

Setting up and Video Recording Asteroid Occultations

With the Celestron 8SE SCT telescope, IOTA VTI,
and Watec 910hx-RC video camera, recording on
a Canon ZR45mc mini-DV camcorder

Richard Nolthenius – Dept. Chair - Cabrillo
College Astronomy



This is a Tutorial for Setting up the 8” Celestron Nextstar 8SE for Video Recording Asteroid Occultations

- ...explicitly for those with the exact equipment that I use for doing asteroid occultations and grazes
- It's intended to provide a reference for my students and colleagues who will be using the complete “**2nd Unit**” setup that I've assembled for Cabrillo College Observatory.
- This is a cookbook! Follow the steps in order...





Make sure clamp is unscrewed to the point you can insert scope rail

Set up the tripod.

Make sure the slot holding the scope is sloped upward roughly like this. I've found if it's instead initialized aimed straight up, the scope gets disoriented. I like to position the initial set-up so the azimuth is aiming roughly towards my target, and set up my gear table accordingly.



I port the OTA (Optical Tube Assembly) in its original box, mounting rail up. So, grab the OTA by the rail and hoist it up to the mount



**Insert OTA (Tube) into the slot. Awkward, with just 2 hands.
Move the tube fore and aft till it's about as shown. That'll
be ~balanced on the support arm and minimize power draw
during the fast slews to objects (avoid blown fuses!)**



**support OTA tube
with one hand,
tighten knob with the other.
Awkward!**





**OTA
mount
rail**

**tighten
knob
here**

**Here's the rail,
now mounted in
the arm slot,
tightened down**



Grab the Smaller Box - the Eyepiece Box



From the Eyepiece Box, get the laser sight, 2" Diagonal and Q70 32mm Eyepiece



NTE
ELECTRONICS, INC. 
5.0A
Fast Acting
74-5FC5A-C

Fuses. The short ones are for the purple rim male plugs

Laser sight

ORION®

32mm
Q70™ Super-Wide Angle
2" Eyepiece

2" Diagonal



Mount the Red dot laser sight on the telescope dovetail rail



Tighten the laser sight to the dovetail using the lower 2 zinc screws. Make sure it's level and parallel to the OTA. Fine adjustment on pointing is later



Unscrew the Celestron 1.25" Visual back from the Celestron and replace it with...



...the Celestron 2" Diagonal. It mounts to the SCT threads, on the back of the 8SE Scope



The 2" Diagonal mounted. (The 2nd Unit scope, however, has a Celestron 2" Diagonal, not the Meade diagonal shown here)



Insert Orion Q70 32mm Eyepiece. This is the one whose field of view matches the C2A finder charts I make

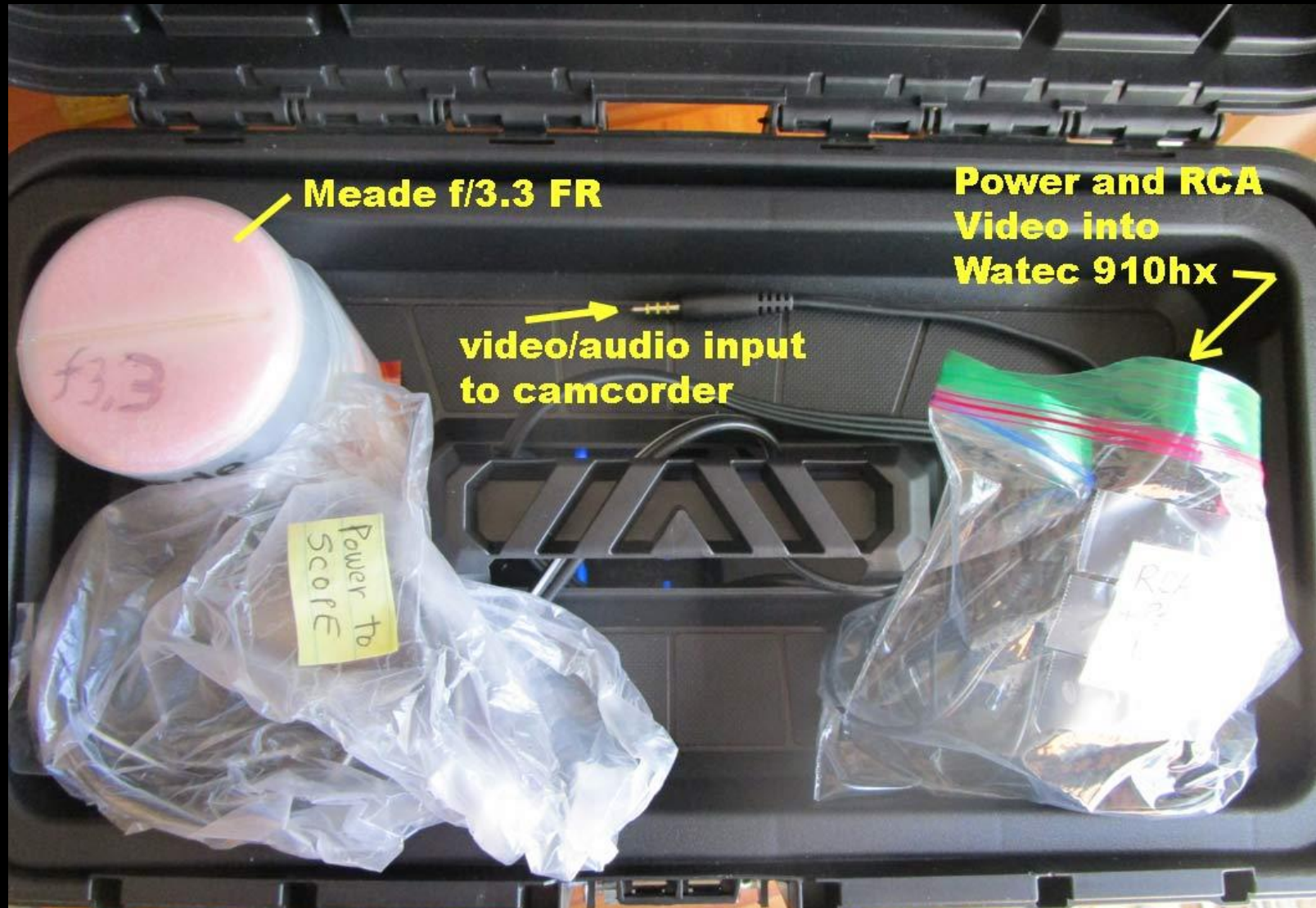


Now that it's set up, and before aligning, we need to be sure the scope is stable

- Push the tripod tips well into the ground.
- No shifting around even a little, or you lose pointing ability, or even if you can still find your target, you'll find it'll slowly drift across the chip, and remember that we want not only the target on the chip, but suitable comparison and tracking stars as well, so we want no drift, if at all possible



Open OccBox2; a Husky 16" 2-level toolbox from Home Depot (19" if you're building from scratch?).
I keep wires in sandwich bags to avoid tangle



Never “hot plug” any component! Always connect the power cords to the equipment BEFORE powering on at the battery. That especially includes the scope. Plug in the scope power cord now. It’s bagged in the OccBox2



The 14Ah 12VDC Battery Powering All Components is in the bottom of OccBox2

- I don't like "hot plugging" from either direction, including at the battery socket. I've blown fuses!
- So I bought 2 triple sockets (made by *LED Innovations*, see Amazon). They have a push-button switch simultaneously powering all 3 outlets. That way, I can leave all components permanently plugged in, and power them up with a push of a button.
- The primary triple-socket is on the right side of the battery for the VTI and scope. There is a secondary triple-socket on the left side of the battery for the Watec video camera. However, the left side doesn't turn off once it's on (Why? It's a mystery!), so... we will connect the Watec power cord now:



We'll Now Make the Power to All Components "Live"

- Because, contrary to my original intent, the Watec camera power lead cannot be turned off without powering off all the components, so we'll go ahead and power on the Watec as we power on the other components. That means we need to plug in the power cord into the Watec now.
- So, let's get out the Watec camera...

