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Acknowledgements

I would like to express my deepest appreciation to the following deep sky imagers for allowing the use of their thumbnails in *The Advanced Imager Catalog*. For years, I have been inspired by their results and, thanks to their generosity, I have been permitted to include their thumbnails within CCDNavigator. Without their hard work and leadership in capturing these images, this catalog would not be possible. In alphabetical order by their last names, they are:

- [Ken Crawford](#)
- [Russ Croman](#)
- [R. Jay GaBany](#)
- [Rob Gendler](#)
- [William McLaughlin](#)
- [Dean Salman](#)
- [Johannes Schedler](#)
- [Star Shadows Remote Observatory](#)
- [Kitt Peak Visitor Center](#)

Ken Crawford images from his observatory, Rancho Del Sol, in California. His work has been published in magazines, books and on the Internet and several of his images have appeared on "Astronomy Picture Of the Day" (APOD). Ken's imaging craftsmanship is highly respected by all those who know him. Within *The Advanced Imager Catalog*, Ken's thumbnails are labeled with his name and his website is www.rdelsol.com.

Russell Croman has been widely recognized for his superb images. After imaging from his backyard in Texas for several years, he established a remotely operated observatory in New Mexico during 2005. His images have been published in numerous national magazines. Russ is well known for his generous sharing of technical knowledge and skills. Within *The Advanced Imager Catalog*, Russ's thumbnails are credited with his name and his website is www.rc-astro.com.

R Jay GaBany images from his home in San Jose, California and with remote observatories in New Mexico. He has also imaged from Kitt Peak, Arizona. Besides being a skilled imager, Jay shows exceptional wit in his titles and the written descriptions of his images. His writing skills can be enjoyed at "Universe Today", an Internet newsletter for space enthusiasts and his personal enthusiasm for astronomy seems boundless. Within *The Advanced Imager Catalog*, Jay's thumbnails are labeled with his name and his website is www.cosmotography.com

Robert Gendler is legendary for his images of the night sky. He imaged for years from his driveway in Connecticut but now has a remote observatory in New Mexico. He has produced stunningly beautiful images achieving world-wide accolades from both locations. Rob's finest images are contained in his upcoming book "*A Year in the Life of the Universe*". Within *The Advanced Imager Catalog*, Rob's thumbnails are labeled with his name and his website is www.robgendlerastropics.com. A few of Rob's images were done in collaboration with Martin Pugh in Yass, New South Wales, Australia. You can see more of Martin's work at www.martinpughastrophotography.id.au

William McLaughlin images the Oregon night sky from his Raptor Ridge Observatory and previously from the ARGO Observatory of which he was a founder. Bill has produced many wonderful images from both these locations and I personally believe his planetary nebula images are among the finest ever recorded. His images have been published in numerous magazines around the world and he has generously shared his knowledge through lectures and articles. Within *The Advanced Imager Catalog*, Bill's thumbnails are labeled with his name and his website is www.nightskypictures.com.

Dean Salman images the Sharpless catalog and other deep sky objects from his observatory near Tuscon, AZ. His photos have been published in Astronomy magazine and Sky & Telescope magazine. Currently Dean uses an AP1200GTO with an Epsilon 180 and an SBIG ST-10 equipped with Astrodon filters, an excellent system for capturing the wide-field Sharpless objects in which he specializes. Dean also offers a free software package, CCD Explorer, for managing images that you've taken. Dean's images are labeled with his name and you can visit his website at www.ccdimages.com.

Johannes Schedler images from Panther Observatory in the southeastern part of Austria. His images have been published in a variety of international magazines, books and on the Internet. Johannes readily shares his knowledge of image processing with others and presented on this topic at the Advanced Imaging Conference in 2005. Within *The Advanced Imager Catalog*, Johannes's thumbnails are labeled with his name and his website is www.panther-observatory.com.

Star Shadows Remote Observatory (SSRO) in New Mexico is a cooperative venture owned and operated by Jack Harvey, Rick Gilbert, Jim Thibert and Steve Menaker. Their images have been selected for Astronomy Photo Of the Day (APOD), SETI Explorer and Sky & Telescope Magazine. Within *The Advanced Imager Catalog*, their thumbnails are labeled with the name **SSRO Team** and their website is www.starshadows.com.

Kitt Peak Visitor Center, an office of NOAO/AURA/NSF (National Optical Astronomy Observatory / Association of Universities for Research in Astronomy / National Science Foundation), has enriched the lives of the general public and many amateurs (myself included) with their Nightly Observer Program (NOP) and Advanced Observer Program (AOP). These public outreach programs make an unparalleled astronomy experience possible for anyone. Furthermore, the images taken by amateurs in the AOP represent a prolific selection of high quality images of deep sky objects. Within *The Advanced Imager Catalog*, these thumbnails are credited as **Kitt Peak AOP** and their website is www.noao.edu/outreach/aop/observers/bestof.html. The name of the individual who took the image is embedded in the file names there. For example, the file "M13bash2.jpg" was taken by "Bash".

In addition, I acknowledge the use of NASA's *SkyView* facility (<http://skyview.gsfc.nasa.gov>) located at NASA Goddard Space Flight Center. The ability to retrieve the Deep Sky Survey (DSS) images through the *SkyView* website is a tremendous resource for amateur astronomers.

In developing CCDNavigator2, I have been given very able assistance by my Beta Testers. These include:

Frank "Sandy" Barnes, Jonathan Burnett, Rick Gilbert, John Smith, and George Whitney. While each of these individuals made contributions to the operation of CCDNavigator, I'm especially grateful to Jonathan Burnett for suggesting the exporting of Dark Cycle information to calendars and to George Whitney for suggesting that I allow preview retrievals while setting up targets for autoguiding.

Steve...

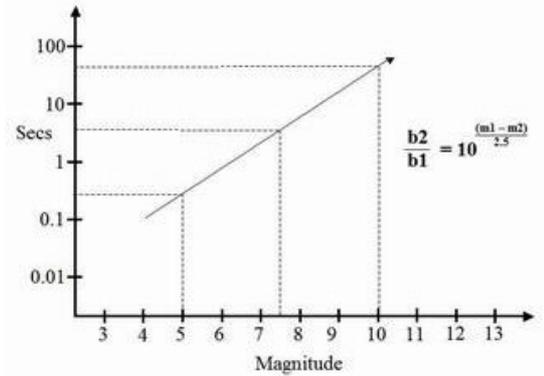
Steve (at) CCDNavigator (dot) com

Guidestar Exposure Calculation

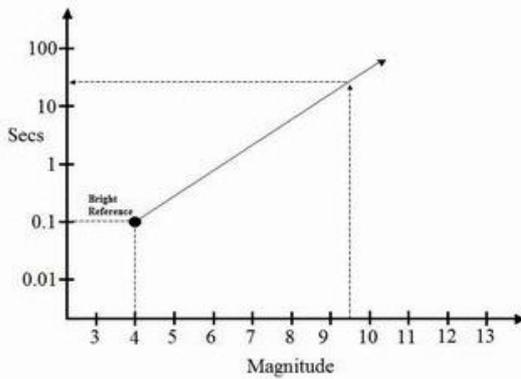
This section explains CCDNavigator's approach to setting the exposure for an autoguider using reference values that establish guiding exposures for the brightest and faintest stellar magnitudes to be used.

How it works

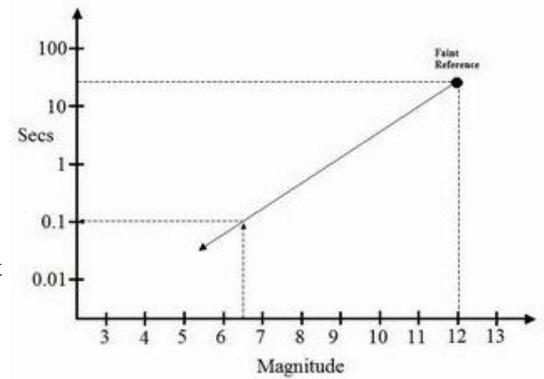
The relative brightness of stars varies exponentially as shown in the figure to the right. If the figure's equation is considered, it can be seen that if two stars differ by 2.5 magnitudes, their brightness values differ by a factor of 10. Likewise if there is difference of 5 magnitudes between the stars, their brightness differs by a factor of 100. So, if a magnitude 5 star produces a particular guider ADU at an exposure of 0.3 seconds, then a magnitude 7.5 star would require a 3 second exposure and a 10th magnitude star would demand 30 seconds to produce a similar ADU level at the guider.



Experienced users know it is impractical to guide at the same ADU value for any guide star, especially when a wide range of magnitudes is considered. Instead, two reference points will be used, one for bright guide stars and a second reference for dim guide stars. This is considered in the graphs below.

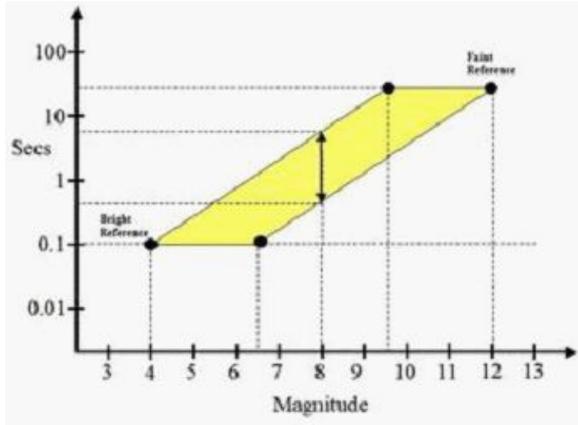


Suppose, for example, that we experimentally determine for a particular system that a bright 4th magnitude guide star requires a 0.1 second exposure for good guiding characteristics (left graph) and that a faint 12th magnitude star requires 15 seconds (right graph). These two reference points may have quite different ADU values at the autoguider but both operating points provide acceptable guiding. These reference points can be extrapolated to different magnitudes using the formula in the first figure.



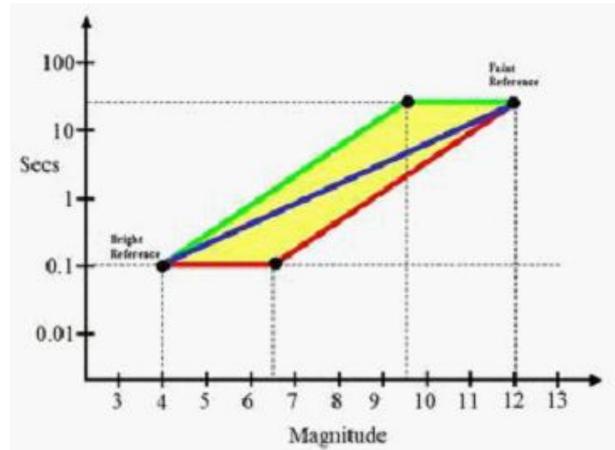
The table to the right shows the exposure for equivalent ADU counts using the formula from the first graph for the example bright and faint guidestar magnitudes just mentioned (mag 4.0 and mag 12.0 respectively). The column labeled Bright Reference begins at magnitude 4.0 and extrapolates down to magnitude 12.0 whereas the column titled Faint Reference begins at magnitude 12.0 and extrapolates up to magnitude 4.0. From the table, we can see that the bright reference exposure exceeds 15 seconds for stars fainter than magnitude 9.6 and that the faint reference exposure is less than 0.1 seconds at magnitude 6.4 and brighter. These values establish the limits beyond which the extrapolation for the particular reference exposure should not be used because the faint reference exposure will be unnecessarily short and the bright reference exposure will be unnecessarily long.

Guidestar Mag	Bright Reference (Constant ADU/SNR)	Faint Reference (Constant ADU/SNR)
4.0	0.1	0.01
4.4	0.1	0.01
4.8	0.2	0.02
5.2	0.3	0.03
5.6	0.4	0.04
6.0	0.6	0.06
6.4	0.9	0.09
6.8	1.3	0.13
7.2	1.9	0.18
7.6	2.7	0.27
8.0	3.9	0.38
8.4	5.6	0.55
8.8	8.1	0.80
9.2	11.7	1.15
9.6	16.9	1.66
10.0	24.4	2.40
10.4	35.3	3.46
10.8	50.9	4.99
11.2	73.4	7.21
11.6	105.9	10.40
12.0	152.8	15.00



From these observations, we can establish a range of acceptable guiding exposures. The parallelogram seen in the figure to the left represents this region as bounded by the two reference points. If we consider an 8th magnitude star, the exposure could range from 0.38 to 3.9 seconds. If the exposure were set to 0.38 seconds, the guider's operation would be similar to the 12th magnitude faint reference star. But if set to 3.9 seconds, the operation would be similar to that of the 4th magnitude bright reference.

Based on this understanding, it is possible to define three strategies - short, medium and long - for exposure duration



which are illustrated in the graph to the right. The green line provides the longest acceptable exposure while the red line provides the shortest acceptable exposure. It is also possible to choose a value that is midway between the longest and shortest values as shown by the blue line. At the reference points, all three strategies converge to the same exposure value. Notice that for stellar magnitudes below 6.5, the exposure value is locked to that of the bright reference point and that for magnitudes greater than 9.5 it is locked to the faint reference point's exposure of 15 seconds.

