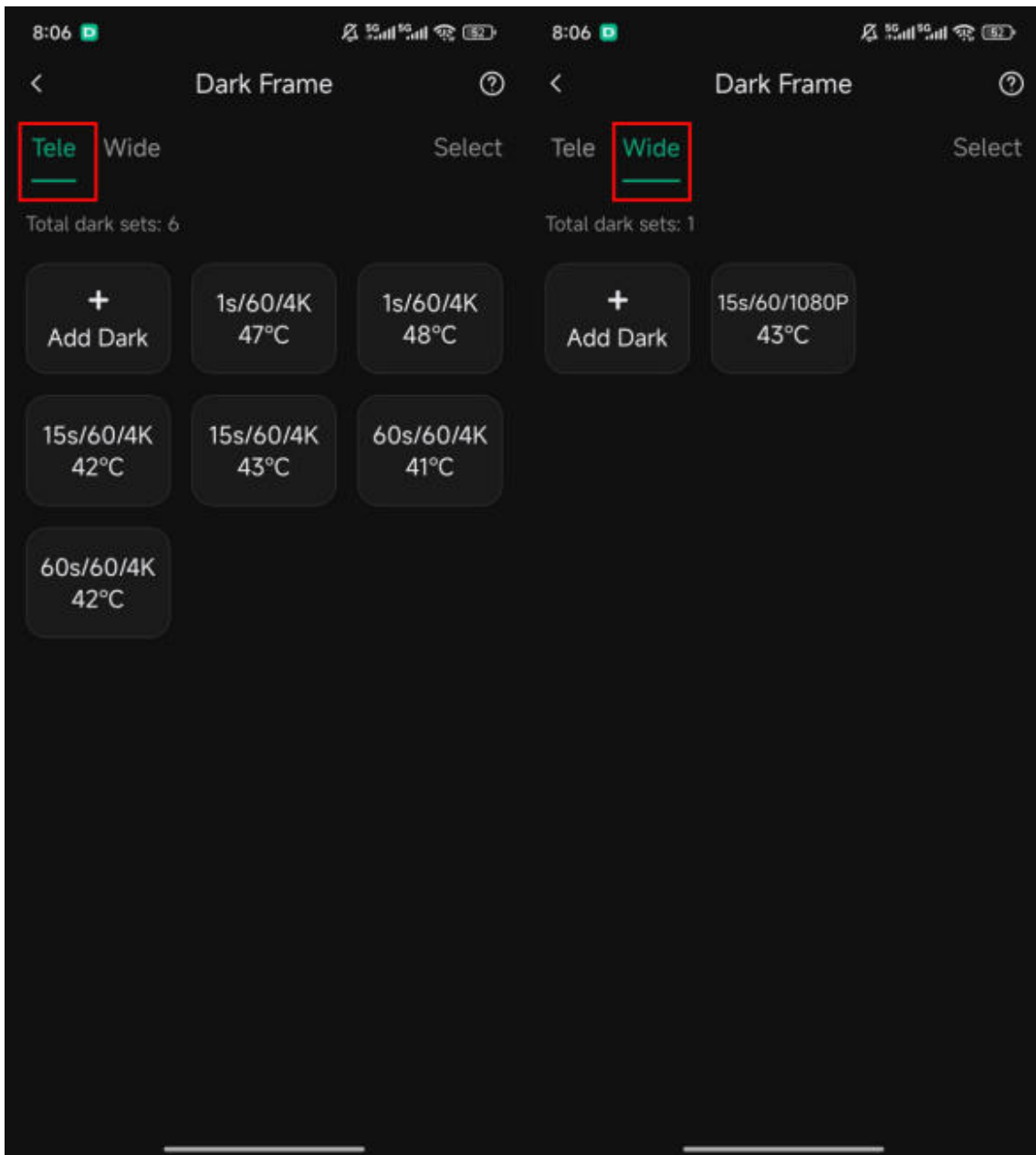
Every camera sensor produces minor electronic noise, appearing as faint speckles, hot pixels, or uneven glow in photos, especially during long exposures. Therefore, we need to capture this dark noise and use it to neutralize our astrophotography images — this process is known as **dark frame calibration**. DWARF will require proper dark frames for each session.



To capture darks, use the DWARF's built-in **Dark Frame** tool: (this will be covered again further down in this section)

- Install the **ND filter**
- Fully **retract the lens cylinder** (closed position)
- Match **exposure, gain, and resolution** exactly to your light frames
- Capture darks at a **temperature as close as possible** to your imaging session (this may involve you needing to place your DWARF device outside and let it acclimate to the current conditions)
- Use the **same lens** you'll be imaging with (Wide or Tele)

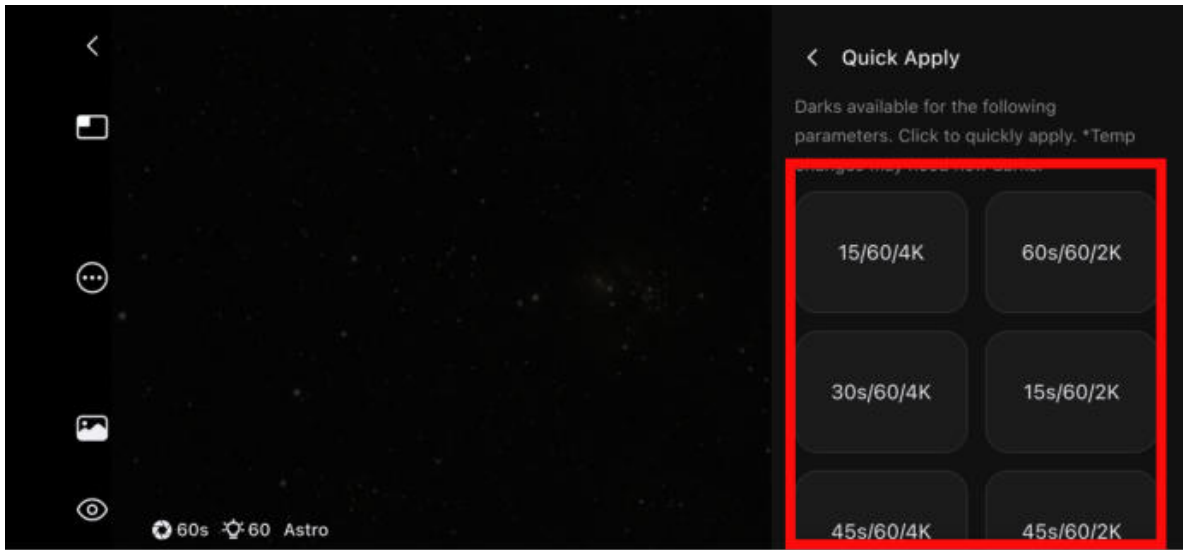




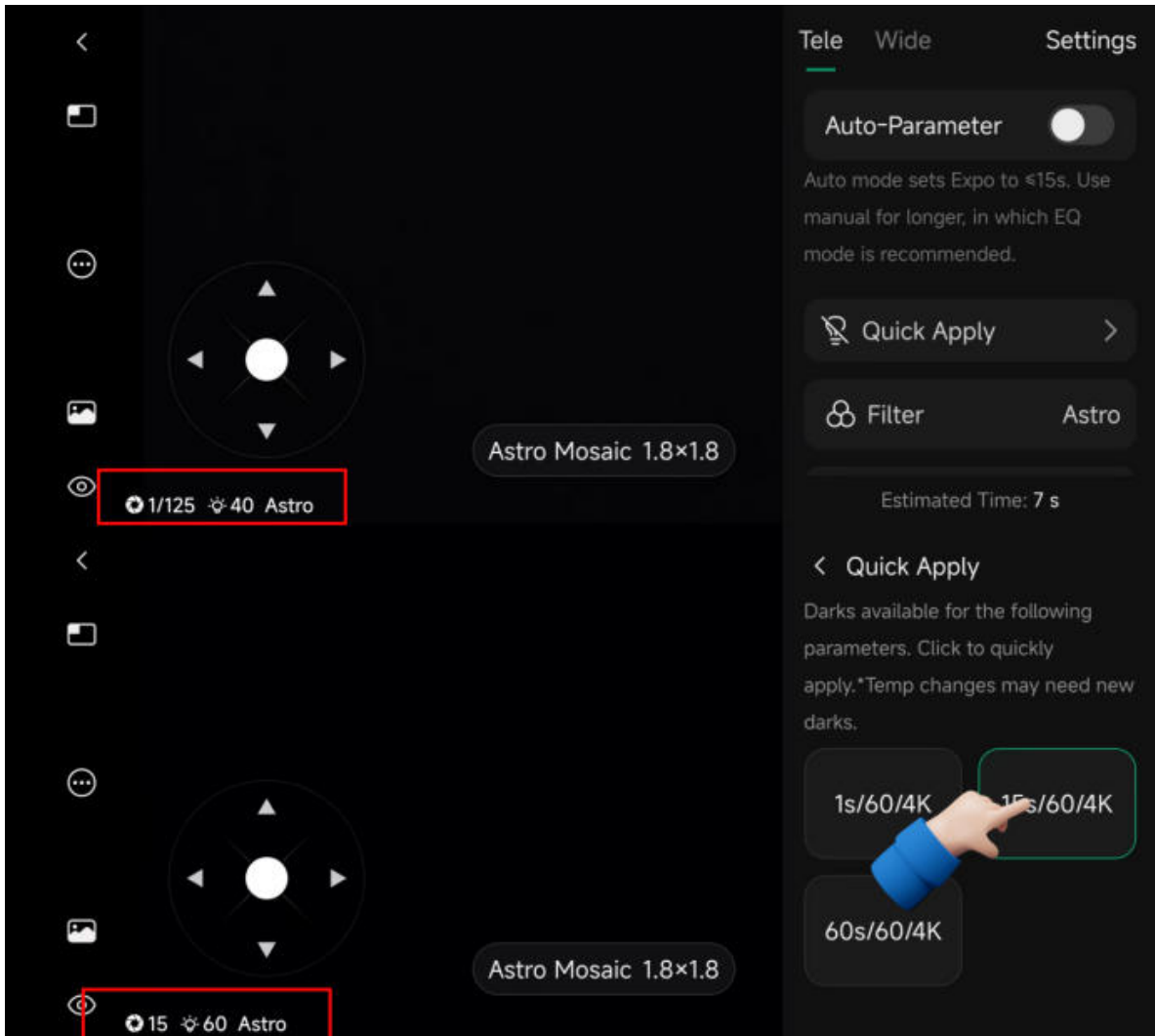
3.2.3.2 Use Quick Apply to use a saved Parameter Set

Quick Apply is accessed from **Session Settings** when **Auto-Parameter** is turned off (see image below). It allows you to quickly browse all dark frames currently stored on your DWARF device.

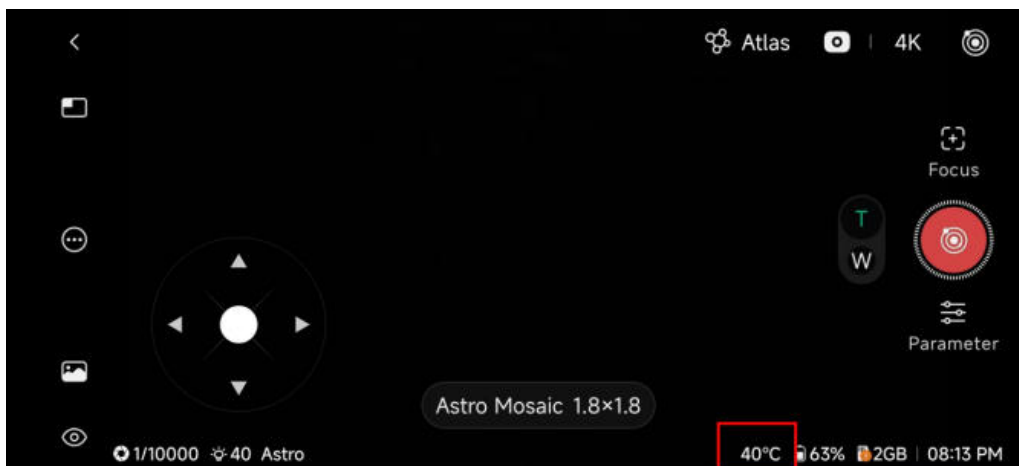
Your DWARF may already include several **factory-installed dark frames**. Each dark frame entry clearly lists its **exposure, gain, and resolution**, making it easy to identify which ones match your current session settings. These typically reflect the parameter combinations you use most often—since they were created to match your previous capture sessions.



So it is conveniently listed in the first row of the manual parameter panel, allowing you to **apply your favorite shooting settings with a single tap.**



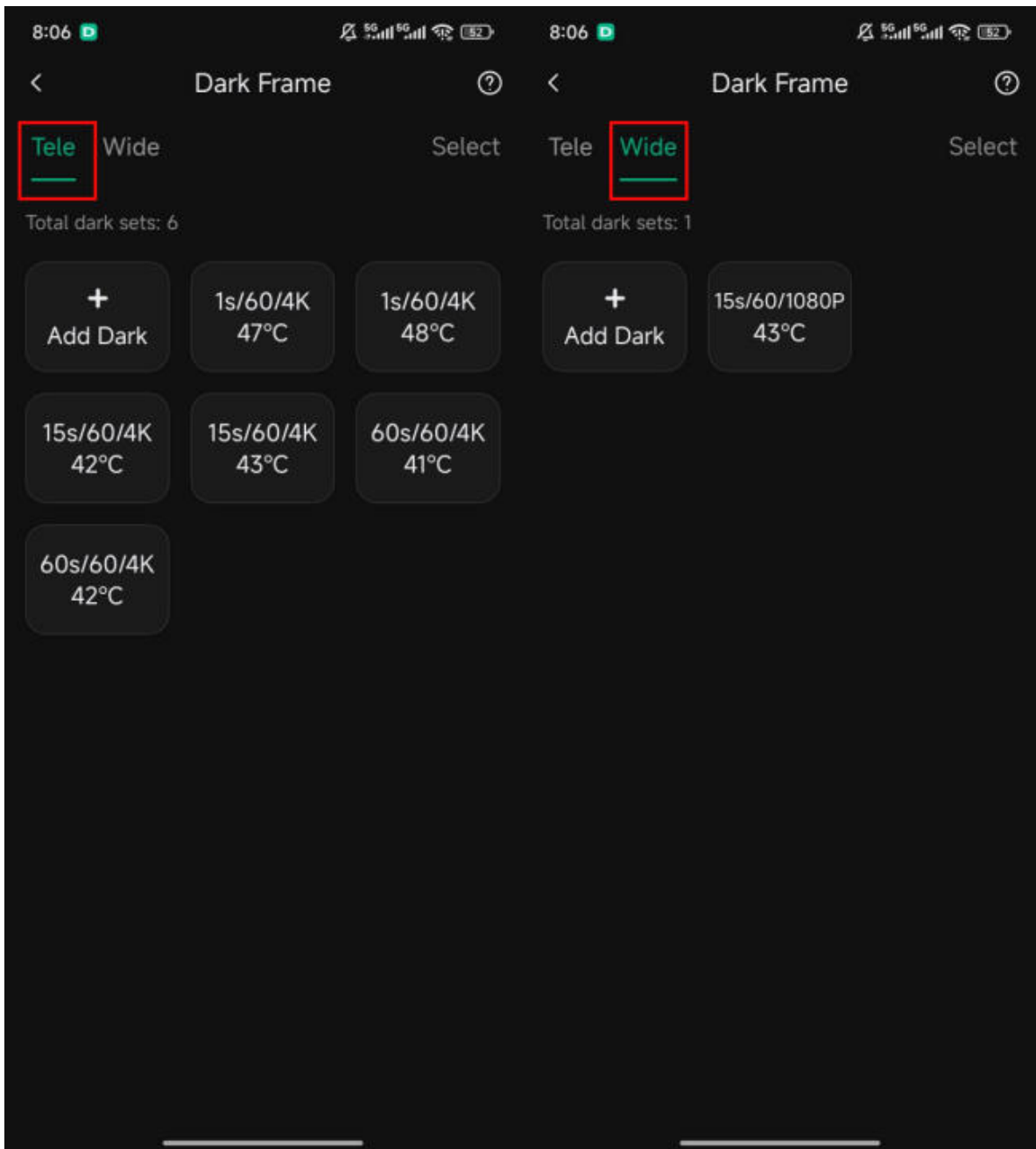
- Dark frames captured with the **same exposure, gain, and resolution** but at **different temperatures** are automatically grouped together for easier browsing and selection.
- Even if your exposure and gain are identical, you may still need to **recapture dark frames when the sensor temperature changes**. You can review all darks with non-matching temperatures in the **Dark Management** section.
- The **current sensor temperature** is displayed on screen. If the temperature difference exceeds $\pm 8\text{ }^{\circ}\text{C}$, your DWARF will automatically prompt you to retake dark frames before starting the session.
- You may **dismiss this prompt** and capture dark frames manually at a later time, but accuracy may be affected.



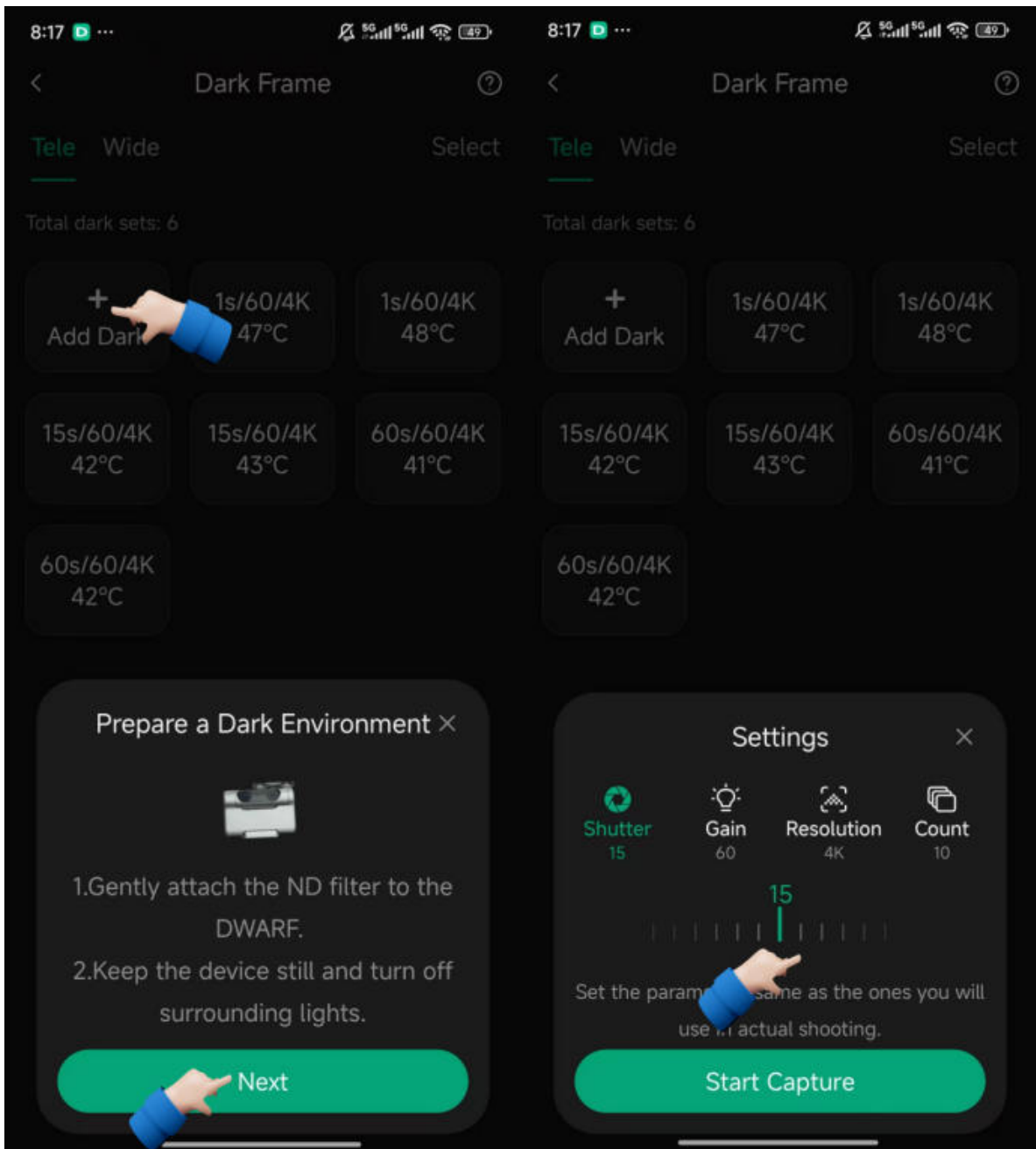
3.2.3.3 Managing Dark Frames

To manage your stored Dark Frames, you can access this option from the main app home screen by selecting **Settings > My Device > Image Calibration > Dark Frame**. ([Section 1.4.2 - My Device](#))

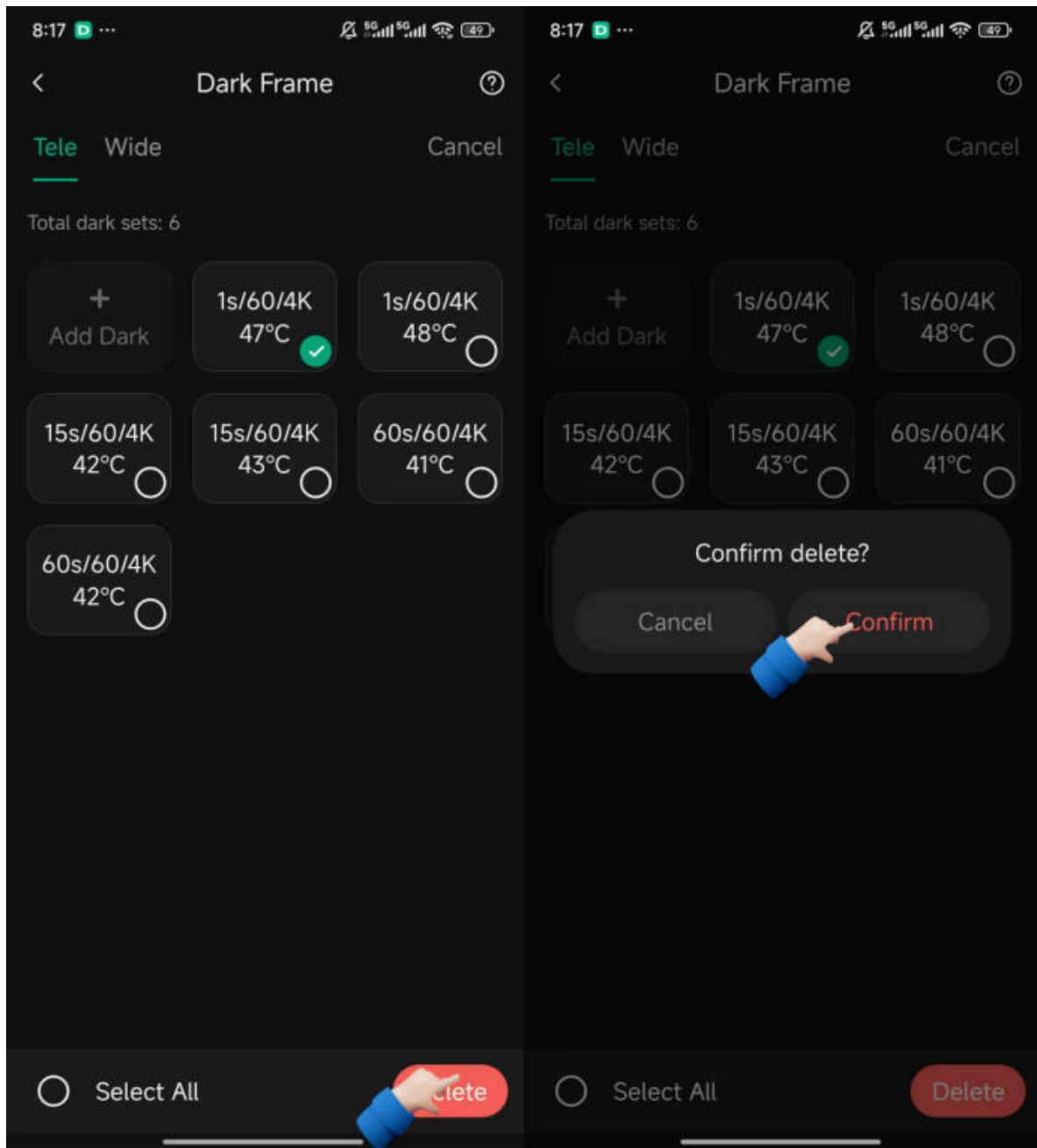
In the Dark Frame section, for every different set of parameters or each one-degree difference in temperature, a new entry will be created, and **each entry can store up to 20 dark frames**.



- Tap "**Add Dark**" to capture new dark sets.
- Adjust Shutter/Gain/Resolution/Total Sub Count
- Telephoto Darks: 40 gain is the lowest setting allowed for DARKS, same as when adjusting parameters in Deep Sky Mode
- Completion time will vary based on Shutter setting and total sub count



- To "**Remove**" dark files, long-press any saved dark entry, select one or multiple, then press confirm to complete the process.



3.2.3.4 When to Recapture Dark Frames?

Before (or after) each astrophotography session, Your DWARF automatically checks whether the existing dark frames match your current shooting conditions. If any key parameters differ significantly, a new set of dark frames should be captured to ensure optimal stacking results. You should **recapture dark frames** in the following situations:

1. When shooting parameters change

If you adjust the **exposure time, gain, or resolution**, the previous dark frames will no longer match the new settings. Some users have found taking an extra set of darks after a session is completed will greatly help with improving results, especially if you choose to use

Megastack later to restack your session, which will apply the most appropriate darks found stored on the device. The temperature during your session may change significantly from when you started your session, so keep that in mind, especially during colder months. Dark frames must **perfectly match your shooting parameters** in order to accurately remove sensor noise.

2. When ambient temperature changes significantly

Large temperature shifts (typically greater than ± 8 °C) alter the sensor's thermal noise pattern, rendering old darks invalid.

It's recommended to take new dark frames whenever the temperature changes substantially — especially when the night cools down rapidly, change in seasons (Summer / Winter)

Depending on the temperature at your location, having your device sit outside for 15 to 30 minutes prior to the start of a session will help your DWARF device acclimate to the external temperature and give you better results in capturing dark files. You can safely monitor the sensor temperature on screen to see how much of a change applied before starting and after.

3. When prompted “Dark Frame Missing” or “Dark Frame Mismatch”

Your DWARF device automatically monitors its dark library and will alert you if the parameters or conditions are inconsistent.

Simply follow the on-screen instructions to perform a new dark capture, and the system will update your calibration frames accordingly

4. Where do I take Darks?

Best practice is to capture dark frames in the **same—or at least a very similar—environment** where you'll actually be using the device. You *can* take darks indoors, but be aware that **warmer indoor temperatures will affect the results** and may not match real imaging conditions.

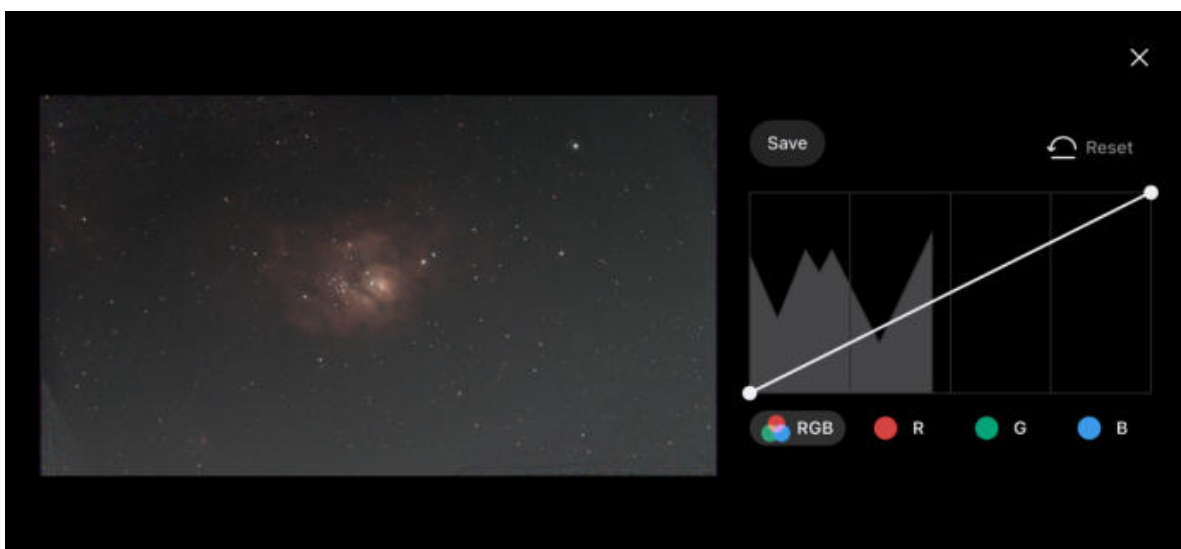
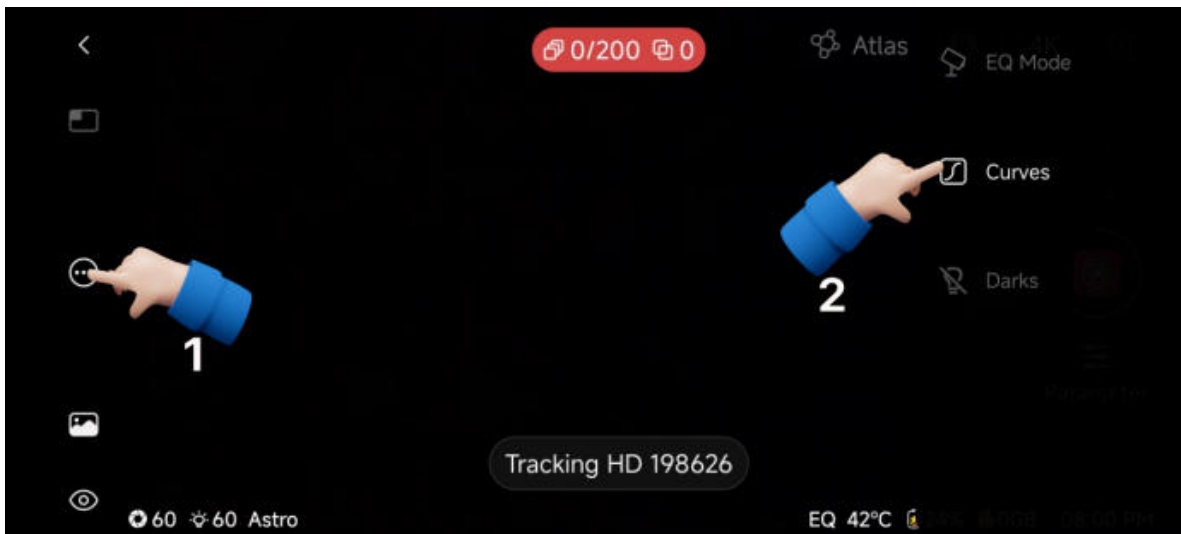
Many users take advantage of **cloudy or poor-weather nights** to capture darks outside.

That's not a wasted evening—it's prep work that pays off on the next clear night.

Try to build a **library of darks across the temperature range** you expect to encounter during your outdoor sessions. Do that once, and future imaging becomes faster, cleaner, and far less frustrating.

3.2.4 Curves (Stretching Tool)

During shooting, you can adjust the **Curves** to fine-tune the **RGB color balance** and enhance the **overall brightness and contrast** of deep-sky objects. This process, known as **stretching**, redistributes pixel brightness to reveal more details.



- Curves Note:
 - Pulling down the **left side** of the curve darkens the background, while lifting the **right side** brightens nebulae and galaxies. If you'd like to explore advanced techniques, you can find many great tutorials online — but don't worry, **sometimes it's all about intuition!**
 - After adjusting, don't forget to click **Save** — your edited photo will be saved **directly to your phone or tablet's photo album as a JPEG only**, making it easy to share right away.
 - Any saved images or manual adjustments while using the curves function will **NOT** affect any individual subs or your final stacked image during a live session.
 - Click **Reset** to restore the previous curve settings.

3.2.5 Astro Mosaic

Astro Mosaic refers to a technique in astrophotography where multiple adjacent images of the night sky are captured and then stitched together into one large, continuous picture. It allows you to photograph **celestial objects larger than a single frame's field of view**, such as the **Veil Nebula**.

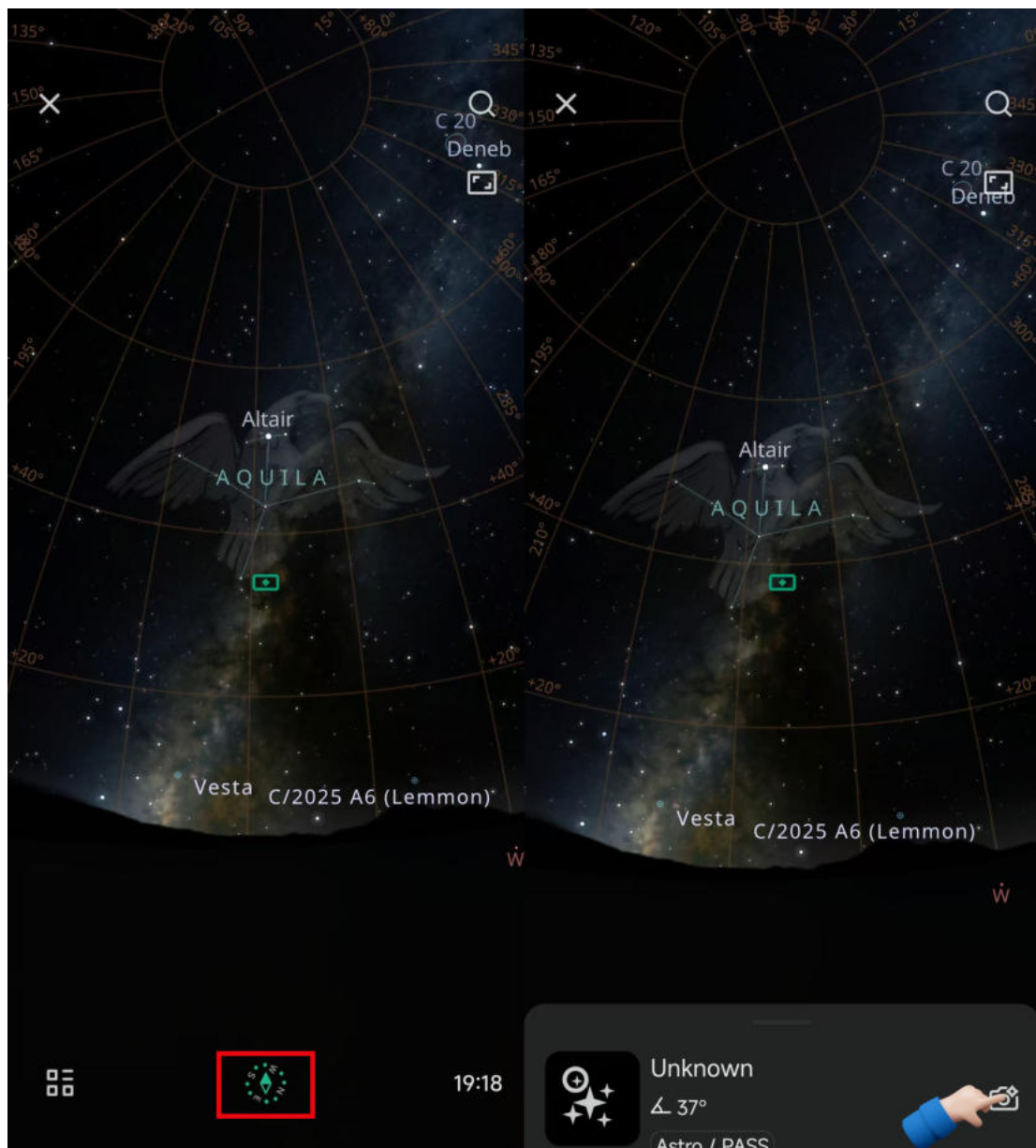
For detailed operation steps & more info, please refer to [Section 3.9 Astro Mosaic](#).