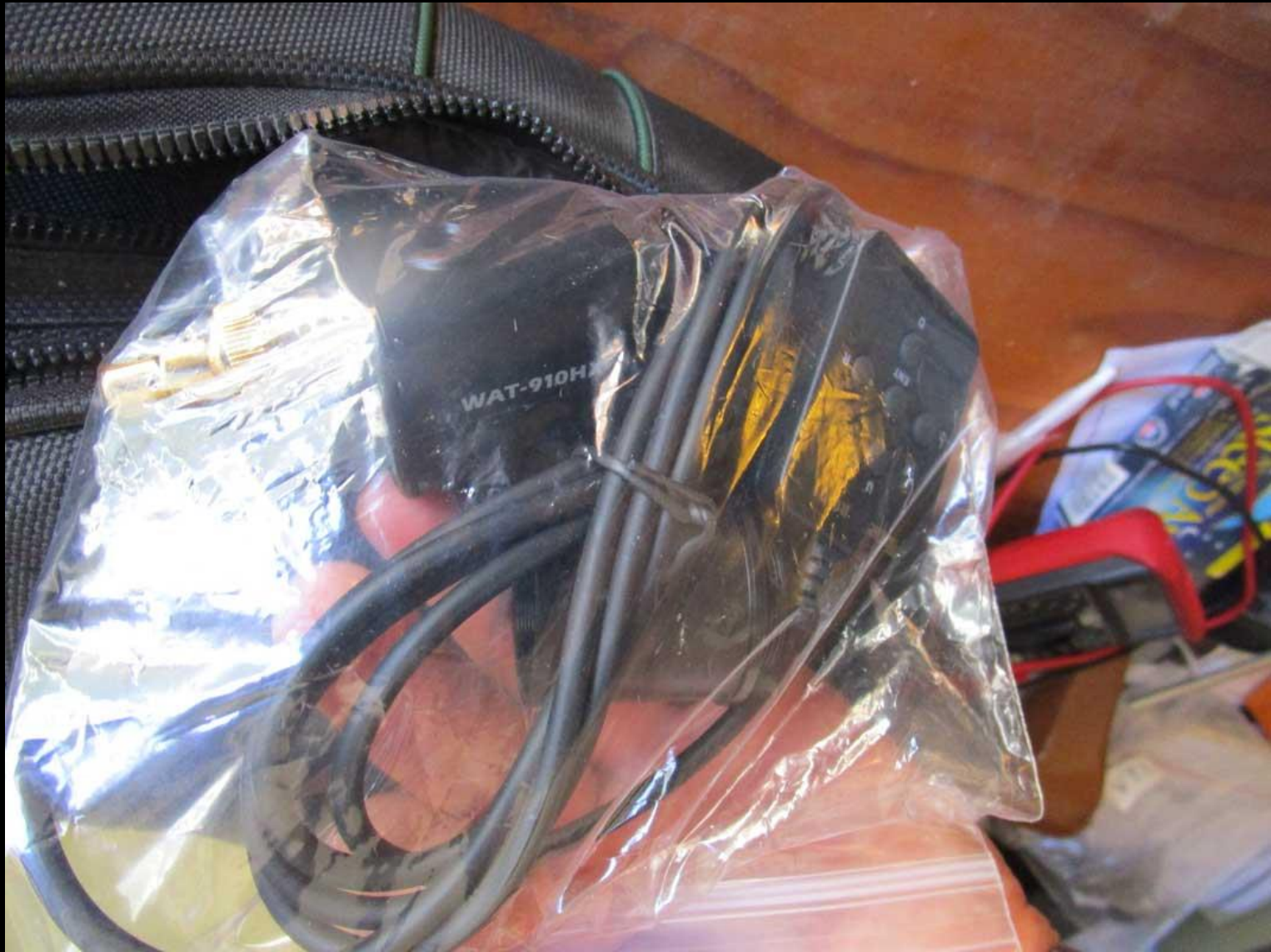
Get the Watec video camera from the canvas camcorder case side pocket



**Watec 910hx-RC video camera,
in plastic bag, in CamCorder canvas case**



Be careful, it's \$750, and has a remote control with flimsy wiring, easy to damage



Raise the top level of OccBox2 just a bit, to see the VTI, wiring, and the primary triple-socket on the right side of the battery, next to the VTI. If you pulled off the ground lead from the battery after last use, now is the time to re-connect it.

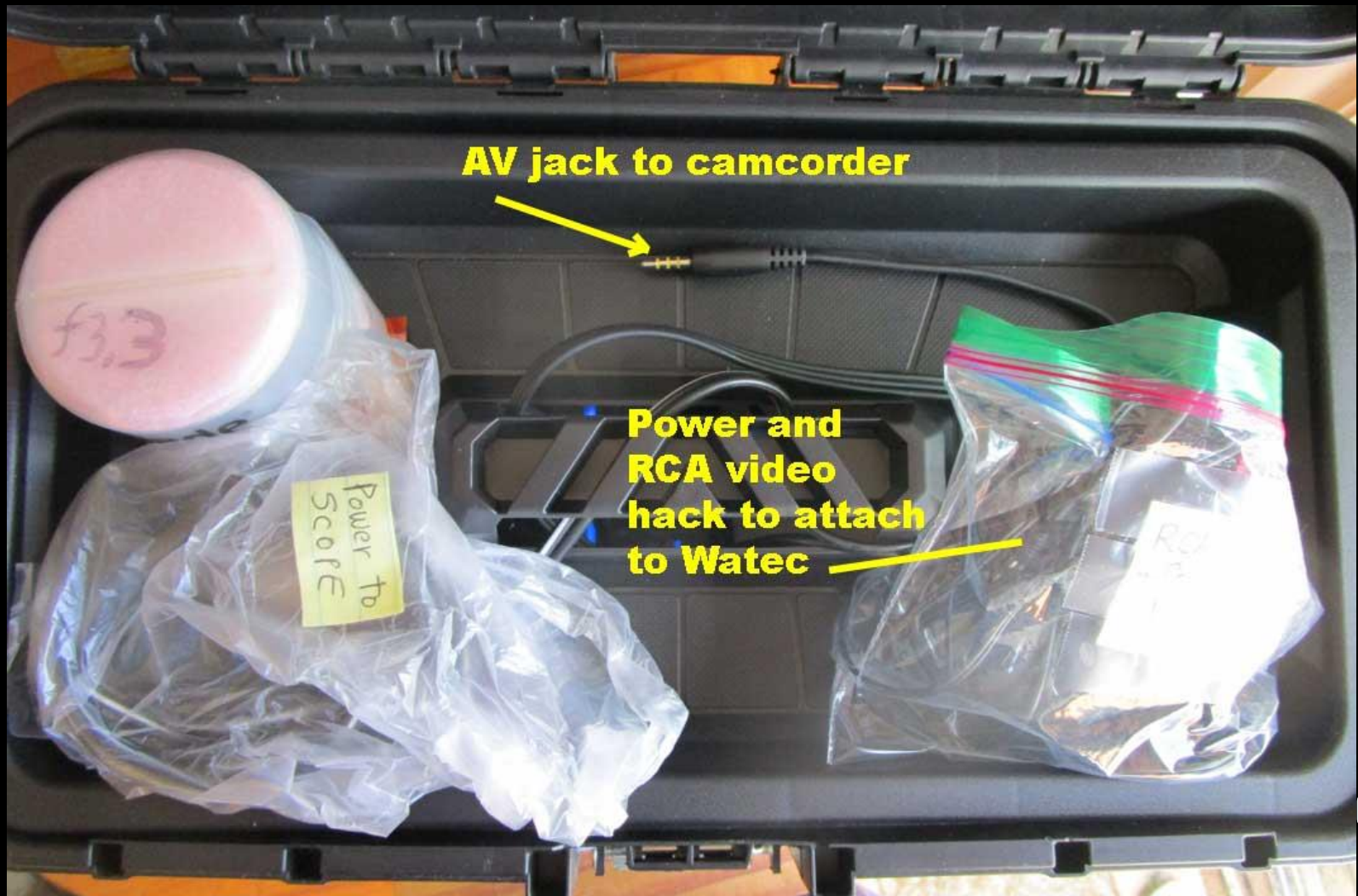




Verify the Watec power plug is OFF: That means, lift the OccBox2 top layer and look at the triple-socket on the LEFT side (up against the wall as shown), and make sure it is not glowing purple. If it is, push button to power off.