Depending on the user's equipment, one or the other of these strategies can be chosen. Users with Adaptive Optics (AO) will generally prefer shorter exposures since this provides the fastest AO update rate. However if the user is directly guiding their mount, longer exposures will reduce the effects of seeing more. CCDNavigator provides all three choices of these guide exposures.

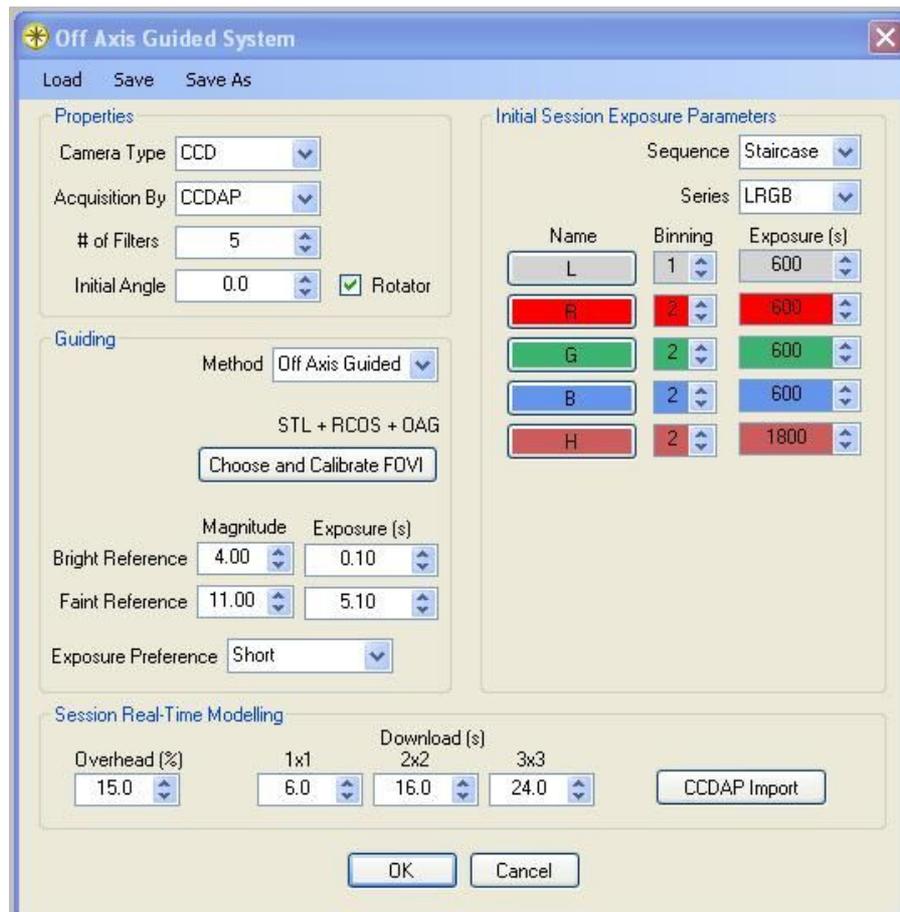
To use this capability, the user must first choose the brightest and faintest magnitudes that will be used for guiding. They should then experimentally determine the exposure value for the bright and faint magnitude reference points for each filter. These values can be entered into CCDNavigator and when a guide star is selected, CCDNavigator will then calculate the exposure according to the user's preference of "Long", "Medium" or "Short" exposures.

Camera

This window holds the various parameters associated with the camera. The camera name is displayed in the title line of the window, in the example the camera is named "RCOS+STL6303E" but it will initially be named "Default". The camera parameters cannot be changed while planning a session, once targets have been added to the session, it is "locked" to disallow access.

To create a new camera, simply modify the parameters as you wish and then click "Save As", enter the name which you prefer (short names are best) and click "Ok". This will create and save it as a new camera. To modify the camera, simply make your changes and click "Save" to update it. "Load" will let you choose any previously created camera file.

It contains five panels: Properties, Guiding, Initial Session Exposure Parameters and Session Real-Time Modeling.



The Properties panel holds the basic camera configuration values:

- **Camera Type** - Either CCD, DSLR or OSC cameras are supported. Various options in the Camera window will be hidden or revealed accordingly. For example, DSLRs and OSCs do not have controllable filters so the entire panel listing filter names will be hidden.
- **Acquisition By** - Either CCDAP, ACP, MaxImDL or CCDSoft can be chosen; however, full session plans can only be exported to CCDAP and ACP. Simple single target sequences can be exported to MaximDL and CCDSoft but these will only control the LRGB sequence. And CCDSoft can only support the "Shuffle" method of sequencing.
- **# of Filters** - This control sets the number of filters that are in the camera.
- **Initial Angle** - This parameter establishes the starting angle of the camera. For users without a rotator, this should be set to 0 degs for "landscape" format or 90 degs for "portrait" format. For users with rotator, this will only be used as the starting angle for EZ-Guide.
- **Rotator** - Check this box if you have a rotator.

The Guiding panel controls the following functions:

- **Method** - This sets the guiding method to be used during EZ-Guide and can be Unguided, Guidescope, Off Axis Guided or Self Guided. Off Axis guided systems can have the guidebox at any position in the Field-Of-View. Guidescope can be offset from the center of the Field-Of-View. A very simple calibration routine will lead you through the steps to properly model these systems. This choice of guiding method will determine how EZ-Guide operates and also where the guide star reference exposures are set. Note: DSLR and OSC camera types cannot select "Self Guided" for guiding method.
- **Choose and Calibrate FOVI** - This button is used to set up the autoguider so EZ-Guide can properly place guidestars on the guiding camera. Just below this button is the name of the TheSky6 FOVI chosen during the process. If you switch from one profile to another, EZ-Guide will set TheSky6 FOVIs to the one selected for each camera during this process. *If you do not choose and calibrate an FOVI, EZ-Guide cannot*

operate properly. For all guiding methods, you will be asked to click on a corner of the main camera and center it in TheSky6. This allows CCDNavigator to calculate the size of the main camera's Field-Of-View. See the figure below for clarification about this operation. Then, in the case of Off Axis Guided or Self Guided systems, you will be asked to click in the middle of the guide box and center it in TheSky6. In the case of Guidescope systems, you will be asked to center two opposite corners of the guidescope allowing the offset and size of the guidescope to be calculated. These calibrations need be done only once for any particular camera configuration and are automatically restored when switching from one camera to another. In all cases, a single FOVI must represent the camera and the guiding system. See [EZ-Guide](#) for more details.

To set up the guiding bright and faint reference controls, you must first decide what range of stellar magnitudes you wish to use for autoguiding. For most users, a range of 4th to 8th magnitude is reasonable for guidescopes and 4th to 12th magnitude for Off Axis guiding but a wider or narrower range can be chosen.

Next, using your equipment on a night of normal seeing, locate a star with a stellar magnitude that closely matches your intended Bright Reference magnitude. Record the actual magnitude of the chosen guidestar and train your autoguider on this star using the Clear or Luminance filter. Experiment with the exposure duration until you are satisfied with the guiding, then record your preferred exposure duration for this filter. If you are using the Self Guided method, switch to a different filter and adjust the exposure until you have preferred values for all of your filters. If you are using Guidescope or Off Axis Guiding methods, you do not need to make measurements for each filter. Now, repeat this procedure with a star that closely matches your intended Faint Reference magnitude and record the star's actual magnitude and your preferred exposure for each filter.

The reference magnitudes from your field testing are to be recorded as follows:

- **Bright Reference - Magnitude** - Set this to the actual bright reference star's magnitude as selected in your field testing.
- **Faint Reference - Magnitude** - Set this to the actual faint reference star's magnitude as selected in your field testing.

If you are using either the Guidescope or the Off Axis Guided method, record your field testing exposure values as:

- **Bright Reference Exposure** - This value will be found in the Guiding panel next to the Bright Reference Magnitude. Simply enter your preferred exposure in this control
- **Faint Reference Exposure** - This value is also in the Guiding panel, just set it to your preferred value found in field testing.

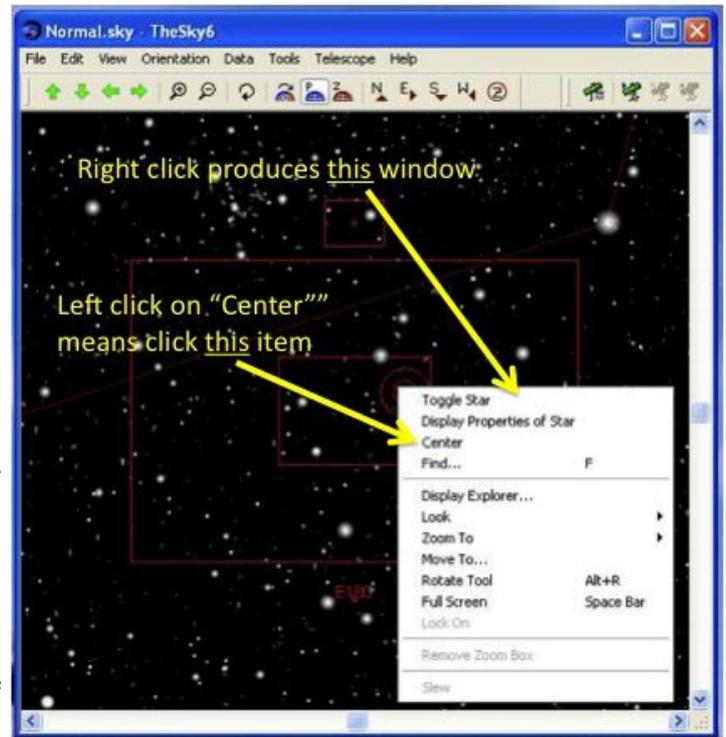
If you are using the Self Guided method, then the exposure controls are found in the Filter Properties window which is accessed by clicking on a filter name. The window that appears will have a Bright Reference Exposure control and a Faint Reference Exposure control enabled in it.

- **Bright Reference Exposure** - This value will be found in the Guiding panel next to the Bright Reference Magnitude. Simply enter your preferred exposure in this control
- **Faint Reference Exposure** - This value is also in the Guiding panel, just set it to your preferred value found in field testing.

Note: The faint reference magnitude can range from mag 9 to mag 14. It is recommended that wide field system users with guidescopes set this value to mag 9, otherwise, the number of stars found will be excessive and take extra computation time. Users with off axis or self guided systems should choose a mag between 12 and 14 or there may be no appropriate guidestars found. It is also recommended that in TheSky6, the user double click on "View", "Display Explorer", "Stellar", "Star" and the small box next to "Display Properties" and set the "Faintest Magnitude Limits" to 14. This will speed up the database retrieval system and will display guidestars within the range of any CCDNavigator selection process. CCDNavigator uses the Guide Star Catalog (GSC) and the Hipparcos/Tycho catalog for guidestar identification so it is also recommended that you set TheSky6 to display stars from these catalogs. This can be done by clicking on "View", "Display Explorer", "Stellar", "Star" and the small box next to "Stellar Options" followed by "Catalogs/Astrometry" and set the checkboxes for the Guide Star Catalog and Hipparcos/Tycho.

When the autoguider exposure is calculated from these values, CCDNavigator offers an exposure preference which should be set based on the user's system requirements.

- **Exposure Preference** - This chooses short, medium or long auto guider exposures. The choice depends on whether or not Adaptive Optics (AO) is being utilized and, if non-AO, how frequently your mount needs to be corrected. Here is some guidance on setting the Exposure Preference:
 - "Short" preference - If you are using AO, the "Short" preference will give the fastest AO cycle rate. If you are not using AO, this preference may tend to "chase seeing" if your reference exposures are short so it is probably not the best choice. But if your mount has severe tracking problems, it may be better than letting the mount drift.
 - "Medium" preference - This is probably the preferred mode for direct (non-AO) guiding for mounts of good quality especially if the reference exposures have high ADU counts. This mode will tend to average out seeing effects due to the longer guiding exposures.
 - "Long" preference - Users of very high quality mounts which are in excellent polar alignment may prefer this mode since it will do the most to average out seeing effects and will make the smallest corrections to the mount during tracking. This setting may also prove useful on nights of exceptionally bad seeing.



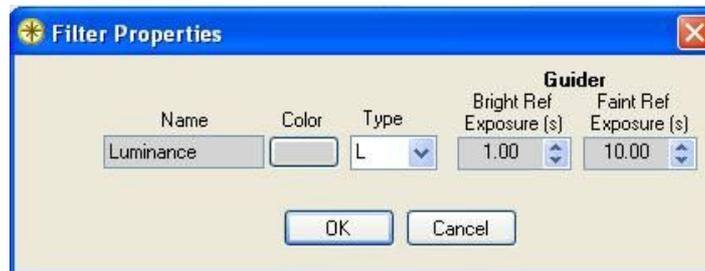
- In all cases, if a guidestar is chosen with the bright reference magnitude value (or brighter), the exposure will be the reference value no matter what preference is selected. Likewise, if the guidestar is used having the faint reference magnitude value (or fainter), the exposure will be set to the reference value irrespective of the preference.
- No matter what preference is used, the guiding will have an ADU count and SNR that is (approximately) at least as good as the faint reference point but no better than the bright reference point.
- Note that some variation in ADU and SNR will occur due to the spectral characteristics of the guidestar when guiding through different filters, especially narrowband ones.

Once these parameters are set, CCDNavigator will calculate and export a guiding exposure based on the magnitude of the actual guidestar selected by EZ-Guide. The guiding exposures can be seen in the [Session Plan](#) when it is viewed.