3.2.6 Wide-Angle Astrophotography (The Milky Way)

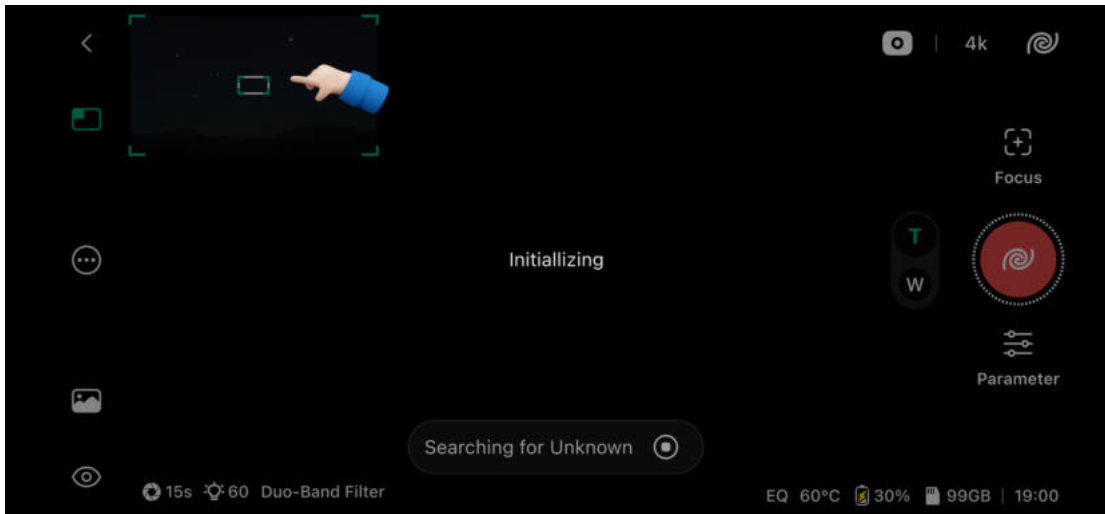
If you have the chance to visit a dark site with minimal light pollution, try capturing the **Milky Way**, the result will be stunning. Remember, light pollution greatly affects wide-field imaging quality.

Steps

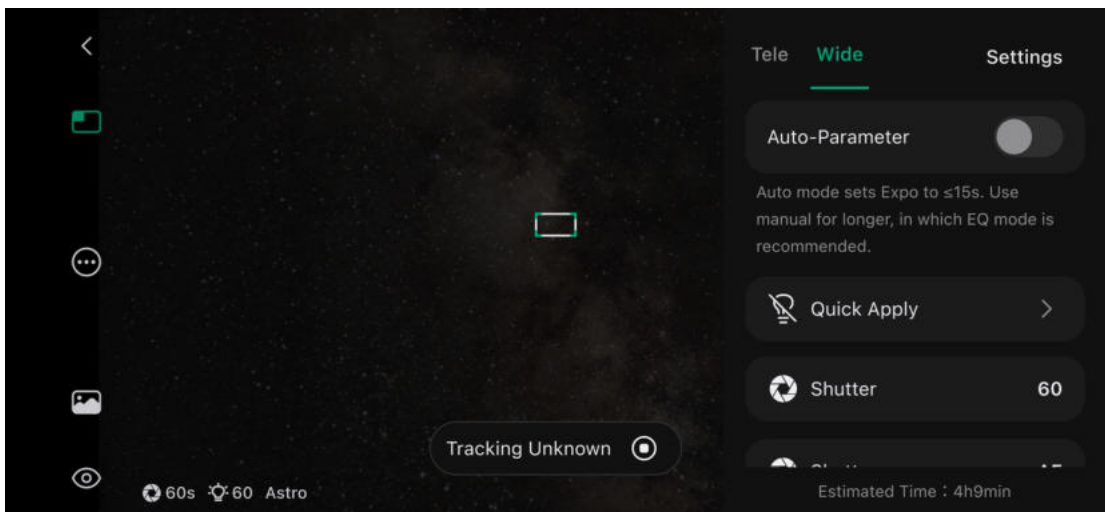
1. **In Deep Sky Mode, set up EQ Mode.** Capturing the Milky Way usually requires an exposure time of 30 seconds or longer to collect enough light and reveal the faint structures of the galactic core. So setting EQ is a must. This also ensures accurate long exposures with the wide-angle lens.
2. **Select your target in the Sky Atlas .** Point your phone toward the region of the Milky Way you wish to photograph and find a star roughly at the center of that desired area. Select it.



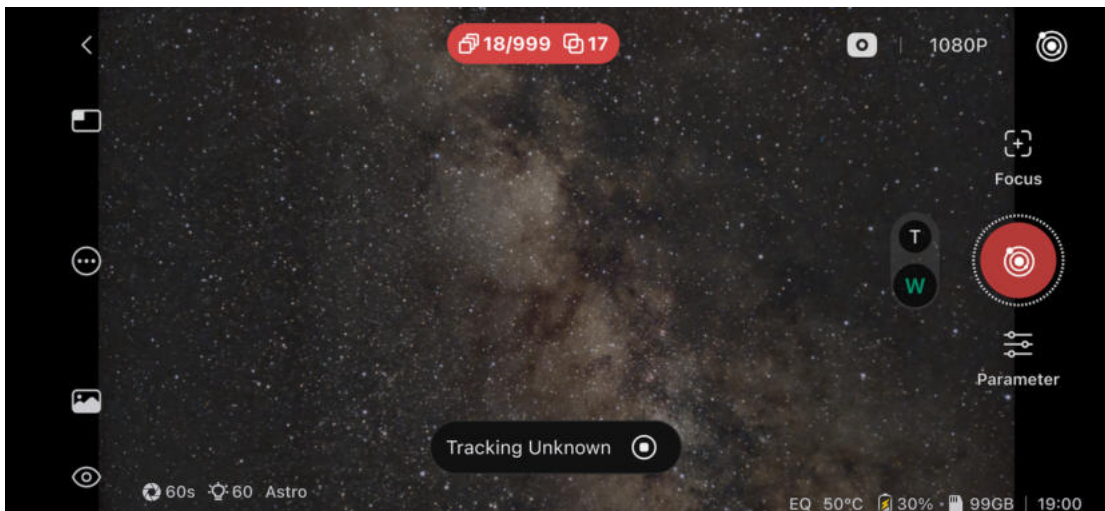
3. Tap that camera to use the **One-click Goto**, and lock onto the target automatically.
4. **Switch View:** Change the **wide-angle lens** to the **main perspective** — make sure the **wide view** is on the main screen before shooting! (So it takes picture with the wide lens)



5. Adjust Wide Parameters: Set Exposure = 60 s, Gain = 60, select Astro Filter, and set Frame Count = 100.



6. Tap “Shoot.”



7. If prompted, capture a **dark frame** for better calibration.

8. During stacking, you can fine-tune the curve adjustment. You may also process it in Stellar Studio!

Note:

1. When photographing the Milky Way, DWARF 3 **relies on the telephoto lens to perform precise tracking** of a selected target near the galactic center.
2. The wide-angle is a fixed focal length, there is **no focus** function as that is restricted to the telephoto lens, so have no worries if you are trying to adjust the focus and not seeing any changes.

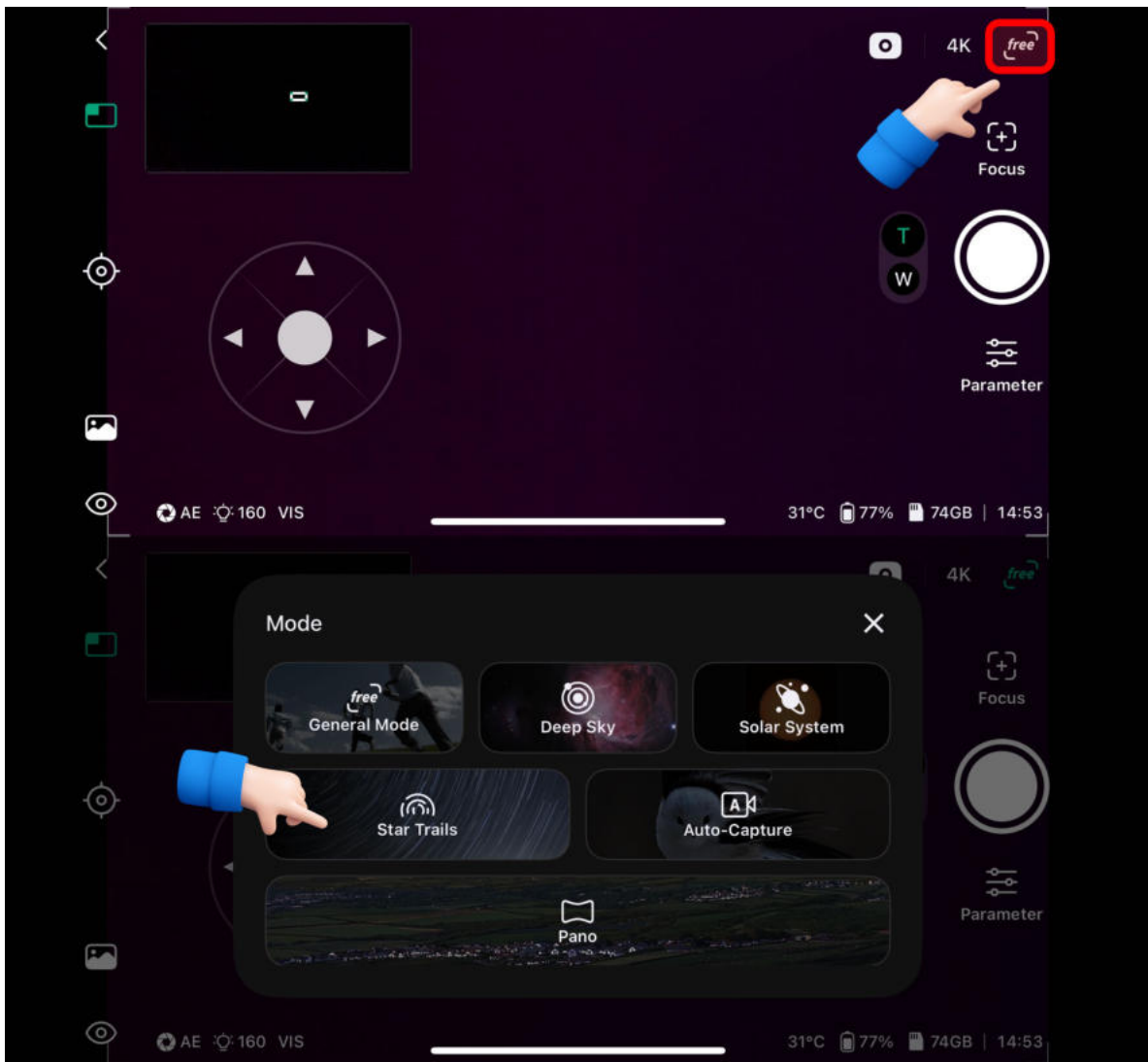
The wide-angle lens takes the picture, but the actual tracking is handled by the **telephoto lens**, ensuring stable long exposures and clear, detailed images of the Milky Way's core.



Demo image of the Milky Way with the following parameters: Shutter 60s, Gain 10, 60 frames. Processed with additional software

3.2.7 Star Trails

1. Tap the icon in the top-right corner to switch modes and enter Star Trails mode.



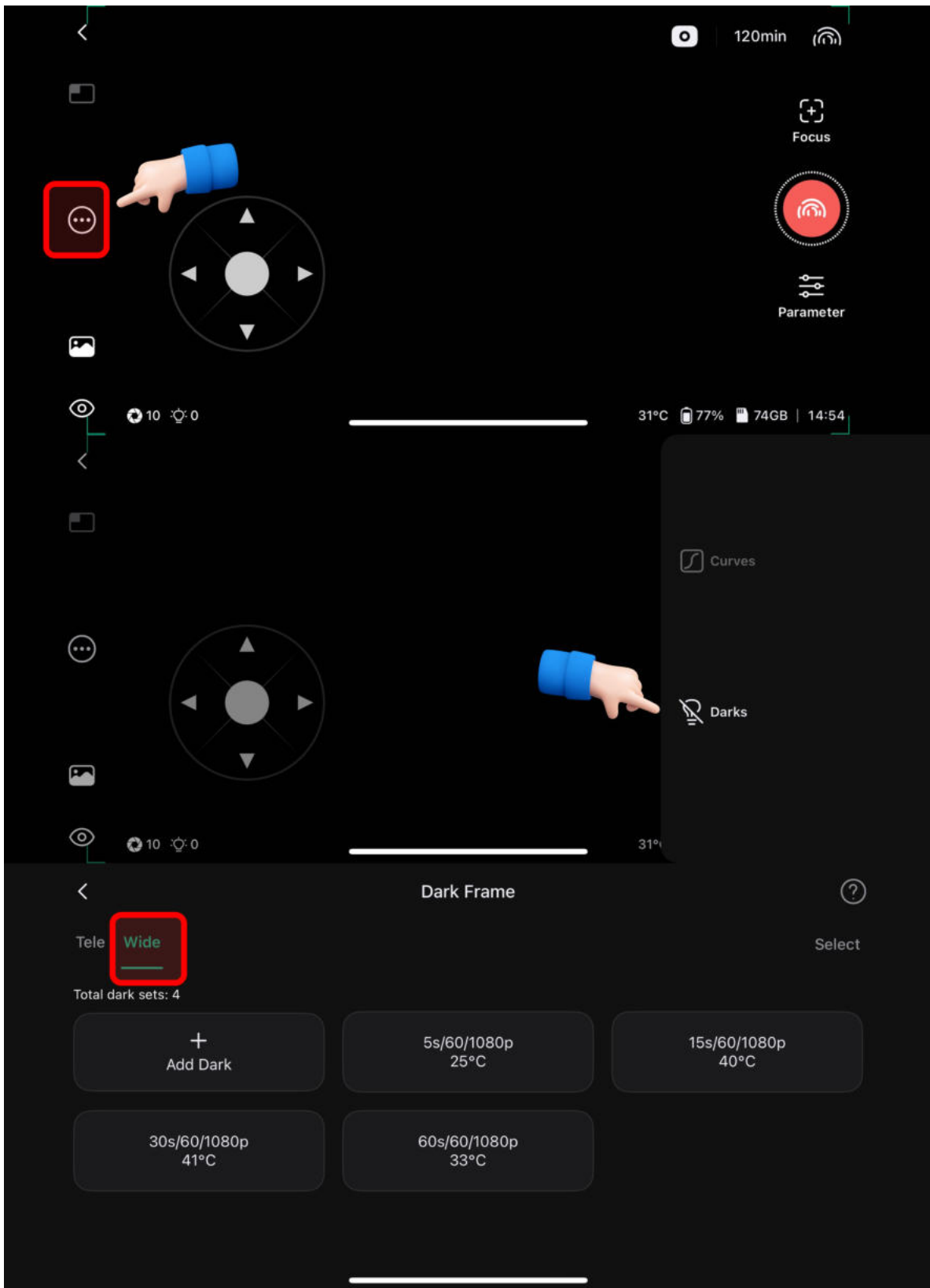
2. Capture Wide-Angle Dark Frames (Optional)

You can skip this step if a suitable dark frame is already available in the Dark Library. A "suitable" dark frame must meet the following criteria:

- The exposure time and gain match your current capture settings.
- The ambient temperature during the dark frame capture is close to your current temperature (within a range of $\pm 8^{\circ}\text{C}$).

Example: If your current shooting temperature is 28°C , any dark frame captured between 20°C and 36°C can be used.

Tap "..." button on the left of the screen, tap "Darks", and select 'Wide-angle Dark Field' to complete the capture by following the on-screen instructions.



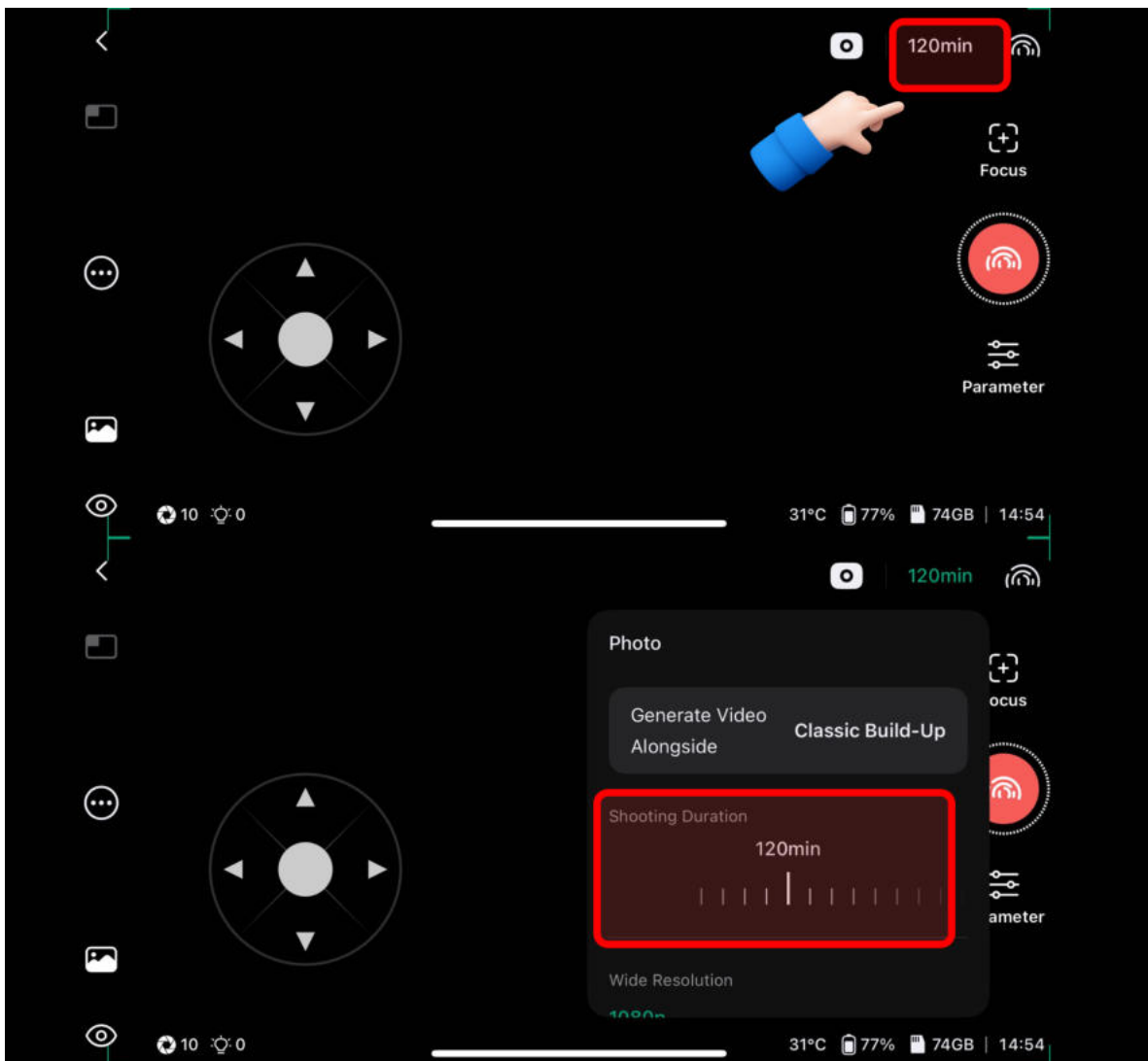
Note: Since star trails are captured using the wide-angle lens, the dark frames must also be taken with the wide-angle lens.

3. Composition

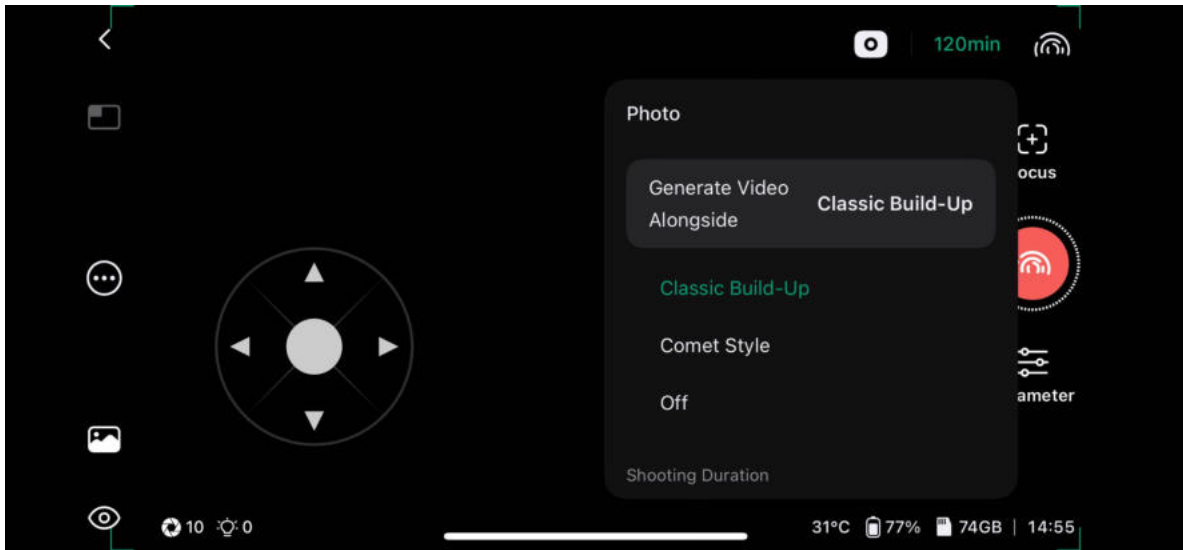
- **Framing your shot:** If you wish to include terrestrial foregrounds (scenery) in your frame, use the **Virtual joystick** to adjust the composition before you start.
- **Choosing your direction:** The appearance of star trails varies depending on the direction the camera is facing. To capture the **concentric circle effect** (circumpolar stars), please point the lens toward the **North**.

4. Duration and Video Generation

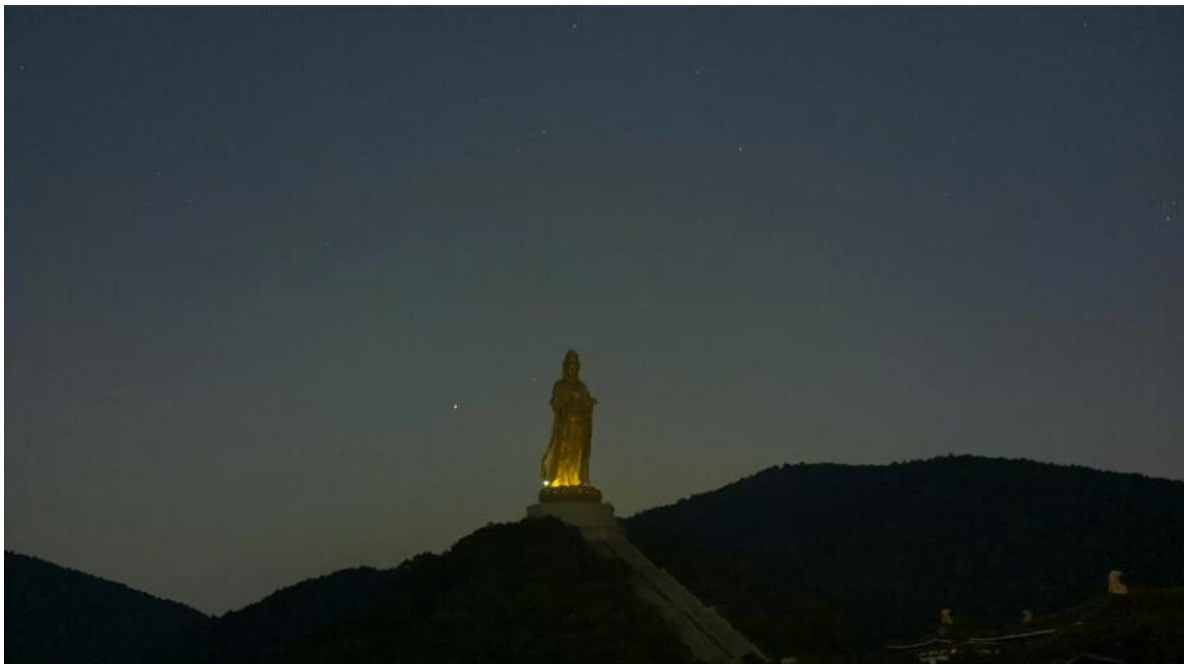
- **Trail length vs. Time:** The length of the star trails depends on your total shooting duration; the longer the session, the longer and more dramatic the trails will appear.
- **Setting the duration:** You can select a shooting duration ranging from **30 to 360 minutes**. If you select **∞ (Infinite)**, the device will continue capturing until you manually stop it.



- **Video output:** You can choose whether to automatically generate a star trail time-lapse and select your preferred video style.



Sample star trail video styles. Footage provided by user '阿靖婧婧'.



Classic Build-Up



Comet Style

Star trail videos are generated frame-by-frame from each individual exposure. The video length depends on your selected shutter speed and total shooting duration.

If the generated video is less than 1 second long, it will not appear in the App album. However, the file remains stored on the device and can be accessed by connecting to a computer.

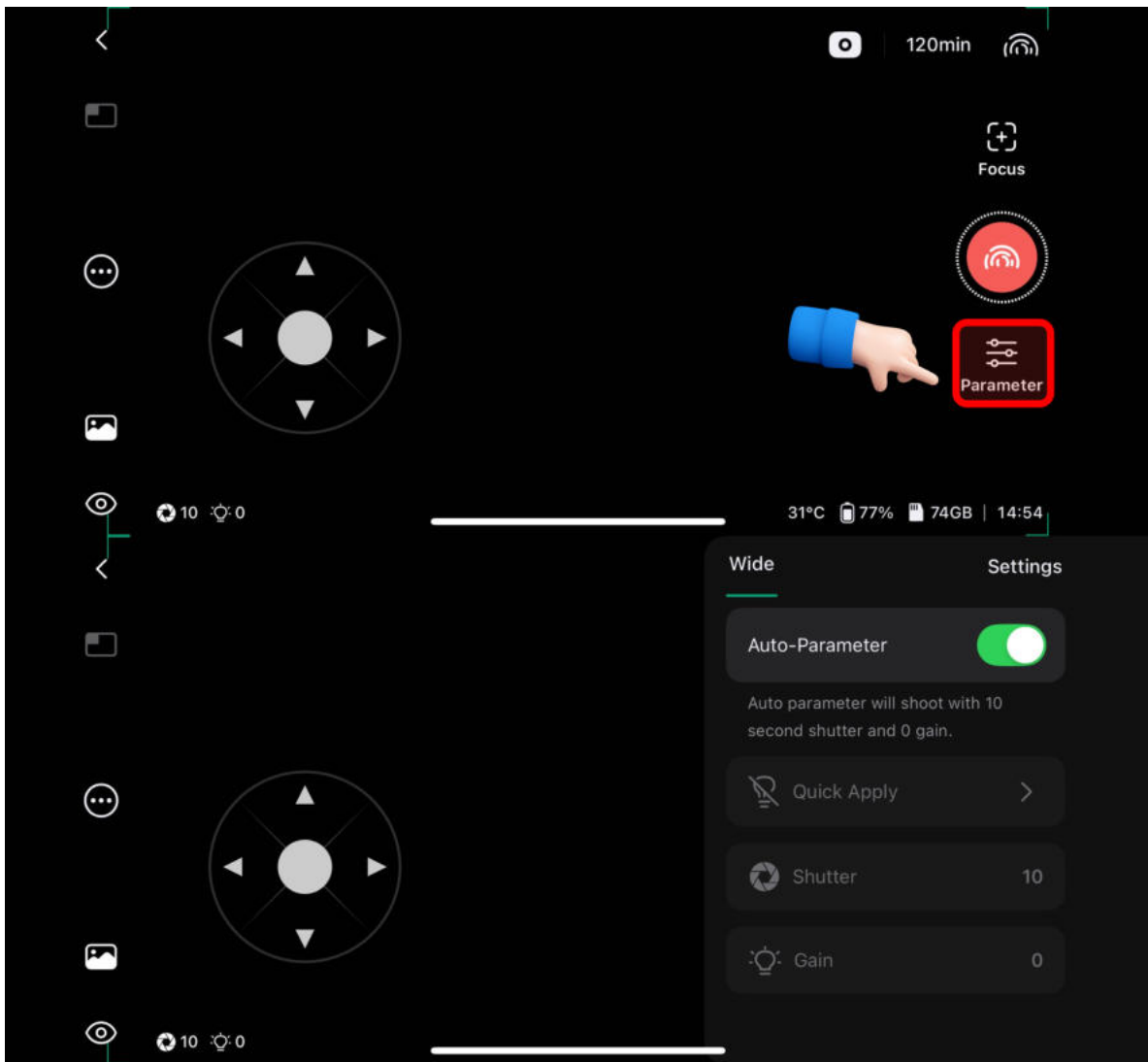
To generate a video longer than 1 second, you need to shoot for at least 45 minutes with a 90s shutter, or at least 30 minutes with a 60s shutter.

5. Parameters

You can complete the parameter settings using either of the following methods:

Method 1: Automatic Settings

For your first capture, we recommend using the **Auto-Adjustment** mode.



Method 2: Quick Settings

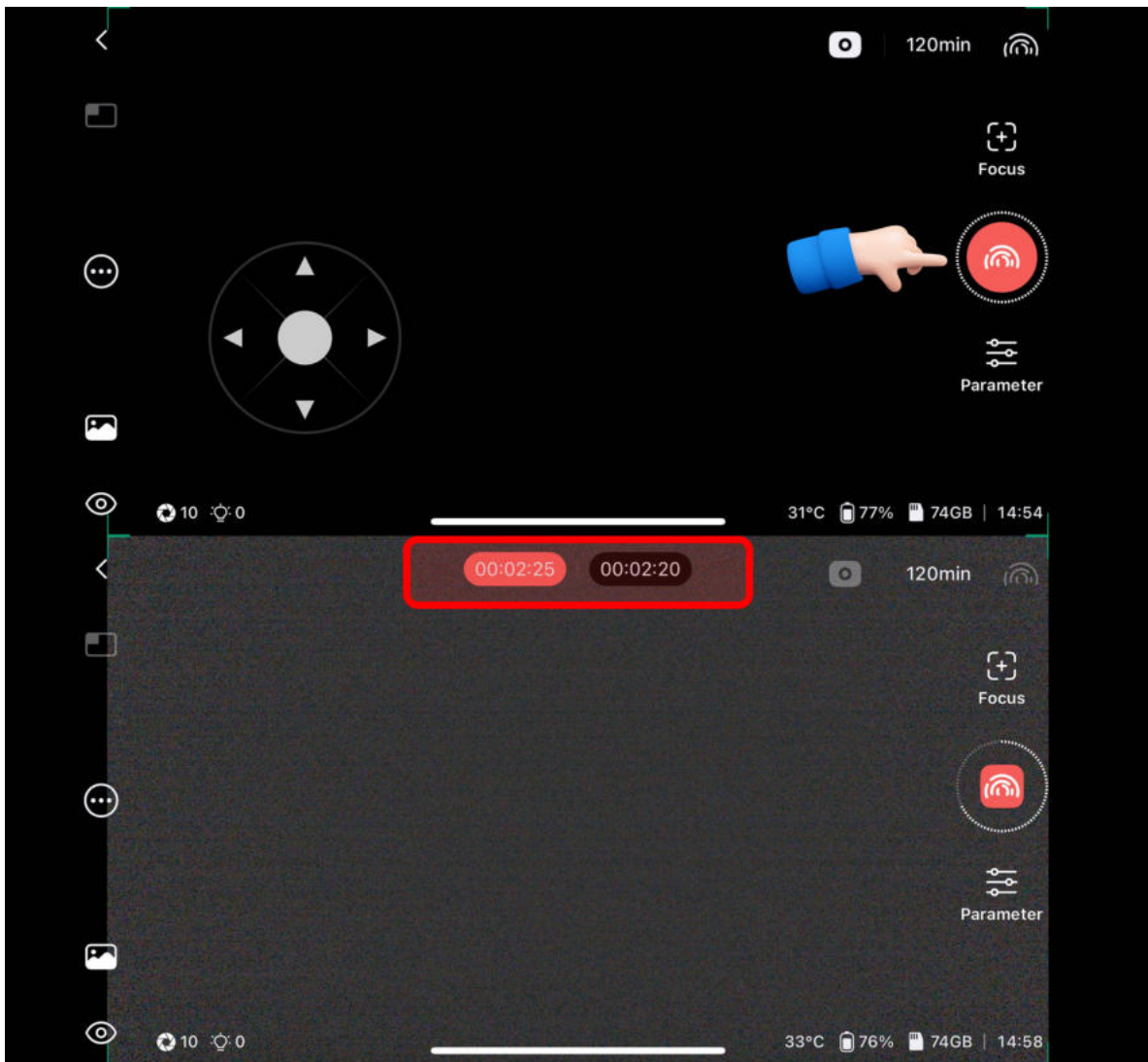
Quick Settings will match parameters based on your existing Dark Library.

Method 3: Manual Settings

Manually adjust Shutter Speed and Gain.

Note: You must disable **Auto-Adjustment** before you can use Quick or Manual settings.

Once you have configured the parameters, tap the shutter button to start capturing.



During the star trail stacking process, you will see a Red timer and a Black timer on the interface. Their meanings are as follows:

- **Red Timer:** Represents the **current shooting progress**, indicating the total duration the device has captured so far.
- **Black Timer:** Represents the **stacking process**, indicating the total duration of exposures that the algorithm has successfully stacked.

3.3 Solar System Mode

In this mode, you can use different formats like **Astro stacking photos or time-lapse videos** to shoot the **Sun, Moon, and other planets** in the Solar System.

Solar System Mode Note:

DWARF 3 is not designed or optimized for planetary imaging. Its small aperture and imaging system are intended for wide-field and deep-sky targets, not high-

resolution planetary detail.

Example: You can expect Jupiter and Saturn to appear primarily as **bright points or very small disks**, with limited color information. Under good conditions, you may see **Jupiter's larger moons as separate points of light**, and in rare cases Saturn's rings may be faintly suggested, but not resolved with detail.

That said, experimentation is encouraged. Many users continue to push the device creatively and capture results that exceed expectations within these constraints.

3.3.1 Solar Imaging

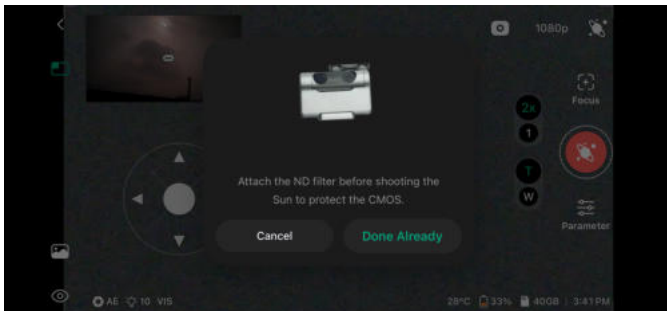
Solar imaging with **DWARF 3** allows you to safely capture detailed photos and videos of the Sun's surface, including sunspots and other dynamic solar features. With precise auto-tracking and focus, DWARF 3 can follow the Sun's movement across the sky. By using the **included ND solar filter**, the telescope reduces the Sun's brightness to a safe level for both the sensor and your eyes.

Steps:

1. **Place DWARF 3 on a stable, flat surface and power on** the device and **connect** it to your phone or tablet. Keep the front of the telescope body facing forward.
2. Enter **Solar System Mode**. Select **Sun**.

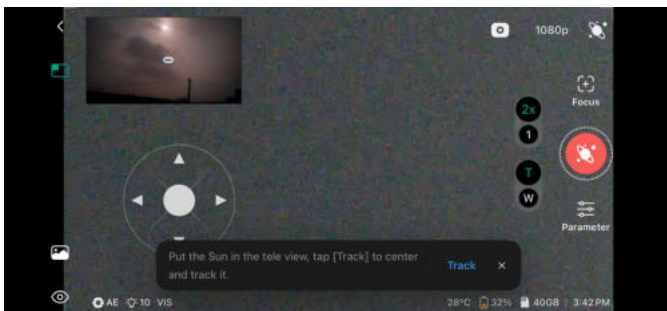


1. Attach the **Solar Filter**. Use the dual-lens to locate the Sun in the tele frame (**roughly center**).



Once the preparations above are complete, please tap "Done Already."

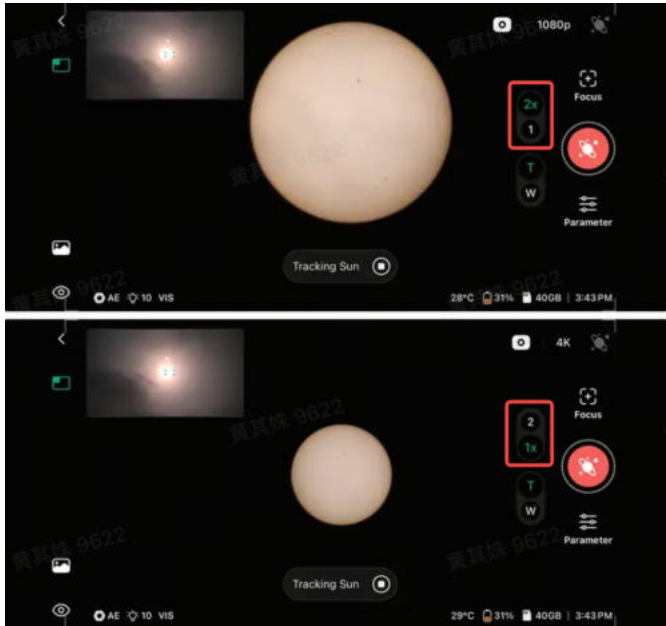
4. Tap **"Track"** and the sun will be precisely **centered, focused and tracked.**



☒ **Device Note:** The telescope cylinder will first retract briefly to recalibrate before stable tracking begins. You may notice a brief pause in viewing before it restarts tracking and alignment.