Now get the bag with the Waterc power plug and RCA jack in OccBox2. Connect the power and video RCA jacks to the Waterc camera.



Connect the brass video RCA jack (top) and the power plug (beneath), as shown





Lift the OccBox2 lid, and push the left triple-socket power button on, powering the Watec camera. Verify the triple socket rim glows purple. If not, you may have blown a fuse in the male 12VDC jack plugged into the triple socket at top. Replace fuse and try again. 

Push the button switch. You'll see the triple socket rim glow blueish purple. One of the plug rims will also glow purple, this powers the secondary triple-socket on the left side of the battery for the Watec



**If the socket rim doesn't glow purple,
your astro adventure might be over.**

**Triple socket fried? Is there a burnt
smell? Did you remember to push the
neg lead back onto the battery terminal?**

- If the triple socket rim glows purple, but the male plug does not, then you've probably blown the fuse in the male plug... So you'll have to replace it, using the box of 5 amp short fuses in the eyepiece box





If it's the plug to the scope, unscrew the tip and check the fuse (glass fuse here). If it's a ceramic fuse you won't be able to tell if it's blown, so just try replacing it anyway. It takes the long 5 amp

fuses 

These are the (longer) glass fuses to use for the other two (non-purple rim) male plugs going in the triple-socket. They're in the small eyepiece box



Confirm the VTI has power - the red light glows. The green light will only come on after some seconds, and only begin pulsing when it has acquired satellites. If no red power glow, try pushing on the power cord on the back, gently.



Remove the tube corrector plate cover. It rotates out of a slot, then lifts off



Turn on the power for the laser sight, twisting the knob here clockwise. Confirm the red laser dot projected on the sky by looking down the sight



**Remove the scope paddle from its cradle
and then power on the scope by pushing
the “1” on the switch**



You'll see the scope "verify packages" and then be ready for you to hit "Enter" to begin the alignment process



Slew the scope up, down, left, and right

inside menu's Scroll up and down



But First, You Must have the scope pointed where the software thinks it's pointing BEFORE you start alignment

- Use the big arrow keys to make the scope aim towards the northern horizon, flat, underneath the north star. You don't have to make it precise, just guesstimate where that is and point the scope there.
- Only then should you begin the alignment process... if you don't pre-aim to the north horizon, the scope may recycle back to start after you think you've aligned on your second star. It got confused and bailed.

 **CELESTRON**

Select Method
Auto Two Star

NexStar[™]+

ALIGN

BACK

SOLAR
SYSTEM
1

STARS
2

DEEP
SKY
3

IDENTIFY
4

SKY
TOUR
5

▲
SCROLL
6

MENU
7

HELP
8

▼
SCROLL
9



OBJECT
INFO
0

MOTOR
SPEED

**After initial
pointing, now
Scroll down to
“Auto Two
Star” and Hit
“Enter”**



To align the scope, the hand paddle will ask you for the local Time and Date. Be Sure your watch is accurate - It should be no worse than a few seconds off



- Enter the local clock time (not UT), it'll ask you *am* or *pm*, and use “scroll” key to toggle between, then hit “Enter” when correct. You can use 24hr time if you want... your choice.
- “Enter”, in general, takes you forward in the process.
- Similar toggle for *Daylight Savings Time* or *Standard Time*



The scope might also need you to enter your Longitude and Latitude, unless it already has good coordinates. To the nearest latitude and longitude minute or two is good enough.

Frankly, I've observed at locations a degree or three off from home and not have it ask me for Long/Lat again, and it still points just fine



You'll manually aim at two bright stars to complete the align process.

So first, it'll ask for the first star

- To get accurate “Go To” performance, you want to select two hand-paddle-known stars as far apart in the sky as you reasonably can. I like to use Polaris for one of my stars, and the second star be close to the target occultation.
- Alas, you'll have to learn the Arabic names for many stars you presently may only know by their Greek alphabet/constellation names.
- Use the scroll keys to go through the star list until you find the star you want. I often start with Polaris.
- When you reach your chosen star...





Slew the scope up, down, left, and right

Menu Scroll up and down

Hit “Enter” when the list shows the star you want.

- Now it'll instruct you to use the scope slew buttons to navigate to the chosen star. But first...



Before Slewing to Your Align Stars...

- Make sure you have plenty of slack on the power cord to the scope, since it rotates with the scope when it moves in azimuth!
- The scope may decide to rotate the “long way around” in azimuth and if you strain or pull out the power cord you have to start all over (or worse if something gets rudely yanked!).
- It might even be best to power the scope with an independent battery sitting under the tripod, if you can.
- Again, I like to position the initial set-up so the azimuth is aiming roughly towards my target, and set up my gear table accordingly.





Push the motor speed button, then "9" for fast, and "5" for very slow

Motor speed

It should automatically default to the fast motor speed. To change, push the "Motor speed" button and then "9" for the fastest speed (push one after the other, not together). When target-close, you'll want to go slower, like "Motor speed" "5" or "6".



When the red laser finder dot is on your chosen star...

- ...Hunt for it in the eyepiece and get it centered as well as you can. Again, I like to start with Polaris as star #1, since Polaris will not drift while I then...
- ... adjust the position of the laser dot so it agrees with the eyepiece centered star. If you see the star somewhere in the eyepiece field before adjusting, then don't bother with perfectly centering the laser dot.



Adjust the vertical position of the red dot on the sky using this knob



Adjust the horizontal position of the red dot on the sky with this knob



CELESTRON

Center Polaris
ENTER when ready,

NexStar™

When centered
hit ENTER
then ALIGN

ALIGN

ENTER

BACK

Move
scope
with
these
keys

SOLAR
SYSTEM
1

STARS
2

DEEP
SKY
3

IDENTIFY
4

SKY
TOUR
5

▲
SCROLL
6

MENU
7

HELP
8

▼
SCROLL
9

OBJECT
INFO
0

MOTOR
SPEED

Now that your first star is centered in the eyepiece, click **“ENTER”** and then **“ALIGN”**

It will then ask you for the second star. Use the *Scroll* keys to find another star far away from your first star, and close to your occultation target if possible.