The Initial Session Exposure Parameters panel sets up the properties for each filter and provides the starting point for exposing of targets. After a target has been added to the session plan, these values will initialize the sequence type, series allocation, binning and exposure for each filter named in the Series control. These values (Sequence, Series, Binning and Exposure) are used as initial values which the user can modify from inside the Session window. The values can be modified independently for each target.

- **Sequence** - This dropdown window lets you choose between "Staircase" sequencing and "Shuffle" sequence. Staircase sequencing will order the frames such that L frames are taken at the highest possible elevation, B frames at the next highest and so on through G, R and H. An example staircase sequence where the target transits in the middle of the sequence is RRGGBLLLLLLBBGRR. This method tends to maximize resolution in the L frames and avoids extinction in the B frames. The Elevation Priority determines the order for the filters. Learn more about this topic in [Optimal Scheduling](#). Shuffle sequencing takes the frames in a repeated cycle of L, R, G, B, H where a specific number of L, R, G, B and H frames are taken during each cycle. A common shuffle sequence is (LRGB)(LRGB)(LRGB) but a more general case is (LLLLRRGGGB)(LLLLRRGGGB)(LLLLRRGGGB) which takes four L frames, two R frames, three G frames and one B frame per cycle. The shuffle method attempts to balance the acquisition of data so that if a session must be terminated, there is a chance of having enough data for an image.
- **Series** - This determines the initial allocation of frames to the various filters for L, RGB, LRGB, NB(Narrow Band) and H filter sets. You can modify the choice of series in the Session window by clicking on Exposure and no matter what quantities of frames are set for the target, you can change all of them in the Session window. The filters chosen for initialization depend on the Elevation Priority values. See the discussion on Elevation Priority in [Optimal Scheduling](#).
- **Filter Name**- There is a row provided for each filter based on the number of filters selected in the Properties panel. The filter name and other filter properties can be changed by clicking on the button which will launch a Filter Properties window for the filter. If you're using CCDAutoPilot, the filter names in CCDNavigator and CCDAutoPilot must match for proper importing of the session plan.
- **Bin** - These parameters set the binning mode for each of the filters when acquiring images and can be set to 1x1, 2x2 or 3x3 binning.
- **Exposure** - The values entered set the actual imaging times for each filter used by the camera in the exported session plans.

By clicking on a filter name to reveal a Filter Properties window, various properties of each filter can be modified.



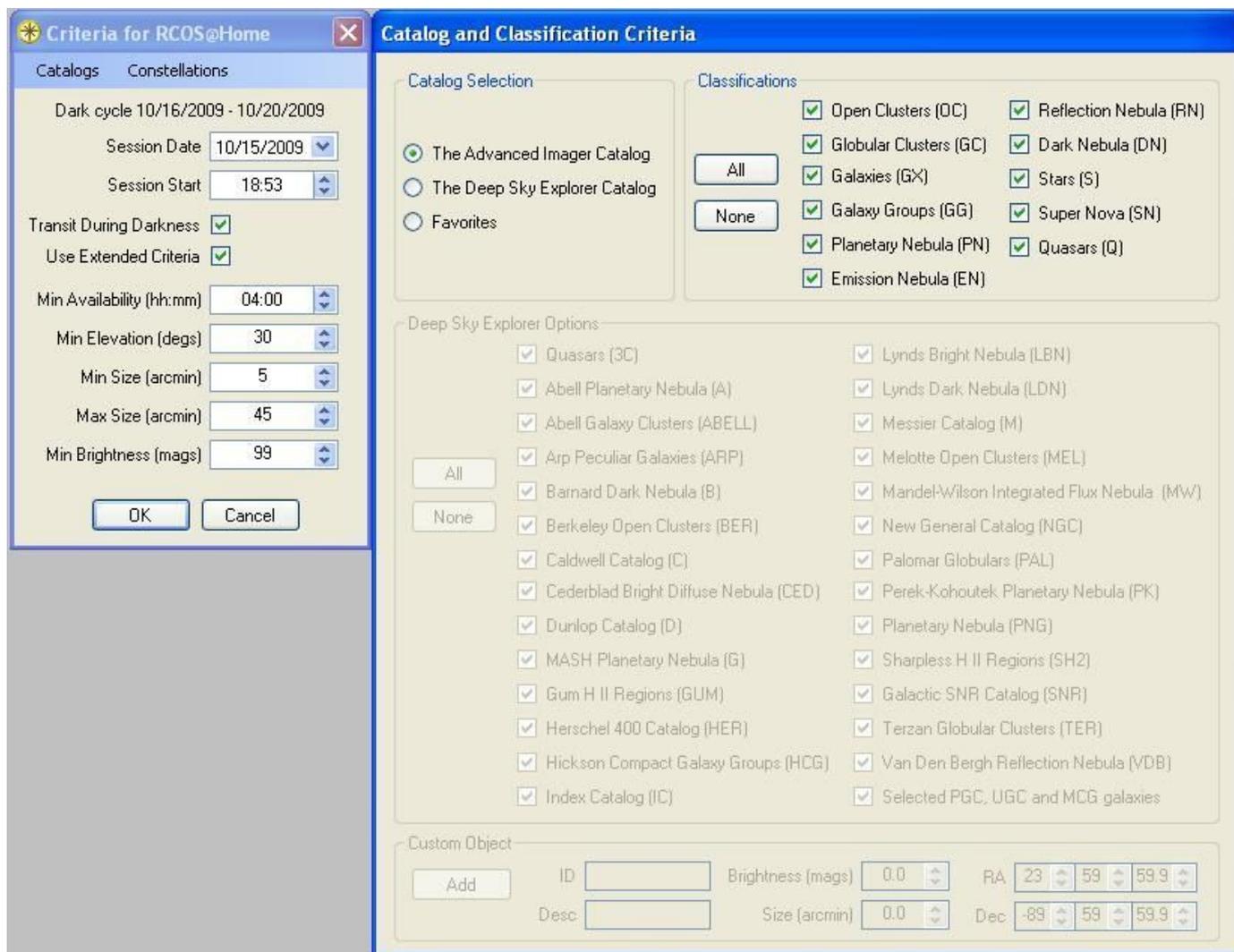
To change the filter's name simply highlight the current name and type in whatever name you wish (but it is recommended that short 1 to 3 letter names be used). The color of the filter can also be changed, this is merely a cosmetic feature for CCDNavigator and has no connection to the actual filter color. Each filter also has a "Type" value which determines what type of filter it actually is (eg. L, R, G, B, etc) and the elevation priority used when setting up frame sequences. The filter Type controls the Staircase sequence frame allocation optimization whereby the filters with the highest priority will be used at the highest elevation values of the target and it also determines which filters are initialized for the "Series" selection (eg. LRGB, RGB, NB, etc). If the Self Guided method is being used, a Bright Reference Exposure and a Faint Reference Exposure will be present and if CCDSoft is the Acquisition program, a Slot value will be present which should be set to the filter wheel slot position (numbered from 1) where the filter is located.

The Session Real-Time Modeling panel models the various delays that occur when an imaging session executes including download times and average overhead as a percentage.

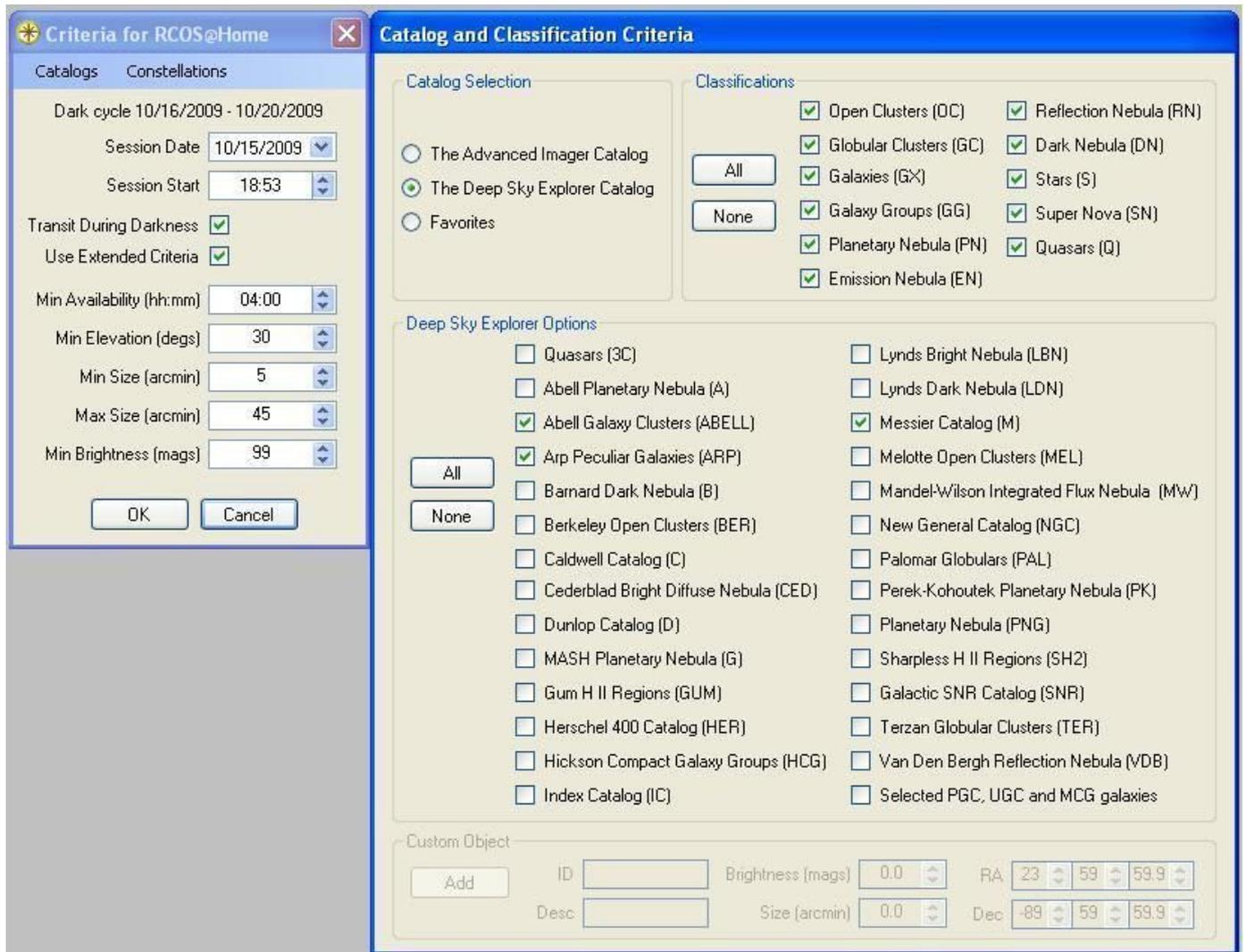
- **Download** - These parameters estimate the total exposure time for each frame based on the binning mode. The camera download times can be found on your manufacturer's website.
- **Overhead** - "Overhead" models time spent precision slewing of the telescope with plate solves and settling delays, slewing to/from focus stars and focusing, guidestar acquisition with dithering delays, and meridian flips. It can be calculated by timing a session from the start of imaging to the end of imaging with all the normal operations taking place, subtracting the amount of time actually spent exposing and downloading the frames and dividing the remaining time by the session's duration.
- **CCDAP Import** - The download and overhead parameters are measured during actual sessions by CCDAP4 version 4.12.3 or later and can be imported using this button. The user must browse to a CCDAP4 logfile for a session that completed normally or these parameters will not exist in the logfile. For best results, the logfile of an all night session that operated without abnormal events (such as cloud delays, frequently lost guidestars, etc.) should be used.

Catalogs

The Criteria window's "Catalogs" menu item allows the user to select alternate catalogs and filter targets by their object classification. Clicking on this menu item will launch a "Catalogs and Classification" window next to the Criteria window. In the "Catalog Selection" panel, you can choose between "The Advanced Imager Catalog", "The Deep Sky Explorer Catalog" or the "Favorites" catalog. *The Advanced Imager Catalog* presently has over 500 objects with mostly color thumbnails taken by some of world's best imagers.