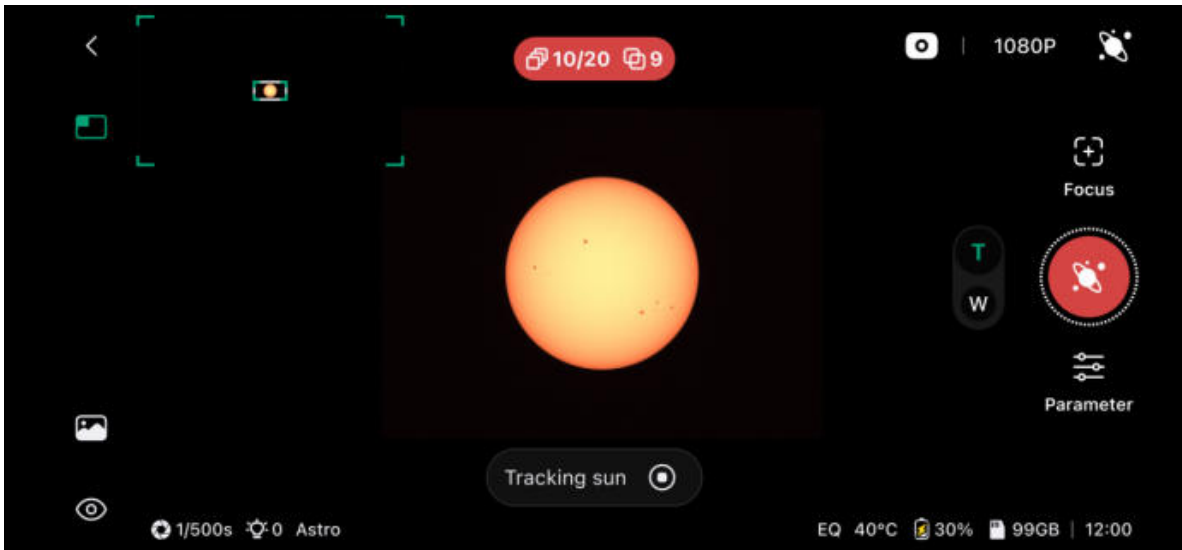
5. When tracking the Sun, tap “2x/1x” on the right side of the screen to toggle between 1x and 2x views.

☒ The **1x** view offers **4K** sizing with a wider field of view, while the **2x** view provides a **1080p** cropped image, making the sun appear larger.

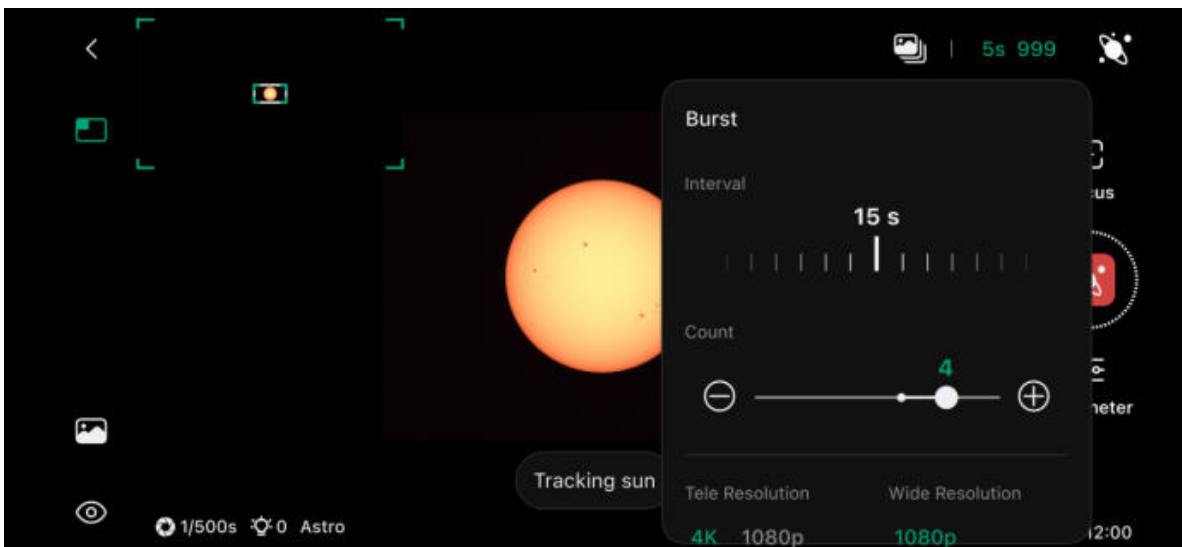
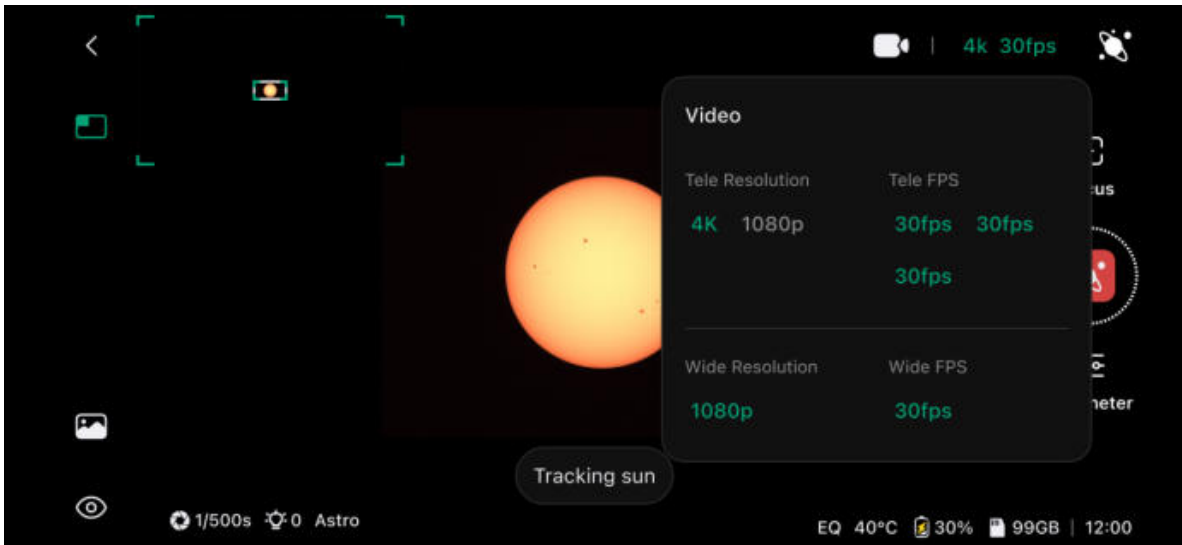


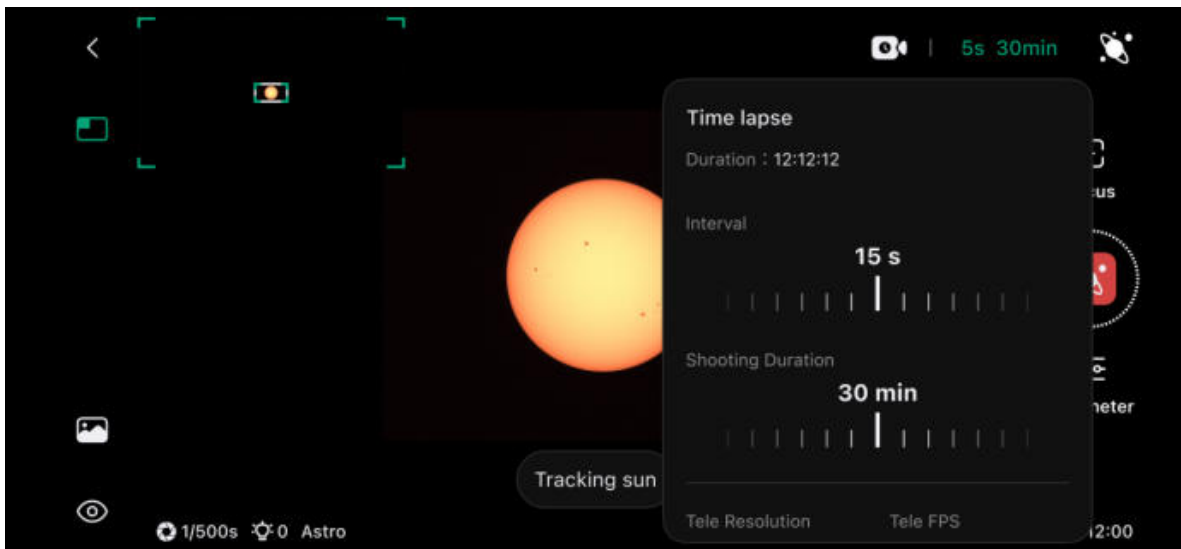
Note: Magnification cannot be changed once you tap 'Start Capture' in the next step.

6. Tap **Shoot** to start imaging — the **auto parameters** are already optimized for solar capture.



6. You can also switch to **Video Mode** or **Time-lapse Mode** to record the Sun in different styles.





Additional Solar Notes:

- **Exposure caution:** Other shooting modes **cannot automatically optimize shutter settings** for the Sun or Moon. You may get overexposed images.
- **Recommended session settings:** For your first capture, start with **20–30 images** per session. You can set up to 999 images, but long sessions increase **heat exposure**, which may trigger safety shutdowns. DWARF 3's recommended **sensor operating temperature is below 60°C (140°F)**. If the internal temperature reaches this limit, the device will **automatically shut down** to protect itself.
- **Auto-focus:** During auto-focus, the camera adjusts exposure and gains automatically—typically around **1/250s–1/200s exposure, gain = 0**, and **VIS filter** applied. You can manually adjust **hue and white balance** if desired.
- **Lens orientation:** Since there's no "astro" calibration for Sun or Moon tracking, **keep the lens cylinder facing forward** (DWARFLAB logo side) while tracking to ensure accurate alignment.



3.3.2 Moon Imaging

DWARF 3 lets you capture the Moon's **craters, mountains, and subtle shadows** in impressive detail. Using its **telephoto lens** and **built-in tracking system**, DWARF 3

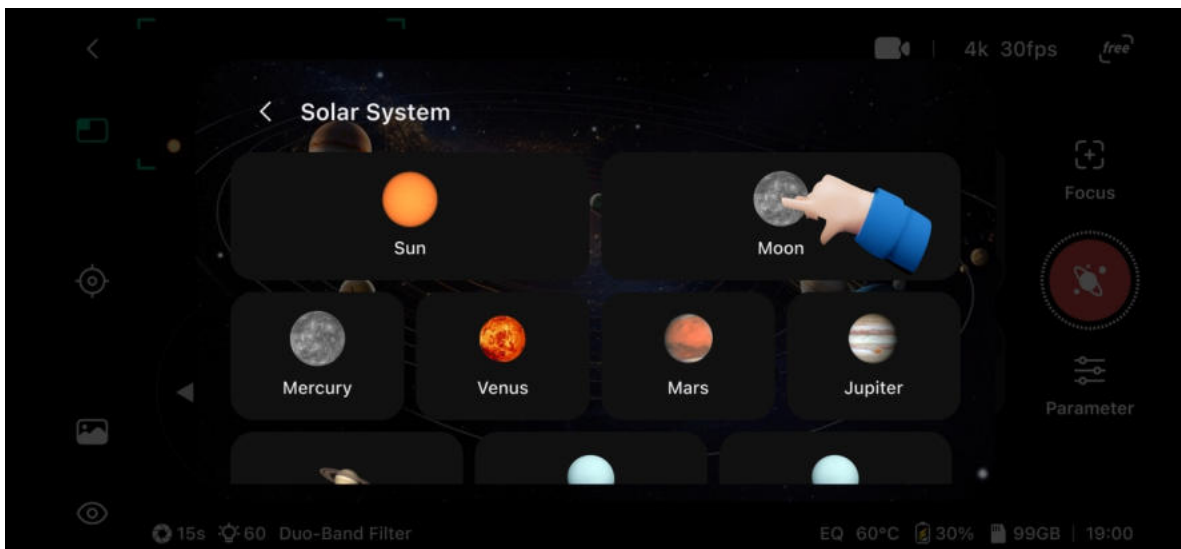
automatically follows the Moon's motion, keeping it centered for sharp, stable shots. You can capture **single images, videos, or time-lapses** to document the Moon's changing light and surface textures throughout its phases.

Moon imaging works similarly to solar imaging, with a few key differences:

- **No ND filter needed:** Unlike the Sun, the Moon does not require a neutral density filter.
- **Best timing:** nighttime is ideal, when the Moon is most visible.
- **Daytime or evening imaging:** You can also capture the Moon during daylight, generally **late afternoon or early evening**, as long as it is bright enough and unobstructed for DWARF 3 to detect and track.

Steps:

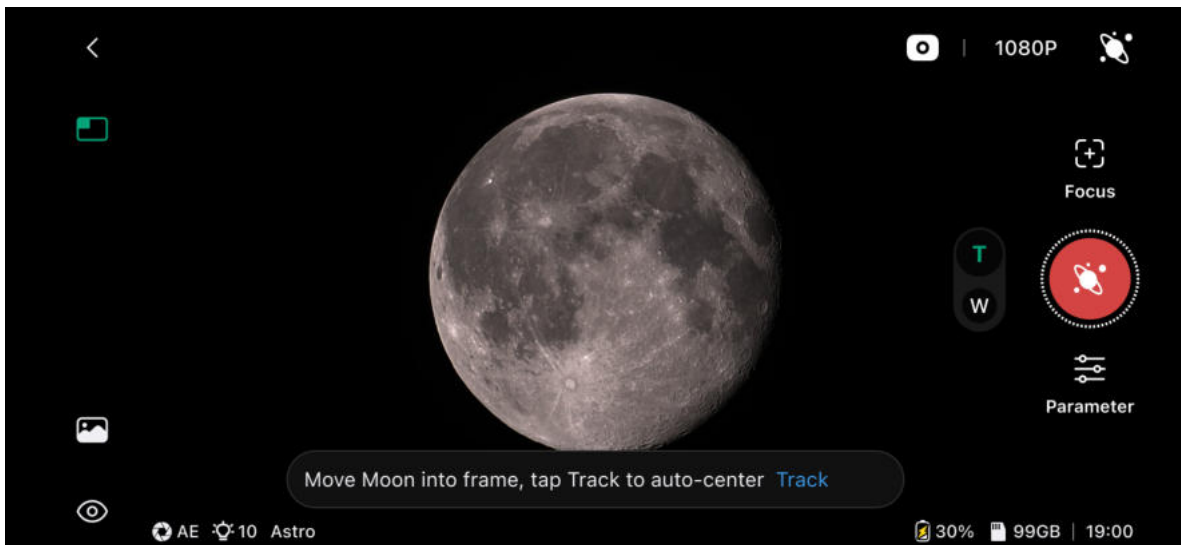
1. Place **DWARF 3 on a stable, flat surface and power on** the device and **connect** it to your phone or tablet. Keep the front of the telescope body facing forward.
2. Enter **Solar System Mode**. Select **Moon**.



3. Use the dual-lens to locate the Moon in the tele frame (**roughly center**).



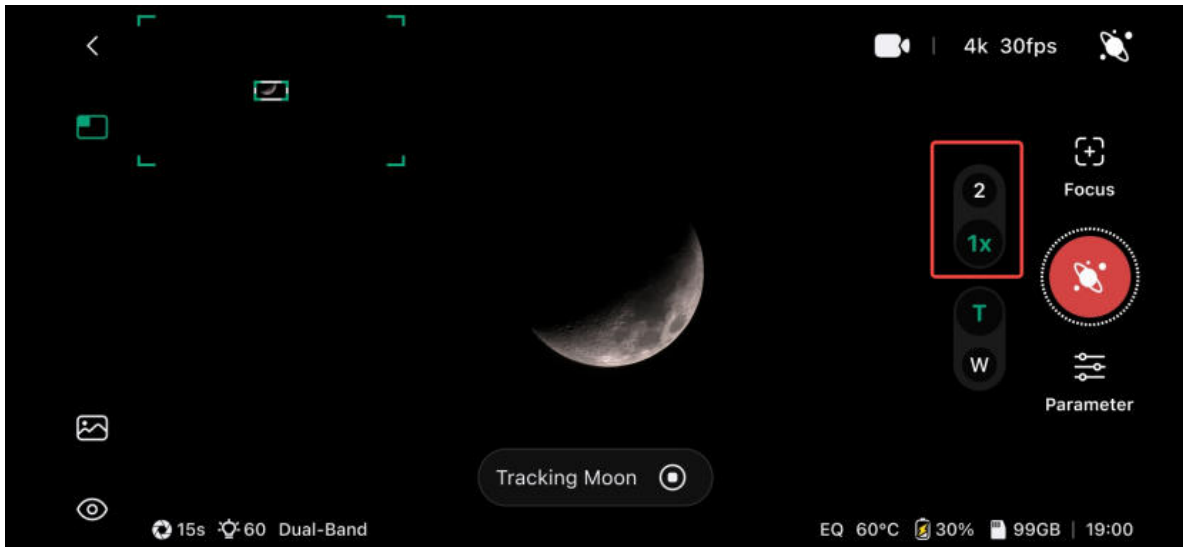
4. Tap "**Track**" and the moon will be precisely **centered, focused, and tracked**.



⊠. **Device Note:** The telescope cylinder will first retract briefly to recalibrate before stable tracking begins. You may notice a brief pause in viewing before it restarts tracking and alignment.

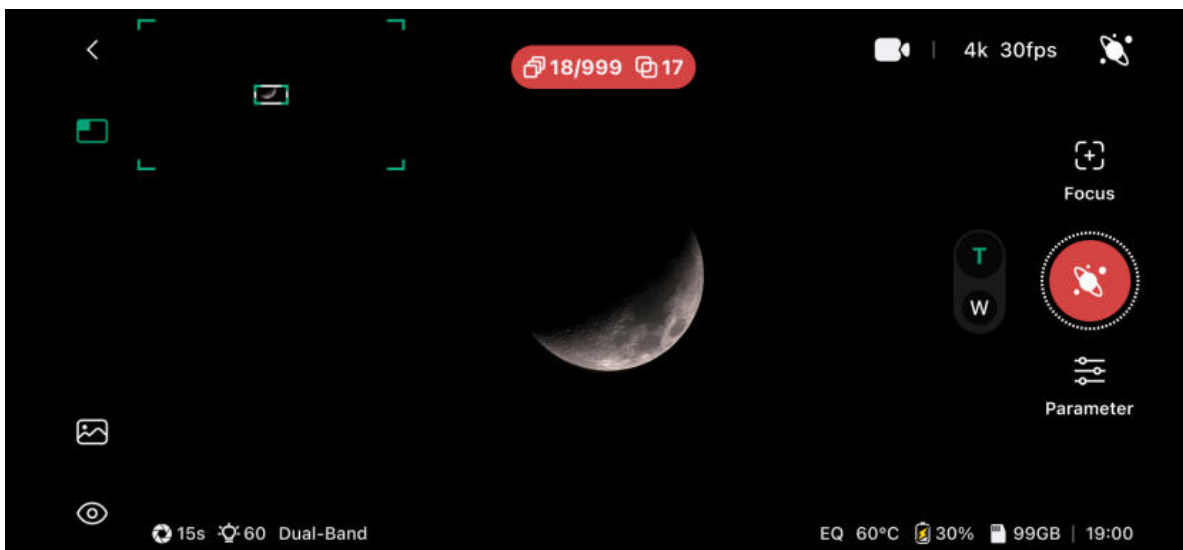
5. When tracking the Moon, tap “2x/1x” on the right side of the screen to toggle between 1x and 2x views.

⊠ The **1x** view offers **4K** sizing with a wider field of view, while the **2x** view provides a **1080p** cropped image, making the moon appear larger.

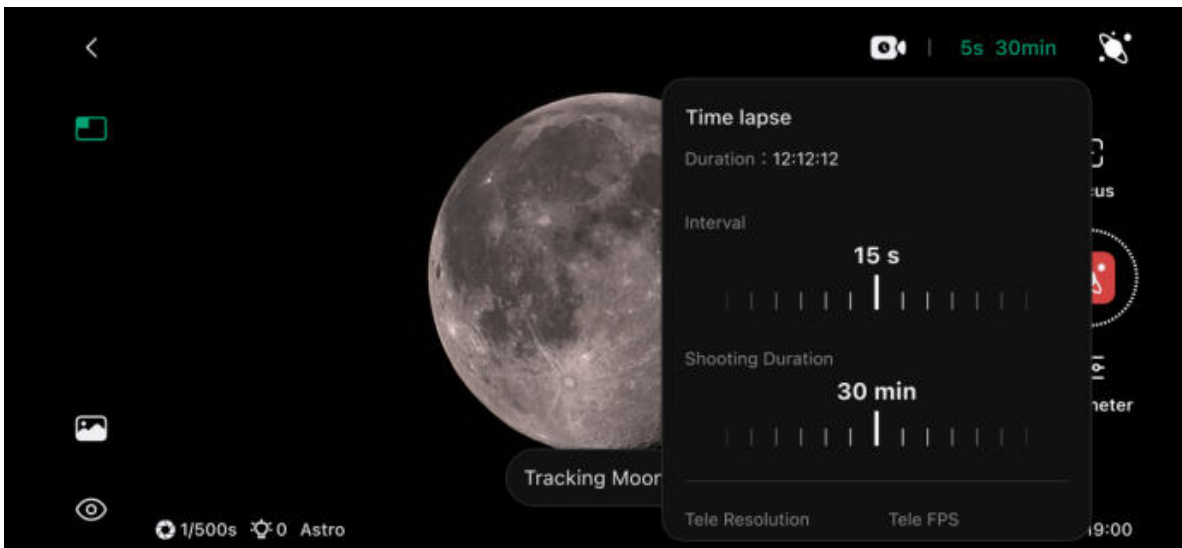
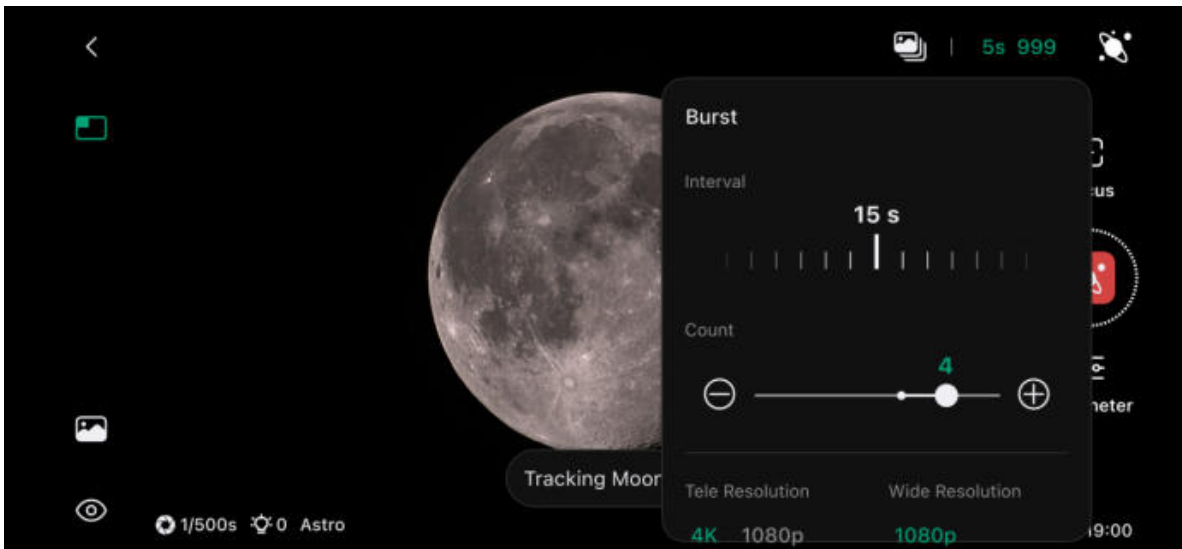
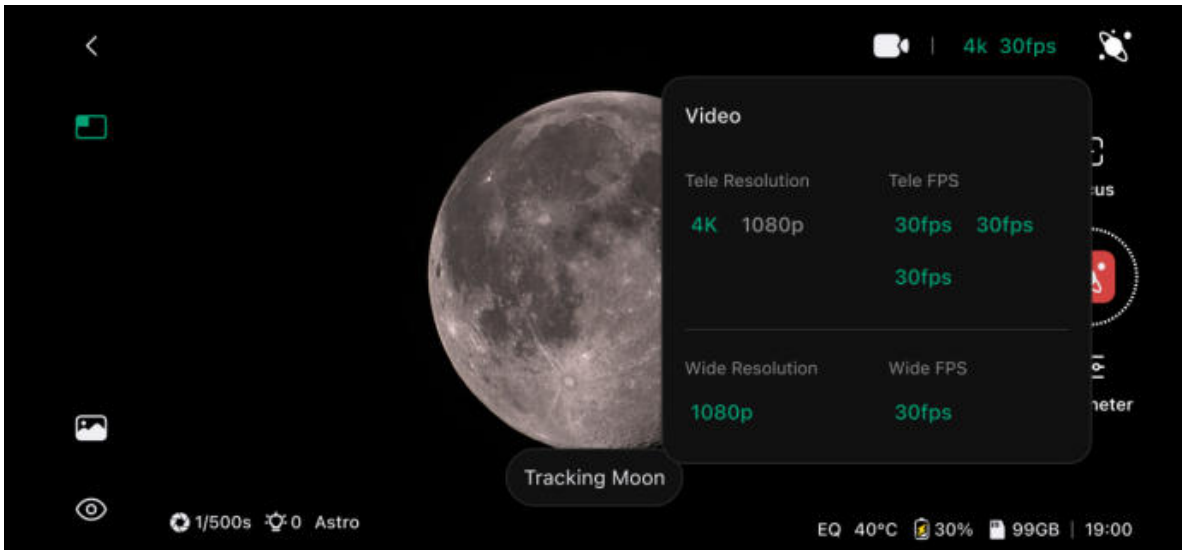


Note: Magnification cannot be changed once you tap 'Start Capture' in the next step.

6. Tap **Shoot** to start imaging — the **auto parameters** are already optimized for moon capture.



7. You can also switch to **Video Mode** or **Time-lapse Mode** to record the Moon in different styles.





Additional Moon Notes:

- **Exposure caution:** Other shooting modes cannot automatically adjust shutter settings for the Sun or Moon, so overexposed images are possible.
- **Lens orientation:** Since there's no "astro" calibration for Sun or Moon tracking, always keep the **lens cylinder facing forward** (toward the DWARFLAB logo) to ensure accurate tracking.



3.4 Auto Capture Mode

Follow these steps to use DWARF 3 to automatically detect, track, and record fun things around you.

3.4.1 Ground Auto Capture

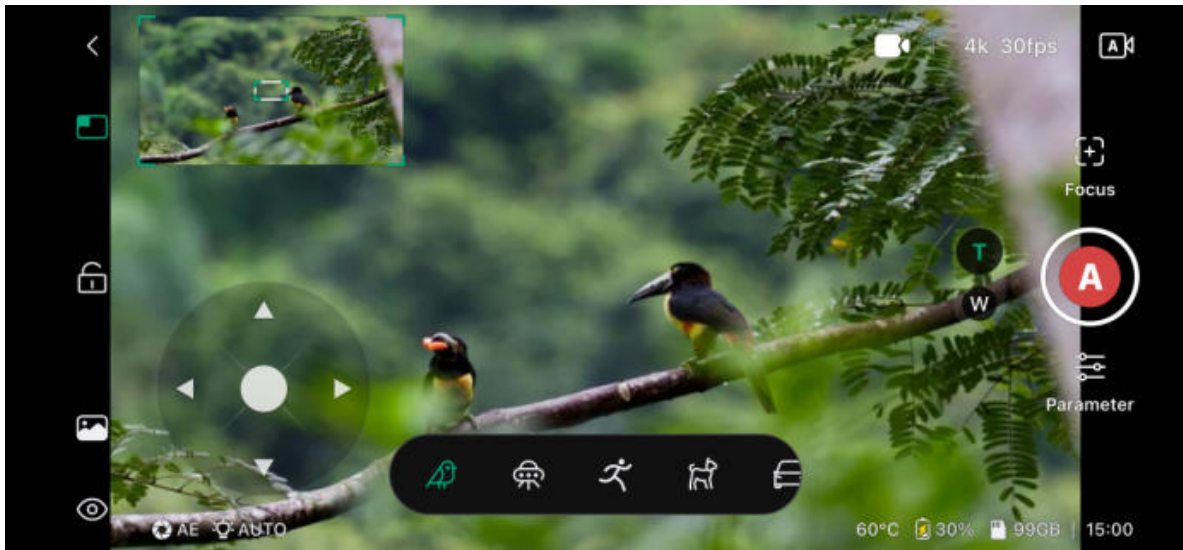
Steps

1. Face the Target

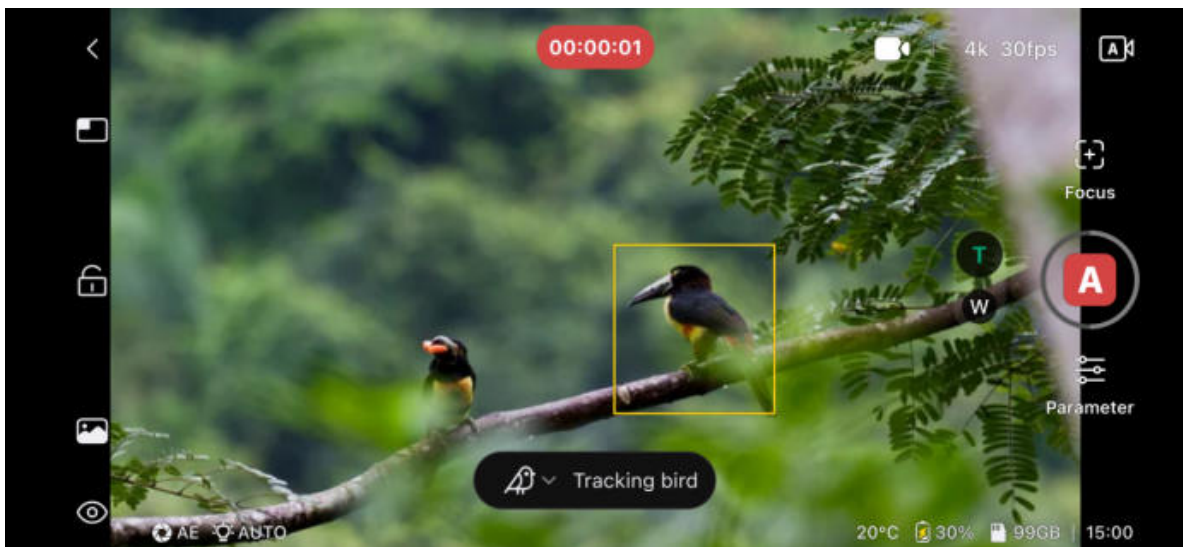
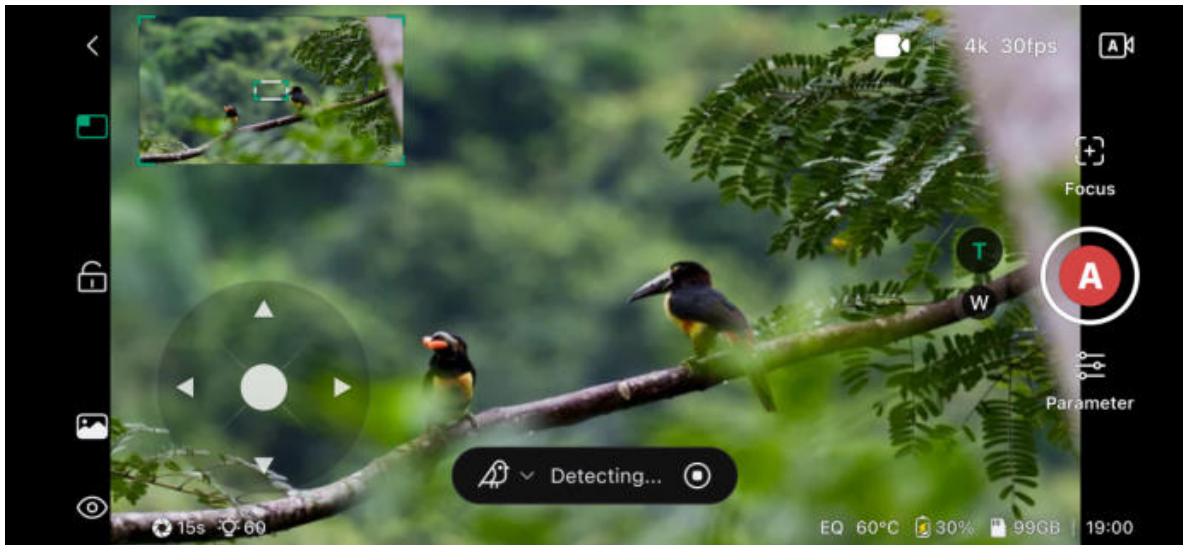
Point the telescope lens roughly toward the direction of your target.

2. Choose Target & Auto Record

From the **bottom menu**, select the type of target you want to **auto-track**. DWARF will automatically search for the selected target through both the **wide-angle** and **telephoto** area, **identify it**, and begin **tracking and recording** with the telephoto lens. (**Recommend enable AF-C in focus panel**)



Currently, DWARF can recognize and track **six types of terrestrial objects: birds, people, dogs, cars, airplanes, and boats.**

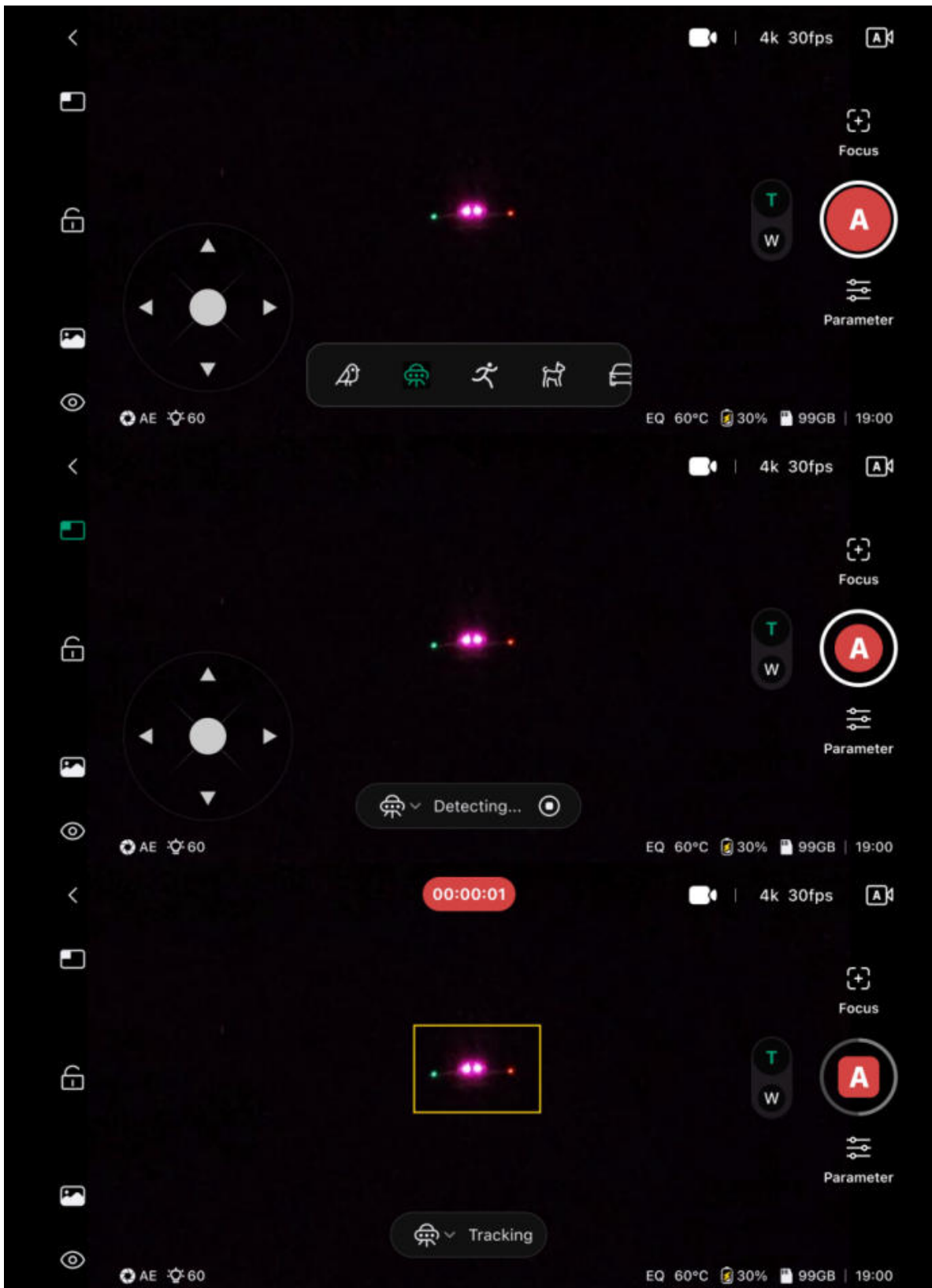


- To achieve the best detection results, do not manually select tracking objects or perform operations such as moving the device during the target detection phase.
- If detection fails, check whether the target is within the frame and whether it appears clearly focused in the telephoto view. You can use the **joystick** or tap **Auto Focus** to adjust the view if needed. Of course, you can also adjust parameters in the Function menu anytime.
- When the internal storage is less than 1GB, recording will automatically stop and save. When the battery is below 7%, shooting will automatically stop and save.