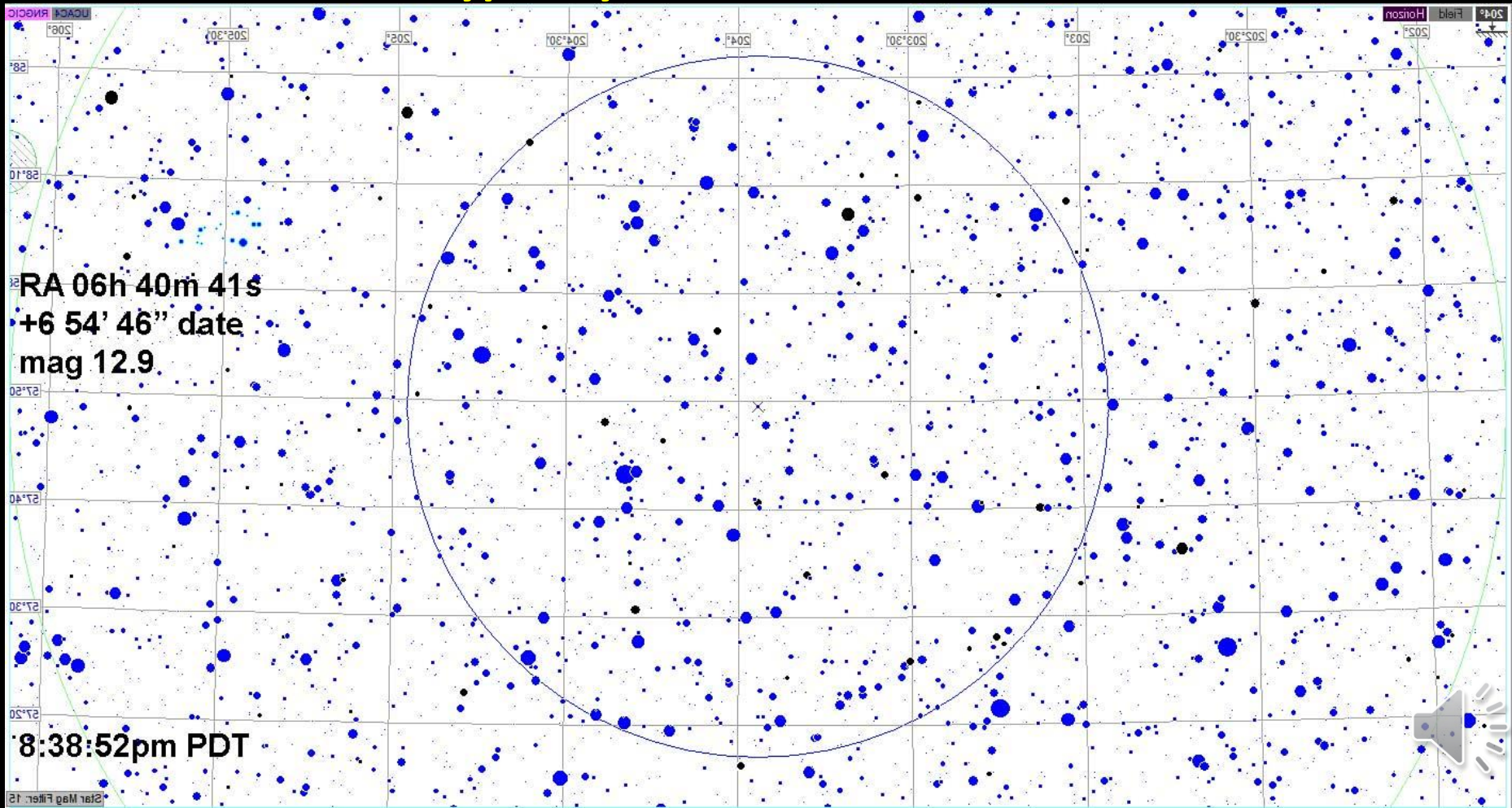


“SCROLL” to get the hand paddle list to a second star you like, hit “ENTER”

- The telescope will now automatically slew to somewhere close to that star. If wildly off, check hand paddle’s time and long/lat. It might rotate the long way around - I can’t predict – so watch the power cord doesn’t pull out, or you’ll have to start over on the scope.
- Use the scope positioning arrow keys shown on the last slide to center it on the laser dot and then in the eyepiece
- Then hit “ENTER” and “ALIGN” once again
- The keypad should now say “*Alignment Successful*” (if not, start alignment over and pick different stars) and you’ll then hear the motors engage as it now auto tracks the sky.



Now it's time to slew to your Occultation Target Star. Pull out the Q70 Eyepiece Finder Chart. It's the one with the big circle field of view. I print on it the RA and Dec for the target and sometimes for nearby bright stars, using the C2A or IOTA Preston map "on date" coordinates, which will differ from the J2000 position by a couple of arc minutes typically. You need the "on date" RA/Dec...



 **CELESTRON**

Center Polaris
ENTER when ready,

NexStar+™

ALIGN

ENTER

BACK

SOLAR
SYSTEM
1

STARS
2

DEEP
SKY
3

IDENTIFY
4

SKY
TOUR
5

SCROLL
6

MENU
7

HELP
8

SCROLL
9



OBJECT
INFO
0

MOTOR
SPEED


Hit "MENU"
First

Then
SCROLL
down to
"Go To
RA/Dec"
and then
hit
"ENTER"

Hit *MENU* then
SCROLL down
several lines, past
"GET RA/Dec"
until you get to
"Go To RA/Dec",
and then hit
"ENTER"



It's important that there be reasonably bright stars, 10th mag or brighter, in your field of view


- ...so you can see them on the camcorder LCD screen when you later insert the Watec 910hx because they'll not yet be focused at this point.
- For sparse areas of the sky, this may mean sending the scope not exactly to the target, but to a 10th or brighter star a few arc minutes away, from which you can offset to the target after it's Watec-focused. Often I'll enter RA,Dec for such a star on my Q70 eyepiece chart.
- In Milky Way regions this is usually not necessary - there's plenty of bright enough stars near the target 

How to Enter the RA/Dec Coordinates

- Enter the RA: hr, min, sec.decimal one after the other, and only then hit **“ENTER”**
- Now for the Declination. First is the sign (+ is northern, - is southern). If the sign is correct as is, hit **“ENTER”**. If not, hit a **“SCROLL”** button to reverse the sign, then **“ENTER”**. It should now position over the Dec degree field
- Type in Declination: Deg, min, sec and then hit **“ENTER”**
- The scope will slew to your target position.
- You should see at least some of the stars from the Q70 eyepiece chart eyepiece circle, properly oriented. (My experience is that the 8SE's Go-To is pretty good, as long as you chose alignment stars far apart and took care to center them.) Use a 10th mag or brighter star very near your target, put it very slightly right of center. It may still not be centered on the Watec chip, but close.





When a bright-ish star near the target is (slightly right of) centered in the eyepiece, it's time to gently remove the 2" diagonal and Q70 eyepiece, and get the f/3.3 focal reducer from the OccBox2. But before grabbing the f/3.3... 

The clearance between the camera and mount base isn't large enough to accommodate the preferred optical train: The f/3.3 Reducer, 1.25-to-c, and Watec 910hx with RCA and power cords.

- This is a problem if the scope must be aimed overhead at an altitude greater than 72 degrees. Pay close attention to the altitude of your occultation, not only for event time, but up to a half hour before event time. If it is higher than 72 degrees, you'll need to alter the equipment as I'll describe later.
- For now, I'll assume your target's altitude is lower than 72 degrees, as is typical...



If the Target's altitude is less than 72 degrees during the ~half hour before and during Event time...

- ...then follow the procedure below...
- (If the altitude is greater than 72 degrees, so that the target is nearly overhead, skip forward several slides)





Before mounting to the scope, screw the 1.25" Celestron visual back and f/3.3 reducer together. Then screw the f/3.3 threads onto the scope. FYI there is 35mm of separation from the lens surface of the f/3.3 reducer to the far tail end of the visual back.



In the Watec bag you'll find the *Astromania* 1.25"-to-c adapter mount barrel. Remove the Watec cap.



Screw on the 30mm long *Astromania* barrel onto the Watec's spacer ring, and put it back into the plastic bag and place bag in the upper level of the OccBox2. You don't mount it on the scope yet.



Orient the Watec as below, and push it as far in as it will go, then tighten the lock screws. Below: "1st Unit" Watec 910hx

Be sure the brass RCA jack is oriented on the top, "Watec" label on left side. This insures proper finder chart orientation!



Here's the same orientation, for the "2nd Unit" Watec 910hx-RC camera



Video jack "up"