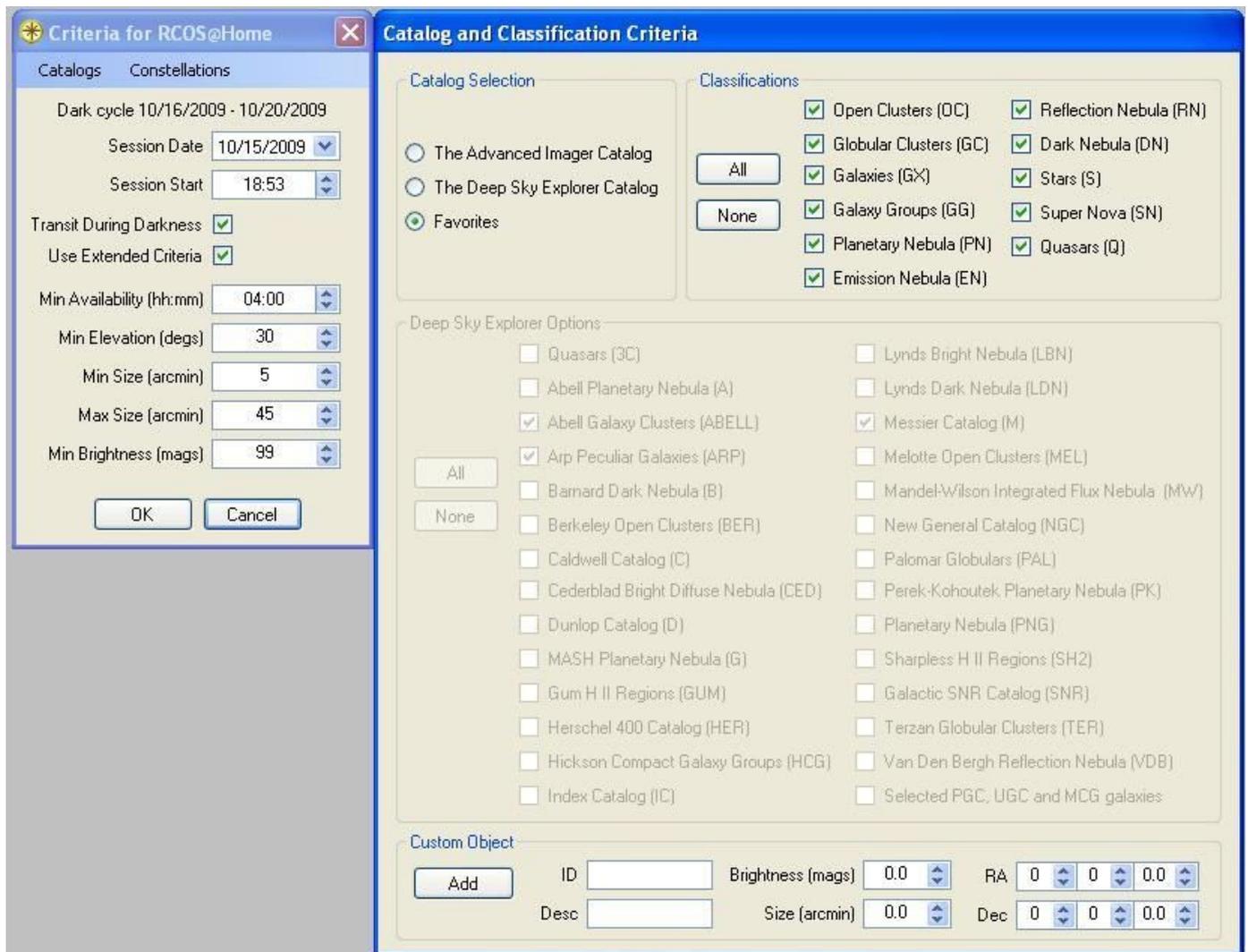


When "The Deep Sky Explorer" catalog is selected, the Deep Sky Explorer Options becomes enabled. *The Deep Sky Explorer Catalog* contains 28 astronomical catalogs with nearly 28,000 objects including a thumbnail of each. Simply click on the check boxes to enable/disable each astronomical catalog. Using the Deep Sky Explorer catalog is a great way to check out potential imaging targets for future sessions letting you "Boldly go where no imager has gone before"!



The Favorites catalog is made up of targets that have been added to the Favorites list from their target information window. When Favorites is selected, a Custom Object panel will become enabled where you can add objects that are not in any of the catalogs to CCDNavigator by entering their ID, Description, Brightness, Size, Right Ascension and Declination. If available, a JPEG image of the target can be placed in the folder "My Documents\CCDWare\CCDNavigator2\Catalogs\FAV Thumbnails".

When Favorites is selected as a catalog, its list of objects are treated exactly like any other catalog. The Criteria must be satisfied for the Favorites catalog objects to be presented as targets.



Classifications

This panel allows you to filter targets according to their object classification. Eleven categories are available. Catalogs have been processed as much as possible to be sure the classification of objects is correct but astronomical catalogs frequently have either errors or contain unclassified objects. Objects that are unclassified are not filtered based on these criteria and will be presented as candidate targets provided they pass all other criteria for selection. The object Classifications choices are always used when filtering target lists so if no targets are presented, check your Classifications choices.



Get Involved

If you want to see *your* initials & images popping up in CCDNavigator and you have a quality image that is not already in "The Advanced Imager Catalog", send me an email:

1. The email "subject" should be "OBJECT by YOUR_NAME" (for example NGC1234 by John Smith).
2. A URL that goes directly to the full scale image so its quality can be reviewed. Please do not make me find it in your website.
3. Attach a 150 pixel wide x 100 pixel tall JPEG thumbnail named "OBJECT.jpg" (eg. NGC1499.jpg) with a file size 12 KB or less. No spaces between the catalog and number please.
4. Your name written exactly as you want it listed. Please be sure it will fit space allocated for credits in the target information windows.
5. Your website URL so users can visit your website and see your images. This, along with your name and initials, will be used in the acknowledgements.
6. Your email address (this is only for me to communicate with you, no other use is made of email addresses)
7. A brief note describing anything unusual about the object. Please do NOT include technical info about your equipment or how you imaged it.

Here are some guidelines for catalog submissions. Please follow them, they're not much trouble for you but will make my processing of submissions far easier.

- Please do not send objects that are already listed in the catalog. Be careful about submitting catalog names that identify an object already listed by another catalog name. For example, M42 and NGC1976 are the same object. Do a little research before submitting please.
- Also think about the quality of your image before you submit it. While I am primarily interested in expanding the catalog with new objects, I also don't want to include sloppy work nor should you want your name associated with bad results.
- Color images are preferred but B&W images are perfectly acceptable.
- Please submit only one image per email, this will greatly facilitate my handling of submissions.
- I will try to respond to every submission but if your object is already in the catalog and I am swamped, please accept my appologies if there is no reply. I mean no disrespect and genuinely appreciate your submissions.

Good shooting!

Steve...

Steve (at) CCDNavigator (dot) com

Classification Systems

Dreyer Classification

The Dreyer classification notation is given below:

- Ab.....about
- n.....north
- alm.....almost
- neb.....nebula
- am.....among
- nf.....north following
- app.....appended
- np.....north preceding
- att.....attached
- nr.....near
- b.....brighter
- N.....Nucleus, or to a Nucleus
- be.....between
- p.....pretty (before F,B,L,S)
- biN.....binuclear
- p.....preceding
- bn.....brightest towards
- pg.....pretty gradually the north side
- pm.....pretty much
- bs.....brightest towards
- ps.....pretty suddenly the south side
- P.....poor
- bp.....brightest towards
- quad.....quadrilateral the preceding side
- quar.....quartile
- bf.....brightest towards
- r.....resolvable the following side (mottled,not resolved)
- B.....bright
- rr.....partially relolved,
- c.....considerably some stars seen
- ch.....chevelure
- rrr.....well resolved, clearly
- co.....coarse, coarsely consisting of stars
- com.....cometic
- R.....round
- cont.....in contact
- RR.....exactly round
- C.....compressed
- Ri.....rich
- C.G.H.....Cape of Good Hope
- s.....suddenly
- Cl.....cluster
- s.....south
- d.....diameter
- sp.....south preceding
- def.....defined
- sf.....south following
- dif.....diffused
- sc.....scattered
- diffic.....difficult
- st.....stars
- dist.....distance or sev.....several distant
- susp.....suspected
- D.....double

- sh.....shaped
- e.....extremely,
- stell.....stellar excessively
- S.....small
- ee.....most extremely
- sm.....smaller
- er.....easily resolvable
- triN.....trinuclear
- exc.....excentric
- trap.....trapezium
- E.....extended
- v.....very
- f.....following
- vv.....very, very
- F.....faint
- var.....variable
- g.....gradually
- *.....a star
- *10, a star of 10th magnitude
- gr.....group
- i.....irregular
- **.....double star
- inv.....involved, involving
- ***.....triple star
- iF.....irregular figure
- !.....remarkable
- l.....little, long
- !!.....very remarkable
- L.....large
- !!!.....a magnificent or
- m.....much otherwise interesting
- mm.....mixed magnitudes object
- mn.....milky nebulosity
- st 9.....stars from the 9th
- M.....middle, or in the magnitude downwards middle
- st 9 13.....stars from the 9th to 13th magnitude

Galaxy Classification

Astronomers classify galaxies based on their overall shape (elliptical, spiral or barred spiral) and further by the specific properties of the individual galaxy (for example degree of ellipse, number of spirals or definition of bar). The system of galaxy classification is called the Hubble "tuning fork" diagram, and is the Hubble sequence.

Hubble Galaxy Classification

Tuning-fork style diagram of the Hubble sequence is shown below. The Hubble "tuning fork" diagram starts from the left with elliptical galaxies as its base. Elliptical galaxies can be named from E0 to E7. E stands for elliptical while the number indicates how oval-shaped the ellipse is with 0 being ball shape (in other words, a giant globular cluster) to 7 being discus shape. Technically speaking, the number is ten times the eccentricity. For example, an E7 galaxy has an eccentricity of 0.7.

/ - Sa - Sb - Sc -
Sd

E0 - E1 - E2 - E3 - E4 - E5 - E6 - S0

\ - SBa - SBb -
SBc

After the elliptical galaxies the diagram splits into two branches. The upper branch covers spiral galaxies also called lenticular galaxies. It starts off with S0. The "S" means lenticular, the "0" means no arms, and the subscript number indicates how heavily a stripe is absorbed out of the image of the galaxy by dust in the galactic disc. On the same branch are the next 3 types which all have spiral arms. The "S" here also means lenticular, but the lower case

letter after it tell how wound up the arms are. They range from "a" to "d" having the following meanings: Sa - tightly-wound, smooth arms, and a bright central disc, Sb - better defined spiral arms than Sa, Sc - much more loosely wound spiral arms than Sb, Sd - very loose arms, most of the luminosity is in the arms and not the disc. The lower branch of the diagram covers barred spiral galaxies given the symbol "SB". This branch starts with SBO galaxies which is followed by a subscript number that indicates how heavily defined the bar is. After that the branch continues with the SB galaxies which have lower case letters after them that indicates how heavily defined the bar is. They range from "a" to "c" having the following meanings: SBa - a bright center and tight spirals SBb - better defined arms than SBa galaxy and are more loosely wound SBc - even looser arms, and a much dimmer central portion of the galaxy The Milky Way Galaxy is now believed to be an SBb galaxy; previously, it was thought to be Sb like its giant companion, the Andromeda Galaxy.

The De Vaucouleurs System

There is an extension to the Hubble sequence that is in wide use; the de Vaucouleurs extensions. The distinction between the de Vaucouleurs and Hubble classification systems lies primarily with spiral galaxies. While the Hubble type describes spiral galaxies based upon the two criteria of tightness of spiral and barredness, de Vaucouleurs adds a third descriptor, internal ring. Spiralness: galaxies range from E, through S0, through the other spirals, to Im. Barredness: galaxies are described as being A (ordinary), B (barred), or AB (intermediate). Ringedness: galaxies are described as being s-shaped (no ring), r-shaped (ring), or sr (intermediate). Therefore, a galaxy may be described as being SAB(rs)c - Sc spiral, between barred and ordinary, and between ringed and no ring. Visually, the de Vaucouleurs system is often represented in three dimensions, with spiralness on the x-axis, barredness on the y-axis, and ringedness on the z-axis. A cross-section of one spiralness (eg: Sb) will yield a representation in two dimensions with ringedness on the x-axis and barredness on the y-axis. Pictures are available [here](#).

Constellations

This window lets you select a set of constellations to apply as filters to the target list. Only objects that fall within one of the selected constellations will be presented as targets. The buttons at the bottom let you enable "All" or "None" of the constellations or select only those that make an appearance on the session date ("Tonight"). The constellations selected are always used when filtering target lists so if no targets are presented, check your Constellation choices to be sure they make an appearance on the session date.