3.4.2 Sky Auto Capture (UFO)

3.4.2.1 Face the Target & Adjust Focus

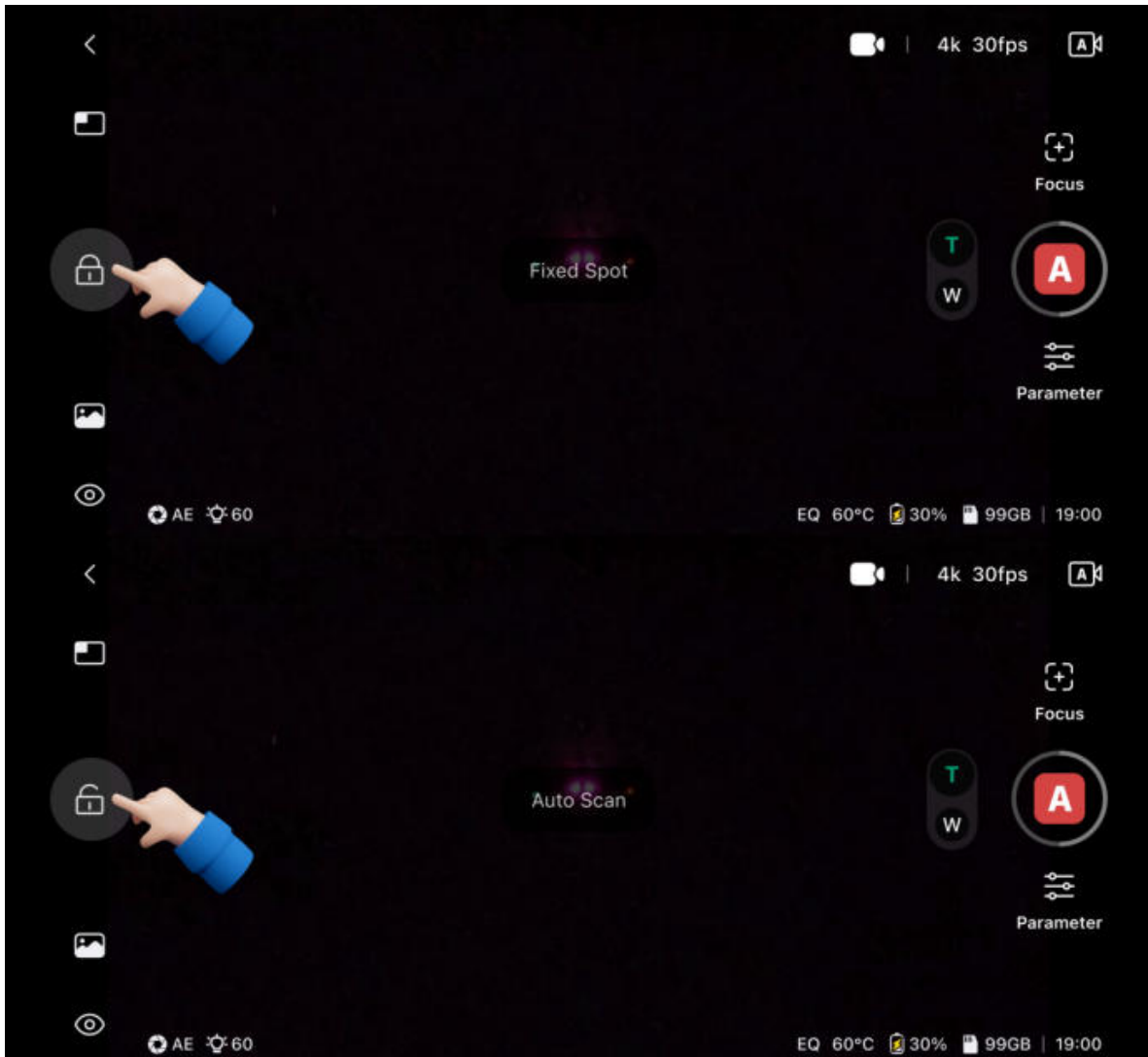
Click 'UFO' icon and follow the guide to complete the focus. Point the camera to the night sky and ensure no ground objects are in the field of view of either lens. DWARF will keep rotating and scanning for moving bright spots in the night sky, initiate tracking, and start recording, allowing you to fully enjoy the unmanned shooting experience.



3.4.2.2 Fixed Spot & Auto Scan

When locked, the device enters fixed-spot mode, detecting UFO at a fixed location. Once unlocked, it switches to Auto-Scan mode to scan the entire sky for UFOs.

To prevent damage from the sun during scans, the Auto-Scan mode is disabled during the daytime.



3.5 Panorama Mode

Capture every detail of the scene before you: use the **telephoto lens** to take multiple high-resolution photos and stitch them together into one stunning panoramic image that reveals incredible clarity and scale.

Follow these steps to create your own professional **gigapixel panorama!**



3.5.1 Switch to Panoramic Mode

Click the icon in the upper right corner to switch modes and enter the panoramic mode.



3.5.2 Place DWARF

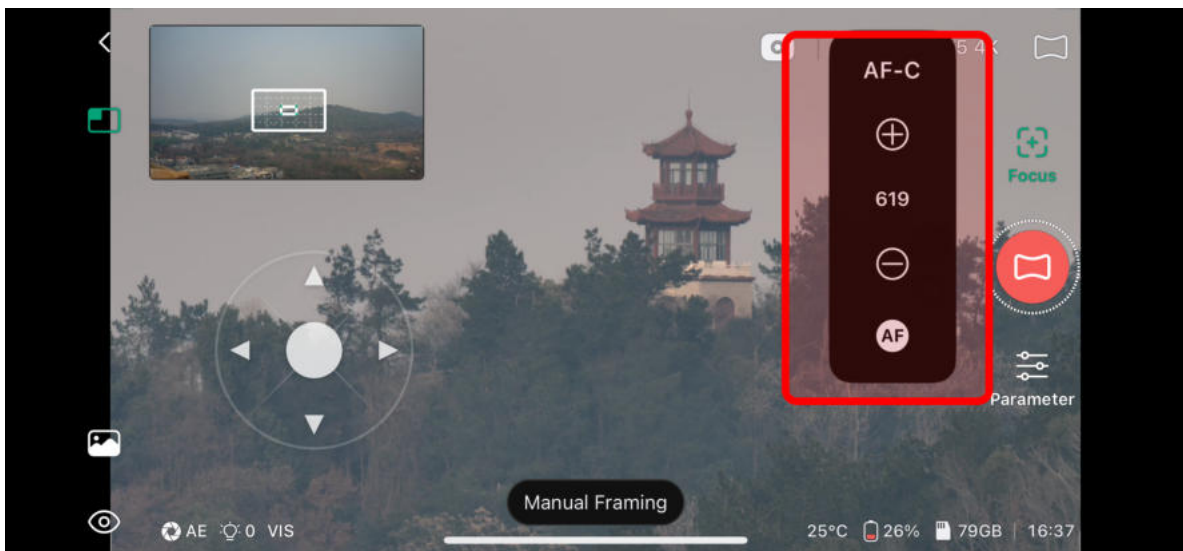
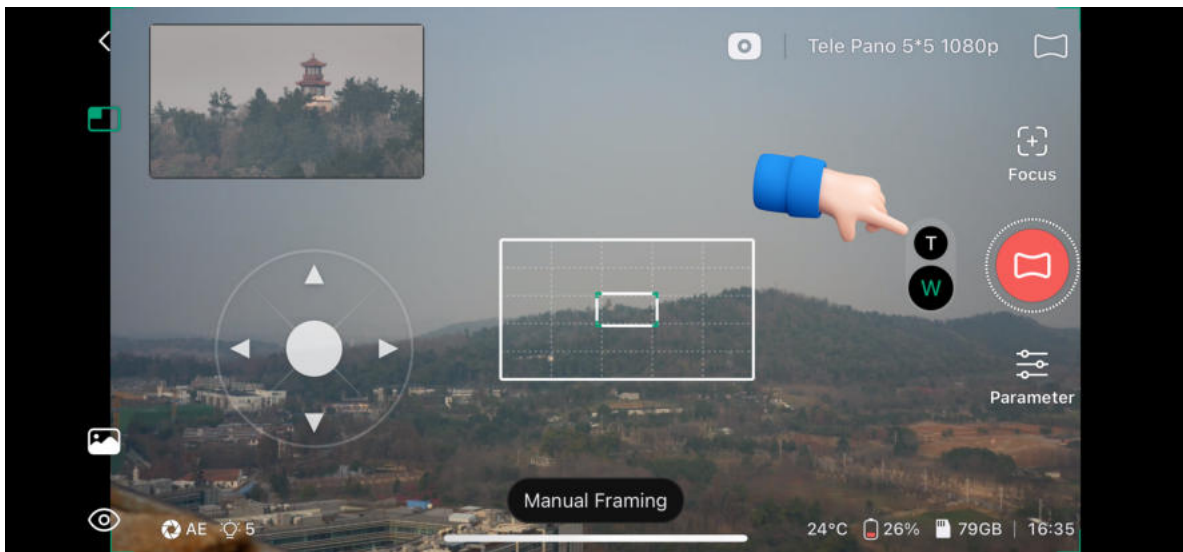
After the base positioning points are aligned, the Logo surface and the lens remain on the same plane and face the center of the frame to be captured.



3.5.3 Focus

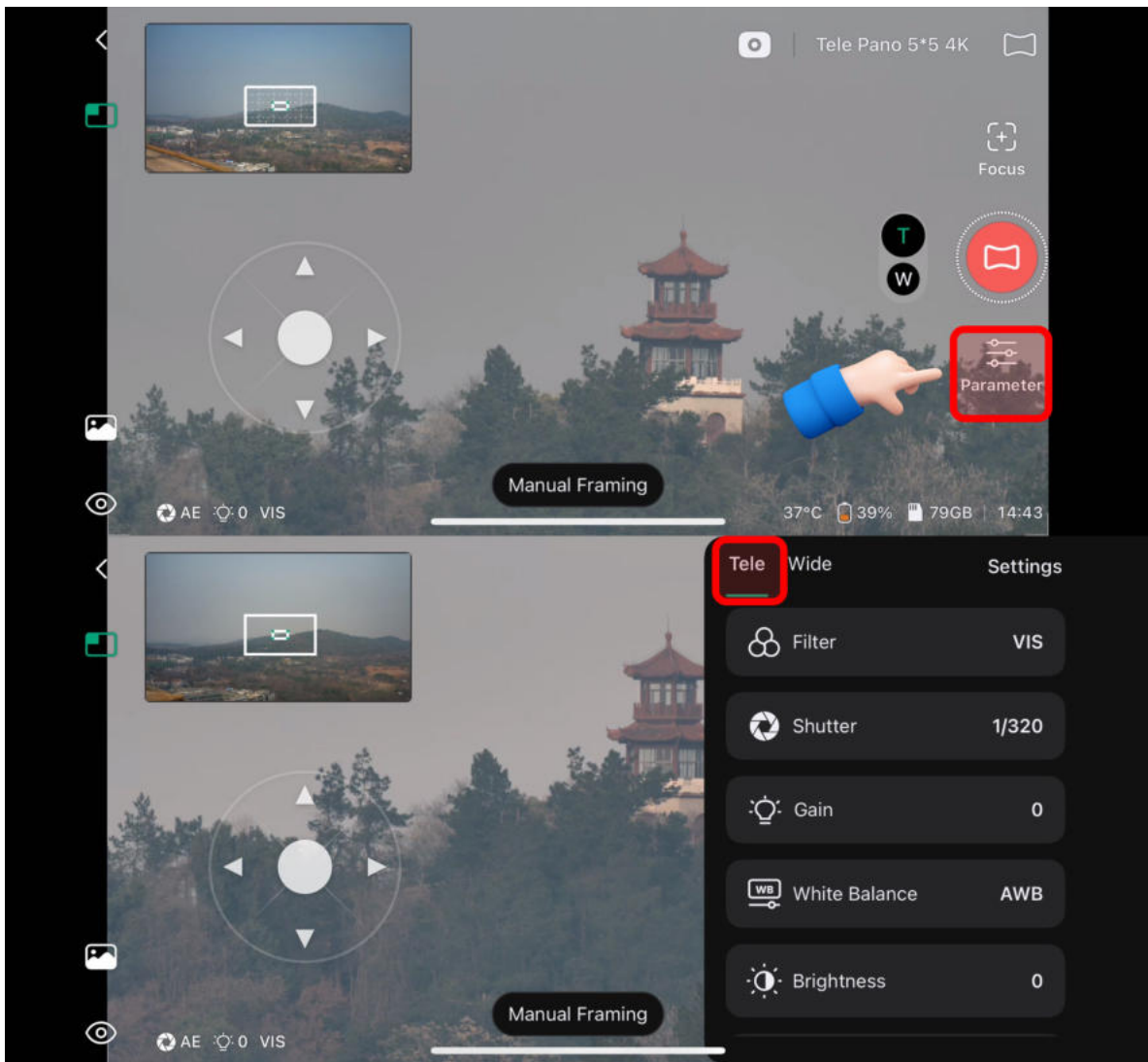
Switch to the telephoto lens for focusing. Click T (Telephoto)/W (Wide Angle) to switch lenses, or directly click on the viewfinder to switch.

Panoramic shooting uses a telephoto lens, so please adjust the focus position in the telephoto field of view.



3.5.4 Set telephoto parameters

Click Parameter - Telephoto



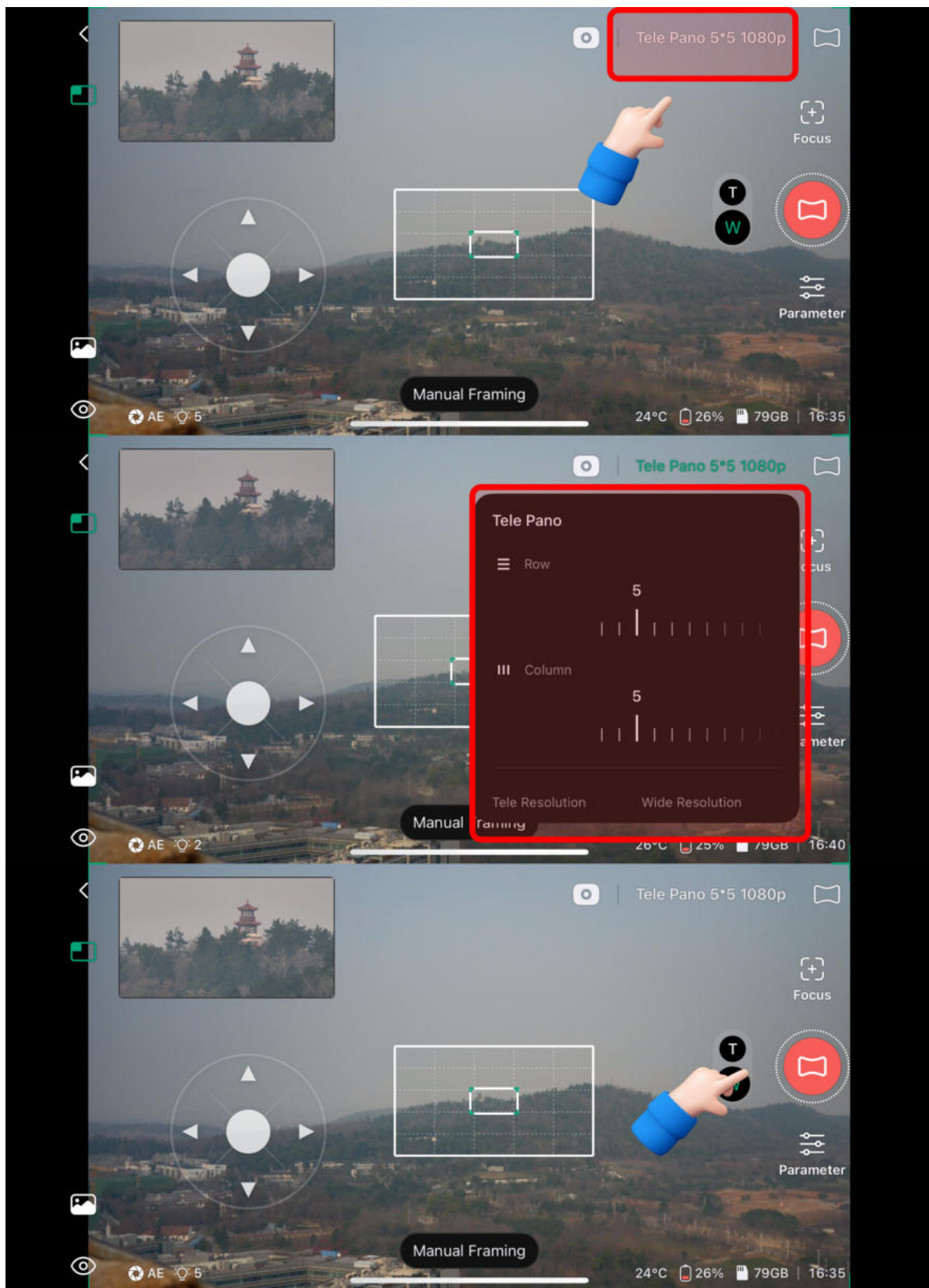
3.5.5 Composition and Shooting

To help you obtain high-quality stitched panoramic images, we recommend:

1. Please try to keep the DWARF3 lens level when shooting.
2. Choose a bright shooting scene.
3. Reduce the sky background (moving clouds).
4. The shooting targets have distinct features and are non-repetitive.

Method 1: Start shooting directly after setting the shooting rows and columns

Rows × Columns represents the number of images to be captured. For example, if you select 5 rows × 5 columns, DWARF will capture 25 images and generate a panoramic image.

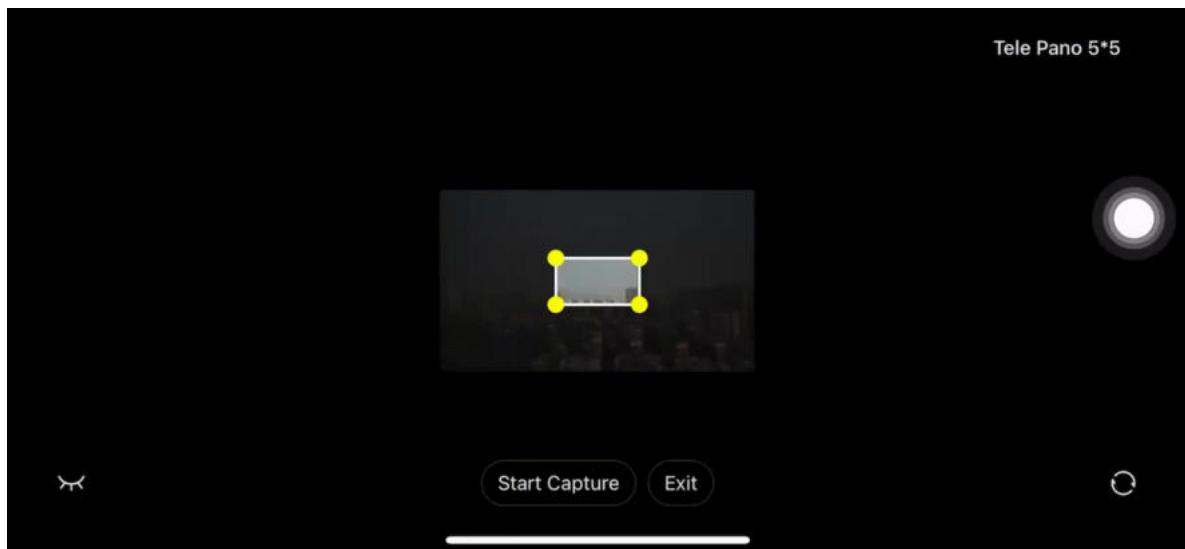


Method 2: Manually compose the shot and then confirm the capture
Click to manually compose the image



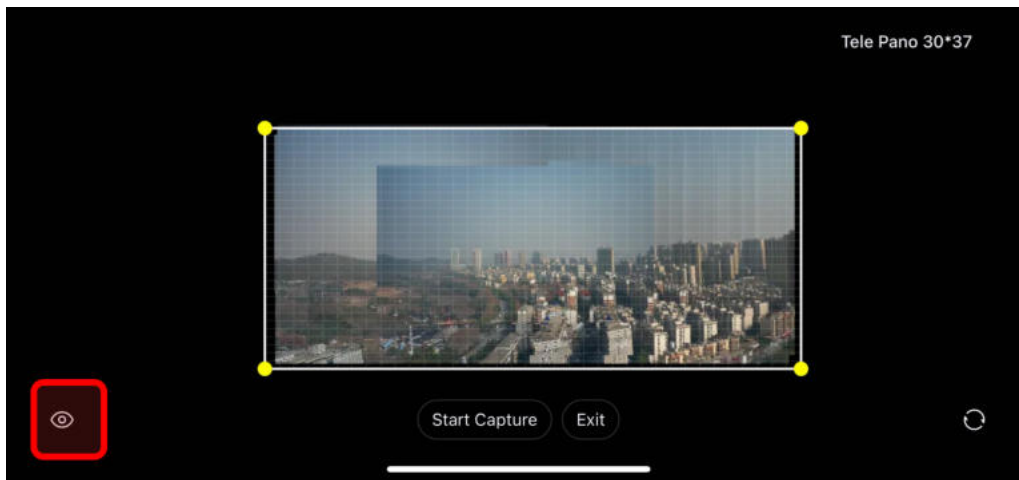
Drag the panorama frame to select the shooting range

DWARF will initially capture a preview image to show the shootable range, and this preview does not represent the final footage effect.

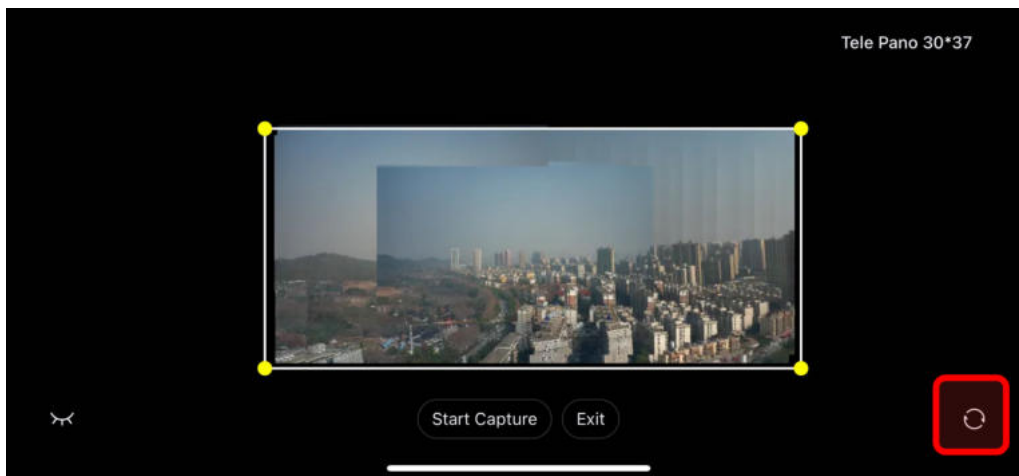


The "Telephoto Panorama 30* 37" in the upper right corner indicates that the shooting grid is 30 rows \times 37 columns, and DWARF will complete the shooting according to this quantity.

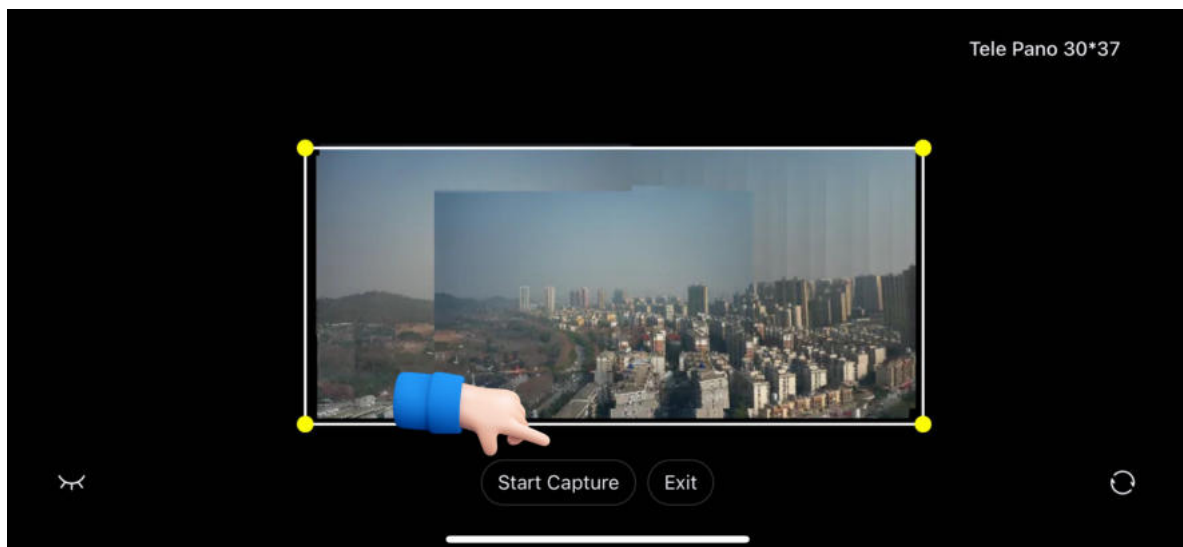
You can also click the icon in the bottom left corner to view the framing gridlines of the current framing range.



When the preview image does not match the real-time image (e.g., after adjusting the DWARF position), you can click the refresh button in the lower right corner to reload the viewfinder preview.

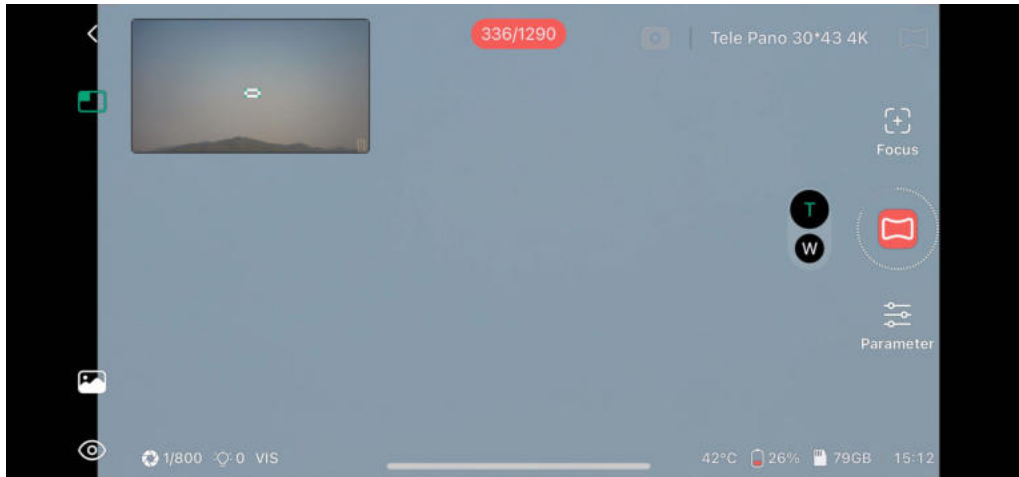


Click to confirm shooting



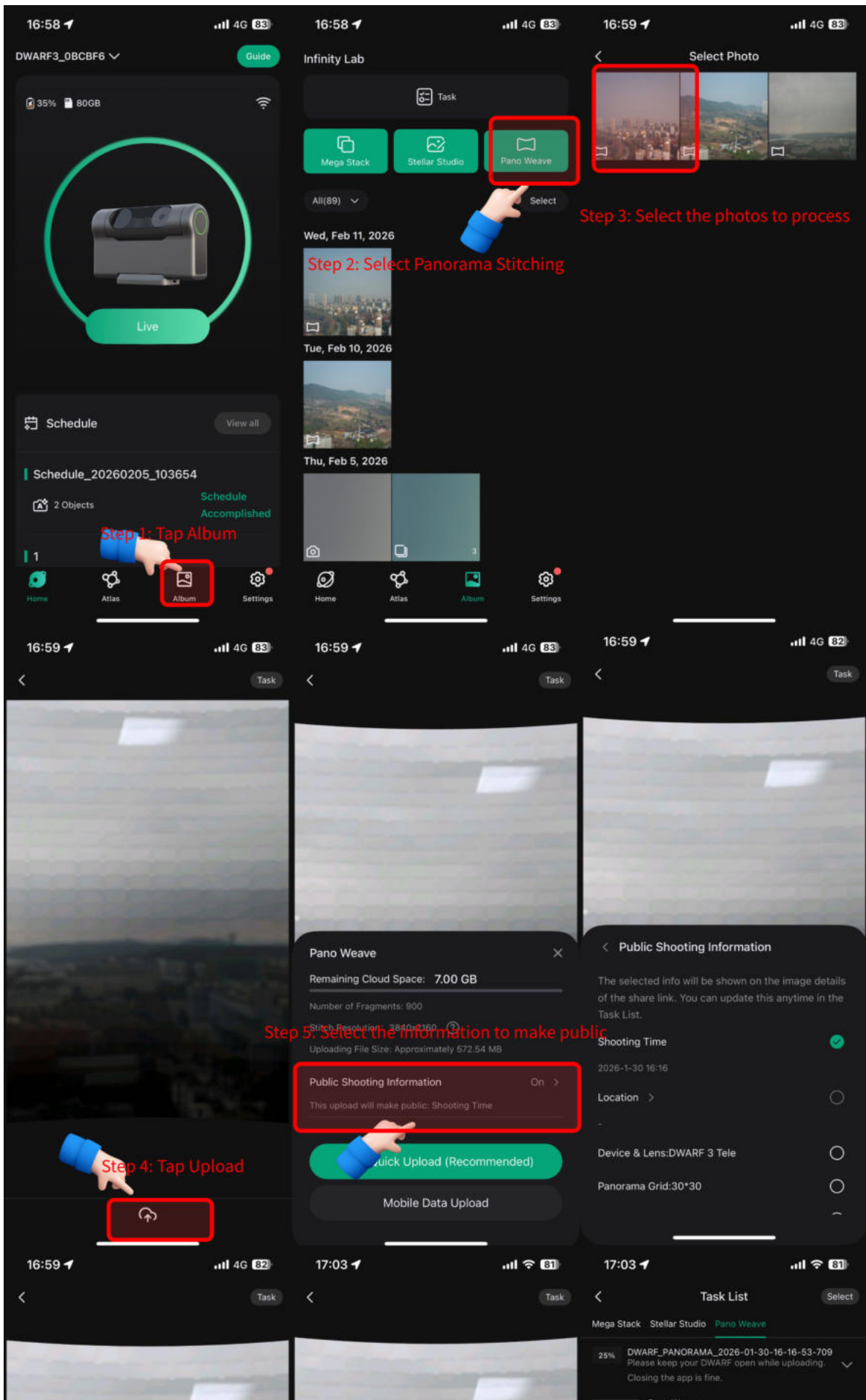
DWARF will automatically take photos based on the number of rows and columns or the composition range you set.

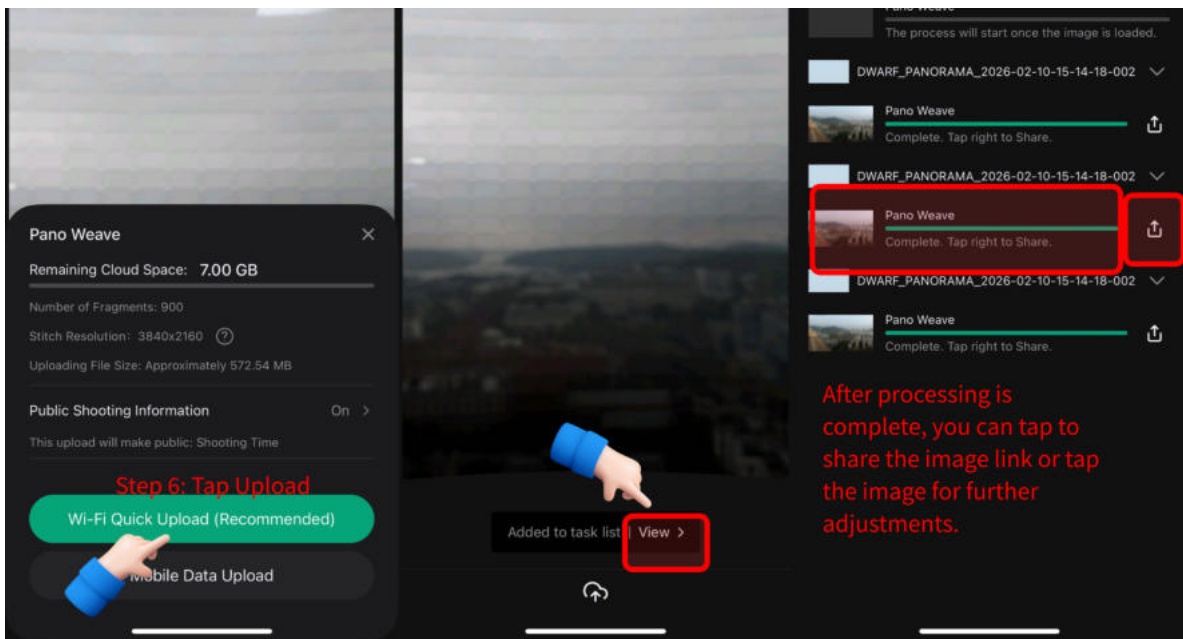
During the shooting process, the screen will display the shooting progress: Number of photos taken / Total number of photos to be taken.