**OSD
remote
unit wiring
on left side**

**When inserted
into scope,
the Watec
must be
oriented like
this**

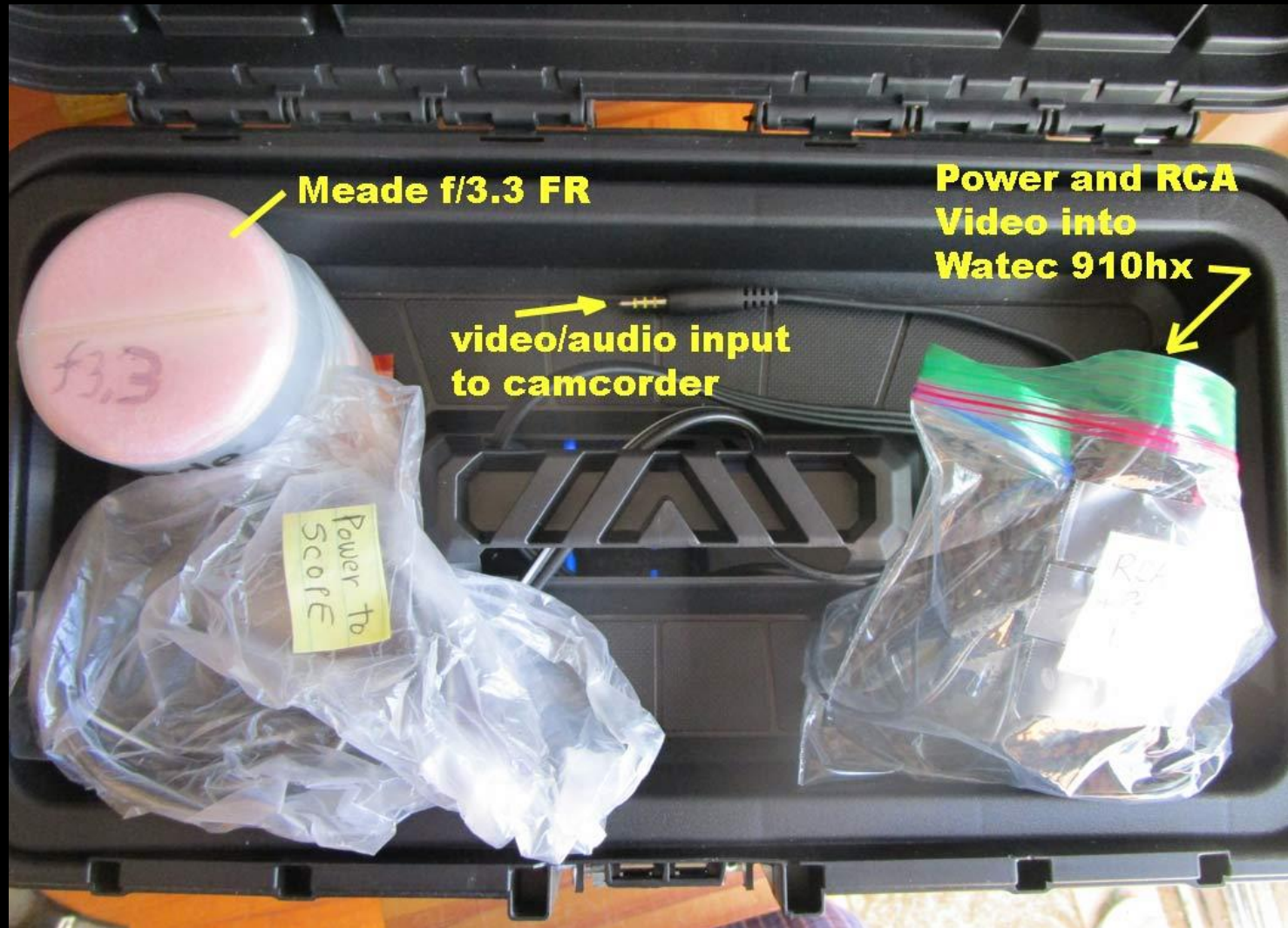


Targets above 72 deg altitude? Watec won't clear mount base. In this case...

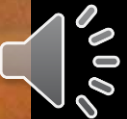
- On the bare 8SE scope's OTA threads at back, screw on the **Celestron Visual Back** directly, with no f/3.3 reducer.
- Insert the 1.25" diagonal into the end of the **Visual Back**.
- Screw the short nosepiece (**not** Astromania) onto the Watec, then screw the **Highpoint 0.5x focal reducer** onto the end of the nosepiece.
- Insert the Watec+nosepiece+0.5x into the end of the diagonal, perpendicular to the optical axis of the scope now.
- In this configuration, must twist Celestron focuser about 1 full turn ***Clockwise*** to achieve focus on the camcorder screen, after removing the already focused 2" diagonal/Q70 combo.
- The Field of View is similar to the previously described set up with the f/3.3, but left-right reversed and optical aberrations are a bit worse.



Initially, OccBox2 looks like this. Note the video/audio input plug sitting on the top level of OccBox2



Now, remove the ZR45mc camcorder and remote control unit from the canvas bag, place it on the top level of OccBox2...

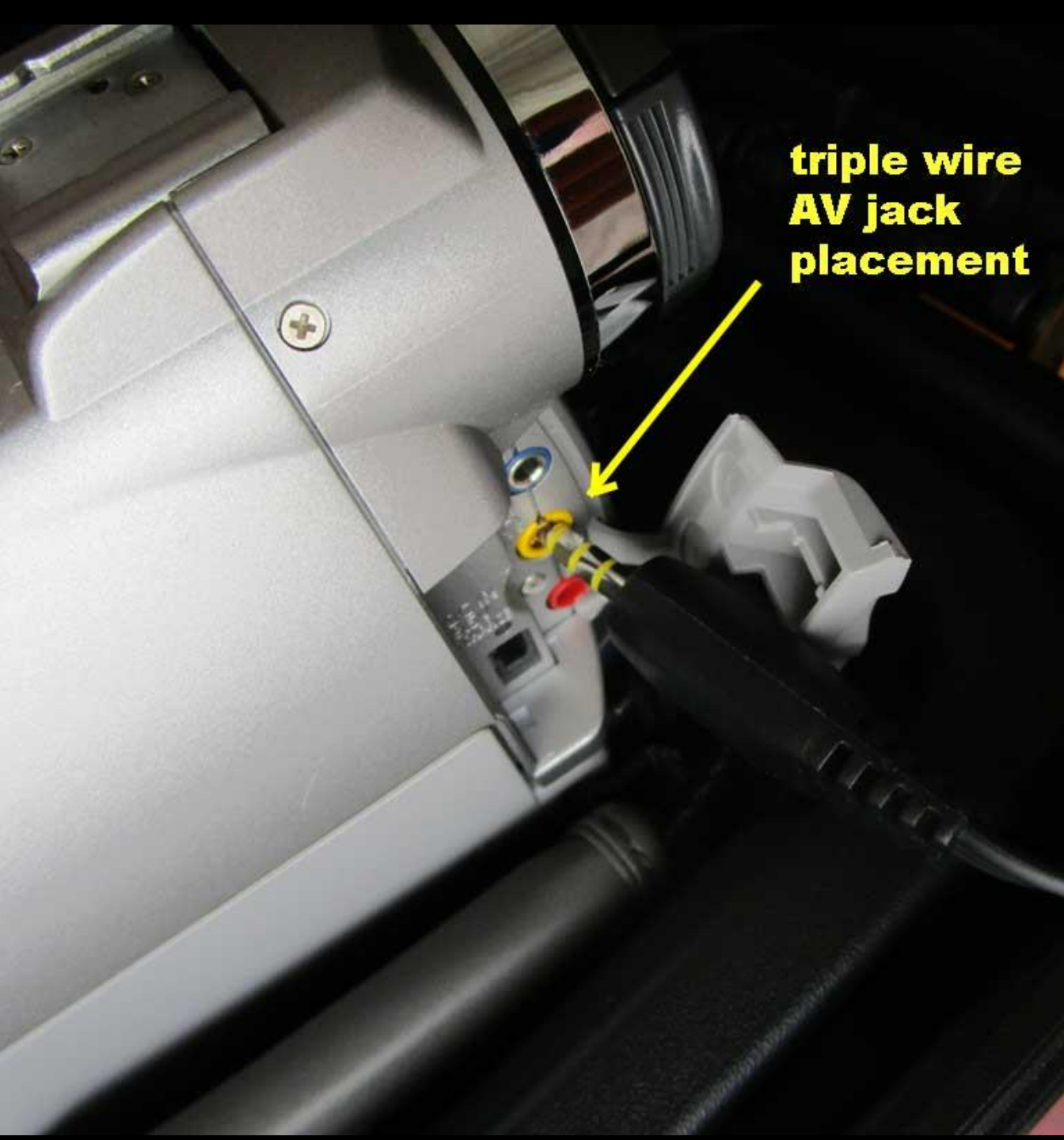


Push the yellow male triple wired jack laying on this layer, into the yellow video female jack on the camcorder, found here...



Video input jack, into yellow hole





**triple wire
AV jack
placement**

**Flip open the
gray cover.
The yellow
male AV jack
sitting on the
top level of
OccBox2
goes into this
hole; insert
the jack**



Unlatch the LCD Screen...



...to open the
LCD screen panel

Push this
backwards...