Criteria for RCOS@Home
Constellation Criteria

Catalogs Constellations

Dark cycle 10/16/2009 - 10/20/2009

Session Date

Session Start

Transit During Darkness

Use Extended Criteria

Min Availability (hh:mm)

Min Elevation (degs)

Min Size (arcmin)

Max Size (arcmin)

Min Brightness (mags)

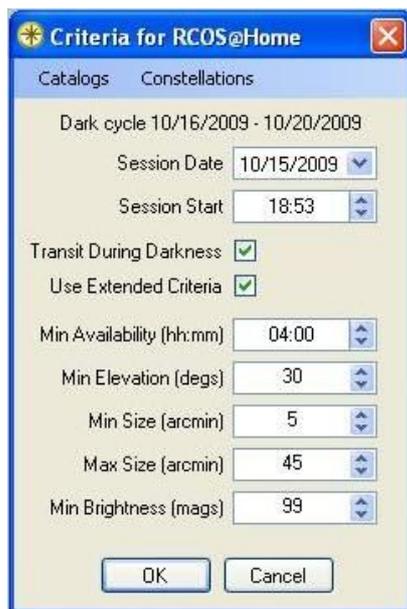
<input checked="" type="checkbox"/> And (Andromeda)	<input type="checkbox"/> Col (Columba)	<input checked="" type="checkbox"/> Lac (Lacerta)	<input checked="" type="checkbox"/> Psc (Pisces)
<input type="checkbox"/> Ant (Antlia)	<input type="checkbox"/> Com (Coma Berenices)	<input type="checkbox"/> Leo (Leo)	<input type="checkbox"/> Pup (Puppis)
<input type="checkbox"/> Aps (Apus)	<input type="checkbox"/> CrA (Corona Australis)	<input checked="" type="checkbox"/> Lep (Lepus)	<input type="checkbox"/> Pyx (Pyxis)
<input checked="" type="checkbox"/> Aql (Aquila)	<input type="checkbox"/> CrB (Corona Borealis)	<input type="checkbox"/> Lib (Libra)	<input type="checkbox"/> Ret (Reticulum)
<input checked="" type="checkbox"/> Aqr (Aquarius)	<input type="checkbox"/> CrI (Crater)	<input type="checkbox"/> LMi (Leo Minor)	<input checked="" type="checkbox"/> Scl (Sculptor)
<input type="checkbox"/> Ara (Ara)	<input type="checkbox"/> Cru (Crux)	<input type="checkbox"/> Lup (Lupus)	<input type="checkbox"/> Sco (Scorpius)
<input checked="" type="checkbox"/> Ari (Aries)	<input type="checkbox"/> Crv (Corvus)	<input checked="" type="checkbox"/> Lyn (Lynx)	<input type="checkbox"/> Sct (Scutum)
<input checked="" type="checkbox"/> Aur (Auriga)	<input type="checkbox"/> CVn (Canis Venatici)	<input type="checkbox"/> Lyr (Lyra)	<input type="checkbox"/> Ser (Serpens)
<input type="checkbox"/> Boo (Bootes)	<input checked="" type="checkbox"/> Cyg (Cygnus)	<input type="checkbox"/> Men (Mensa)	<input type="checkbox"/> Sex (Sextans)
<input type="checkbox"/> Cae (Caelum)	<input checked="" type="checkbox"/> Del (Delphinus)	<input type="checkbox"/> Mic (Microscopium)	<input type="checkbox"/> Sge (Sagitta)
<input checked="" type="checkbox"/> Cam (Camelopardalis)	<input type="checkbox"/> Dor (Dorado)	<input checked="" type="checkbox"/> Mon (Monoceros)	<input type="checkbox"/> Sgr (Sagittarius)
<input checked="" type="checkbox"/> Cap (Capricornus)	<input checked="" type="checkbox"/> Dra (Draco)	<input type="checkbox"/> Mus (Musca)	<input checked="" type="checkbox"/> Tau (Taurus)
<input type="checkbox"/> Car (Carina)	<input checked="" type="checkbox"/> Equ (Equuleus)	<input type="checkbox"/> Nor (Norma)	<input type="checkbox"/> Tel (Telescopium)
<input checked="" type="checkbox"/> Cas (Cassiopeia)	<input checked="" type="checkbox"/> Eri (Eridanus)	<input type="checkbox"/> Oct (Octans)	<input type="checkbox"/> TrA (Triangulum Australe)
<input type="checkbox"/> Cen (Centaurus)	<input checked="" type="checkbox"/> For (Fornax)	<input type="checkbox"/> Oph (Ophiuchus)	<input checked="" type="checkbox"/> Tri (Triangulum)
<input checked="" type="checkbox"/> Cep (Cephus)	<input checked="" type="checkbox"/> Gem (Gemini)	<input checked="" type="checkbox"/> Ori (Orion)	<input type="checkbox"/> Tuc (Tucana)
<input checked="" type="checkbox"/> Cet (Cetus)	<input type="checkbox"/> Gru (Grus)	<input type="checkbox"/> Pav (Pavo)	<input type="checkbox"/> UMa (Ursa Major)
<input type="checkbox"/> Cha (Chamaeleon)	<input type="checkbox"/> Her (Hercules)	<input checked="" type="checkbox"/> Peg (Pegasus)	<input checked="" type="checkbox"/> UMi (Ursa Minor)
<input type="checkbox"/> Cir (Circinus)	<input type="checkbox"/> Hor (Horologium)	<input checked="" type="checkbox"/> Per (Perseus)	<input type="checkbox"/> Vel (Vela)
<input checked="" type="checkbox"/> CMa (Canis Major)	<input type="checkbox"/> Hya (Hydra)	<input type="checkbox"/> Phe (Phoenix)	<input type="checkbox"/> Vir (Virgo)
<input type="checkbox"/> CMi (Canis Minor)	<input type="checkbox"/> Hyi (Hydrus)	<input type="checkbox"/> Pic (Pictor)	<input type="checkbox"/> Vol (Volans)
<input type="checkbox"/> Cnc (Cancer)	<input type="checkbox"/> Ind (Indus)	<input checked="" type="checkbox"/> PsA (Piscis Austrinus)	<input checked="" type="checkbox"/> Vul (Vulpecula)

Criteria

The parameters within the "Criteria" menu item are used to manage the listing of candidate targets including the planned date of your imaging session and other aspects of the candidate targets that CCDNavigator displays. You can change any of these parameters except the date without disturbing any targets already selected for a session. This lets you choose targets from one catalog for a session plan, switch to a different set of catalogs and different selection criteria and add more targets to your plan. Changing the date will clear the session plan of targets.

The menu bar item "[Catalogs](#)" lets you select different catalogs and filter by object classification (galaxy, nebula, etc) while "[Constellations](#)" lets you filter targets based on their constellation but these filtering criteria are only enabled if "Use Extended Criteria" is checked.

Just below the menu bar is the range of dates for the current or upcoming Dark Cycle. These are days of the month when the Moon sets before the start of astronomical darkness and rises after the end of astronomical darkness the next morning.



The target criteria parameters are:

- **Session Date** - This sets the date for the session and defaults to the current date in your computer. Click on the down arrow to view a calendar and select a different date. Notice that as you change the session date, the Dark Cycle dates and the Session Start time are updated. Changing the date will re-initialize the session plan and empty it of any targets already selected.
- **Session Start** - This control lets you start at a time other than the beginning of darkness using the up/down arrows to the right. The Session Start time is limited to being within the hours of darkness. This control can be used to start a session when a particular target reaches availability or to generate a plan after the hours of darkness have begun. When a new date is selected using the Session Date control, the Session Start time will be re-initialized to the beginning of astronomical darkness for that date.
- **Transit During Darkness** - If this box is checked, only targets with transit times during the hours of astronomical darkness will be presented. This criteria is not part of the Extended set and is always applied if checked. Targets that transit during darkness are good candidates for imaging because they will reach their highest elevation at some time during the session. This is when the target is least effected by seeing and color extinction.
- **Use Extended Criteria** - If this box is checked, targets must meet all the criteria including Min Availability, Min Elevation, Min Size, Min Brightness, Classification category (in the Catalog window) and Constellation filter (in the Constellation window). If Use Extended Criteria and Transit During Darkness are both unchecked, then every object in the catalogs chosen will be presented.
- **Min Availability** - Only objects having available imaging times greater than or equal to the Minimum Availability will be picked as candidates. Min Availability is a primary control for limiting the number of targets presented. It is important to remember that objects with low declinations will have short availabilities. If you want to consider these objects, set the Availability to a low value, as low as 0, so they will be listed. The maximum value for the Minimum Availability parameter is the Session Duration (length of darkness) rounded down to the nearest quarter of an hour.
- **Min Elevation** - This parameter sets the Minimum Elevation that objects must reach in the night sky to be listed as candidates. Whenever possible, most imagers prefer not to image objects close to the horizon because of low resolution due to seeing and color extinction. The Minimum Elevation parameter lets you control that aspect of the objects that will be listed as targets. But remember, if an object never reaches this elevation it will not be listed as a target candidate so don't forget to set it to a low value if you are interested in objects that are at low declinations. Depending on the target's position, this parameter will also determine the starting and ending times of availability for imaging a target (only circumpolar objects are not effected).
- **Min Size** - This parameter determines the smallest size of objects that will be presented as a candidates and should be set according to the field-of-view of your imaging system and what size objects are appropriate for it. If you use a wide field system, you may wish to set this to a large value since small objects will have very small scale in your images. You can set Min Size to zero to see all the objects that satisfy all the other criteria but this may give you a very large number of objects to consider depending on your catalog choices. Size is useful in controlling the

number of target candidates since there are more and more targets of decreasing size.

- **Max Size** - This parameter determines the size of the largest objects that will be presented as candidates and is given in arcminutes. Like Minimum Size, you should set this parameter according to the field-of-view of your imaging system and what size objects are appropriate for it.
- **Min Brightness** - This parameter determines the faintest objects that will be presented as targets. Only objects meeting or exceeding this parameter will be listed as candidates. It defaults to magnitude 99 which will reveal all objects meeting the other control parameters.

Notes:

A great many objects in astronomical catalogs do not have size or magnitude specifications. For these objects, the Min Size, Max Size and Min Brightness parameters are ignored when filtering targets but all other criteria are applied.

If any of these parameters are set to unusual values (such as a super large Smallest Size and a very high Lowest Elevation), there may be no objects in the catalog that satisfy all of the criteria.

If you want to see all objects in a catalog or set of catalogs, simply uncheck the "Transit During Darkness" and "Use Extended Criteria" options. This will pass every object in the set of selected catalogs to the target list.

EZ-Guide Positioning

This feature allows users with either off-axis guiders (OAG), internal guidechips or guidescopes to easily select and center a guidestar and have an autoguider exposure calculated for its particular magnitude. For those using an OAG or internal guidechip, EZ-Guide will automatically center the user selected guidestar on the guider, position the telescope so the target is as close as possible to the center of the camera's Field-Of-View (FOV), and calculate an appropriate guiding exposure for it using the Bright and Faint reference data in the [Camera](#) window. For those using a guidescope, it allows repositioning the camera (including rotation if the user has a rotator) for a specific artistic composition after which EZ-Guide will find the brightest star in the autoguider's field-of-view and calculate a guiding exposure. Unguided systems can position the camera with or without rotation according to their system, to achieve a particular composition.

To work properly, **EZ-Guide** requires a single Field-Of-View-Indicator (FOVI) in TheSky6 that matches your camera/telescope combination. For those using OAG or internal guidechips, the FOVI should be accurate with regard to the position of the guiding window relative to the camera window. For those using guidescopes, the FOVI should indicate the coverage of the guidescope as well as the camera so the inclusion of a good guidestar can be made when composing for the imaging camera. An FOVI must be selected even for unguided operation so the correct region in TheSky6 can be displayed while composing the image.

Sky6 has models for various camera / telescope combinations including internal guiders for certain cameras. However for OAG and guide scope users, these models will need modification. Instructions for modifying Sky6 FOVI values are at the end of this section.

In the Camera window, the Guiding panel has a button "Select and Calibrate FOVI" which **must** be used so that EZ-Guide will know the which FOVI is to be used and, for guided systems, location of the autoguider. Simply click this button and follow the directions that will be displayed. It is **essential** to select and properly calibrate an FOVI in order for EZ-Guide to do its work.

When "Add To Session" is clicked in the [target information window](#), EZ-Guide will perform its function. The exact procedure for EZ-Guide varies according to the guiding method:

- **Unguided** - For the unguided method, EZ-Guide simply positions the FOVI at the target coordinates and allows the user to move it to compose the image as they wish. After adjusting the position of the FOVI, simply press "Continue" to place the target in the session plan. "Restart" will return the FOVI to the original position of the target, "Cancel" will terminate EZ-Guide.
- **Guidescope** - For guidescope users, EZ-Guide will position the FOVI on the target, locate the brightest guidestar in the autoguider and prompt the user to make whatever positioning adjustments they wish. If a rotator is available, the user can also use rotation in composing the image. When doing so, the user should consider the presence (or absence) of suitable guidestars in the autoguider box but does not have to select any particular guidestar. After the user has composed the image and clicked "Continue", EZ-Guide will once more locate the brightest star on the autoguider and notify the user of it's magnitude and highlight its position. The user can accept this choice by clicking "Continue" without moving the target's position or rotation angle (if rotation is allowed) and the target will be placed in the session plan. At any time, if the guidestar brightness exceeds the Bright Reference Magnitude in the Camera menu, a warning will be provided. The user can press "Restart" to move the FOVI back to it's original starting point or press "Cancel" to terminate EZ-Guide.
- **Off Axis Guided or Self Guided** - For OAG or internal guide chip users, EZ-Guide will select a guidestar in the region that can be accessed by the autoguider. If a rotator is available, this will be a circular region around the target. If no rotator is used, it will be an area near the position of the guide box. In either case, EZ-Guide will select and present the brightest star found in this region that falls between the bright and faint reference magnitudes as specified by the user in the Camera window. It will give the user a chance to adjust the position of the FOVI for composition and either accept the choice by pressing "Done", reject the choice by pressing "Next" (in this case the next guidestar candidate will be presented), or to cancel the operation by pressing "Cancel". Pressing "Restart" will return to the first guidestar candidate unless the FOVI has moved. In this case, a new set of guidestars is generated. This allows the user to move to any part of the sky and get a valid set of guidestars for that location. For some objects or compositions, this is very useful.

In all cases, while the user is composing the image, the Preview button can be used to retrieve a DSS image of the composition as currently positioned. This requires an Internet connection from the computer. The user can move the FOVI and Preview the composition as many times as they like before continuing.

The target information window displays the Right Ascension, Declination and Position Angle of the target. Prior to positioning of the target by EZ-Guide, this window will show the catalog's data for the target position. After EZ-Guide and the user have completed composing the image, it will show the final location and angle of the target as selected. The target information window also has a Slew button that can take you to the target immediately.