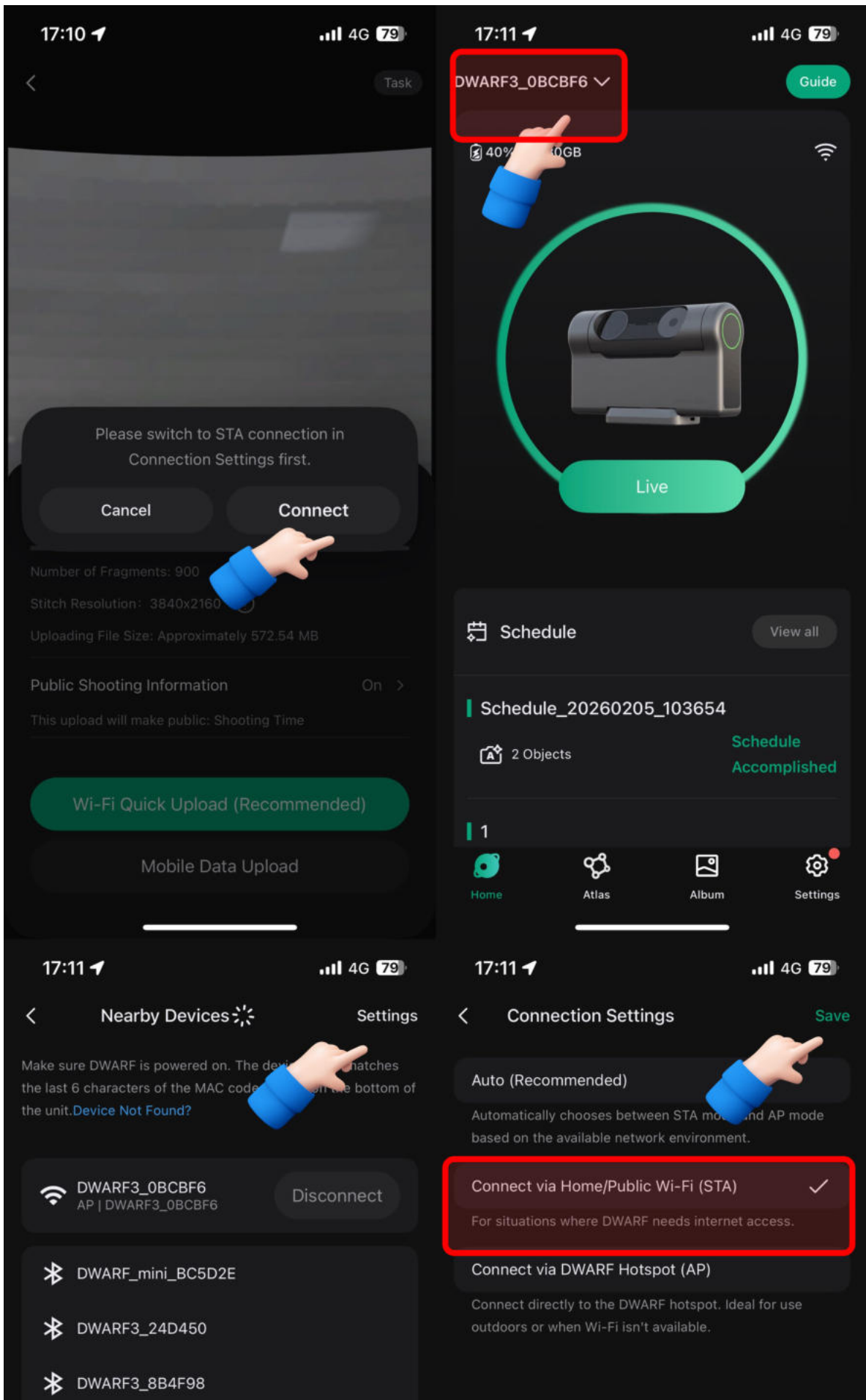
3.5.6 Pano Weave

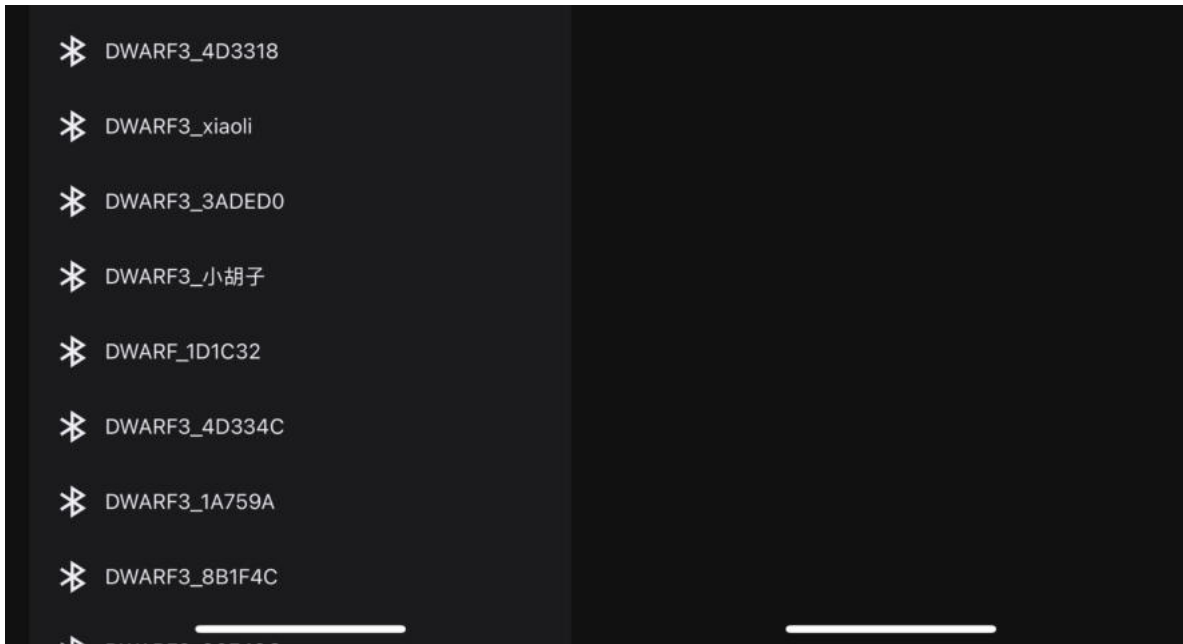
The preview image displayed in the album is a locally quickly stitched one. If you need to generate a high-precision panoramic image, please upload the photos to the cloud for stitching.



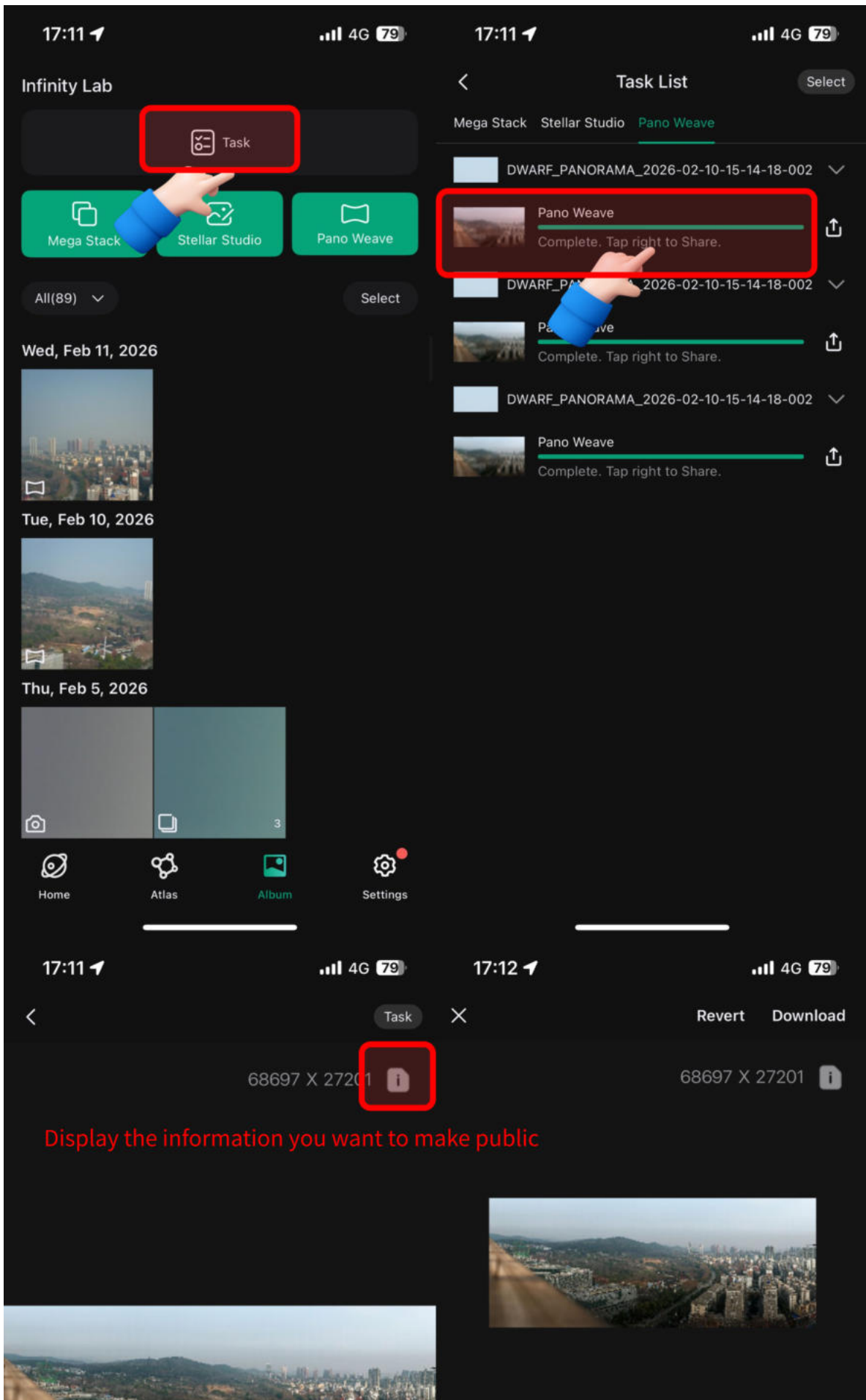


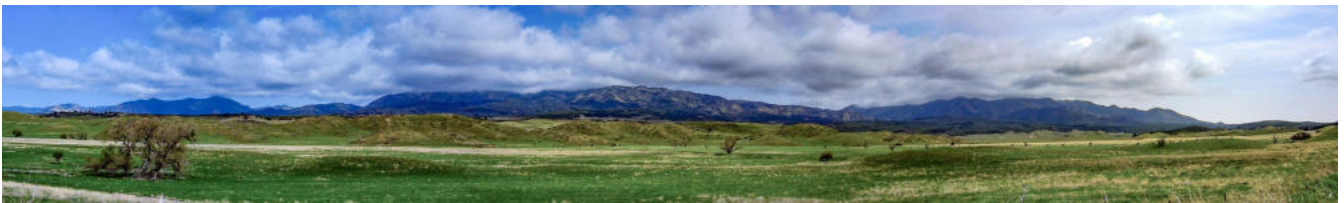
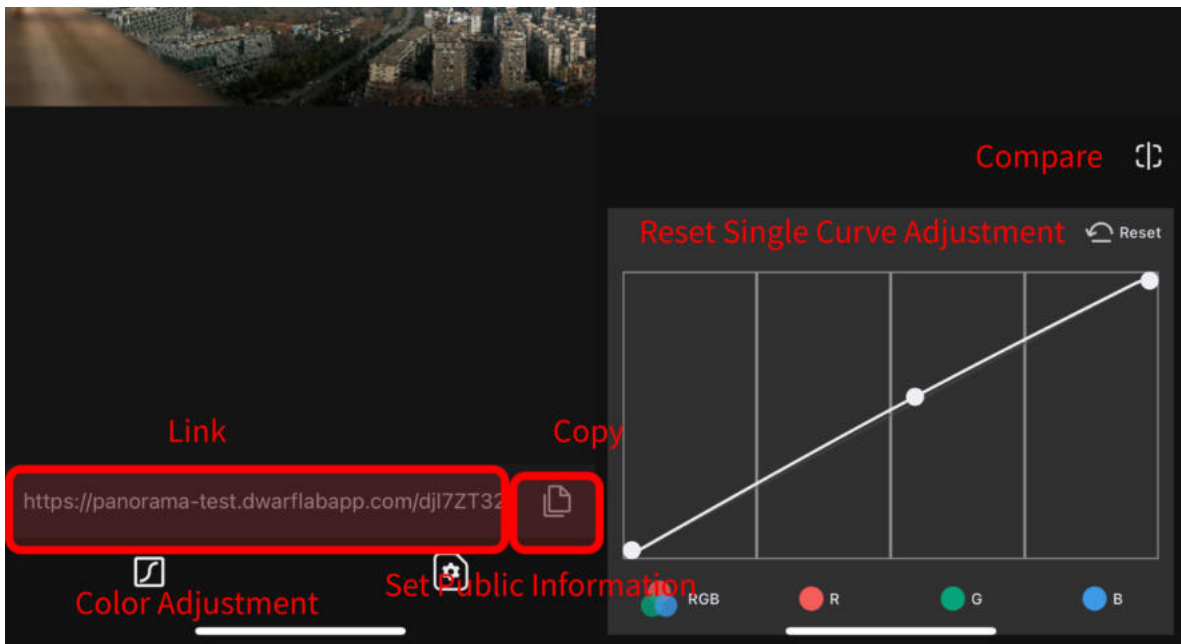
When uploading a panoramic jigsaw using WiFi, if you are prompted to connect in STA mode, the steps are as follows.





3.5.7 Panoramic Image Adjustment





Credit: Mark Bahu, shot by DWARF 3

In the previous sections, we've introduced the **main interface** and explained how to use each **shooting mode** for different scenes.

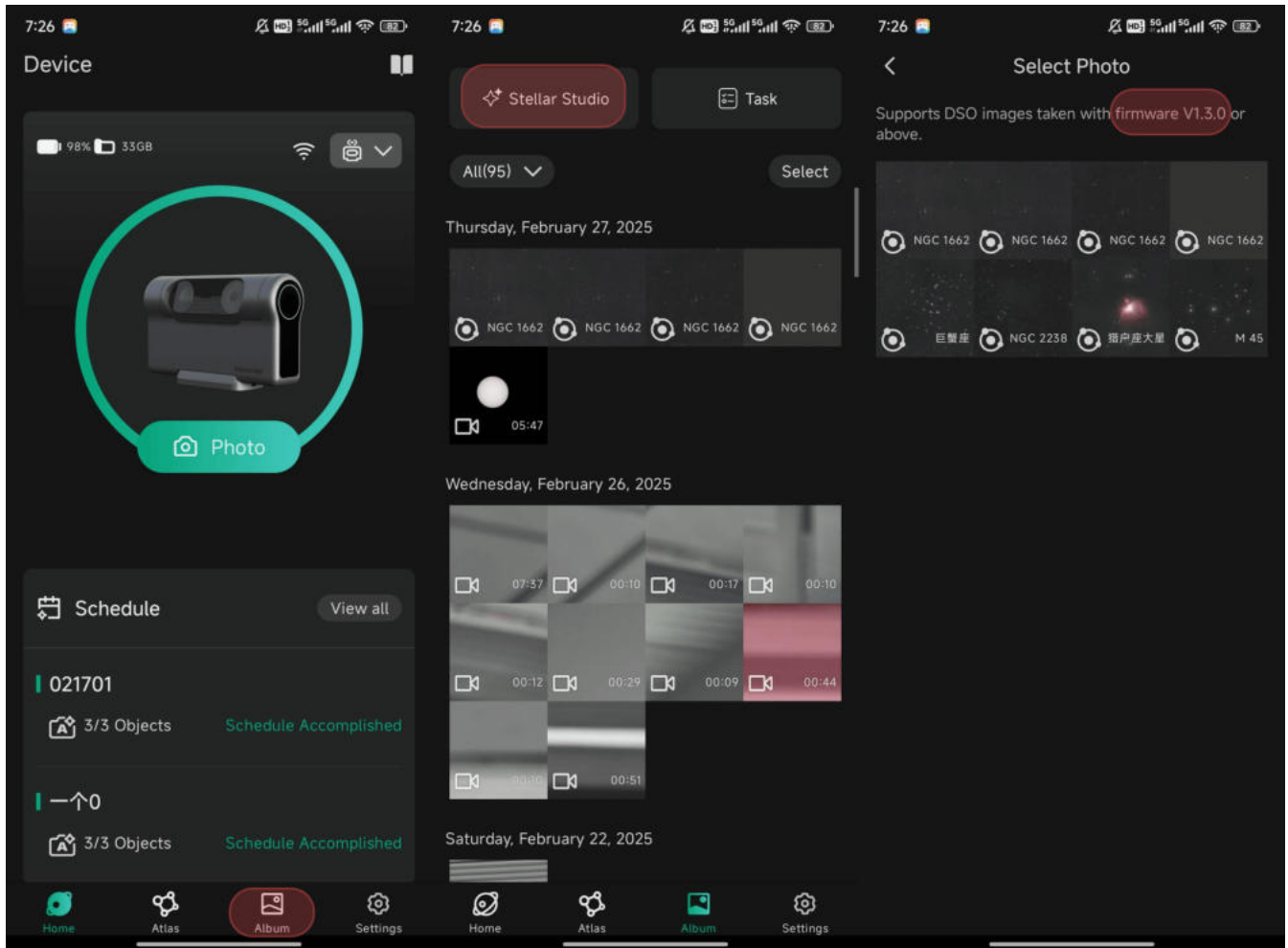
In the following chapters, we'll explore DWARF 3's **signature advanced features** — including **Stellar Studio (SS)** and **Mega Stack (MS)** for astrophotography post-processing, as well as **advanced shooting techniques** like **mosaic imaging** and **scheduled deep-sky captures**. Let's dig in!

3.6 Stellar Studio

Stellar Studio is the post-processing companion to your DWARF 3 Smart Telescope. It transforms raw image data captured by the telescope into polished, detailed astrophotos. After stacking multiple light frames, Stellar Studio allows you to upload your files to our cloud services where it uses a custom algorithmic processing tool to reveal additional details, adjust color balance, reduce noise, and even remove or refine stars for cleaner results. In short, it's where your DWARF 3 data becomes a finished, presentation-ready image.

January 2026 Update: we have included the option to upload Solar and Moon stacked sessions

After completing your Astro session, navigate to the **DWARFLAB App homepage**, select **Album**, then at the top, select **Stellar Studio**. Stellar Studio is designed specifically for Telephoto and Wide Angle deep-sky objects (DSO's).

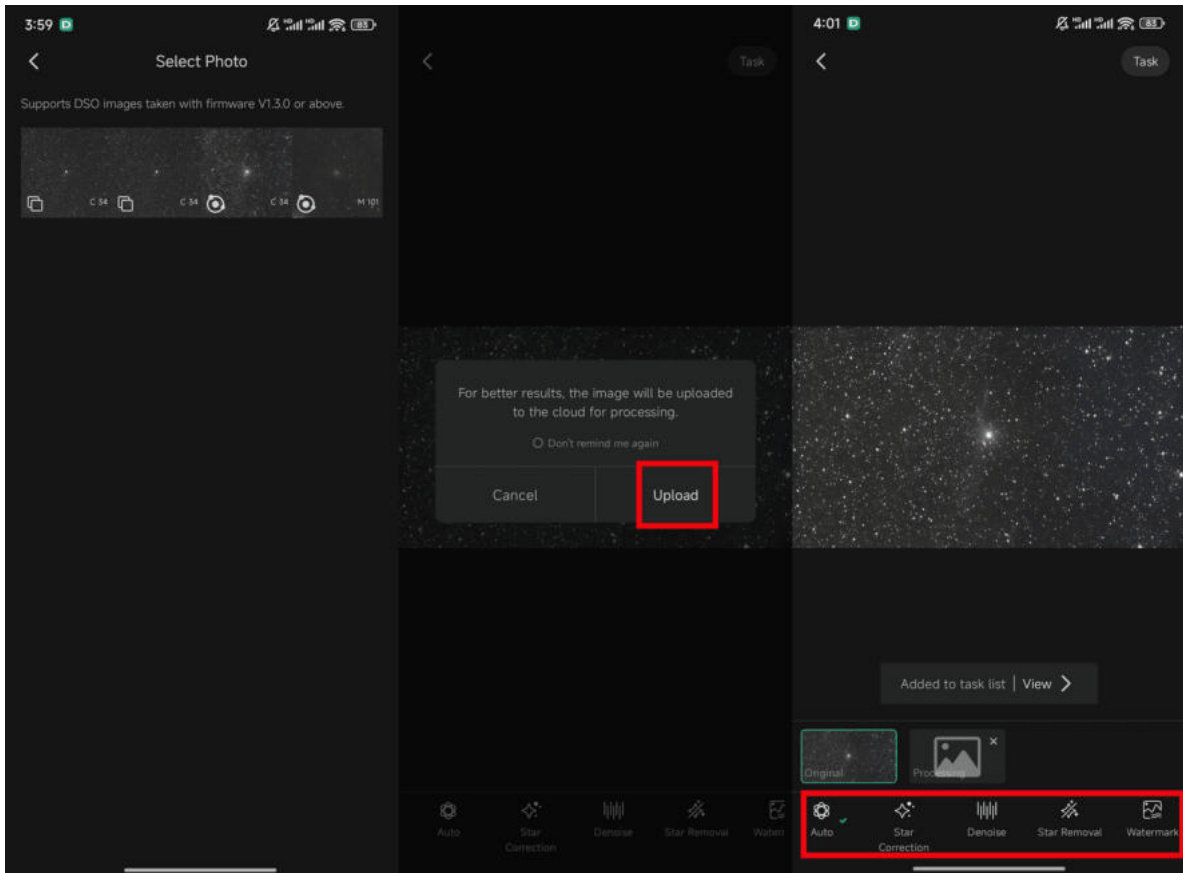


Important Stellar Studio Notes:

Stellar Studio requires you to **upload stacked image files** from the DWARF telescope to an **online (cloud) server**.

- Your phone or tablet must be connected to a **stable internet connection**. Using **STA mode** is recommended.
- If your connection is unstable, uploads may **fail or be delayed**, preventing the process from completing.
- Stellar Studio may display a queue or numbered position in the order it receives your files when uploading or processing the data. This is expected during high usage/high volume of uploads and downloads by other DWARF device users.

- Stellar Studio may be temporarily unavailable due to **maintenance or server issues**. DWARFLAB will work with our server providers to **restore services as quickly as possible**.



3.6.1 Processing Features

Click one of the various options to start the processing of your stacked image

3.6.1.1 Auto Mode

Automatically corrects star shapes, reduces noise, and enhances background uniformity.



3.6.1.2 Star Correction

- Adjusts only the shape of stars.



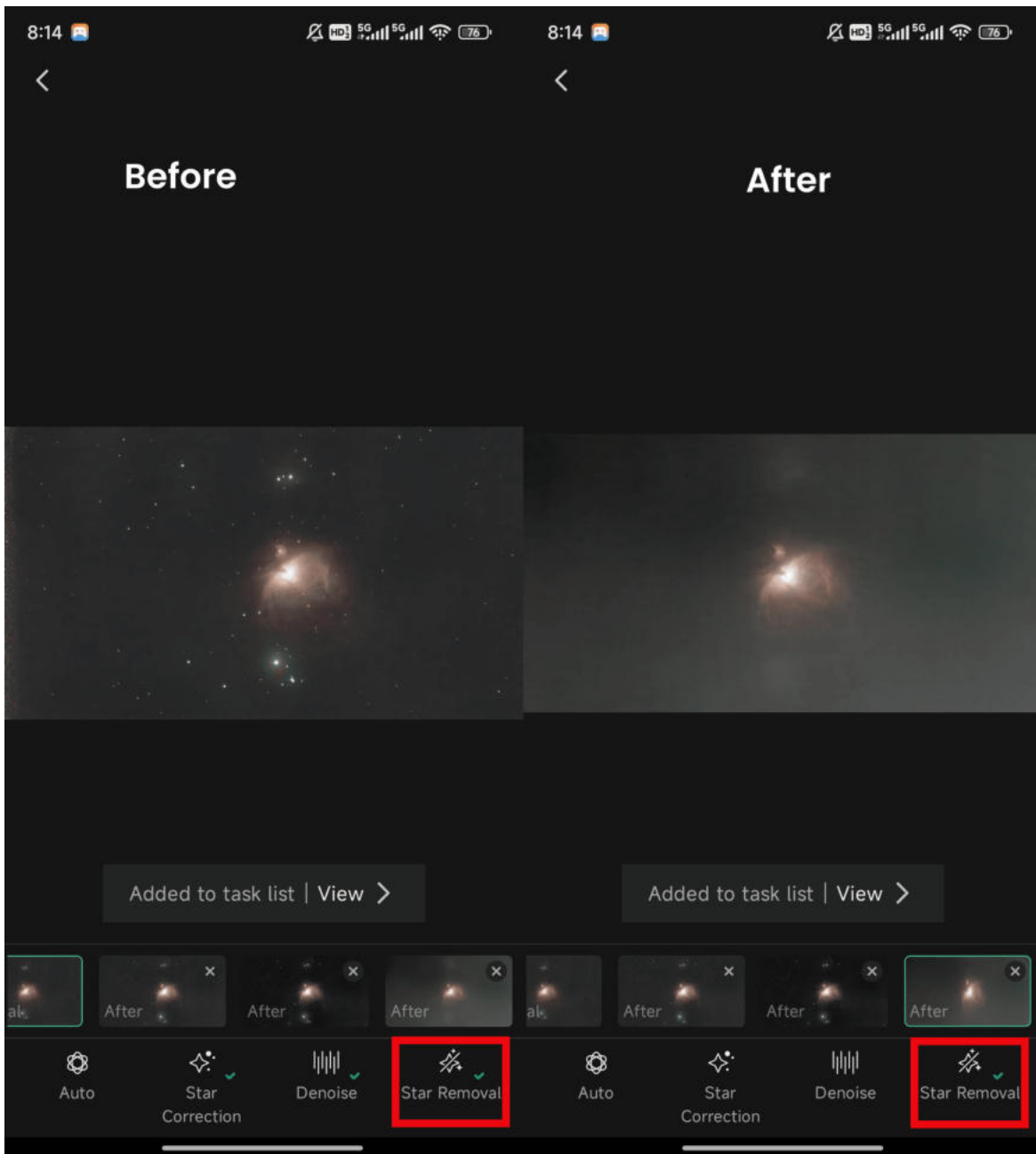
3.6.1.3 Noise Reduction

- Performs only noise reduction on the image.



3.6.1.4 Star Removal

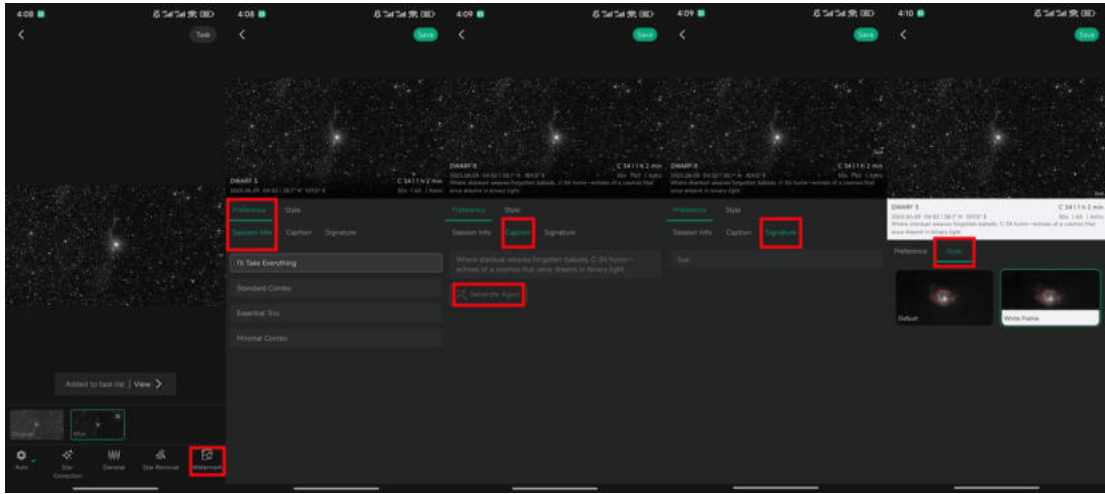
- Only removes all stars from the image, leaving a pure nebula view.



3.6.1.5 Watermark

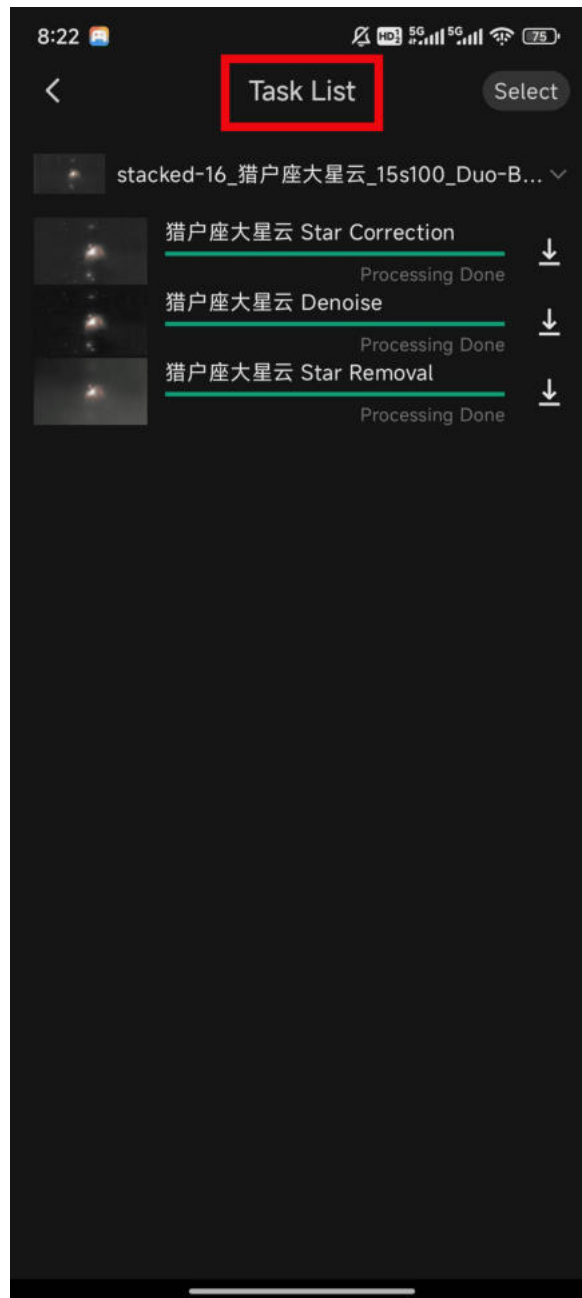
The Watermark feature lets you add **session info, your signature, or a fun caption** to your astro photos.

- Currently, it applies only to **JPG images** and saves them directly to your **phone or tablet photo album**.
- You can choose from **two watermark styles**, with potentially more options coming in future updates.
- Personalize your images and make them truly your own!

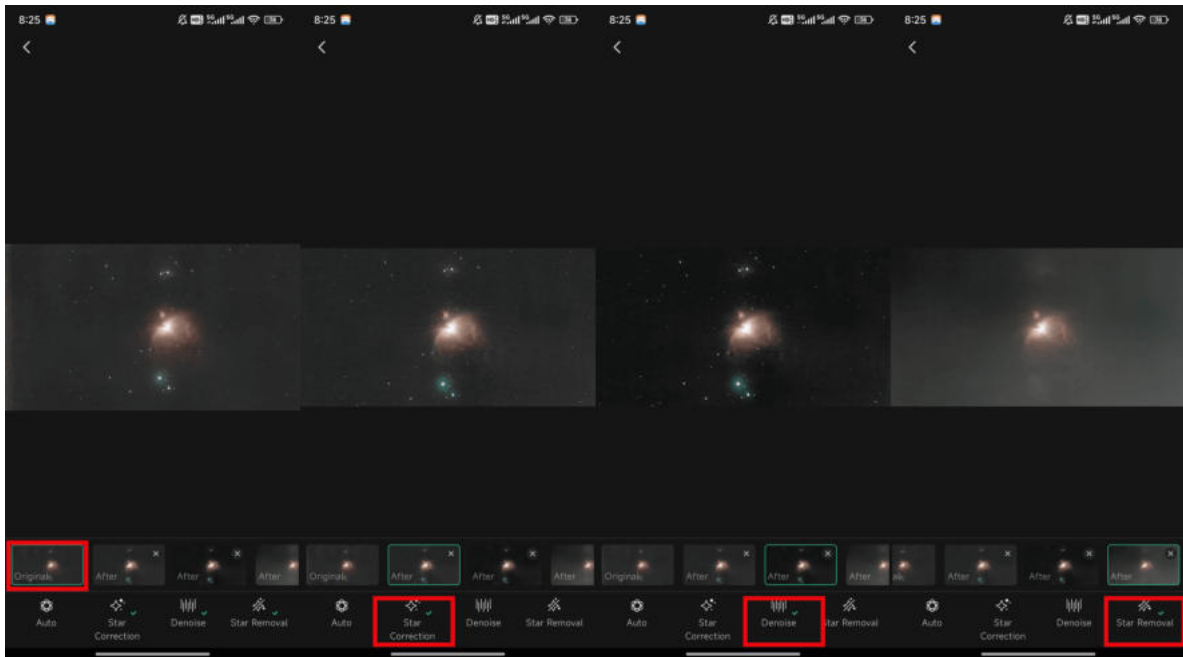


3.6.2 Viewing Results (Task List)

Processed results can be viewed in the **Task** list.



Note: You can apply multiple processing features to the same image, generating separate result images under the same title in the task list.

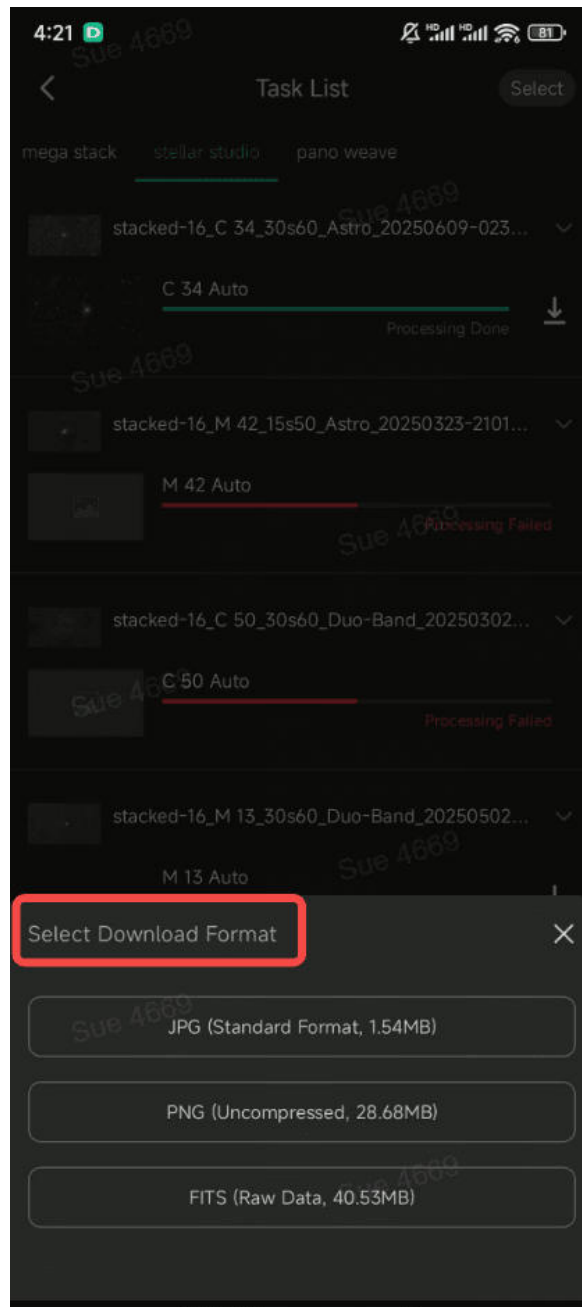


Similarly, you can process an already processed image for multiple times, but **new results will overwrite previous ones**, and the **task name** will reflect the **latest** processing step.

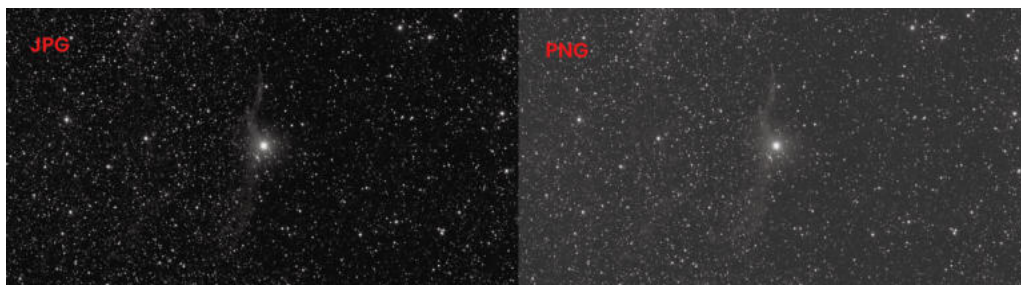


3.6.3 Downloading & Saving Processed Files

Clicking **download** will save a **JPG** or a **16 bit PNG (stretched)** to your phone's system album (for viewing & sharing).



We recommend sharing images directly, and for post-processing, using **PNG** is better as it preserves **more detail in highlights and shadows**.