...then flip open and tilt up the LCD screen



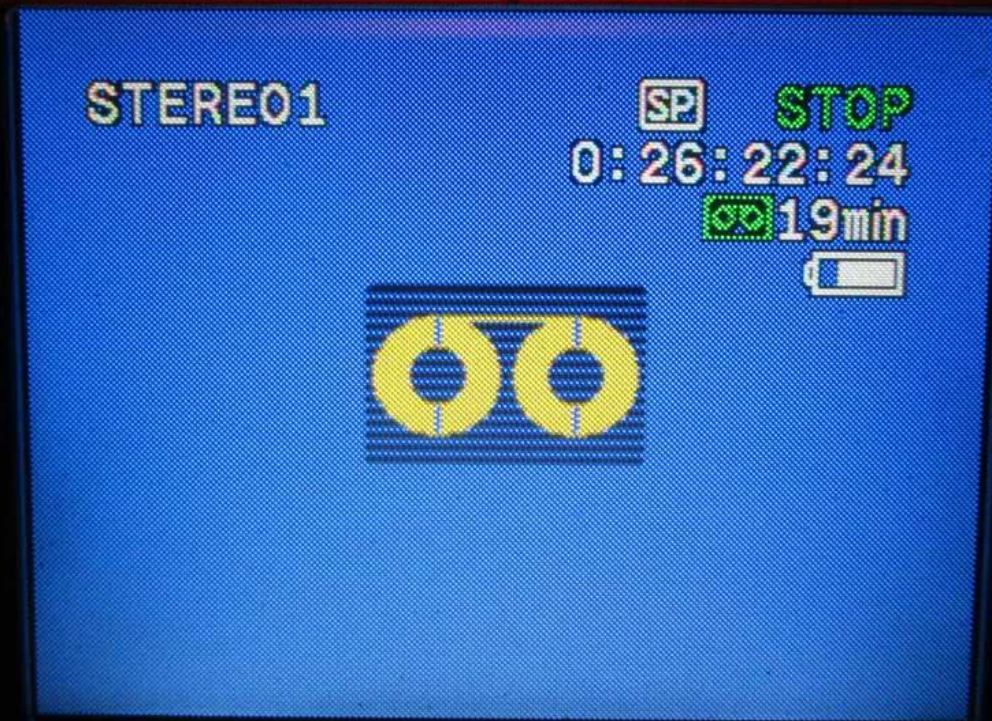
**Turn on the ZR45mc camcorder, into
“external recording” mode, this way. Do
NOT push the big red button!**



**Push in tiny button,
(not red button!),
and rotate downward
into the down position.
This turns on the
camcorder into external
recording mode**



Your LCD screen will look something like this, at this point. Note the battery level - don't run out of juice before the event!



If the camcorder battery dies, there are two spares in the side pocket of the canvas case. To replace, rotate up the camcorder viewing eyepiece and trigger the release latch



This button sends video to the screen



This button toggles on and off between “pause” and “recording”

OK, we now have power to the Watec, to the VTI, and to the Camcorder. You're ready to see the image of your target field. Pick up the camcorder remote and push the red “Rec/Pause” button on the left side. The camcorder LCD screen will now show video coming in, but it'll be in ‘pause’ mode, not yet recording to the miniDV tape.



The LCD screen will look something like this, but not focused yet. Don't focus till we've set a reasonable shutter integration and made sure the Watec settings are correct. (The info on left, top will not be on recording tape)



You may see a message up top, a 2-line message about the “almanac updated”

- The IOTA VTI goes out to the satellites and gets the time and needs to know how many updates to “Delta T” have happened since the VTI was manufactured. When it has this, it corrects the output time stamps and the message lets you know that it now has that data, so that the time stamps are correct.
- If it has not gotten that info yet because the VTI hasn't been powered on long enough or satellite view is poor, you'll see a little “hourglass” on the left side of the UT time along the bottom..



It can take up to 15 minutes for almanac update after powering on. This is why the VTI is the first thing we want to power up, right away.

- When you DO see the “almanac updated”, you can get rid of that line on screen. It just clutters the field of view.
- Push the little black button on the near side of the back of the VTI.
- Be careful, and push the button, it'll reset itself for a few seconds and then time will resume along the bottom, but no annoying almanac lines. Or, leave it alone if it's not bothering you

A Brand New Watec Needs the Proper Settings for Occultation Work.



- Most settings we do just once, after purchase.
- Here's the hand paddle for the Watec 910hx-RC. The keys are labelled for “Up”, “Down”, “Left” and “Right”, and **ENT** in the middle, is “Enter”



Generally: The Up / Down keys take you up and down the on-screen list. The L/R keys take you into/out of sub menus

- Hit the ***ENT*** key to activate the highlighted line
- That may bring up a secondary menu which you navigate similarly.
- ***ENT*** selects the list item you desire
- **Up/Dn** also takes you to a ***RETURN*** or ***EXIT*** key to leave setup altogether.
- Actions take effect immediately. So for example, if you change the shutter integration, you'll see the stars and sky brighten or darken immediately – Nice!

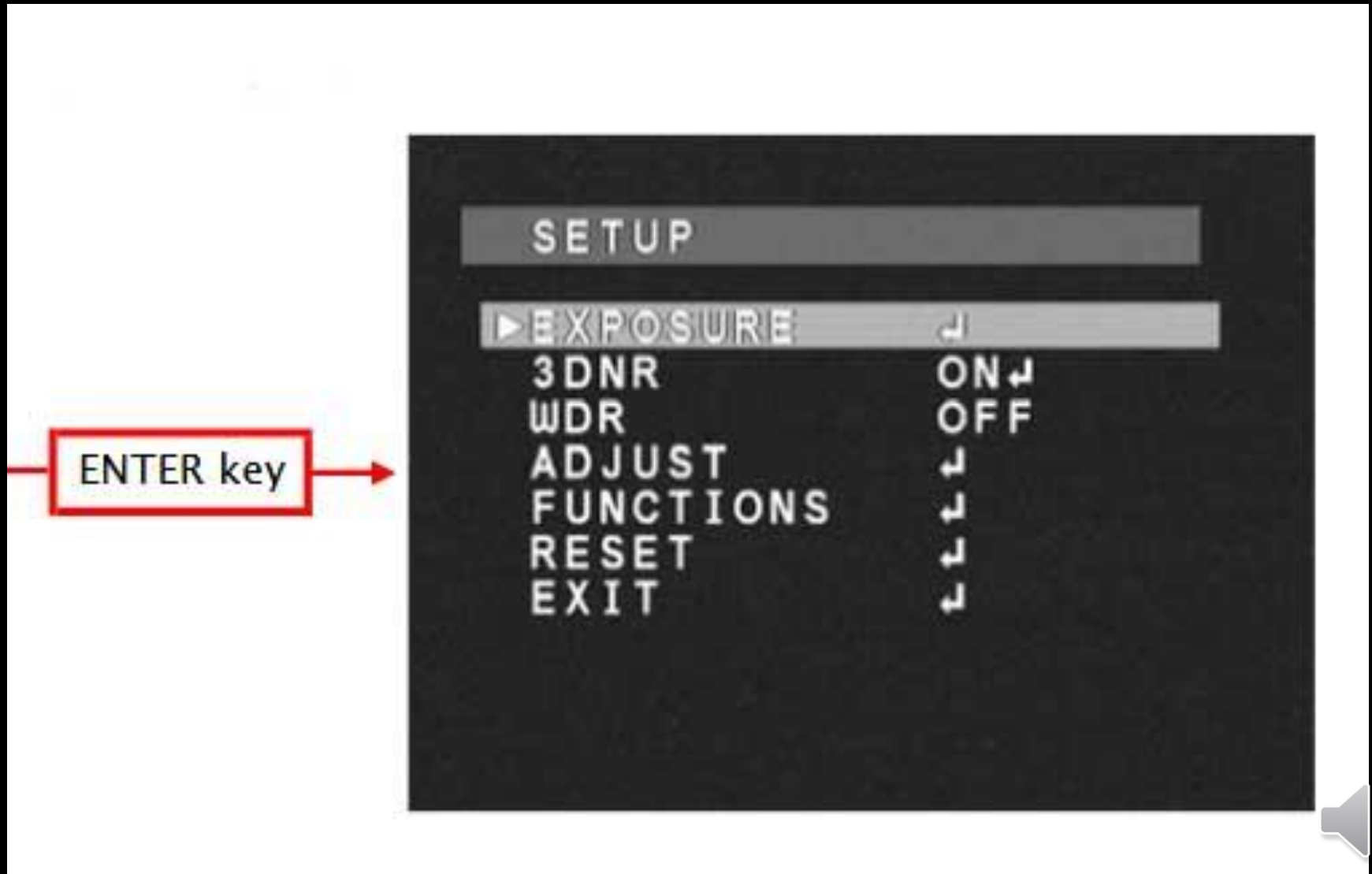


We'll want the proper settings for doing Asteroid Occultations

- Most settings (but not frame integration setting) are done just once when first bought, and never change from one asteroid event to another.
- I've already set these on the "2nd Unit" Watec, but others seeing this and buying new equipment, will want to know the settings.
- Here's the [910hx manual](#) which my students hopefully won't need.
- Now pick up the Watec remote and begin...