Notes:

All Right Ascension and Declination values in CCDNavigator are displayed and exported using the J2000 epoch. This is needed for planetarium software such as TheSky6 and for acquisition software such as CCDAutoPilot. However, when slewing the telescope to targets, the RA and DEC are adjusted for Precession, Nutation and Abberation of Light to the current epoch.

For centering something in TheSky6, CCDNavigator asks you to right click on the object and then click "Center" in the subsequent Sky6 menu but it is also possible to use a normal double click (left mouse button) and then use the "Center" symbol in the information popup that appears..

For Guidescope users, a single FOVI in TheSky6 must be used to represent your camera and guidescope. This requires editing the FOVI. If a rotator

is used, the entire FOVI will be rotated in TheSky6 however EZ-Guide does NOT rotate the guidescope when searching for the brightest guidestar. Even though you do not see the true field of the guidescope on TheSky6 (due to rotation), EZ-Guide will properly find the guidestar that will be used.

TheSky6 FOVI Setup

In TheSky6, click on "View" "Field-Of-View Indicators" to see a list of your FOVIs as they are currently defined. Our goal is to create an FOVI that accurately models your camera, guider and telescope combination(s).

If you have not already done so, select your telescope in "Telescopes" and your camera in "Detectors", then use "Create FOVIs" to generate an FOVI by selecting "My Detector" and "My Telescope" and then clicking "Add My FOVI". OAG users should select a camera in "Detectors" that uses the same guide chip as their OAG. Guidescope users

Next go to "My FOVIs", click on the FOVI that represents your camera and click "Edit". A new menu, "Create/Edit Detector Geometry" will appear that lists all the elements of your FOVI.

OAG Users: Click on the elements (Element 1, Element 2, etc.) one at a time until you find the one that represents the guide box. Sometimes the name gives it away (such as "Guide Chip") but the X and Y dimensions will be smaller than the main camera and also there will normally be a Y offset value. The Y offset value is the distance in arcminutes from the center of the camera to the center of the guide chip. Set the Y offset to the distance in arcminutes to the center of your OAG. It is possible to calculate this value from the physical dimensions of your system but this is very complex and highly dependent on the system. Fortunately this can easily be determined at the telescope as follows: If necessary, rotate the camera/OAG so a star can be moved from the camera's center to the guider's center by adjusting only declination position. Then center a bright star in the main camera and note the telescope's declination position. Move the telescope until the same star is centered in the guider and note the new declination position of the telescope. Subtract the two values and multiply by 60 to get the distance in arcminutes. Enter this value as the Y offset. If your FOVI includes circles that identify the region of the guider when rotated, locate these and also set their X and Y sizes so they align with the guide box (or set them to ZERO which will eliminate them). If you know the X and Y numbers of pixels for your guider, you can enter them or simply leave them set to ZERO.

Guidescope Users: Click on the elements (Element 1, Element 2, etc.) one at a time until you find one that has ZERO values for Size, Offset and Pixels in both X and Y columns. We want to set the X and Y Size values to the actual size of your guidescope's FOV in arcminutes and set the X and Y Offset to your guider's offset. These values can be determined at the telescope as follows: Adjust your guidescope camera so it is aligned with right ascension and declination. Place a bright star at one corner of your guidescope and note the telescope's right ascension and declination position. Move the telescope so the same star is at the corner diagonally opposite the first position and note the new position. Subtract the smaller right ascension value from the larger one and multiply by 15. Next subtract the smaller declination value from the larger one and multiply by 60. These are the X and Y Size values in arcminutes needed by TheSky6. Next center a bright star in the main camera and note the right ascension and declination of the telescope. Then switch to the guiding camera and adjust the telescope's position so the star is centered in the guider. Note the telescope's right ascension and declination. Now subtract the main camera's right ascension position from the guider's right ascension position and multiply by 15 to get the X Offset in arcminutes. Likewise, subtract the main camera's declination position from the guider's declination position and multiply by 60 to get the Y Offset in arcminutes. Enter these values in TheSky6 FOVI detector geometry. If you know the X and Y numbers of pixels for your guider, you can enter them or simply leave them set to ZERO.

You now have FOV that models your camera and guider. TheSky6 assigns lengthy names to the FOVIs, you can replace the "Detector Description" with a shorter name if you wish.

After setting up the FOVI in TheSky6, return to CCDNavigator's "Camera" menu where you can use "Choose and Calibrate FOVI" so your new FOVI can be used for autoguiding setup by EZ-Guide.

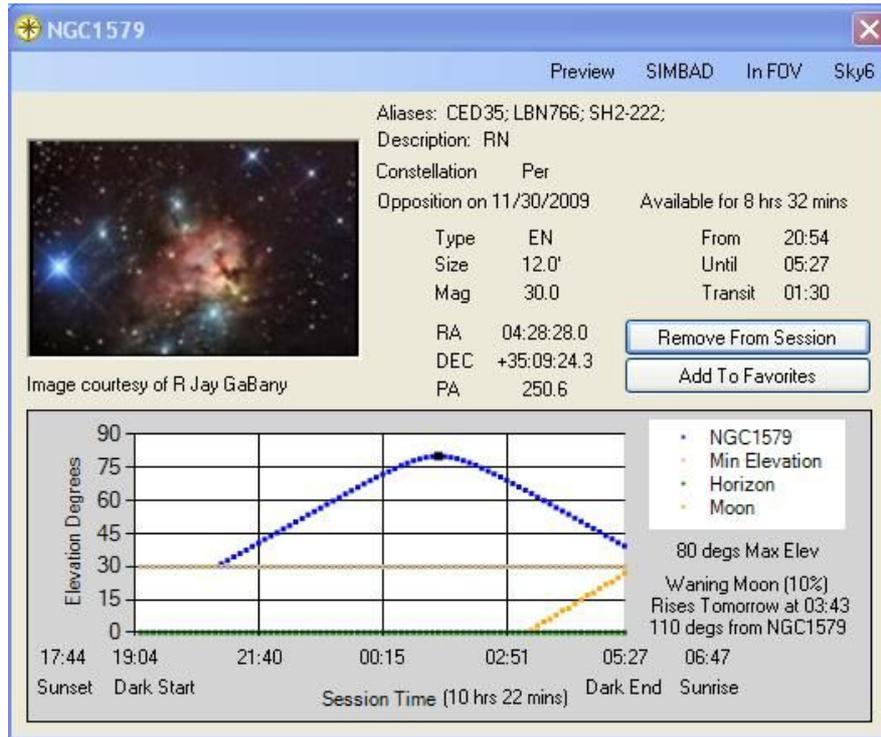
Frequently Asked Questions (FAQ)

1. **When I launch CCDNavigator, it crashes. What is wrong?** Be sure you have the .NET platform version 3.5 installed on your computer. This is a free download from Microsoft and is available at <http://www.microsoft.com/downloads> under the .NET Framework Version Redistributable Package (x86).
2. **When I add a target to the session, CCDNavigator says "Cannot create TheSky6 StarChart Object". Why is this?** You must have TheSky6 Professional Edition installed on your computer in order to position targets for autoguiding. Only the Professional edition provides the ability for other programs to interact with it. Also see FAQ #3 on Vista and Windows 7.
3. **I'm using VISTA (or Windows 7) and CCDNavigator cannot find TheSky6. What can I do?** Be sure that User Account Control (UAC) is at its lowest security setting when installing both programs. Also set the programs to "Run as Administrator". Otherwise you'll get a popup from CCDNavigator saying "TheSky6 is unavailable". In some cases, it may be necessary for you to launch TheSky6 before launching CCDNavigator. For some unexplained reason, this is needed on some systems but not on others.
4. **I don't have TheSky6 on my computer, can I still set up targets?** If TheSky6 is not installed on your computer, many functions performed by CCDNavigator cannot be accomplished. Primarily these include the positioning of the camera's Field-Of-View to achieve a particular composition and the selection of guidestars and calculation of the appropriate guiding exposure. Due to this reason, only the "Unguided" method of autoguiding can be used if When the Camera's "Select and Calibrate FOVI" is executed and TheSky6 is not installed, CCDNavigator will automatically switch to the "Unguided" method. It will also collect the Field-Of-View X and Y sizes from the user in a dialog window. Once this has been done, the user will be able to "Preview" images of targets in the catalogs and they will be able to add targets to a session plan. When adding targets to the session, EZ-Guide will not be utilized and the RA/Dec coordinates of the target as found in the catalog will be passed directly to the session without modification. Session plans created and exported using this arrangement will not have guidestar exposures included. However, in CCDAutoPilot, you can still use autoguiding by setting the options in CCDAP4 so that automatic guidestar exposures are generated by CCDAP4. However, because the target's position is the default catalog location, a guidestar may not be available for guiding with either Off-Axis guiders or Self-Guided cameras. Guidescopes will most likely be able to locate a guidestar for which CCDAP4 can set up a proper guiding exposure.
5. **Does CCDNavigator work with the new SkyX planetarium program?** No. At this time, SkyX Pro is still in the release process and does not yet include the "Object Model" that allows external programs to interface with it. As soon as possible after that capability is introduced, CCDNavigator will be modified to work with SkyX.
6. **I know that a particular object is above the horizon but it does not appear in the target list. Why?** Targets that do not satisfy ALL requirements listed in the "Criteria" menu are listed as possible targets. This includes the object Classification selections and the Constellations choices. Remember that objects must reach the "Min Elevation" criteria to be presented and must also be above it for at least the "Min Availability" amount of time thus these parameters must be adjusted to reveal objects hovering near the horizon as they never reach very high elevations and they are not available for very long.
7. **In the "Camera" window, if I use "Choose and Calibrate an FOVI", I get the message "Camera size is ZERO - try again". What is causing this?** Be sure you are following the directions that pop up during calibration precisely. In particular, after using the right click to identify a point, there is a popup that Sky6 displays that has various options in it including "Toggle Star", "Display Properties", and others. One of these is "Center". Clicking "Center" will cause Sky6 to place the point where you right clicked in the center of the screen. This allows CCDNavigator to read the coordinates of the point for its purposes of figuring the FOV size for your camera or the position of the autoguider. There is a figure showing these items in TheSky6 under the "[Camera](#)" helpfile section. There are similar messages for calibrating the autoguider mechanism.
8. **In the "Camera" window, when I click "Choose and Calibrate an FOVI", I get a message telling me to remove the Sky6 FOVI (or an exception message from Windows). Why?** In Sky6, sometimes the FOVI can become corrupted. They will continue to appear normally but cannot be accessed by other programs. If this occurs, the FOVI must be deleted and recreated. If your FOVI has been custom created, jot down all the relevant information for it before deleting it. Sometimes the error message will be a Windows "Exception" message rather than a popup from CCDNavigator.
9. **My session plans and filters are not importing into CCDAutoPilot4 correctly, how can I fix this?** The names assigned to the filters in CCDNavigator and in the camera control program (CCDSOFT or MaxImDL) used with CCDAutoPilot must match. Otherwise, CCDAP will ignore them when importing. CCDAP acquires the names when it connects to the camera control program. You can edit the filter names in CCDNavigator to match those in the camera control program or vice versa. But they must be the same.
10. **CCDNavigator is not properly compensating for Daylight Savings Time, what's wrong?** DST varies considerably from country to country. For this reason, CCDNavigator uses a Windows utility to determine the dates when Daylight Savings Time should be applied. For this to work properly, the user's PC Time Zone ("Control Panel" "Date and Time" "Time Zone") must be set to the location of the observatory.

Favorites

You can establish a reminder list of potential targets and later utilize them as targets through the **Favorites** feature. Favorites is created in the same format as the catalogs in CCDNavigator and can be imported in lieu of the normal catalogs. CCDNavigator examines this file each time it runs and any time the date is changed in the Criteria window. If any of the objects in **Favorites** list will transit during the session's interval of darkness, a popup will appear that lists those objects. This serves as a reminder to the user that the special targets that they want to image are available during the session. Even though announced targets will be transiting during the session, they may not appear in the target list if the catalog selections and elevation criteria settings do not cause it to be presented. So it may be necessary for the user to select the specific catalog that the object is in from the Deep Sky Explorer Catalog and to set the elevation and other criteria to values that will include them.

In the Target Information Window, there is a button labeled "Add to Favorites" that will place the displayed target in the favorites file. Once this is done, the button becomes re-labeled to "Remove from Favorites".



The entire Favorites list can be imported in lieu of the normal set of catalogs. This is done from the Criteria Catalogs window and is discussed [here](#). A screen shot showing the selection buttons is below. Using the Custom Target controls, the user can add targets to the Favorites list that are not in the normal catalogs.