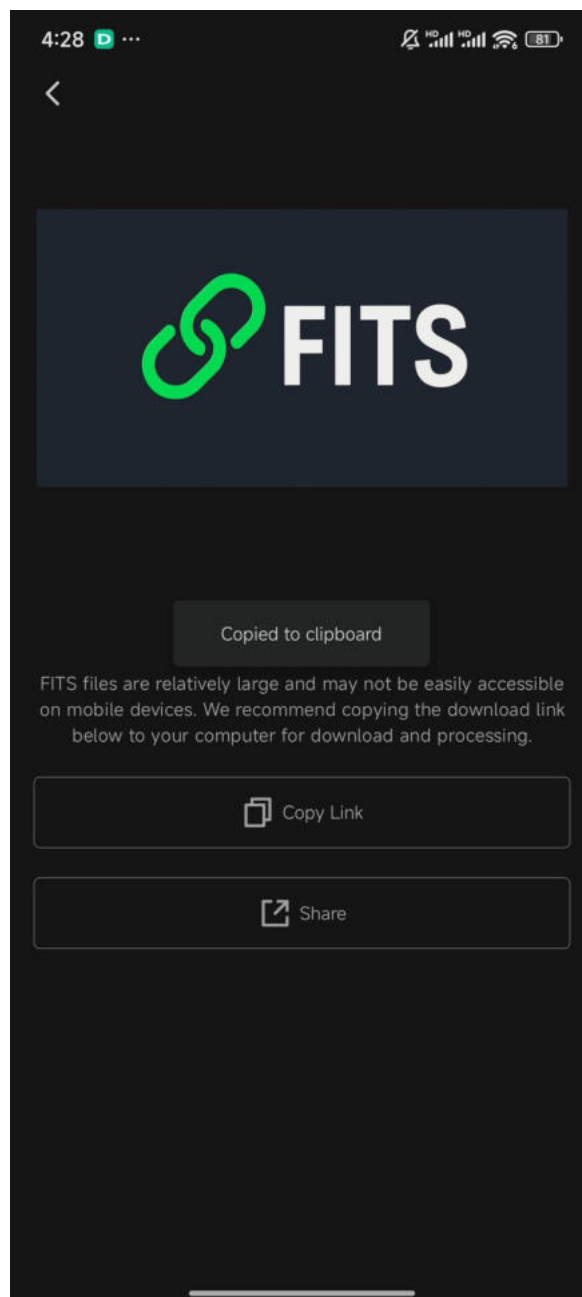


A **RAW file (FITS format)** will be stored in the cloud server for further processing.

How to Access Cloud Files:

Currently, the process to access "cloud" files has two available steps, copy link or sharing the link. By copying and "paste" the link into a browser on your **phone/tablet or typing it into a computer web browser, you can then start the process** to download the file for further use in post-processing applications. Newer operating systems on both phones and tablets (Apple or Android) give some functionality to allow users to save these file types in the file or folder structure on your personal device. If you have a file sharing or storage service (ex Google Drive, OneDrive), it may allow you to save directly to that. Please research how your personal devices can save these file types.

(This process may get updates in the future to assist users with a better method of file saving)



Additional Stellar Studio Notes:

Storage location: JPG and PNG post-processed images are **not saved on your DWARF device**. They are stored directly in your **phone or tablet photo albums**.

Image cropping: Processed photos may appear **cropped** compared to the version in the app's album. This cropping removes **field rotation artifacts**. To minimize cropping, we recommend **shooting in EQ mode**.

- Some images may appear excessively cropped. We are **working on improving this process or adding additional user options**, so future updates should preserve more of the image edges.

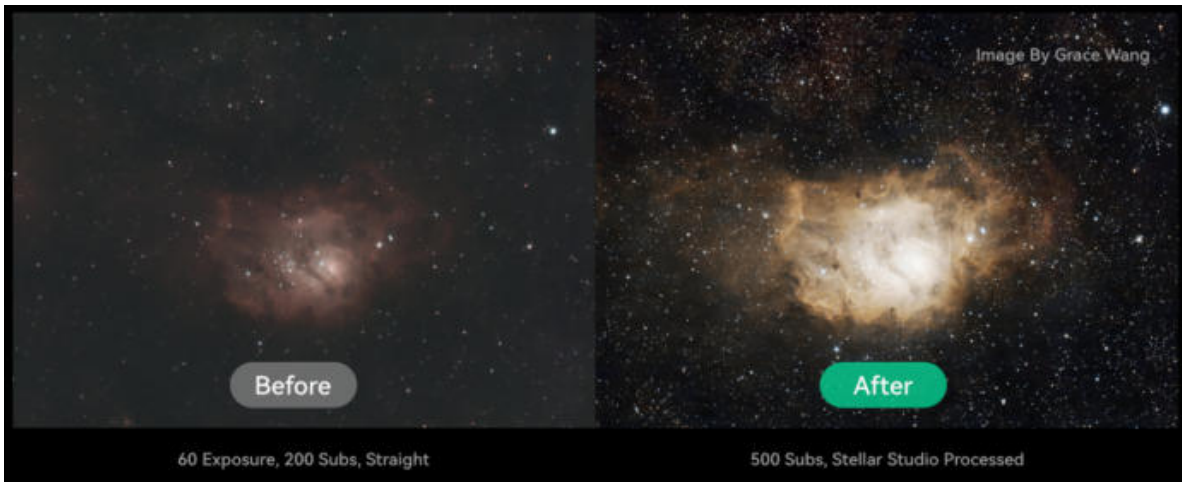
Files moved off the DWARF:

- If a file or folder is **manually moved** off the DWARF device (e.g., to an external drive or PC) and then returned, it will be recognized as an **unknown file**. Stellar Studio cannot process it.
- You can **re-stack the original sub-frames** in **Mega Stack** to generate a new valid file that Stellar Studio can recognize. See the Mega Stack section for additional information.

Mosaic sessions: Re-stacking and processing **mosaic images** is **not supported** (if removed from the device). Once a mosaic session is moved off your DWARF, it **cannot be reprocessed** in Stellar Studio. This feature may be considered in future updates depending on feasibility.

3.7 Mega Stack

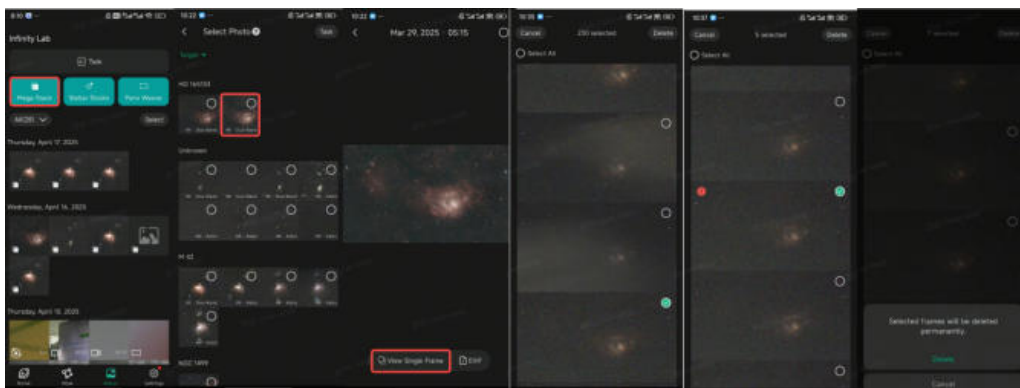
Mega Stack is a powerful new feature that allows you to stack images captured over multiple sessions, breaking the limit of single-session stacking. By combining data from different nights, you can reveal incredible details in deep-sky targets that were previously hidden. This is especially useful for faint nebulae and galaxies — the more you stack, the more you see!

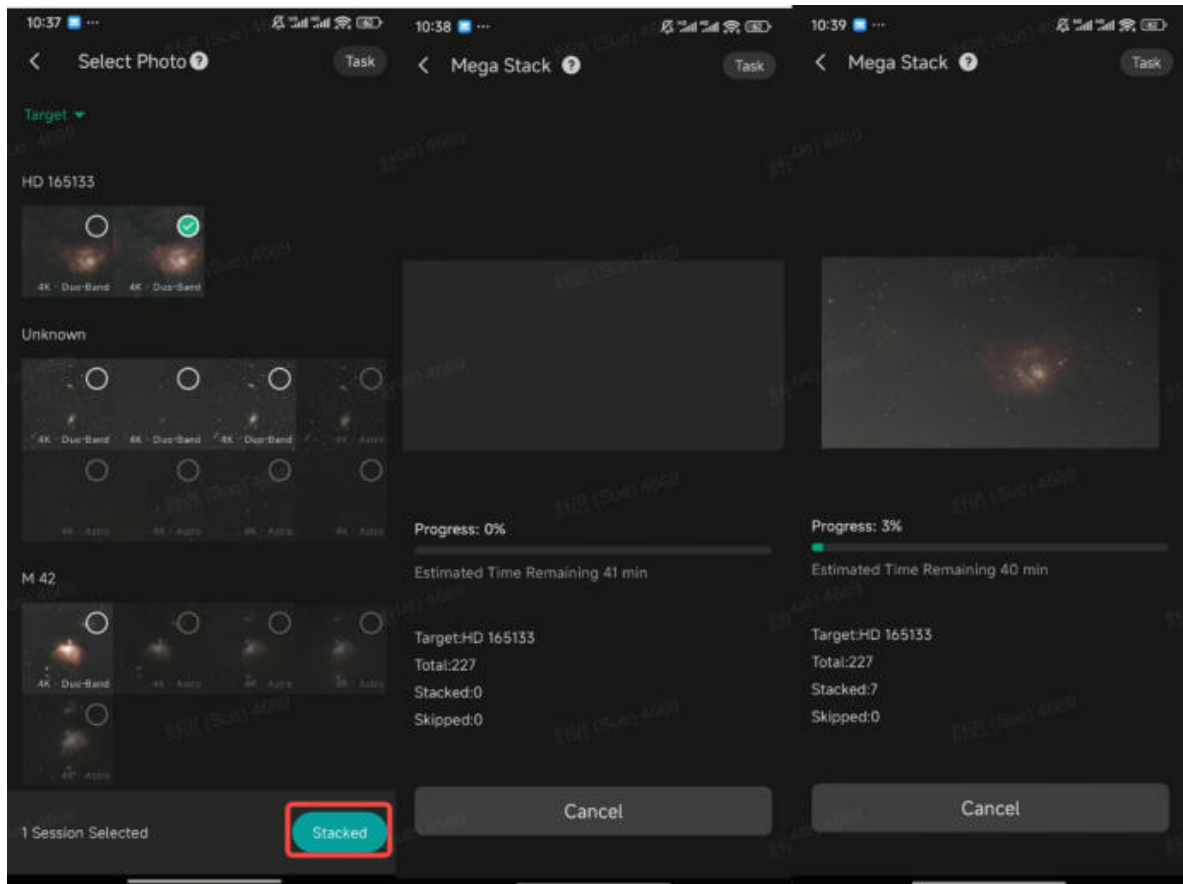


Click on **Mega Stack** to select and stack images of the same target taken with the same filter.

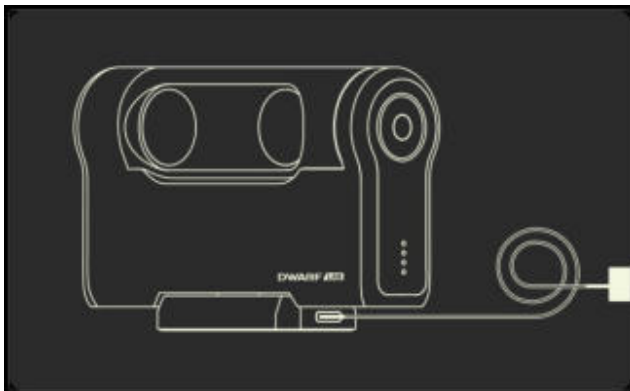
Before stacking, you can tap **View Single Frames** to review individual images and delete any unsuitable ones before proceeding.

In the screenshot below, the image marked with an exclamation mark indicates that this frame was **rejected during stacking**, likely due to **clouds, glare, or poor tracking**.





Waiting for your work - Processing is all completed inside the DWARF and may take a short time or several hours based on the amount of individual frames you are combining to the stack. You **must** keep the DWARF in a "powered-on" state, but you can safely disconnect your phone or tablet while it completes the task. After completion, your results will be saved in the App's album. *(Don't forget to plug in your DWARF to a power source!)*



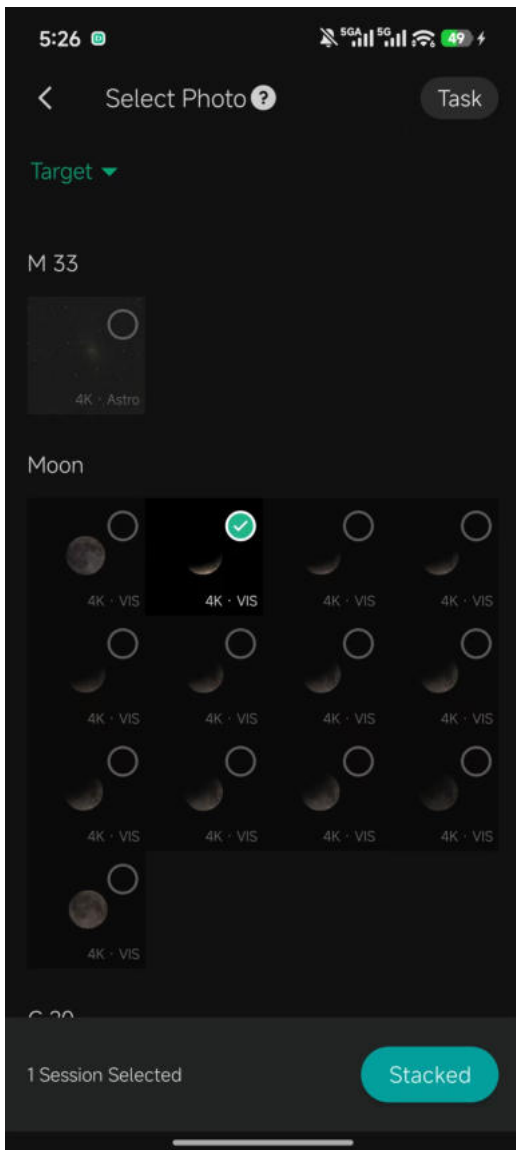
3.7.1 Mega Stack Tips

- To ensure successful stacking, all selected frames must be captured of the **same target** (or celestial objects with identical coordinates) and must use the **same filter**

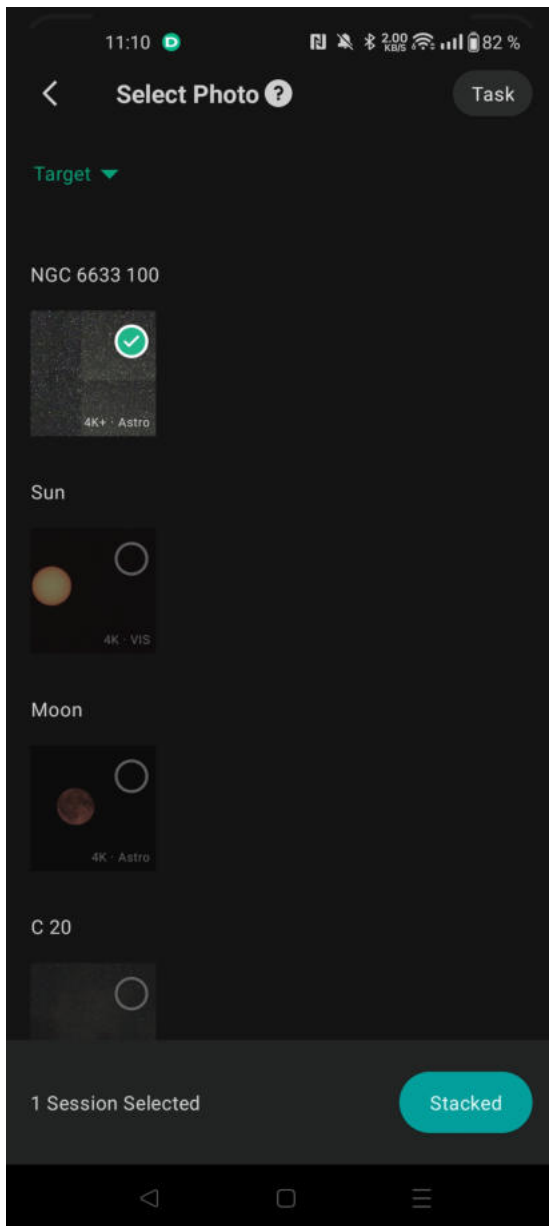
(Vis, Astro, Duo-Band).

Due to different wavelengths being filtered by each type of filter, the resulting image spectrum can vary significantly. At the moment, our stacking process does not yet support compensating for these spectral differences between filters. Unlike other features in Infinity Lab, **Mega Stack does not involve any cloud-based processing. All image stacking is performed **locally on the device (onboard the telescope itself)**. It does not require you to connect through STA mode to start or finish the process.

- MegaStack supports restacking of data captured with **Firmware Version v1.1.8 or later**. DWARF image files that have been moved off the device for storage purposes can be copied back for processing — make sure **not to rename the files**.
- If you intend to use any files in Stellar Studio after they are copied back to the DWARF's file storage, you **MUST** use **Mega Stack** to process and stack the frames again before they will be recognized for **Stellar Studio** to process. If you're wondering where you need to put your files at, be sure to read over the following document to understand the file structure in the DWARF device, "[Get to Know the Files Stored in DWARF 3](#)"
- MegaStack is designed primarily for **deep-sky objects**, but now also supports restacking for single-session **Sun and Moon** captures. Please note that for this case, only **single-session** stacking is supported, as sunspots and the Moon's rotation can affect alignment among frames of different sessions.



- For **Astro Mosaic** (images with adjusted framing), Mega Stack supports only **single-session** stacking, as star positions may shift slightly between sessions. This will ensure higher stacking success.



- The current Mega Stack feature is quite sensitive to star quality and alignment. If there are **frames where the stars appear stretched or have noticeable trailing in any session**, it can cause the entire stacking process to fail — even if just a few frames are affected.
- Although dark data is **embedded** during the initial shooting process, **Mega Stack allows you to reprocess with newly captured dark frames** — especially helpful when temperature conditions have changed, just retake dark frames and then restack the session. This process is automated and will use the best available darks that match your session parameters. This is a good time to re-do your darks if you choose to use Megastack.

3.8 Schedule Shooting

Schedule Shooting allows you to capture celestial objects late at night without staying up. Simply set up your DWARF telescope, which will independently complete the task without supervision. Check the weather forecast to ensure you don't miss any clear night skies due to unexpected conditions!

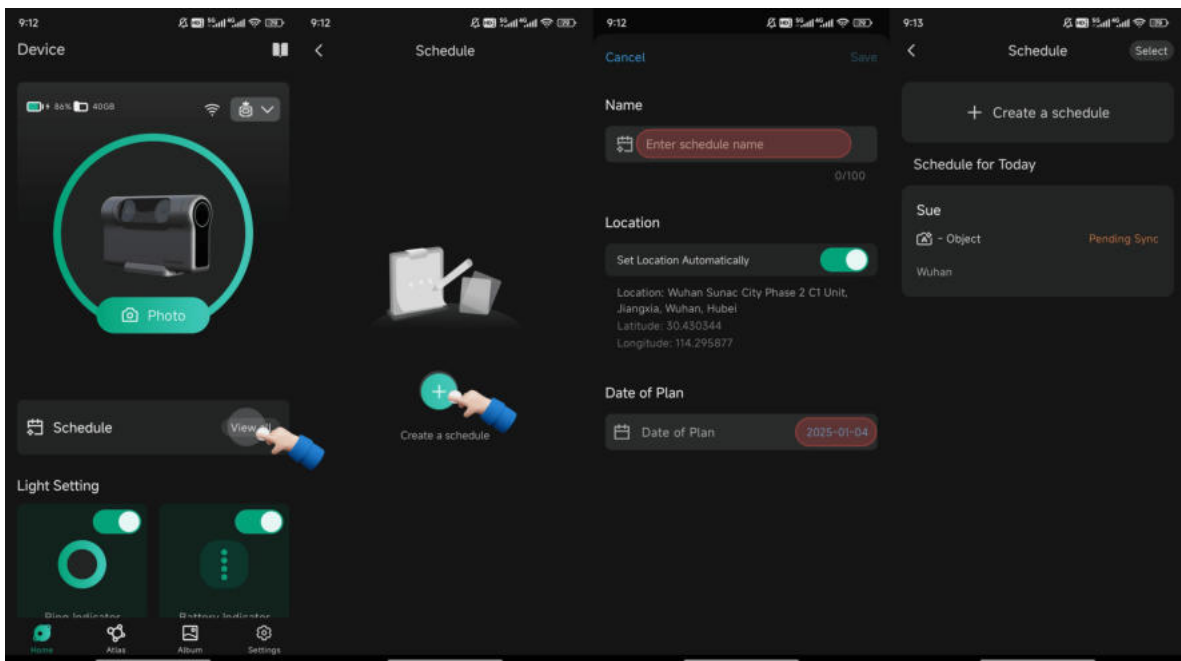
There are two ways to schedule a shooting:

1. Creating a plan directly from the Homepage
2. Creating a plan from the Atlas.

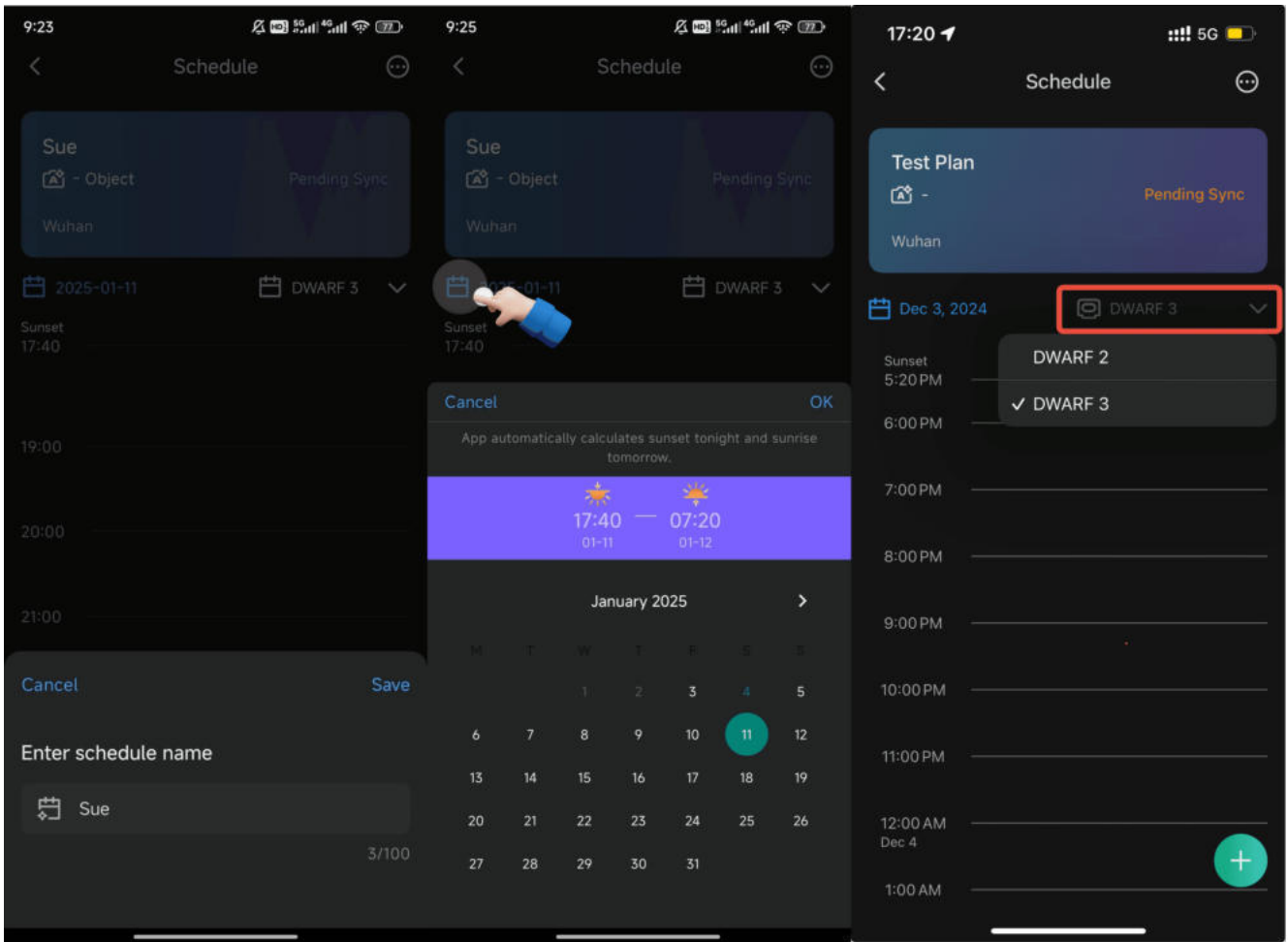
In the next two sections, we'll take a closer look at these features in detail.

3.8.1 Create a Shooting Plan Directly (Homepage)

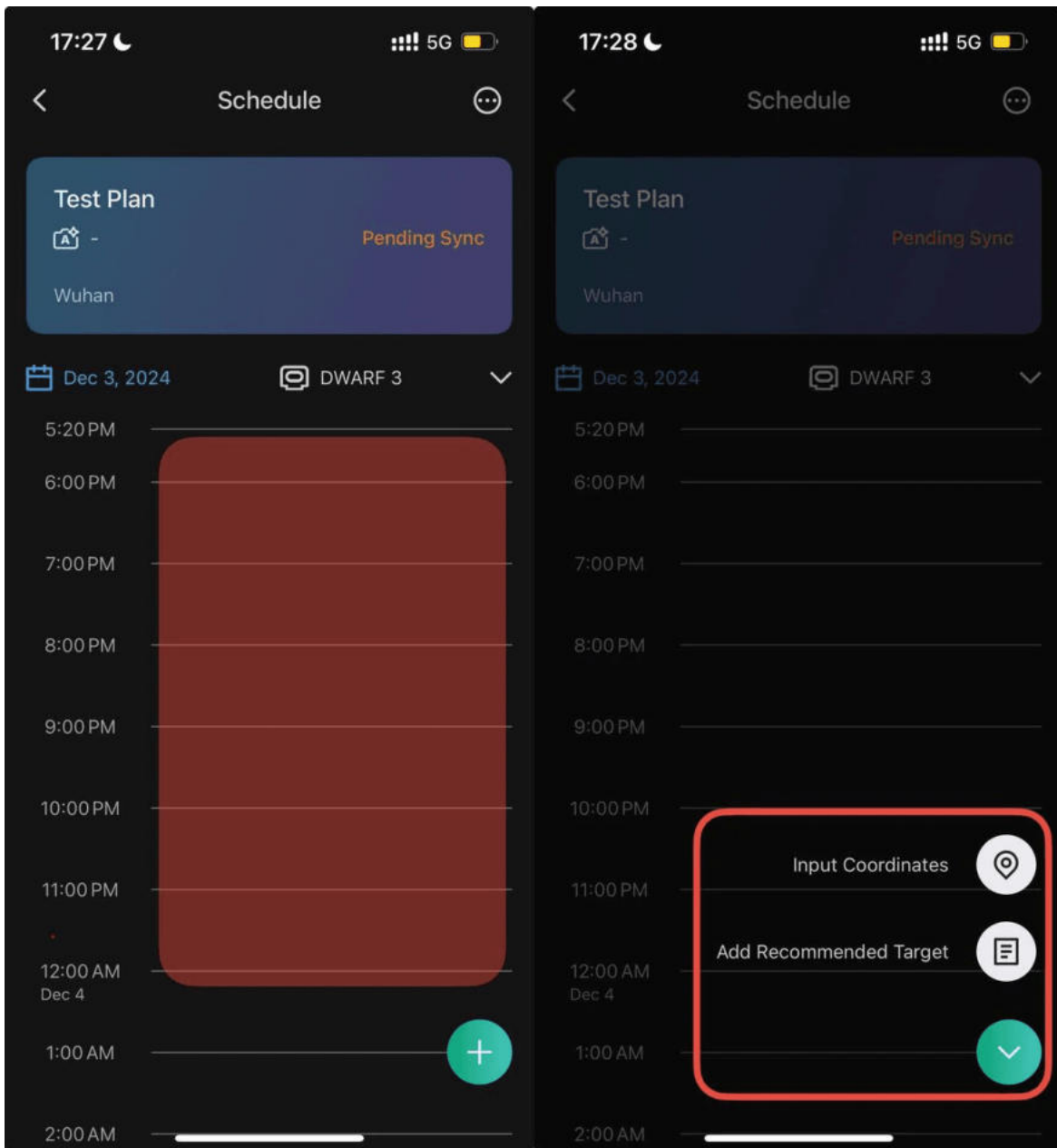
1. **Create a plan:** Follow the prompts to create a plan, fill in the plan name, select the shooting time, and save it.



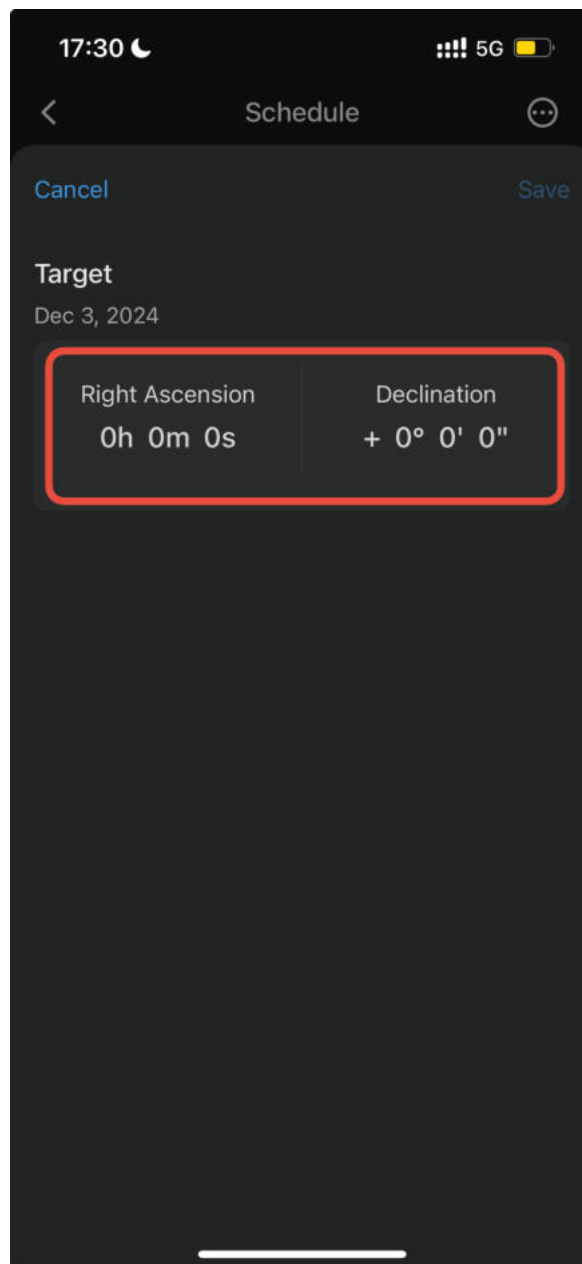
2. **Edit Plan:** Edit plan name and time, change shooting device:



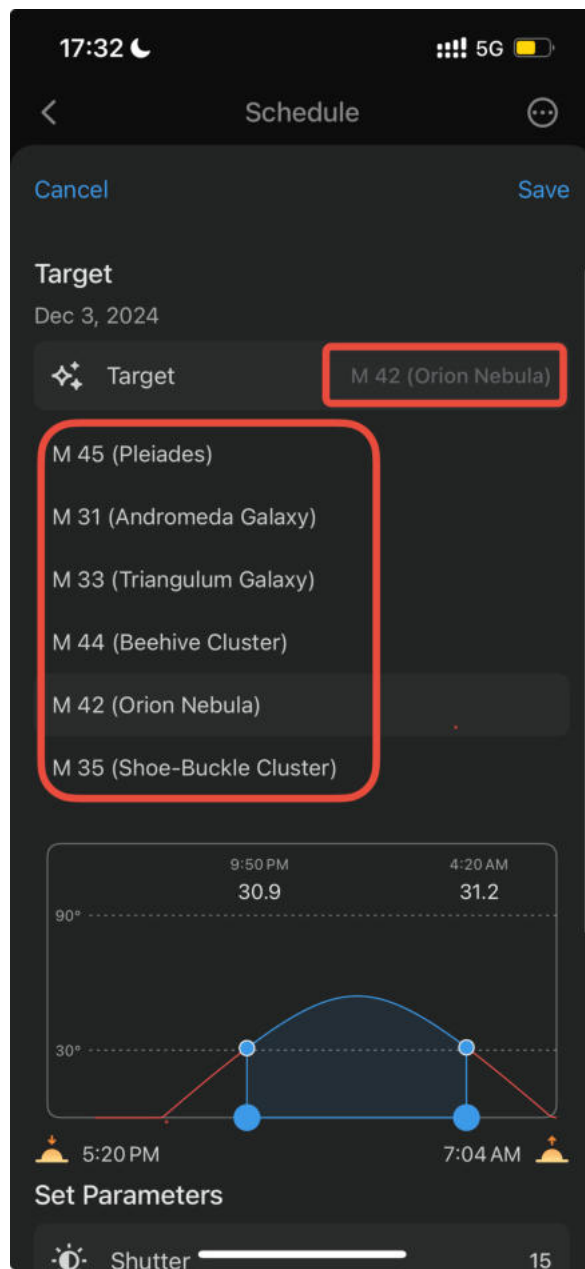
3. **Click** on the blank space in the schedule or the "+" icon in the bottom right corner to add a shooting target:



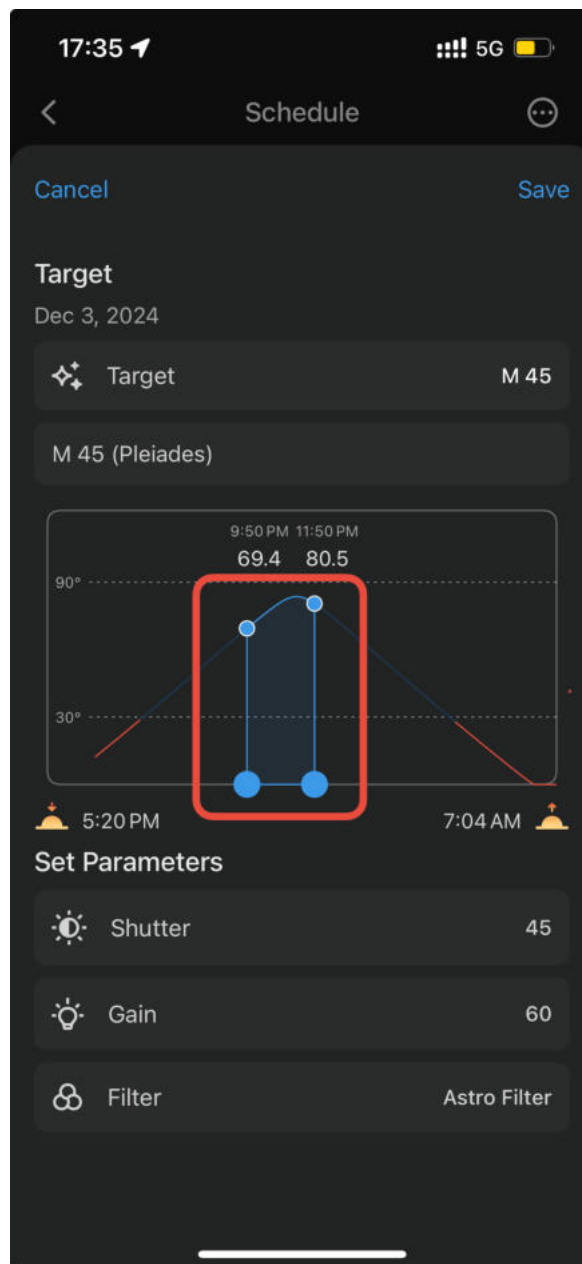
If you select "**Input Coordinates**", click on "Right Ascension" and "Declination" in the image below to input the coordinates.



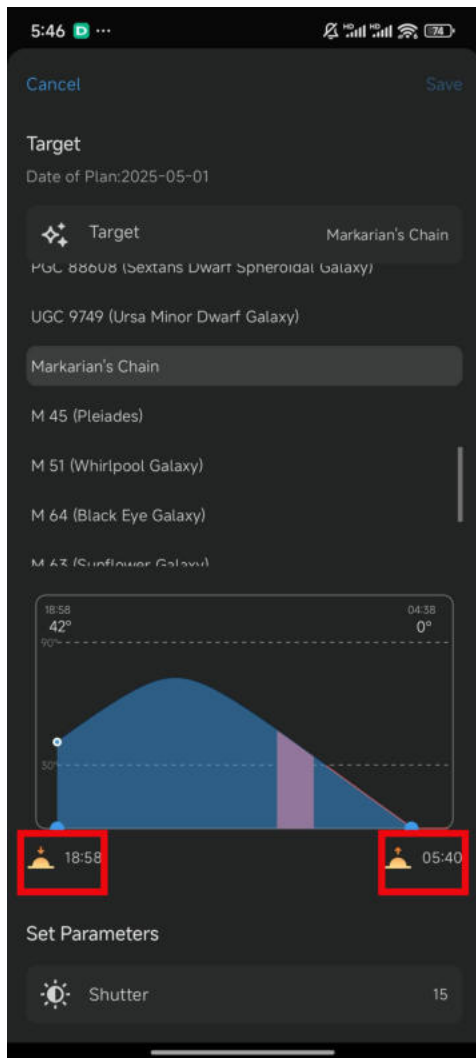
If you select "**Add Recommended Target**", enter the target name in the input box shown below or choose from the recommended list.