Click "**ENT**", brings up the top level menu (below) on the camcorder LCD screen



The following settings don't change – ever - for asteroid occultations...

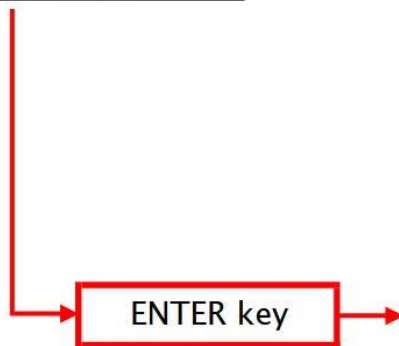
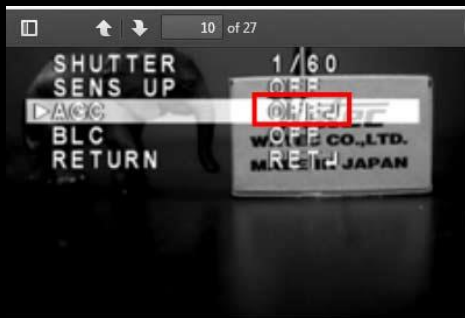
- *So, you will have to do them a maximum of only once; namely the first time, or never, if Rick's already done them for you.*
- **3DNR** (space and time noise reduction) should be “off” (degrades photometric quality)
- **WDR** (wide dynamic range) should be “off”
- Use the “up” key to get back up to **EXPOSURE** and press **ENT** to bring up a new menu...



BLC should be “off” (background lighting)

AGC (automatic gain) should be “off”.

With cursor still on **AGC**, hit **ENT** to bring up submenu **MANUAL GAIN** and set (LR buttons) to maximum, 41dB, These, too, never again change. Then **RETURN** and **RETURN** to get back to the top level menu



← MANUAL GAIN



Navigate to **ADJUST** and press **ENT**

Leave **SHARPNESS** at 4

Set **GAMMA** =1 (good photometry needs this)

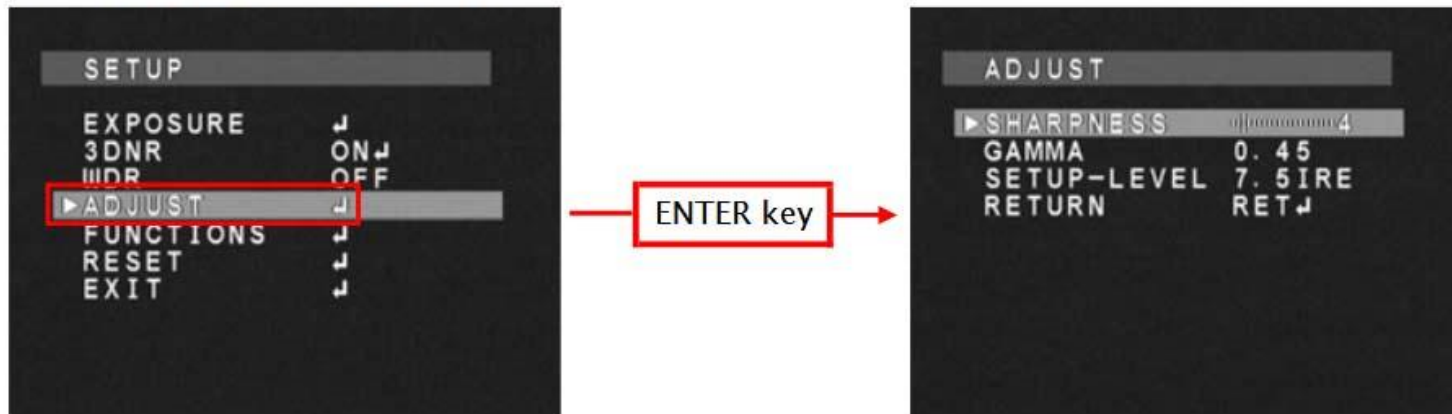
Leave **SETUP-LEVEL** at **7.5IRE**

These, too, never again change
then **RETURN** to the top level menu

3.4 ADJUST MENU

Use this setting to adjust the image quality.

Select ADJUST and press ENTER key to show Adjust menu. Use UP/DOWN key to select one of the lists on the menu, and use LEFT/RIGHT key to adjust.



Now We Set the Shutter Integration Level...

- This is a setting which you'll probably change frequently. It's the main thing you'll be adjusting from event to event and even during a single event.
- It's set inside the **EXPOSURE** menu
- Navigate to highlight **EXPOSURE** and press **ENT** to bring up the next menu, topped by **SHUTTER**



Shutter Integrations

- A **frame** is a combination of two **fields**; the even numbered horizontal interlaced lines, and then the odd horizontal interlaced lines. 2 consecutive fields then is a full frame. The “x” values below refer to fields, not frames.
- The Watec 910hx will integrate fields and frames within the camera before outputting. It dramatically deepens how faint a target you can access! 30 frames per second come in.
- x2 means 2 fields = 1 frame = 1/30sec integration
- I find that for 11th mag stars I usually need x8, 12th mag x16, and 13th mag x32 or x64 (x32 = ½ sec integrations). The Watec can go up to 4 seconds (x256) integration, but time resolution suffers so much you’ll ~never want to go that deep.
- You want your target star to be consistently visible, but not bright. If it’s bright, you may be saturating some of the pixels and this degrades photometric accuracy. Go as short an integration as you can and still constantly see the target star.
- For 9-10th mag **or brighter** stars, x2 is usually good.



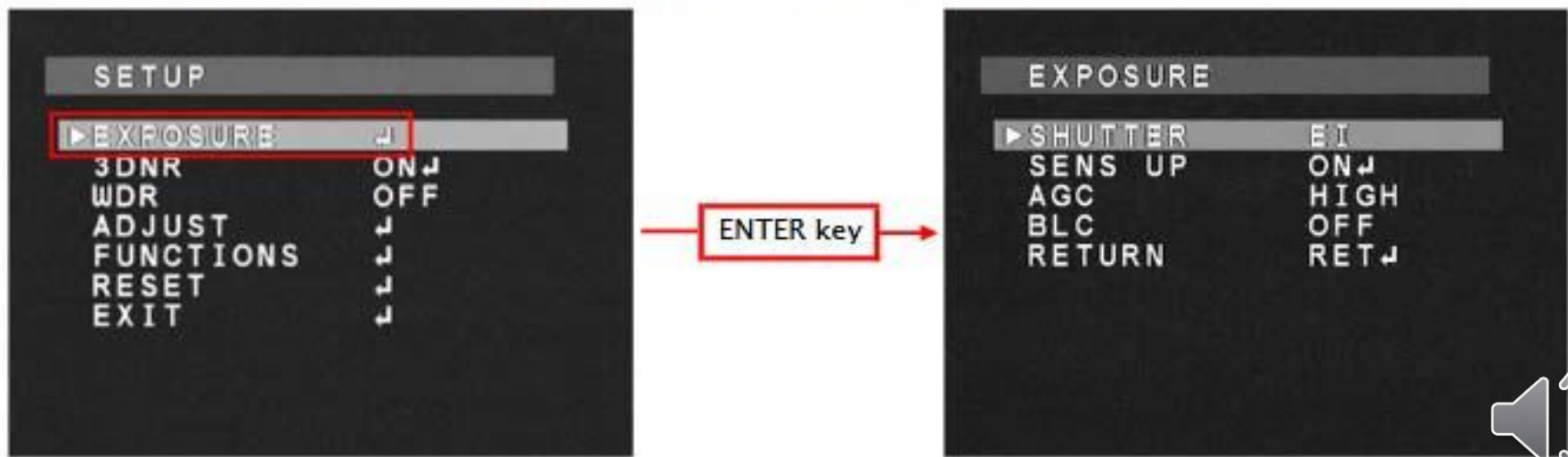
First, ***SENS UP*** should be “off”.