Criteria for RCOS@Home

Catalogs Constellations

Dark cycle 10/16/2009 - 10/20/2009

Session Date 10/15/2009

Session Start 18:53

Transit During Darkness

Use Extended Criteria

Min Availability (hh:mm) 04:00

Min Elevation (degs) 30

Min Size (arcmin) 5

Max Size (arcmin) 45

Min Brightness (mags) 99

OK

Cancel

Catalog and Classification Criteria

Catalog Selection

- The Advanced Imager Catalog
 The Deep Sky Explorer Catalog
 Favorites

Classifications

- Open Clusters (OC) Reflection Nebula (RN)
 Globular Clusters (GC) Dark Nebula (DN)
 Galaxies (GX) Stars (S)
 Galaxy Groups (GG) Super Nova (SN)
 Planetary Nebula (PN) Quasars (Q)
 Emission Nebula (EN)

All

None

Deep Sky Explorer Options

- Quasars (3C) Lynds Bright Nebula (LBN)
 Abell Planetary Nebula (A) Lynds Dark Nebula (LDN)
 Abell Galaxy Clusters (ABELL) Messier Catalog (M)
 Arp Peculiar Galaxies (ARP) Melotte Open Clusters (MEL)
 Barnard Dark Nebula (B) Mandel-Wilson Integrated Flux Nebula (MW)
 Berkeley Open Clusters (BER) New General Catalog (NGC)
 Caldwell Catalog (C) Palomar Globulars (PAL)
 Cederblad Bright Diffuse Nebula (CED) Perik-Kohoutek Planetary Nebula (PK)
 Dunlop Catalog (D) Planetary Nebula (PNG)
 MASH Planetary Nebula (G) Sharpless H II Regions (SH2)
 Gum H II Regions (GUM) Galactic SNR Catalog (SNR)
 Herschel 400 Catalog (HER) Terzan Globular Clusters (TER)
 Hickson Compact Galaxy Groups (HCG) Van Den Bergh Reflection Nebula (VDB)
 Index Catalog (IC) Selected PGC, UGC and MCG galaxies

All

None

Custom Object

Add

ID

Brightness (mags) 0.0

RA 0 0 0.0

Desc

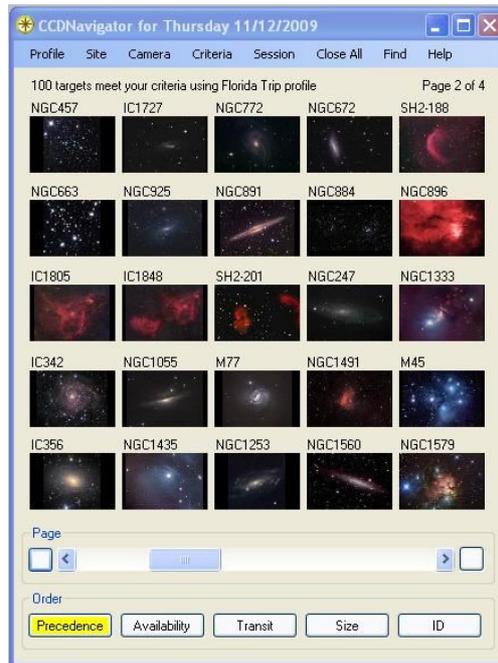
Size (arcmin) 0.0

Dec 0 0 0.0

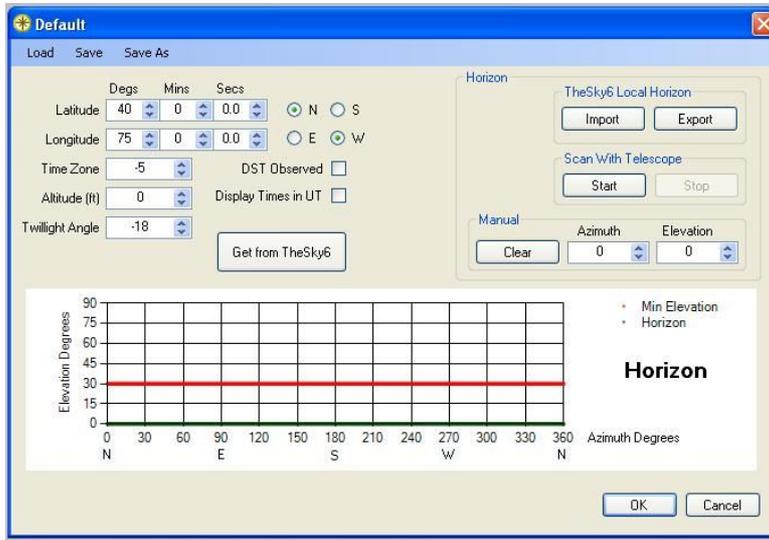
Getting Started

This section will acquaint you with CCDNavigator and take you on a quick tour.

Once installed, simply double click on the "CCDNavigator" icon to launch the application. You will see a window similar to this:

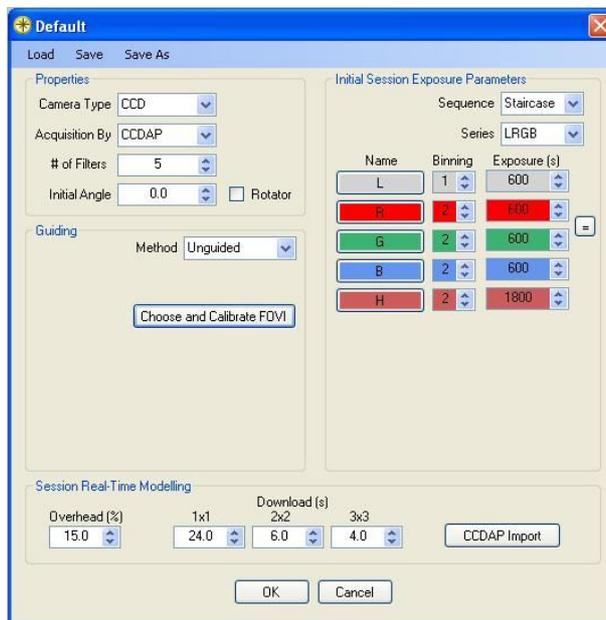


Now, let's start moving in. Click on "Site" and you'll see the following dialog:



If you have your observing location set up in TheSky6, simply click on "Get from TheSky6" to import it to CCDNavigator. Otherwise, set the latitude, longitude and other parameters for your location. Then click "Save As" and specify a name for this site location.

Next we must configure for your camera. Click on "Camera" in the main menu and you'll get a dialog like this:



Select CCD or DSLR to change the window format appropriate to your selection and, if you use a CCD, set the number of filters for your system. For now, select "Unguided" operation and uncheck the "Rotator" box. Click on "Choose and Calibrate FOVI" which will launch TheSky6 and follow the instructions that will appear. For unguided operation, you will be asked to select the Field-Of-View Indicator in TheSky6 and then center a corner of the main camera so it can be characterized. Once this is done, the FOVI name will be displayed just above the "Choose and Calibrate FOVI" button. Also choose an Acquisition method, CCDAP, ACP, CCDSoft or MaxIm DL.

Later you can return to this menu to select a different guiding method and fill out the other parameters of the [Camera](#) dialog. When you do, don't forget to use the "Choose and Calibrate FOVI" so CCDNavigator can properly set up your camera for guiding. But for now, click "Save As" and give it a name, then click "Ok" to return to the main menu.

From the main menu, select a target and click on it. A target [information](#) window will appear with all the technical data for the target. In the graph, the blue line is the target's path through the sky during the course of the evening and the black dot denotes the point when it transits. The yellow line is the Moon's path so we can see that it rises at 2:15 am and gradually moves up to about 30 degs elevation. Also it is 84 degs away from NGC1579. The green line is an obstacle on our horizon but in this case, NGC1579 skims just above it so there is no interference. And the light beige line at 30 degs denotes our chosen Minimum Elevation (set in the Criteria menu) below which the target will not be shown. Let's set NGC1579 up for an imaging session.

NGC1579

Preview SIMBAD In FOV Sky6

Aliases: CED35; LBN766; SH2-222;
 Description: RN
 Constellation: Per
 Opposition on 11/30/2009 Available for 8 hrs 32 mins

Type	EN	From	20:54
Size	12.0'	Until	05:27
Mag	30.0	Transit	01:30

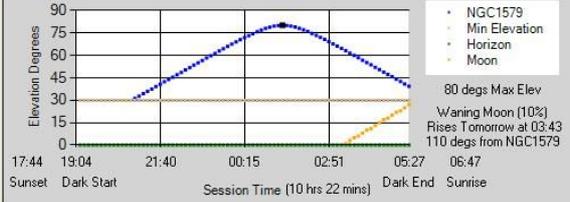
RA 04:28:28.0
 DEC +35:09:24.3
 PA 250.6

Remove From Session
 Add To Favorites

Image courtesy of R Jay GaBany



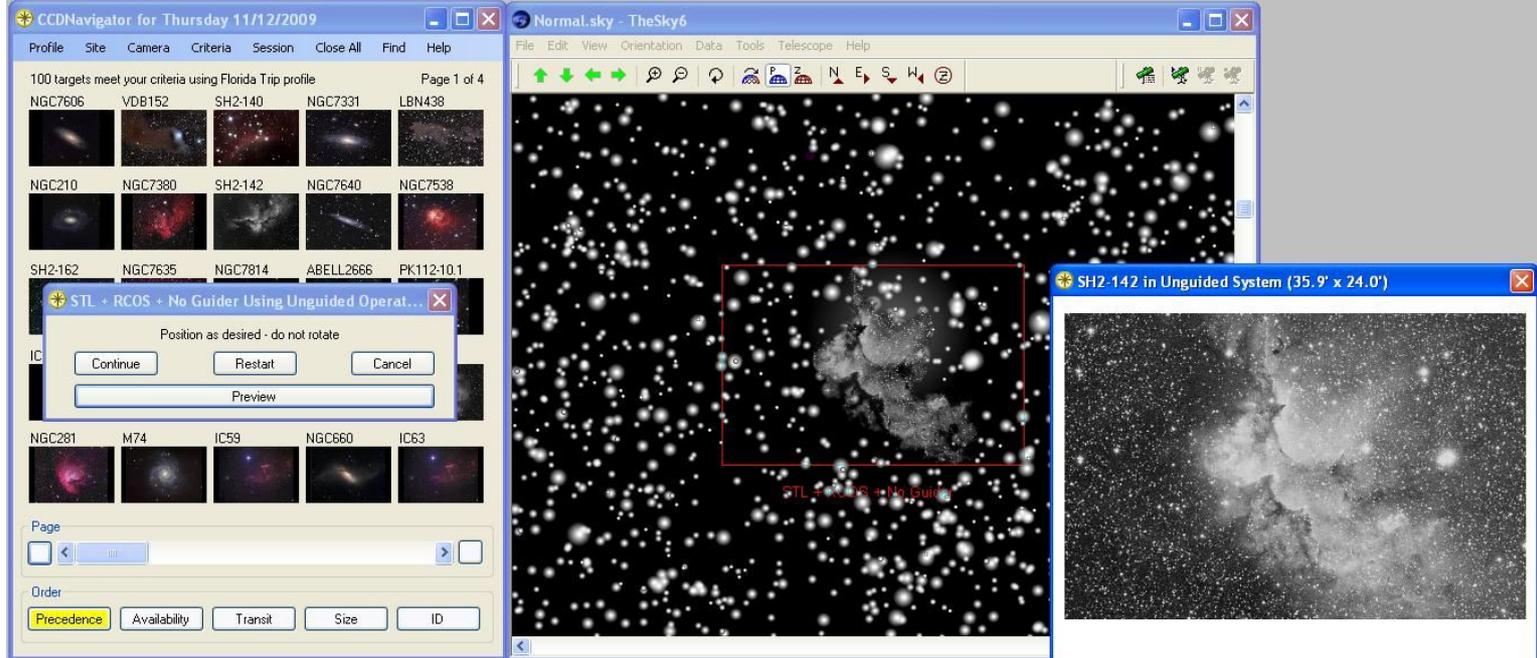
Elevation Degrees



80 degs Max Elev
 Waning Moon (10%)
 Rises Tomorrow at 03:43
 110 degs from NGC1579

Sunset 17:44 Dark Start 19:04 21:40 00:15 02:51 Dark End 05:27 Sunrise 06:47
 Session Time (10 hrs 22 mins)

Now click on "Add To Session" to launch the EZ-Guide operation. For unguided operation, you'll get a window in Sky6 that lets you position your camera as you want on the target. Other guiding methods will automatically select a guide star, position the autoguider on it and calculate the autoguider's exposure based on the brightness of the guide star.



Move the FOVI however you wish by first clicking on any of it's lines and then dragging the boxes that appear to position it as you like. Click on "Preview" to retrieve a DSS image of the target precisely as you have positioned it so you can determine it it's composed as you want. You can move the FOVI and preview its position as many times as you like but when you're finished, click "Continue" to place the target and its position in the session plan and return to the main menu.

Click on another target to see its information window, click "Add To Session" and set it up with EZ-Guide. Now you have two targets in your plan.

Back in the main menu, click on "Session" you'll get a display similar to that below but with the targets you selected. The first target will be selected and its LRGB frame count will be displayed so you can adjust the LRGB counts to whatever you wish. Click on the second target and make adjustments there also. When you click on a target, its information window will be brought to the front and TheSky6 will show the final position you chose for the target. The graph shows how time has been allocated between the two targets and the red lines indicate intervals of time when the target is behind an obstacle on your [horizon](#). By checking the "Override Start Time" checkbox, you can adjust the start time for each target. This is useful for avoiding obstacles but will leave some dead time in the session.