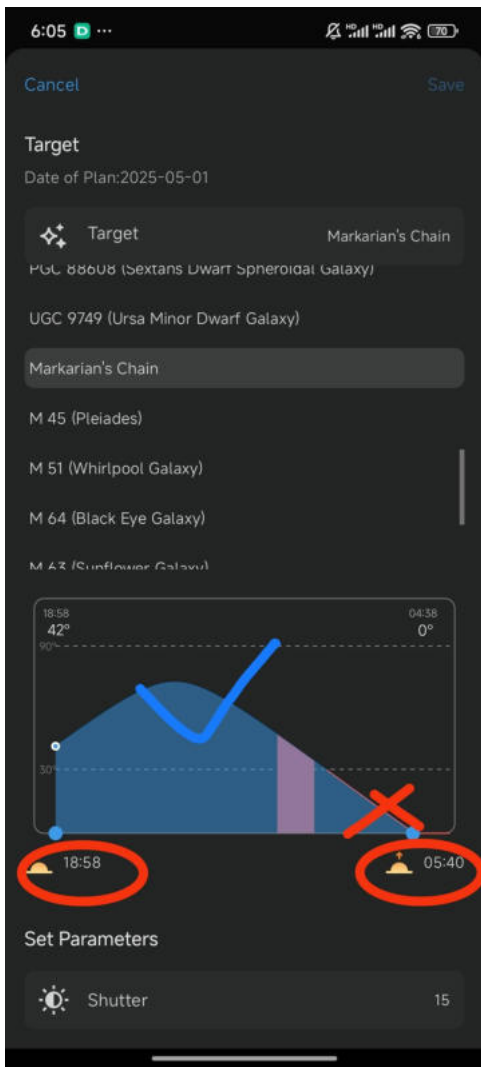
Slide the time range below to set the shooting time:

**Note:**

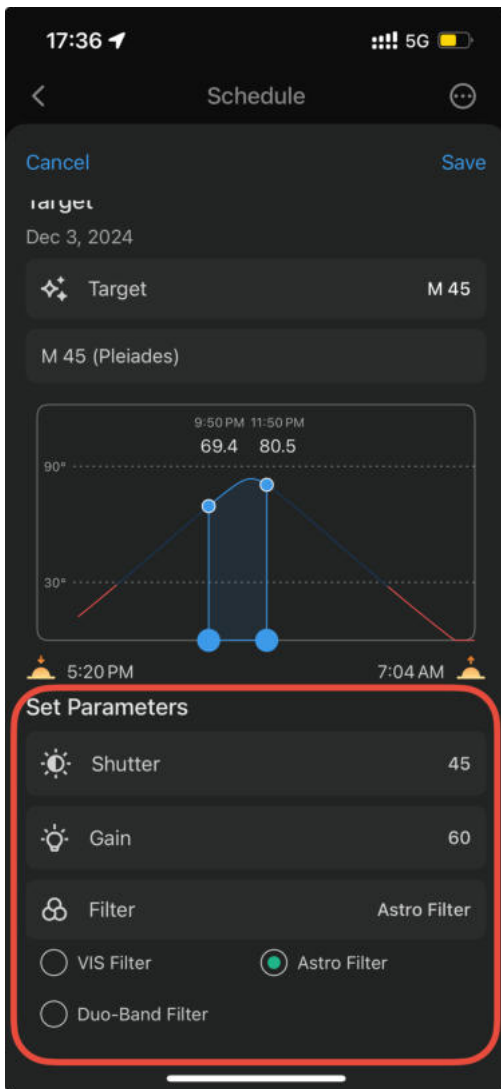
1. The entire curve on the graph represents the time span **from sunrise to sunset**.



2. The **red section** of the curve indicates that the target's altitude is **below 30°**, while the **blue section** means the altitude is **above 30°**.
3. For best results, we recommend scheduling your observation **when the target is above 30°** — that is, within the **blue section** of the curve. So when setting your shooting schedule, make sure to place the session **within the blue zone** for optimal image quality. The **actual degree will be indicated** when you slide the lines to help you set the time.



Click "**Shutter**" "**Gain**" "**Filter**" here to set the parameters:



1. Due to various dynamic factors, the number of frames cannot be set manually. The system will automatically capture the maximum possible frames within the scheduled time.
2. The **maximum exposure time** for Schedule Captures is **60** seconds. This is because D3 is generally optimized for stable tracking at exposure times up to 60 seconds under most conditions. Exceeding this duration significantly increases the likelihood of tracking instability, especially due to polar alignment deviations, mechanical tolerance limits, wind, or environmental changes. Scheduled shooting is typically performed unattended. If a longer exposure fails due to tracking drift or instability, the entire frame is lost, and there is no opportunity to make real time adjustments during the session. Longer exposures also amplify small EQ alignment errors, making star trailing more likely. For these reasons, Schedule Captures are limited to 60 seconds per sub exposure to prioritize tracking stability and overall success

rate. When shooting in manual mode with active supervision, longer exposure times can still be used depending on conditions.

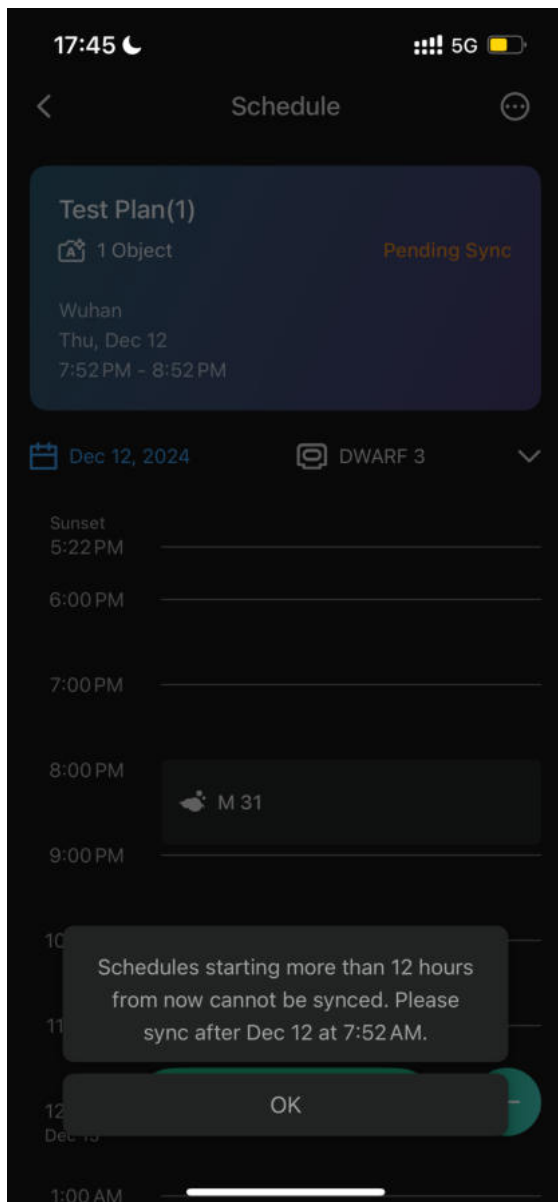
3. In schedule shooting it automatically set appropriate filters for some common targets, with other targets defaulting to astro filters.

4. Synchronize Plan

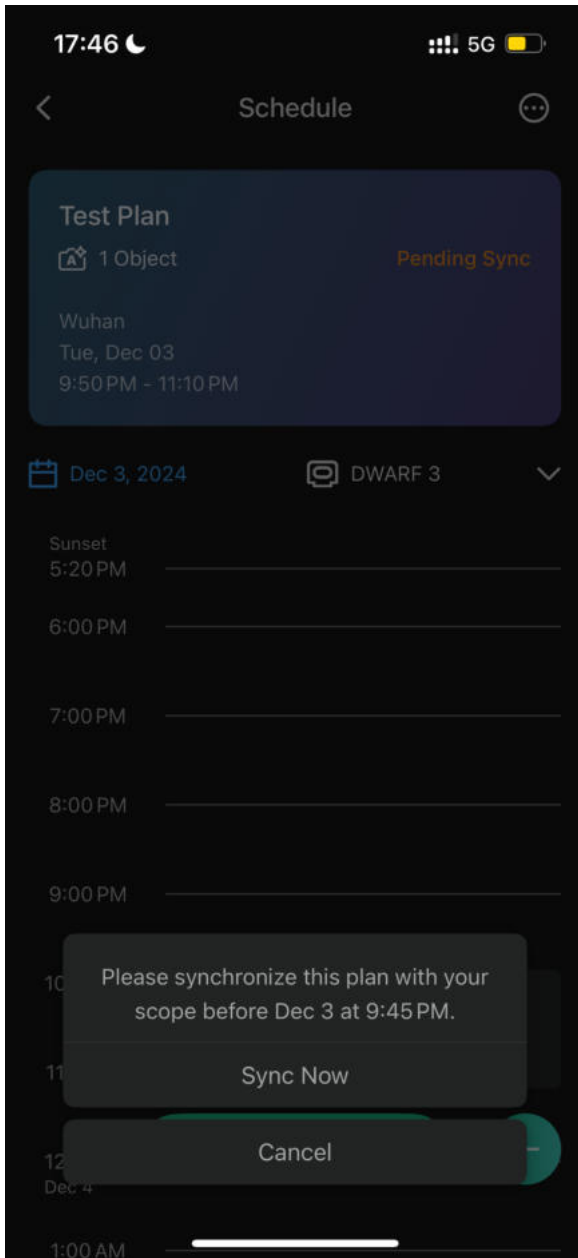
You need to synchronize the configured shooting plan to the DWARF device. Due to the changing visibility of celestial objects, to ensure the plan is executed perfectly:

- Plans can only be synchronized for the same night.
- Synchronization is allowed up to 12 hours in advance and no later than 5 minutes before the plan starts.

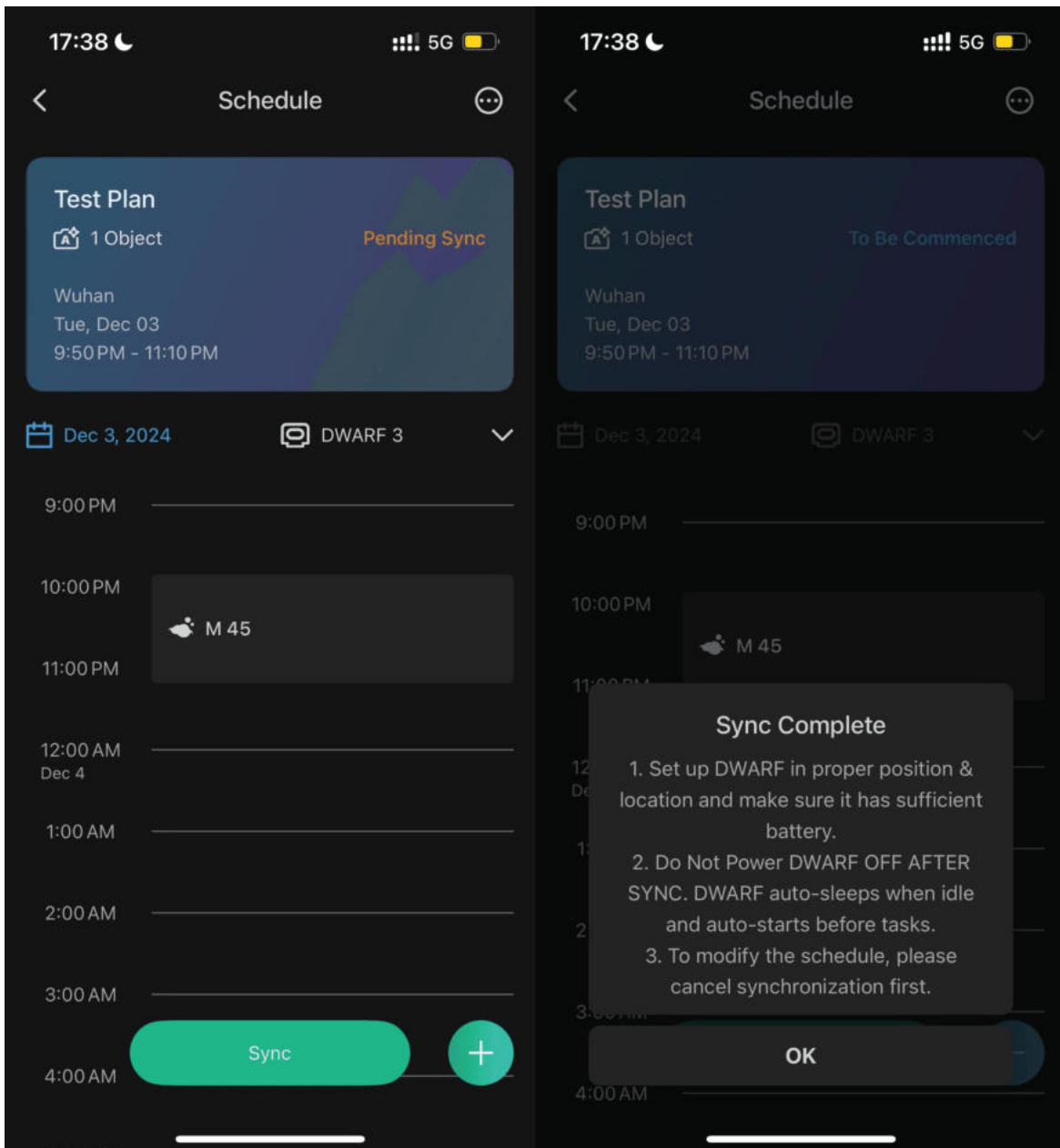
If the synchronization time has not yet arrived, you cannot sync the plan.



Synchronization is **possible** within the **valid** timeframe.



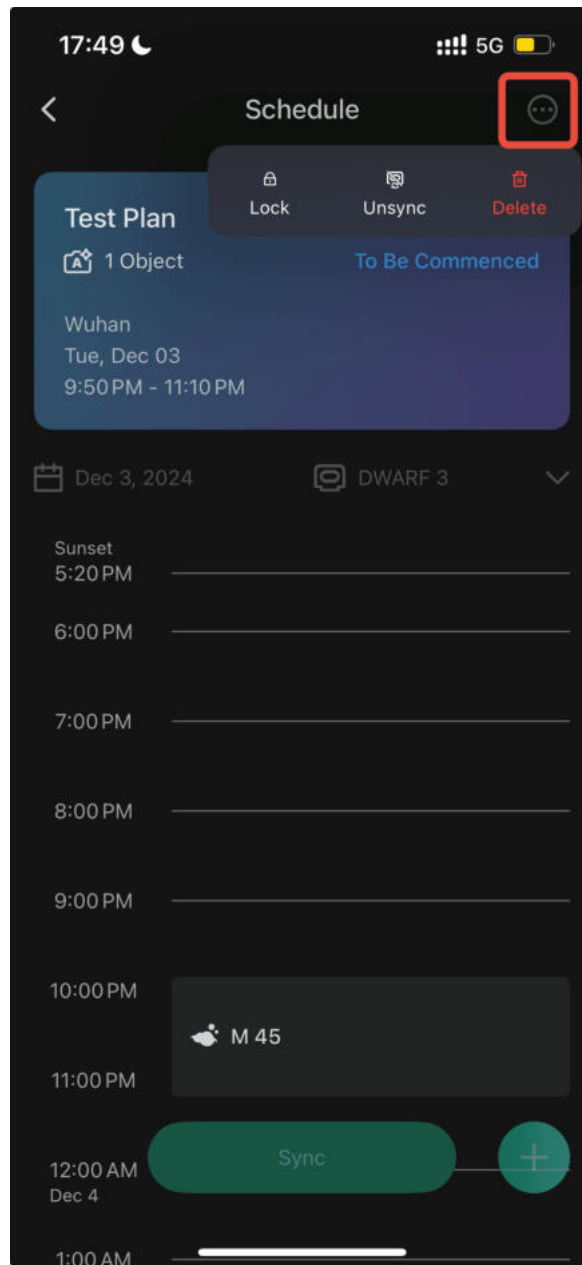
5. Preparation for Shooting



Once synchronization is complete, secure the following items are fulfilled:

- **Sufficient Power:** verify the DWARF device is fully charged.
- **Correct Placement:** Position the DWARF in the appropriate location.
- **Disconnect and Leave:** After all preparations are complete, disconnect your device and step away. DWARF will automatically enter sleep mode and wake up at the scheduled start time.
- **Do Not Power Off:** Ensure you do not hit the power off button.
 - When DWARF is in **Sleep Mode** it looks almost identical to being powered off — no lights, no signals. However - the cylinder (lens) will NOT rotate closed and stay in its open position for it to better process its position and start the scheduled session when the start time begins.

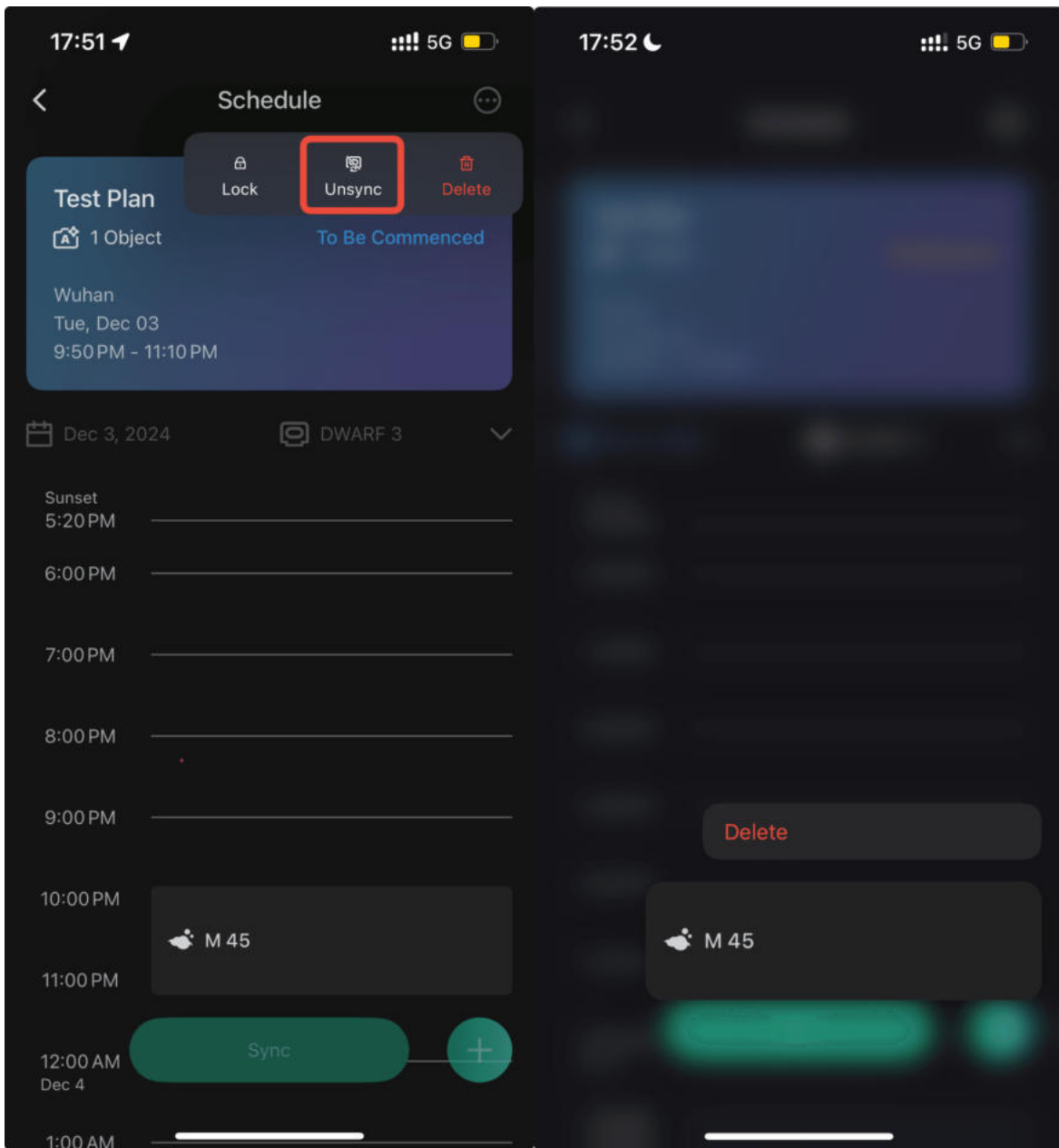
- When your scheduled shooting session has been completed, the cylinder will rotate close to a secure position to protect it. This is also helpful in case your session goes into the daylight hours. As some will notice, it does not completely close (maybe 95%, but this is normal and should not worry the operator)
 - Regarding EQ Mode: You can use EQ mode in Schedule Shooting to align the DWARF with the polar axis in advance. Also, you may turn off the ring light for better results.
 - Regarding Dark Frames: Check the dark frame files before shooting to ensure there are corresponding frames available for stacking. If not, you can capture them now.
 - Do Not Power Off: DWARF will enter sleep mode after 15 minutes of inactivity when disconnected to save power. **In sleep mode, all indicator lights remain off. The device appears completely powered off, but it is in a extremely low-power standby state. But it is not completely powered off and will automatically wake up before the scheduled time.** Do not press the power button, as DWARF will then forget the shooting plan and will not wake up at the scheduled time.
 - Sleep mode and the scheduled shooting function are completely independent. Sleep mode is a power-saving feature that automatically activates 15 minutes after the device is idle and not connected to external power. This behavior applies under all conditions.
 - If your DWARF is connected to external power and you have set up a scheduled session but notice that the device does not enter sleep mode, there's no need to worry — the scheduled shooting will still start normally. Even if the device enters sleep mode later (for example, if charging stops during the waiting period), the scheduled session will still begin as expected.
- **Unexpected Issues:**
 - If you accidentally **power off** the device after synchronizing the plan, please **power it back on, cancel** the synchronization, and **re-sync** the plan. Then, let the DWARF enter sleep mode naturally.



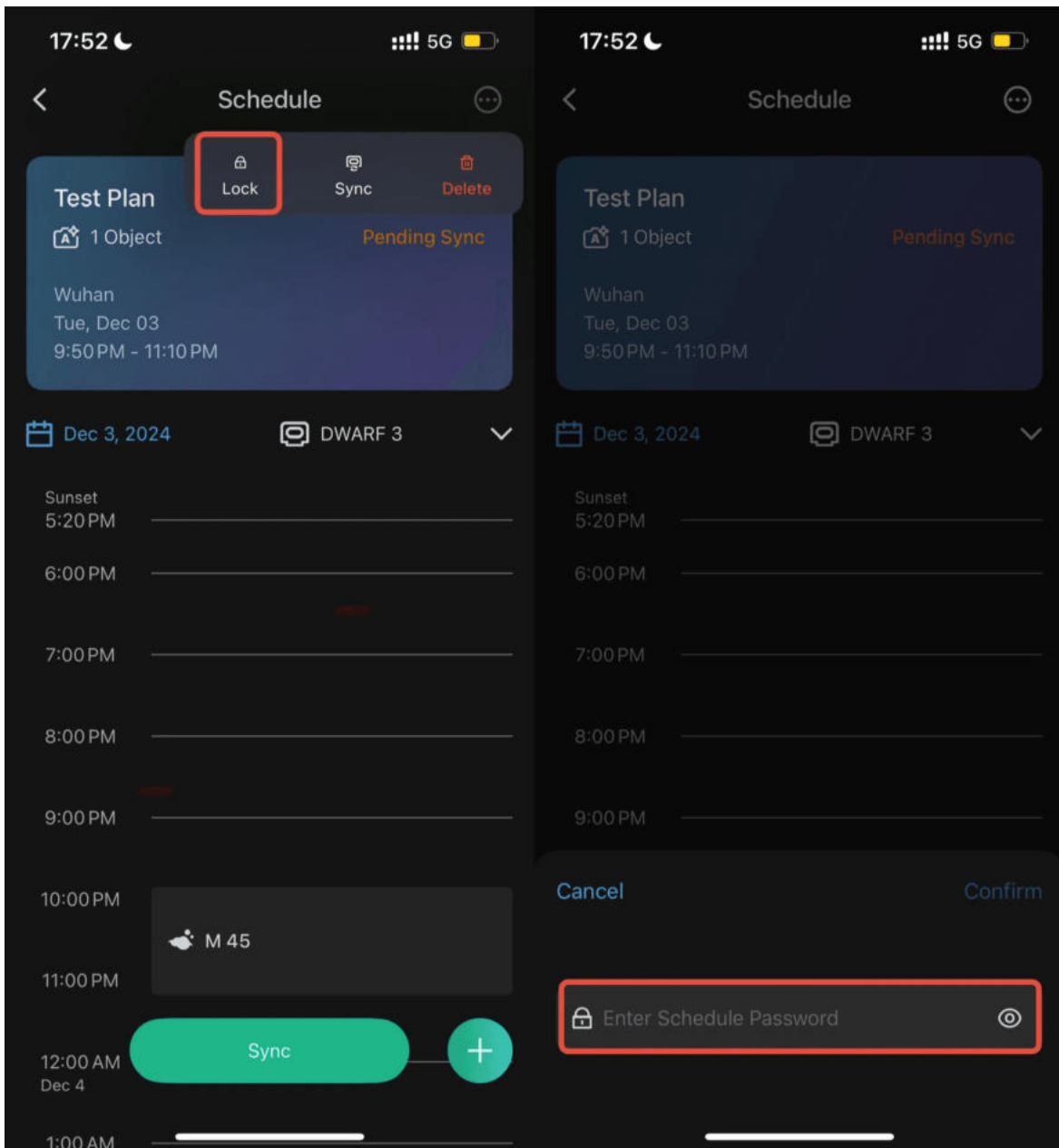
- DWARF in sleep mode **cannot** be woken up. If you need to use it in other sessions, manually turn it on and perform the desirable operations. Restarting will refresh DWARF' s schedule memory, so don' t forget to re-sync your shooting plan for the day.
- DWARF will **not** enter sleep mode while charging. It will only enter sleep mode to save power once the charging stops.

6. Modify Plan

You can modify the plan at any time before it starts. To modify a plan, you must first cancel synchronization. You can add targets at any time. And a long press can delete the target.



Locking a plan prevents it from being accidentally deleted.

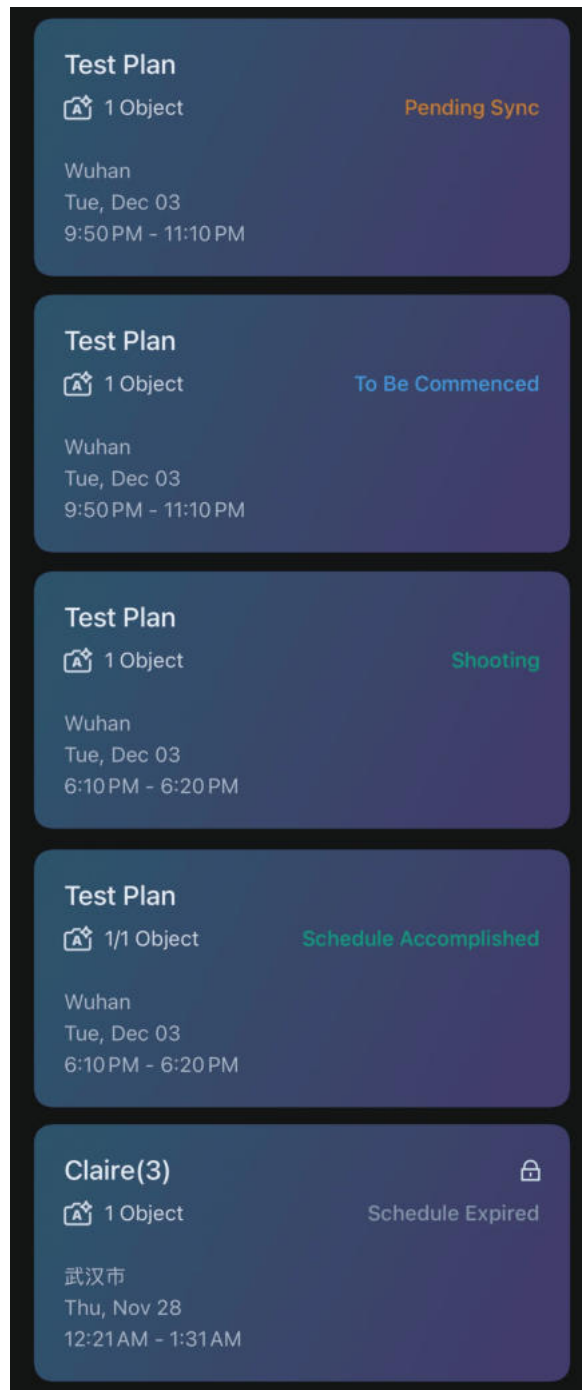


7. Plan Execution Status

Your shooting plan will have the following statuses:

Pending Synchronization, To Be Commenced, Shooting, Schedule Accomplished, and Schedule Expired.

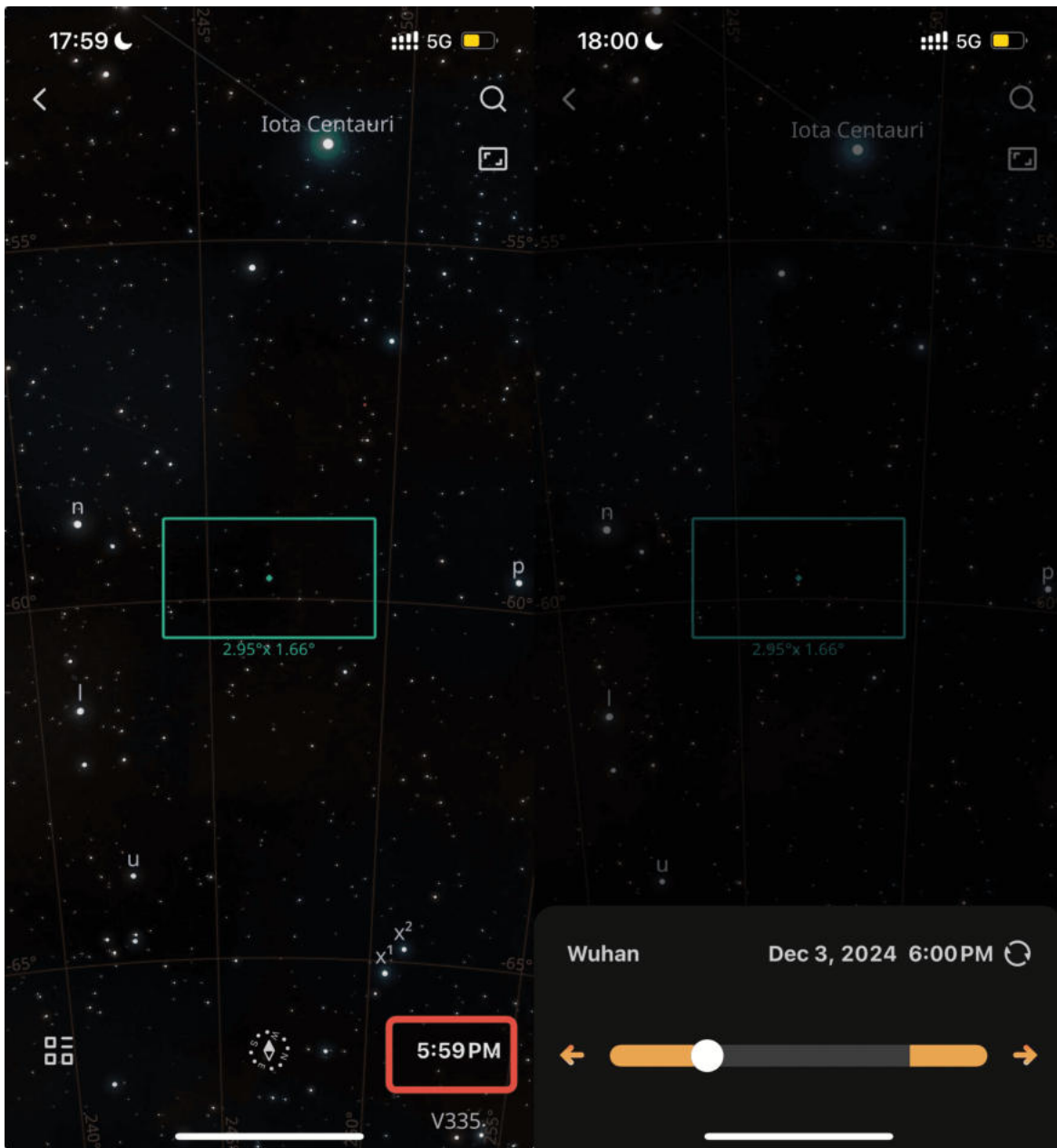
You can connect to a DWARF at any time to check the plan’s execution status. If you encounter a plan execution failure, please upload the log in Settings - Support to get assistance.



3.8.2 Create Plan from Atlas

From the Atlas, you can freely browse and click on a target to directly plan its shooting. To commence, you need:

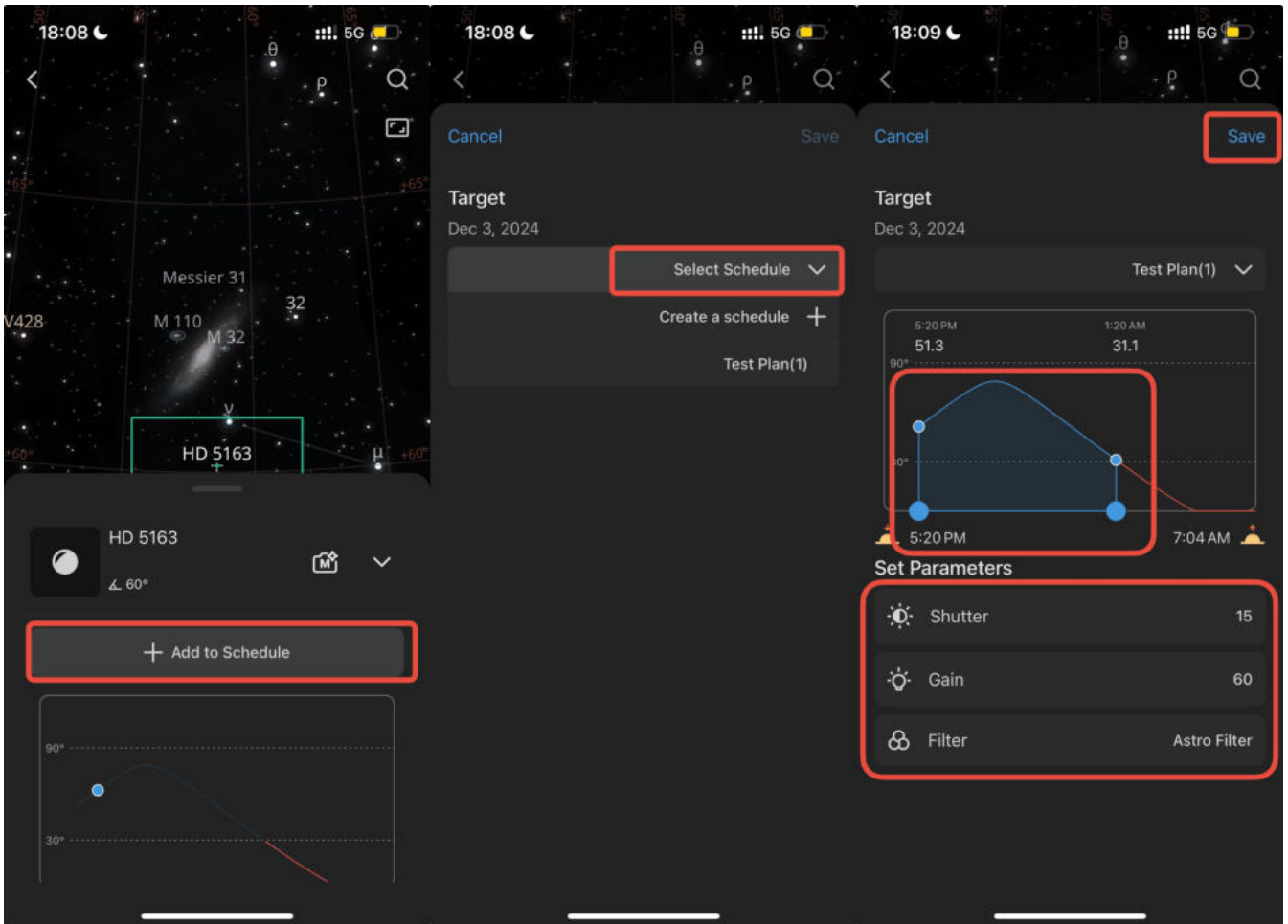
- 1. Choose the Right Time:** click the time icon in the bottom-right corner to select the time you plan to shoot. The Atlas will update to reflect the sky at the selected time.