Then, with ***SHUTTER*** highlighted, press ***ENT*** and then you can use the remote’s ***up*** and ***down*** arrows to cycle between the different integrations. Image below starts with “E1”, but you’ll want ***x2*** on up to maybe even ***x64*** if the target is very faint and stars are sparse.

3.1 EXPOSURE MENU

When adjusting EXPOSURE settings, move the cursor to EXPOSURE and press ENTER key.

Press UP/DOWN button to choose one of the items in EXPOSURE, press the ENTER key to select, and change it with LEFT/RIGHT key. Press the ENTER key to set.



If it's a dark sky, start off with long integrations to see faint finder chart stars easily and get confidently on-target

- Use the **up/dn** keys and you'll see the values go from **E1** to **x2** to **x4** to **x8** to **x16**... up to **x256**. Go until you like what you see on the LCD screen star field, then **ENT**, then navigate to **RETURN** and **EXIT**
- Hang the remote on the scope somewhere safe (like on the finder?) so you won't strain the connector.
- Make sure there's at least one other similar star in your field, besides the target, and that both target, tracking, and comparison stars avoid the hot pixels



Now we need to re-focus the telescope for the Watec camera

- To reach focus, you slowly turn the Celestron focus knob counterclockwise a little more than 1 full 360 degree rotation.
- Watch for the brightest star (which should start out as a “donut” out of focus, and then brighten and focus to a point.
- Don’t be fooled by hot pixels, which are too tiny to look like stars and, of course, don’t go in/out of focus.



You may want to reset the shutter integration now that you can see the target star

- For the Ivar Occultation of Sept 25, the star is a bright 9.4, and the evening sun is at -9 degrees at event time, so that's significant twilight, especially during set-up. Also, the predicted duration is only 0.6 seconds (!)
- For tough events like this, all of these say that you should set the integration at **x2** once you've identified such a star in that situation.



If You've Allowed Plenty of Time

- ...and there is a while before the event, then watch how well the telescope tracks for a bit, and if there's no drift, you can safely turn off the camcorder to save battery life. This is important; those batteries don't last long.
- If you are still on "pause", the camcorder will automatically shut itself off after about 2-3 minutes if you haven't started recording. If it auto-powers-off and you're not done getting things right, push the red "**Rec/Pause**" button to again see the sky on the LCD screen.
- My general rule is to record for a minute before and a minute after an occultation, unless it's an unusually long event, then go longer. Undiscovered moons can be up to 10 diameters away from the asteroid, so that's another rule of thumb; 10x the maximum predicted duration should be what to aim for, or a little longer.



After the event, Click “Stop” on the Camcorder remote to end recording

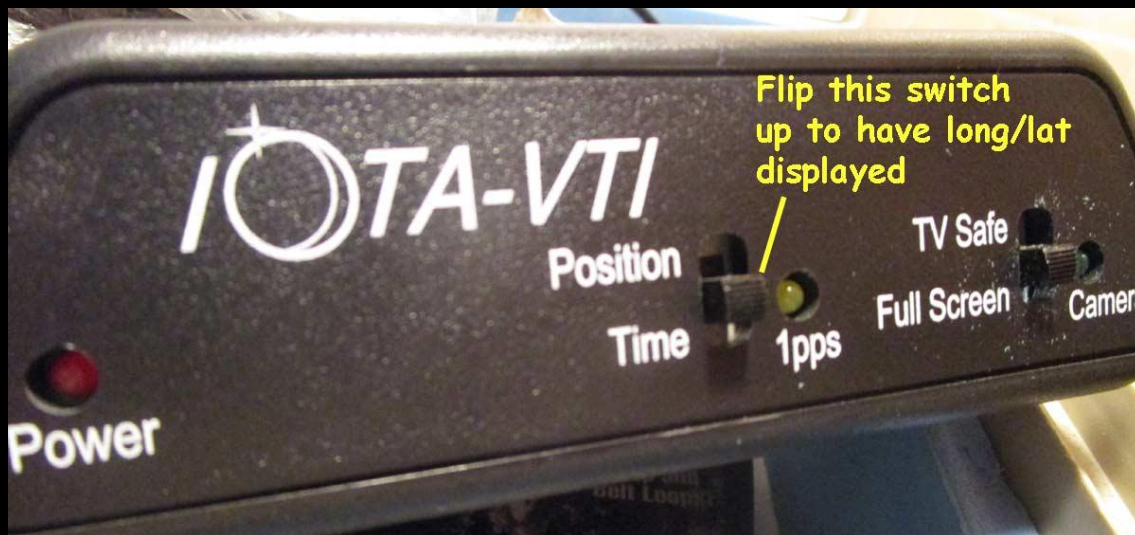
- If you were in a rush and saw a “miss” and are uncertain you actually video recorded the target star, now is the time to verify you had the right star.
- Look carefully at surrounding stars and verify you had the target.
- If you were on the right star, your “miss” may still be useful. And if a “hit” obviously more so.

Next...



To get on tape the GPS Long/Lat (or can just get from GoogleEarth later)...

- Lift the OccBox2 lid. On the front side of the VTI is a little black switch. Raise it from “Time” to “Position” setting. On-screen you’ll see displayed your longitude and latitude and other info.
- Briefly turn back on the camcorder and record



To Review Your Tape...

- On very cold and/or wet nights, keep camcorder warm till use! It's possible that even though you watched the LCD screen and all looked perfect, that the tape actually didn't record! That's happened to me only twice, once in Australia during record cold for the Hayabusa Mission – very bad!
- Push the remote's back-arrow to rewind the tape a few minutes, then push "**play**" to play it. (Do NOT hit the red "**Rec/Pause**" button or you'll record over your event!)



Powering Off, Closing Things Up

- When done, flip up the button switch on the back of the camcorder to be level, which is the “off” position.
- Push the power buttons on the battery triple-sockets to turn off power to everything else. Pull the ground (black) lead off the battery at the bottom of OccBox2
- Unplug everything, pack into their plastic bags.

Official Battery Recording Times, when LCD screen is on (Reality might be less)

- [Link](#) for battery recording (or playback) times, when battery is new and fresh...
- 800 mah => 1h 15m (standard w/ camcorder, and (currently) in the “2nd Unit” here)
- 1500 mah = model BP 511/512 => 2h 15m
- 2600 mah = model BP 522 => 4h 45m
- 3450 mah = model BP 535 => 7h 40m



Parts List as of late 2018

- Celestron NextStar 8SE SCT telescope..... \$1199.00
- Orion Q70 eyepiece..... \$ 100.00
- Celestron 2" diagonal..... \$ 124.00
- Watec 910hx-RC camera..... \$ 700.00
- Canon ZR45mc camcorder (ebay)..... \$ 150?
- Meade or Celestron f/3.3 reducer..... \$ 100? Will have to find on eBay, not made any longer
- Highpoint 0.5x focal reducer..... \$ 26.95
- Astromania 1.25" c-adapter..... \$ 16.00
- Short-nose 1.25" c thread for use w/ 0.5x..... \$ 12.00
- IOTA VTI video time inserter..... \$ 249.00
- 2 Tool boxes (Ace Hardware)..... \$ 26.00
- 8ah 12VDC battery \$ 35.00
- 2 "LED Innovations" triple sockets..... \$ 30.00
- RCA cord, 2 male 2.1mm "N" barrel plugs.....~\$ 30.00
- Various fuses, connectors..... \$ 38.00
- Total..... ~\$2836