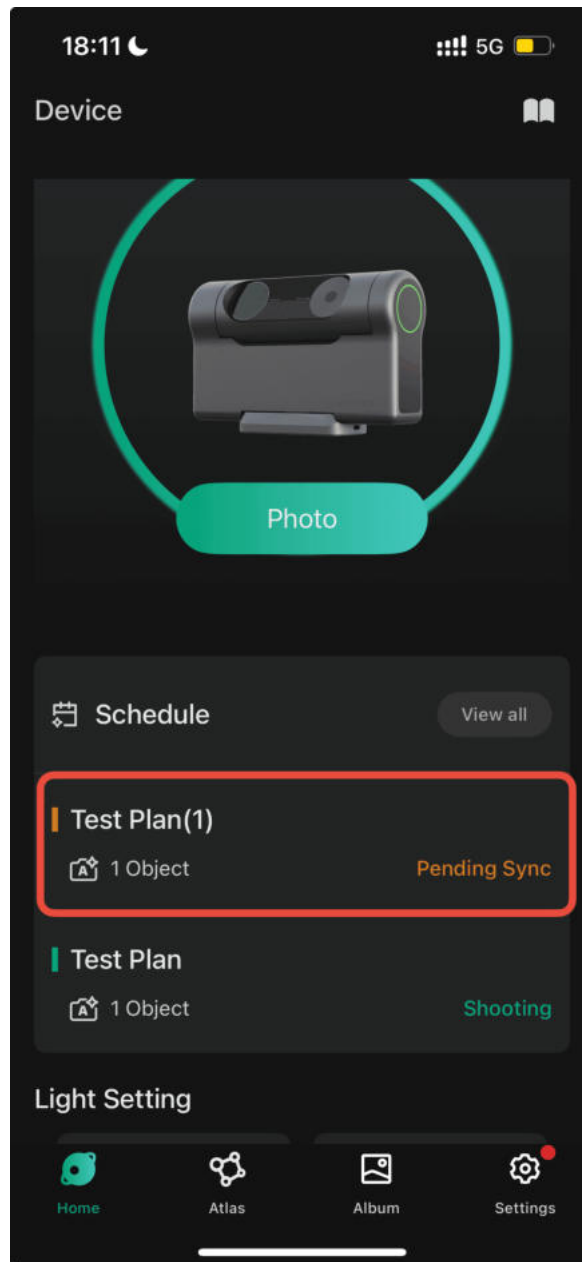
2. **View Targets:** Click the top-right corner to view recommended targets or search for targets to see their visibility.



3. **Select a Target:** Choose your desired target. Swipe the menu to add it to the shooting plan.

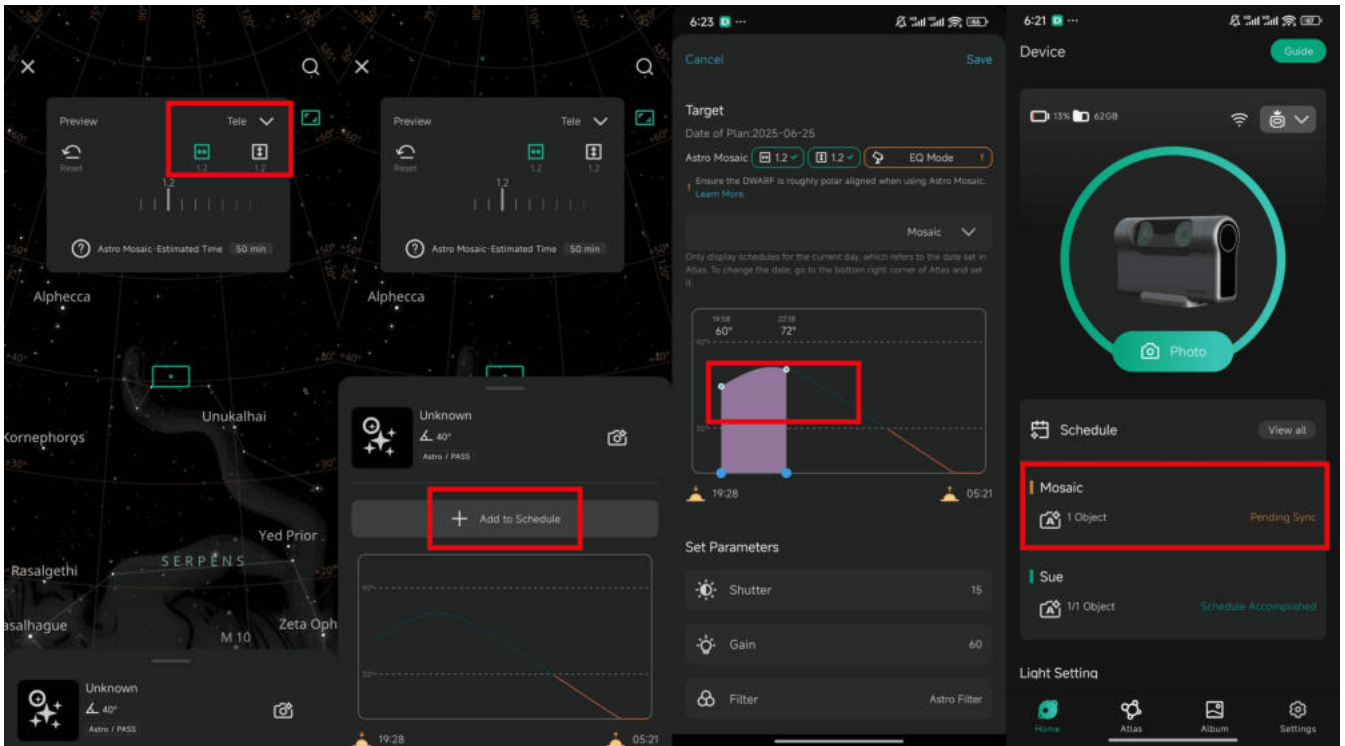


Go back to the homepage to check your newly set shooting plan. All subsequent actions and precautions are listed in the previous section.

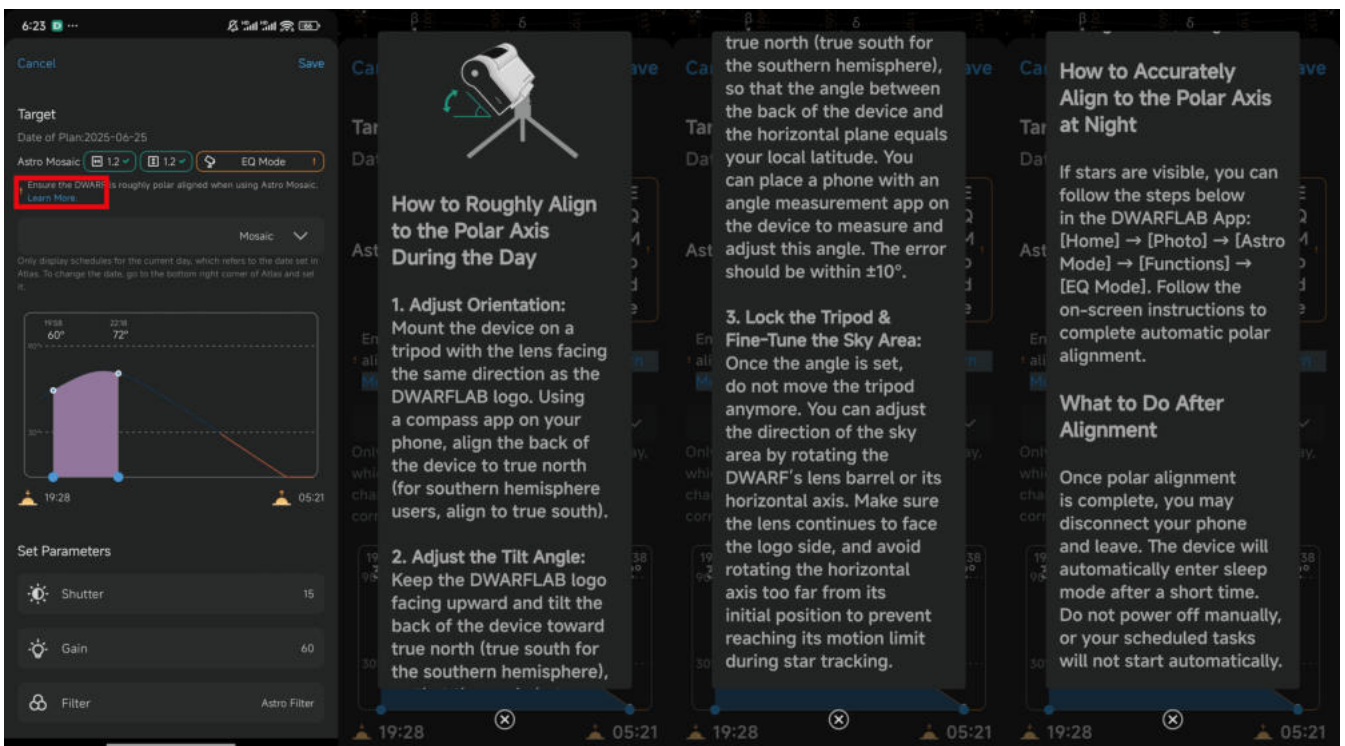


3.8.3 Schedule A Mosaic!

If you'd like to schedule an **Astro Mosaic shoot**, you'll first need to **select your target** and **adjust the preview frame** to your desired composition. Then, swipe up the bottom menu and choose **"Add to Schedule."**



Mosaic imaging requires higher precision, so make sure your equatorial alignment is properly set (roughly aligned if planning during daytime). For a step-by-step guide, be sure to read “Learn More” in the app.



With the Schedule Shooting feature, capturing stunning deep-sky objects has never been easier. Whether you’re planning a night-long astrophotography marathon or simply want to automate your stargazing experience, DWARF 3 ensures precision and convenience!

3.9 Astro Mosaic

DWARF 3's astronomical mosaic feature allows you to capture and stitch together multiple adjacent fields of view, creating a wider and more detailed image of the night sky. It's perfect for photographing large deep-sky objects such as the Orion Nebula and North America Nebula.



3.9.1 Mosaic Field-of-View:

The DWARF 3 supports a maximum 1.8x1.8 zoom perspective. When shooting, DWARF 3 will automatically determine how many segments to shoot based on your selected composition ratio:



- The default view is **1 × 1**, meaning only one segment is captured (no mosaic needed).
- If **either** the horizontal or vertical composition ratio is greater than 1, that direction will use **2 segments**.
- For example, a ratio of **1 × 1.5** results in **2 views**, while **1.5 × 1.5** results in **4 views**.
- **Maximum supported layout:** 1.8 × 1.8, totaling **4 views**.

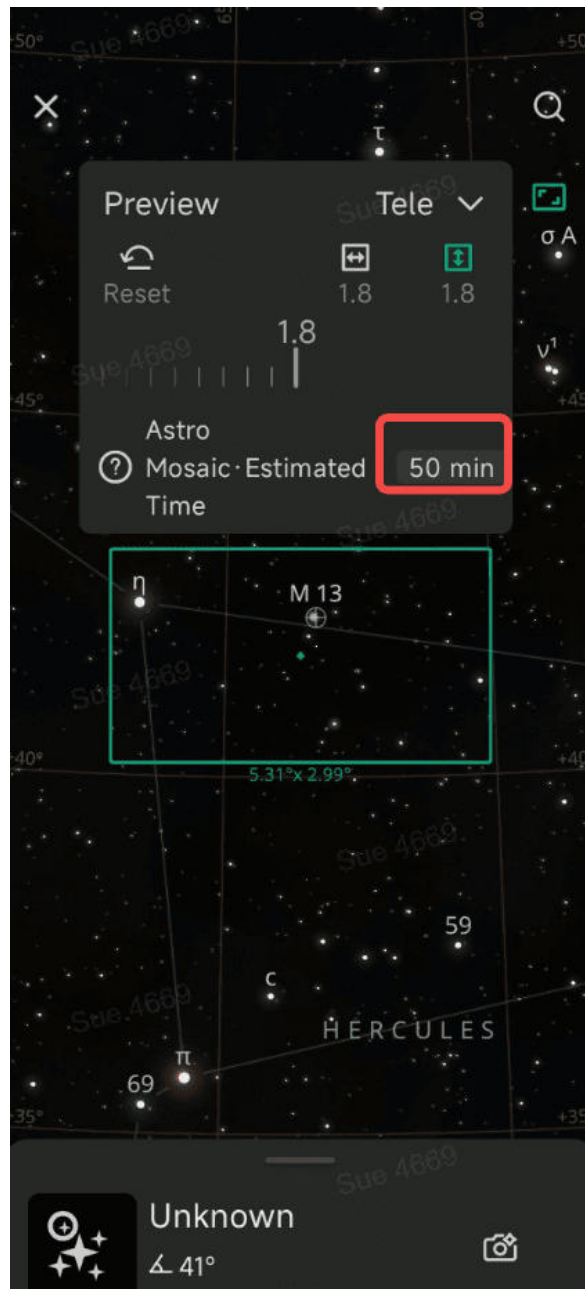
3.9.2 How long does it take to shoot the mosaic?

The estimated shooting time is automatically calculated based on your selected composition size, exposure time, and number of frames.

So for a full 1.8 × 1.8 mosaic (4 views), with 15s expo and 50 frames setting for each view, the estimated time is:

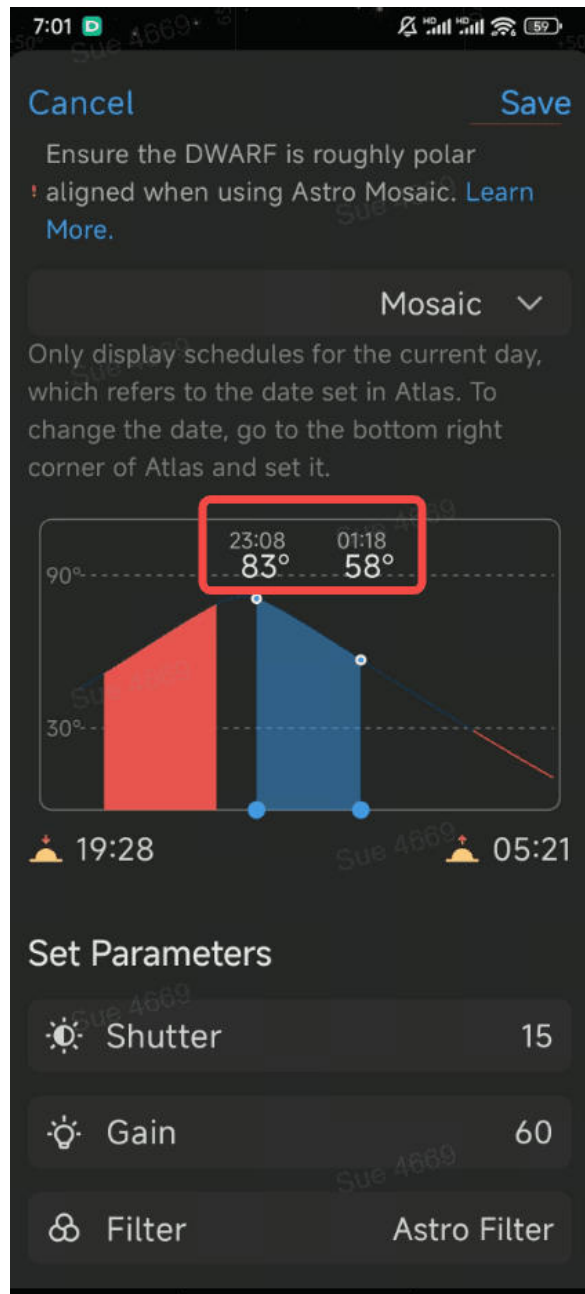
$$15s \times 50 \text{ frames} \times 4 \text{ views} = 50 \text{ minutes}$$

You can also customize the exposure and frame count, and the system will recalculate the estimated duration in real time.

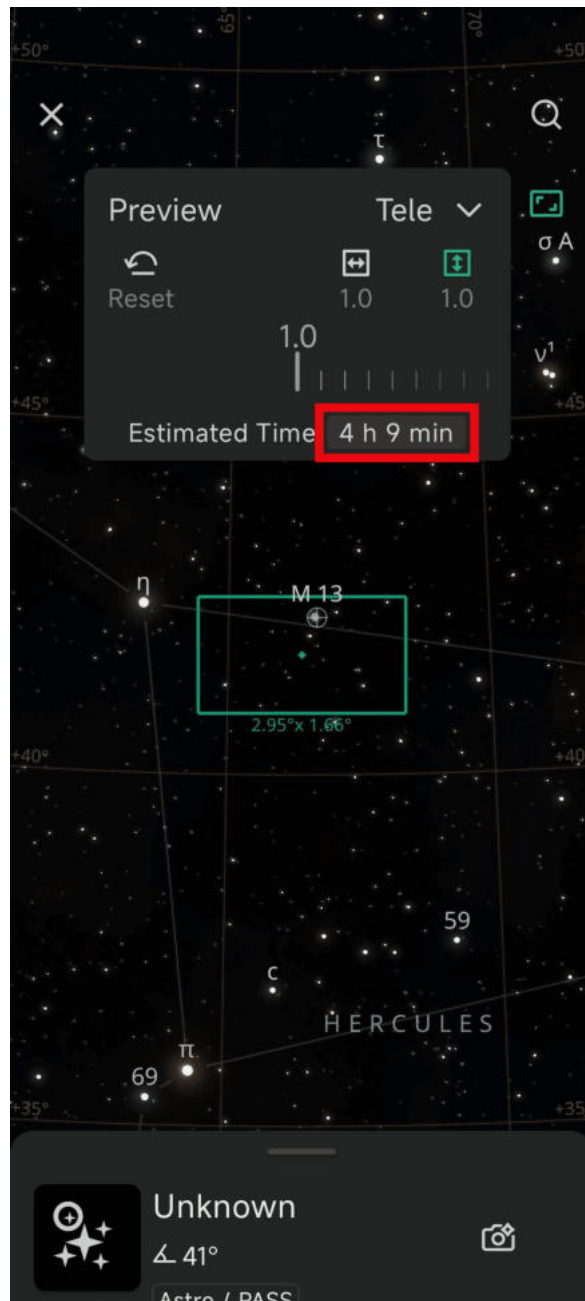


Tips: If you haven't adjusted the parameters, the system will use the **default** settings:

- 15-second exposure per frame
- 50 frames



If you haven't adjusted the frame as well, the system will use the **default** settings: (15s X 999 ≈ 4h9min)

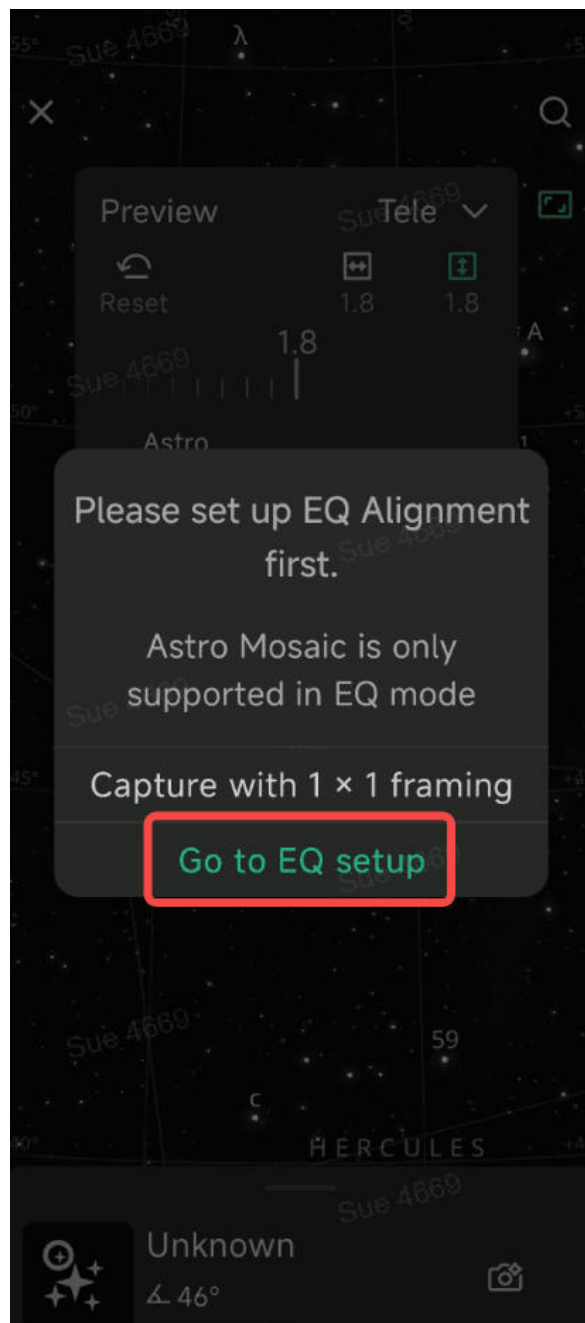


3.9.3 How to use the mosaic function?

3.9.3.1 Enable Equatorial (EQ) Mode

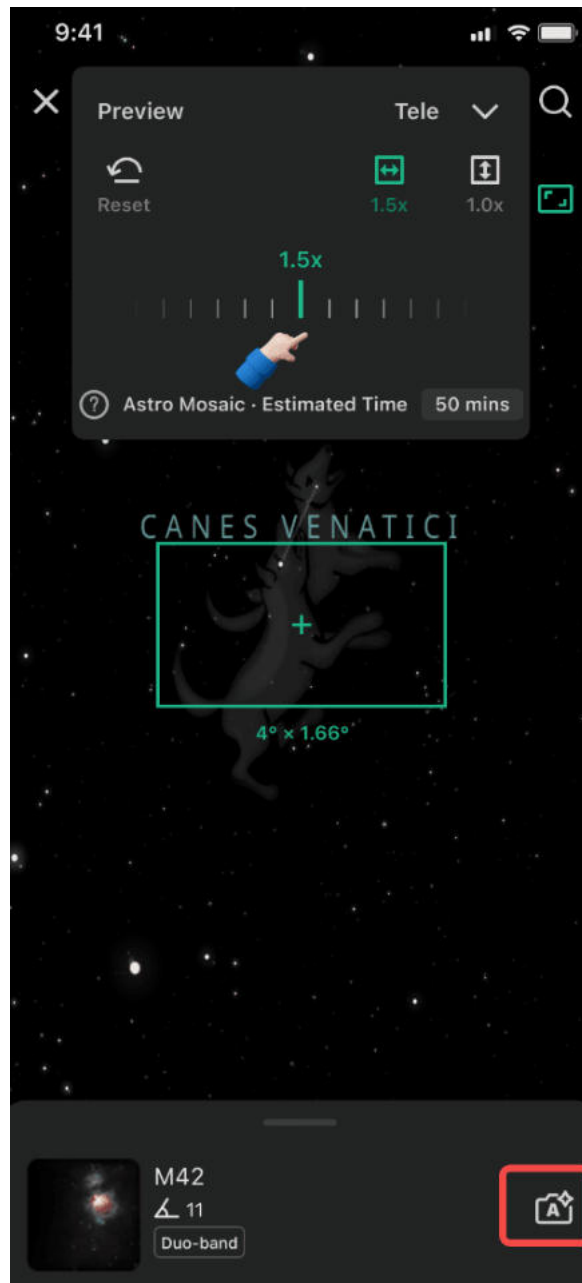
Astronomical mosaics require stable tracking. To avoid image rotation caused by Earth's rotation, EQ mode **must** be enabled for this function.

Tip: After EQ calibration, the preview frame will display real-time pointing direction. (Detail explanation later)



3.9.3.2 Compose in Sky Atlas & Select Target

- Choose your target in the Sky Atlas and adjust the preview frame.
- Tap **GoTo** to locate the target.



Tips:

- Recommended: Orion Nebula, North America Nebula, Vega' s surrounding star fields
- Not Applicable: Moon, planets, comets — small or fast-moving objects

3.9.4 Set Shooting Parameters

After GoTo is complete, go to:

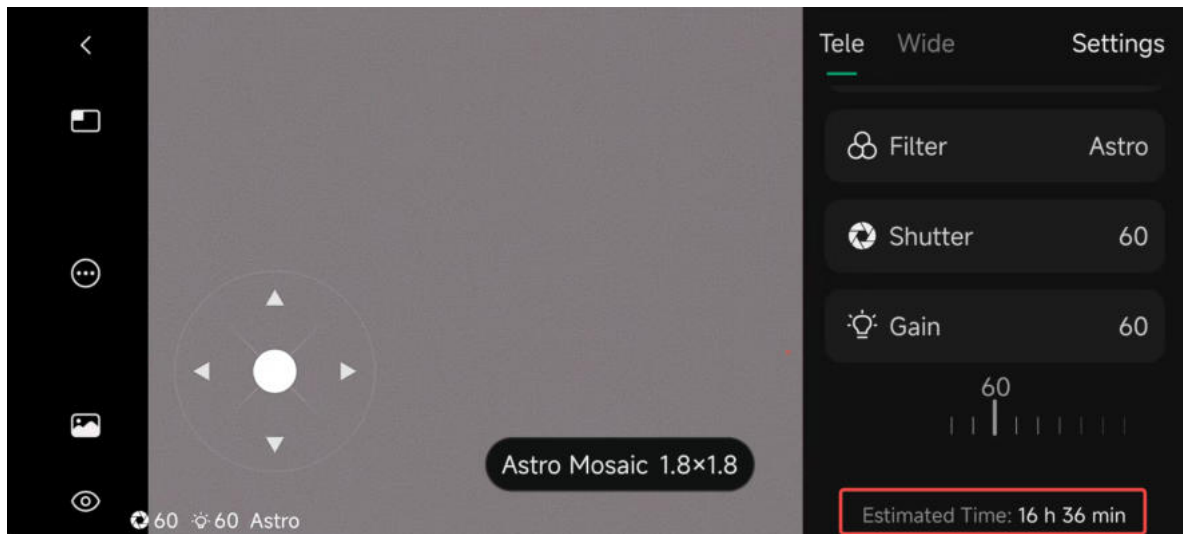
Shooting Interface → Function → Parameter

Here you can customize:

- **Exposure time**

- **Gain**
- **Number of frames**

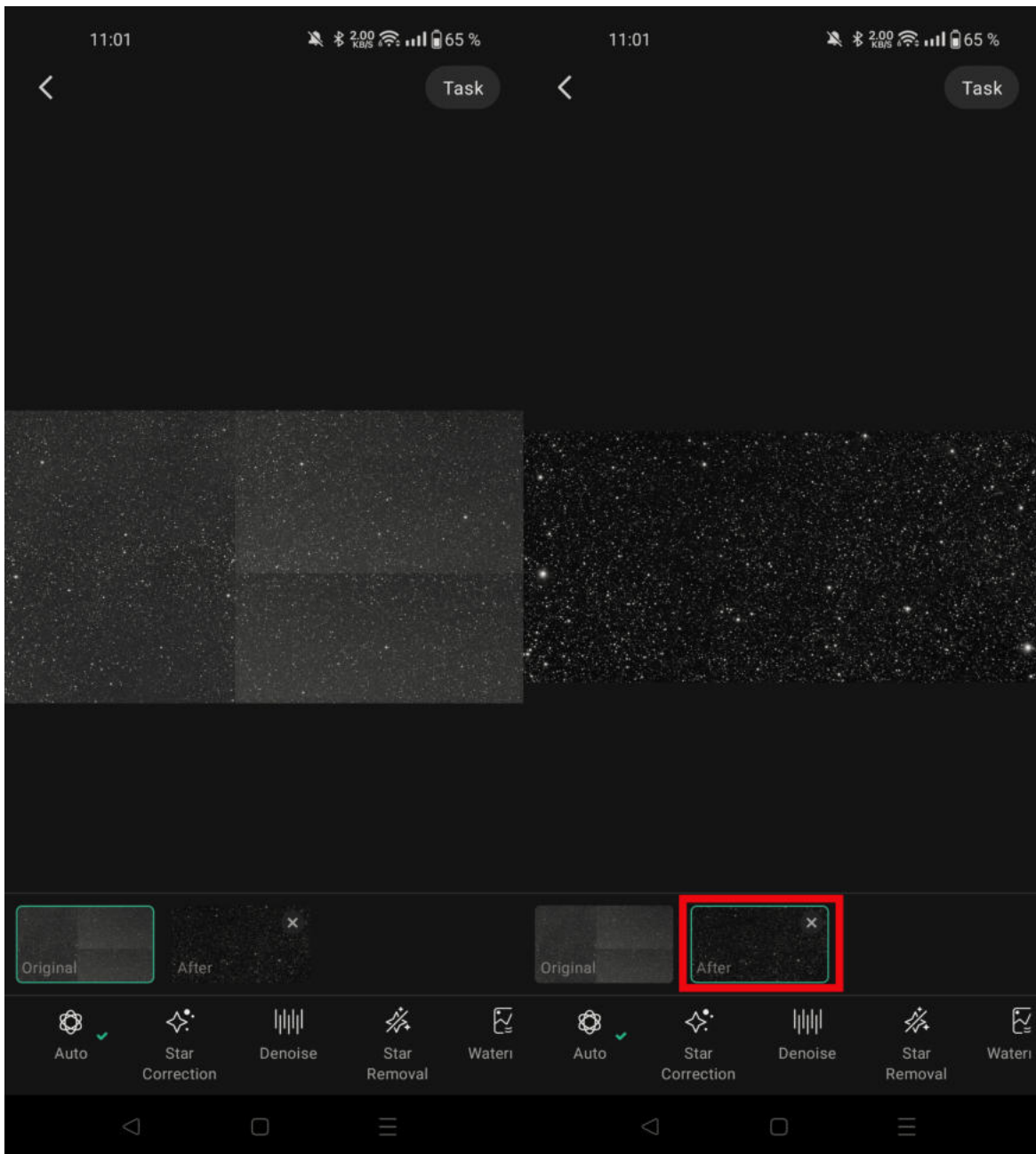
You' ll also see the estimated total shooting time on this screen.



3.9.5 Auto Stitching & Post-Processing

After shooting, DWARF will automatically generate a **roughly preview** mosaic image. We strongly recommend finish your mosaic image using **Stellar Studio**, which can intelligently detect and eliminate edge seams between Mosaic Views.

Go to: **Album** → **Stellar Studio** to post-process and optimize the final result!



If you notice obvious **light seams or edge discoloration**, it's recommended to **manually review and filter the bad sub-frames**, then **restack in Mega Stack** before final processing in **Stellar Studio**.

3.9.6 Notes for Mosaic Rotation

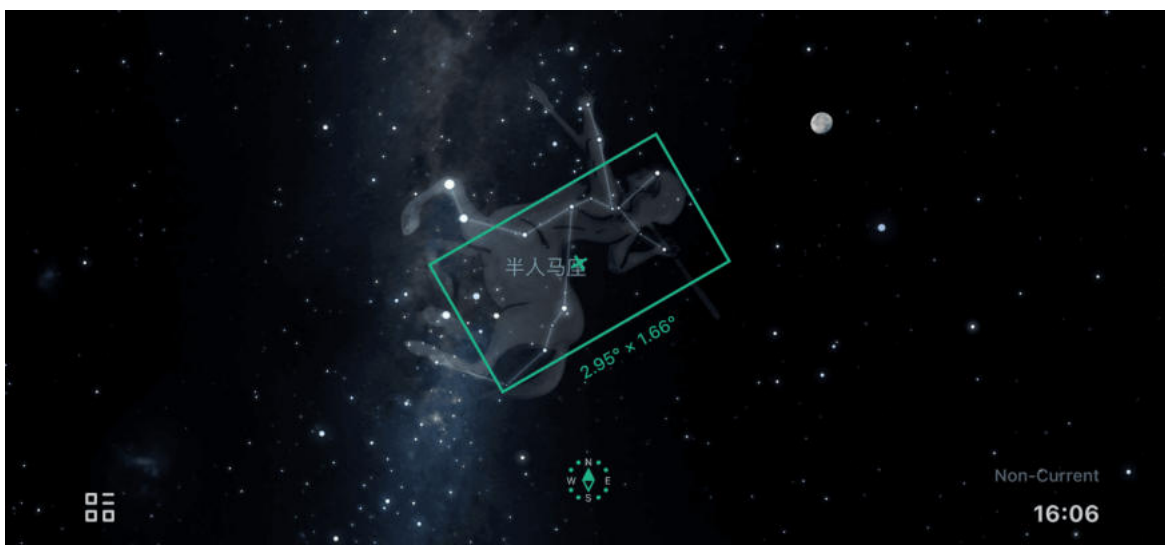
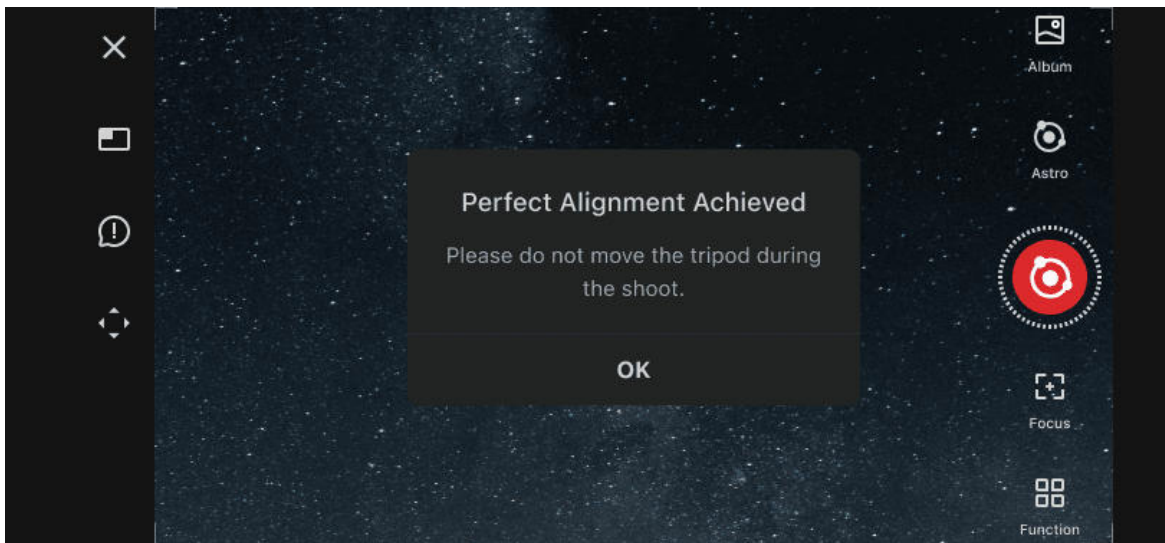
If your DWARF 3 is placed flat on the ground (in Alt-Az mode), the preview frame will always be in a **horizontal** position.



After setting up the equatorial mode, the actual astronomical image will also be **tilted**.



The rotation angle **cannot** be manually adjusted; after all, DWARF 3 cannot yet assume a tilted position like a robot. However, it can calculate the angle through **calibration** (angle calculation in equatorial mode or calibration in GoTo).



Recommended Astro Mosaic Workflow

- Set **EQ Mode**
- Open the **Atlas** and use the **preview frame** to compose your mosaic (adjust position and size)
- **Capture** the data
- **Process in Stellar Studio**

Astro Mosaic Notes & Best Practices

- The **wide-angle camera** may support mosaic mode in a future update, but it's not there yet.
- Mosaic imaging is *far less forgiving* than single-frame shots. Stitching quality lives or dies on capture quality.

To avoid ugly seams and artifacts:

- Get your **EQ alignment as close to 0 deviation** before you start.
- If seams show up, **re-shoot dark frames** and **reject low-quality subs**.
- Restack your single session by using **Mega Stack**, then process your completed session in **Stellar Studio** for the final results!

As an official **DWARF 3 Product Expert**, here's one thing to keep in mind before you embark on your next cosmic adventure:

The **DWARF 3** can take you light-years away—revealing distant stars, nebulae, and the quiet wonders of the universe—but let's be clear: it won't find your missing remote or untangle your love life. Even space tech has limits.

That said, when you look up at the night sky, remember that some of the most meaningful discoveries aren't light-years away—they're right beside you. Use the DWARF 3 to slow down, explore, and uncover both cosmic secrets *and* the small joys hidden in everyday life. Every session has the potential to be memorable if you let it.

So here's to turning every glance at the stars into a journey worth remembering.

And if this helped you at all, give it a ☒ and carve out some time for your next adventure with DWARF 3. The universe isn't going to explore itself. ☒☒