Session Plan For Thursday 11/12/2009

View Export Clear Targets Close All

2 targets - Page 1 of 1

Page

First Next Previous Last Find

NGC7635 NGC1579



NGC1579 Staircase for 4 hrs 30 mins from 00:56 until 05:27

L	R	G	B	H
11	4	4	4	0

Exposure

Start at 00:56

Dark Start 19:04 Session Time 10 hrs 22 mins Dark End 05:27

Targets

- NGC7635
- NGC1579
- Obstruction
- Transit
- Moon

OK

NGC7635

Aliases: CED35; LBN766; SH2-222;
Description: RN

Constellation Per Available for 8 hrs 32 mins

Opposition on 11/30/2009

Type	EN	From	Until
Size	12.0'	20:54	05:27
Mag	30.0	Transit	01:30

RA 04:28:28.0 Remove From Session

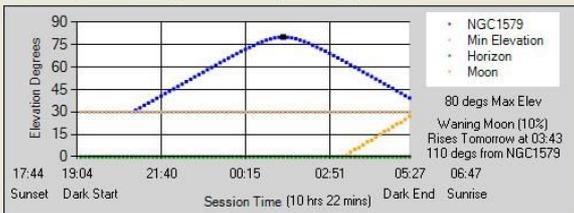
DEC +35:09:24.3 Add To Favorites

PA 250.6

Image courtesy of R Jay GaBany



Elevation Degrees



80 degs Max Elev

Waning Moon (10%)
Rises Tomorrow at 03:43
110 degs from NGC1579

17:44 19:04 21:40 00:15 02:51 05:27 06:47

Sunset Dark Start Session Time (10 hrs 22 mins) Dark End Sunrise



If you want to make changes to the camera's binning or exposure information, click on "Exposure" to see the following window. Here you can change the binning, exposure, sequence type and series type. For now, just leave these however they are and click "Ok".

Session Plan For Thursday 11/12/2009

View Export Clear Targets Close All

2 targets - Page 1 of 1

Page First Find

NGC7635

NGC7635 Star

Exposure

Overri

Dark Start 19:04 2

targets GC7635 GC1579

Obstruction transit Moon

OK

NGC7635

Preview SIMBAD In FOV Sky6

Aliases: Bubble Nebula; CED210; LBN549; C11; Description: EN

Constellation Cas Available for 6 hrs 9 mins

Opposition on 9/11/2010

Type	EN	From	19:04
Size	15.0'	Until	01:14
Mag	30.0	Transit	20:23
RA	23:20:55.9		
DEC	+60:53:40.2		
PA	353.6		

Remove From Session Add To Favorites

Image courtesy of Rob Gendler

Elevation Degrees

54 degs Max Elev

Waning Moon [10%]

Rises Tomorrow at 03:43

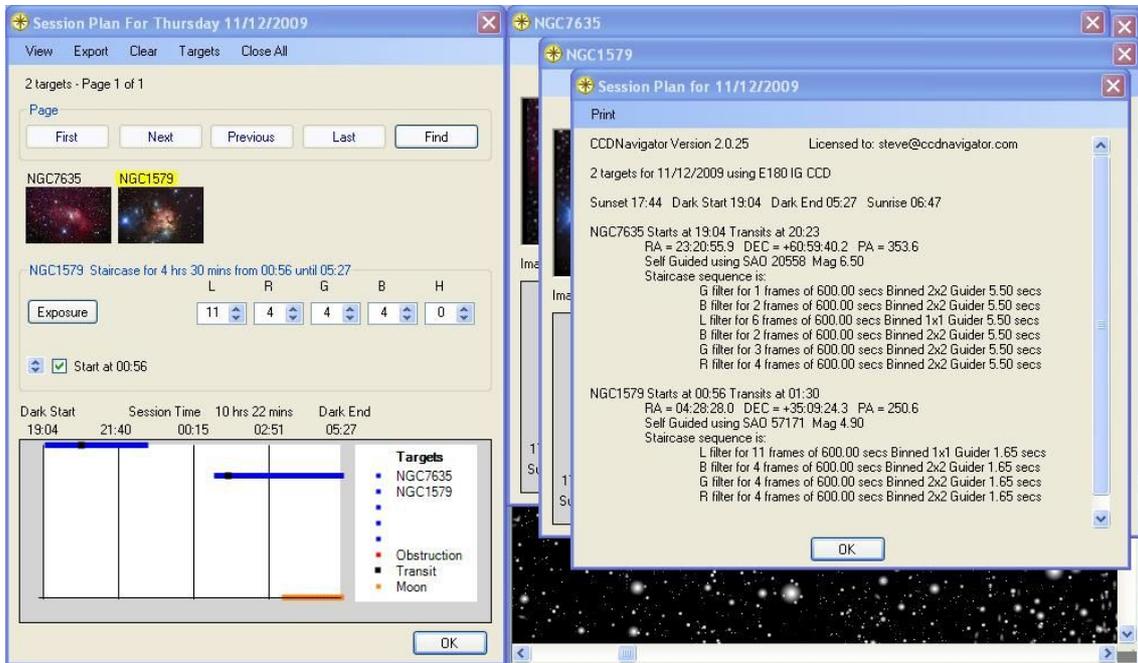
124 degs from NGC7635

17:44 19:04 21:40 00:15 02:51 05:27 06:47

Sunset Dark Start Session Time (10 hrs 22 mins) Dark End Sunrise

Session Time (10 hrs 22 mins)

Now click on "View" to see the session plan. This gives all the details of the frame scheduling and all the other elements of a session. After studying the session plan, click "Ok" to close it and return to the Session window.



That's all there is to creating a session! Now you'll want to save it with the "Export" menu item so it can be imported by your acquisition program and executed by it.

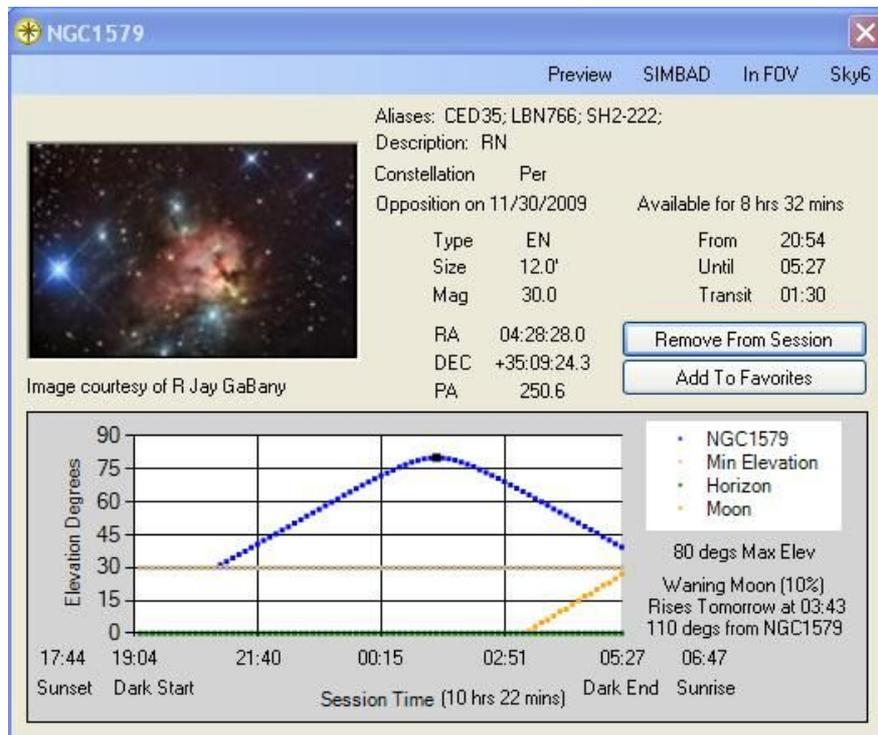
I hope this quick tour gets you on a fast track to using CCDNavigator! Good luck imaging!

Target Information Window

Any time you click on a thumbnail, a target information window will appear that provides detailed data about the target so you can determine if you want to image it or not. Both the [Main](#) menu window and the [Session](#) window allow you to retrieve multiple target information windows. The window also provides various controls associated with targets such as adding it to the session plan or to the Favorites catalog.

Data for the target is displayed including any aliases for it, a description, the constellation it is in, the next date of opposition which is the best time to image it, the classification type, size and magnitude of the target, its Right Ascension, Declination and Position Angle. Key times for imaging the target are listed, including its maximum availability in hours and minutes, the "From" time and "Until" time, as well as the transit time. "From" time is the moment when the target has passed above the minimum elevation criteria during the hours of darkness while the "Until" time is the moment when it has passed below the minimum elevation. "From" will be the same as the start of darkness if the target is already above the minimum elevation when darkness begins. Likewise the "Until" time will be the end of darkness if the target is still above the minimum elevation when darkness ends. These two times and the transit time are the basis for the scheduling algorithm in CCDNavigator.

The graph within the information window depicts the elevation of the target during the night of the session, the target's transit time is marked with a black dot (if it occurs during the hours of darkness). It is labeled with the times of Sunset, beginning of darkness, the quarter- and mid-point times of the night, the end of darkness and the time of Sunrise the next morning. It also shows the Minimum Elevation line which delineates the "From" and "Until" times when the target can be imaged. Information about the Moon is given and it's separation from the target and the Moon's elevation throughout the night is also graphed (if the Moon is visible). The local Horizon is drawn for the azimuth values that the target moves through so you can see if the target passes behind any obstructions during the session.



The information window has two button controls"

- "Add To Session" button will start [EZ-Guide](#) to set up the target for guiding per the methods chosen in the Camera window and will then place in the [Session](#) plan. If the target is already in the plan, this control will be labeled "Remove From Session" and clicking it will take that target out of the session.
- "Add to Favorites" button will place the target in the Favorites catalog which can later be imported. This is useful for planning future sessions with targets you find interesting. When CCDNavigator is first launched or any time the session date is changed, the Favorites list is checked to see if any of them are available for imaging on that session date.

There are four menu items:

- "Preview" menu item will retrieve a B&W deep sky image that matches the Field-Of-View for your camera/telescope as established in the [Camera](#) object.
- "SIMBAD" menu item launches a browser linked to scientific articles about the object from the [SIMBAD](#) database.
- "In FOV" menu item gives a list of all objects found in the collected [catalogs](#) of CCDNavigator that fall within the Field-Of-View of your system.
- "Sky6" has three submenu items.
 - "Show Object" will cause TheSky6 to display the target at the Right Ascension, Declination and Position Angle (PA). For targets that have not yet been positioned for guiding, the default catalog position and rotation angle will be used. Targets that have been set up for autoguiding will be position per the results of EZ-Guide and if a guide star has been selected, it will be highlighted in TheSky6 and a Sky6

information box will display information about the star.

- "**Slew Direct**" will connect TheSky6 to your telescope and send it directly to the target's location.
- "**Slew via Star**" will connect TheSky6 to your telescope and send it first to a nearby bright star where you can center and "sync" your telescope

Installation and Updates

Be sure you have the .NET platform version 3.5 installed on your computer. This is a free download from Microsoft and is available [here](#). You should also install .NET 3.5 Service Pack 1 which is [here](#).

You also need TheSky6 Professional Edition from Software Bisque. This can be purchased [here](#).

To install CCDNavigator:

1. Save the CCDNavigator ZIP file anywhere in your system.
2. VISTA and Windows 7 users should disable User Account Control (UAC) during installation.
3. If you received CCDNavigator through email, you must then right click on the ZIP file, select "Properties", and click "Unblock".
4. Next double click on the ZIP file and then click "Install". If you prefer, you can "Extract" the installation files to a convenient folder and then double click on "Setup".
5. After some prompts, your ZIP installer will extract CCDNavigator and install it on your system.

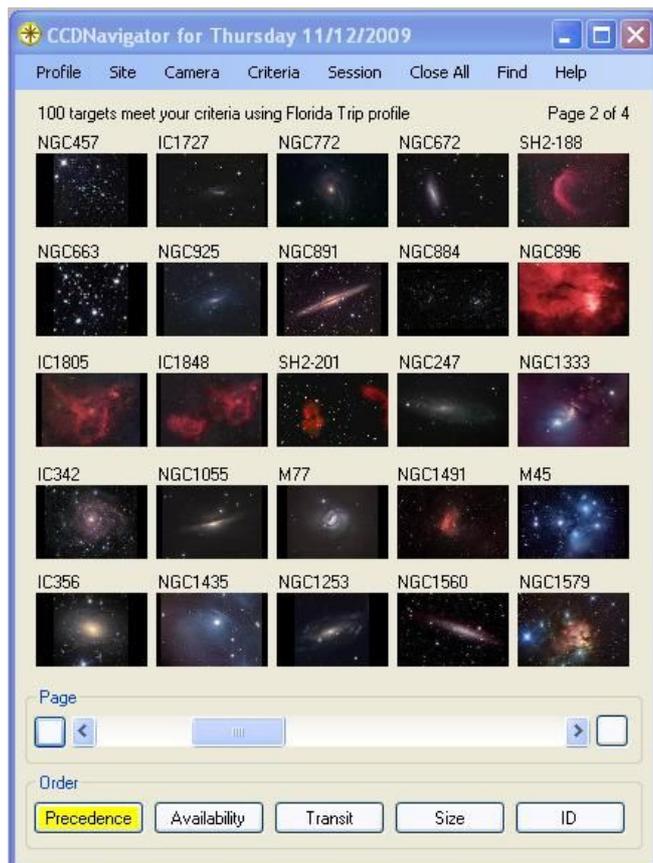
CCDNavigator includes an "Auto Update" function that will download and install the latest version on your computer provided that it has Internet access. It must also be enabled in the "Help" menu dropdown.

Main

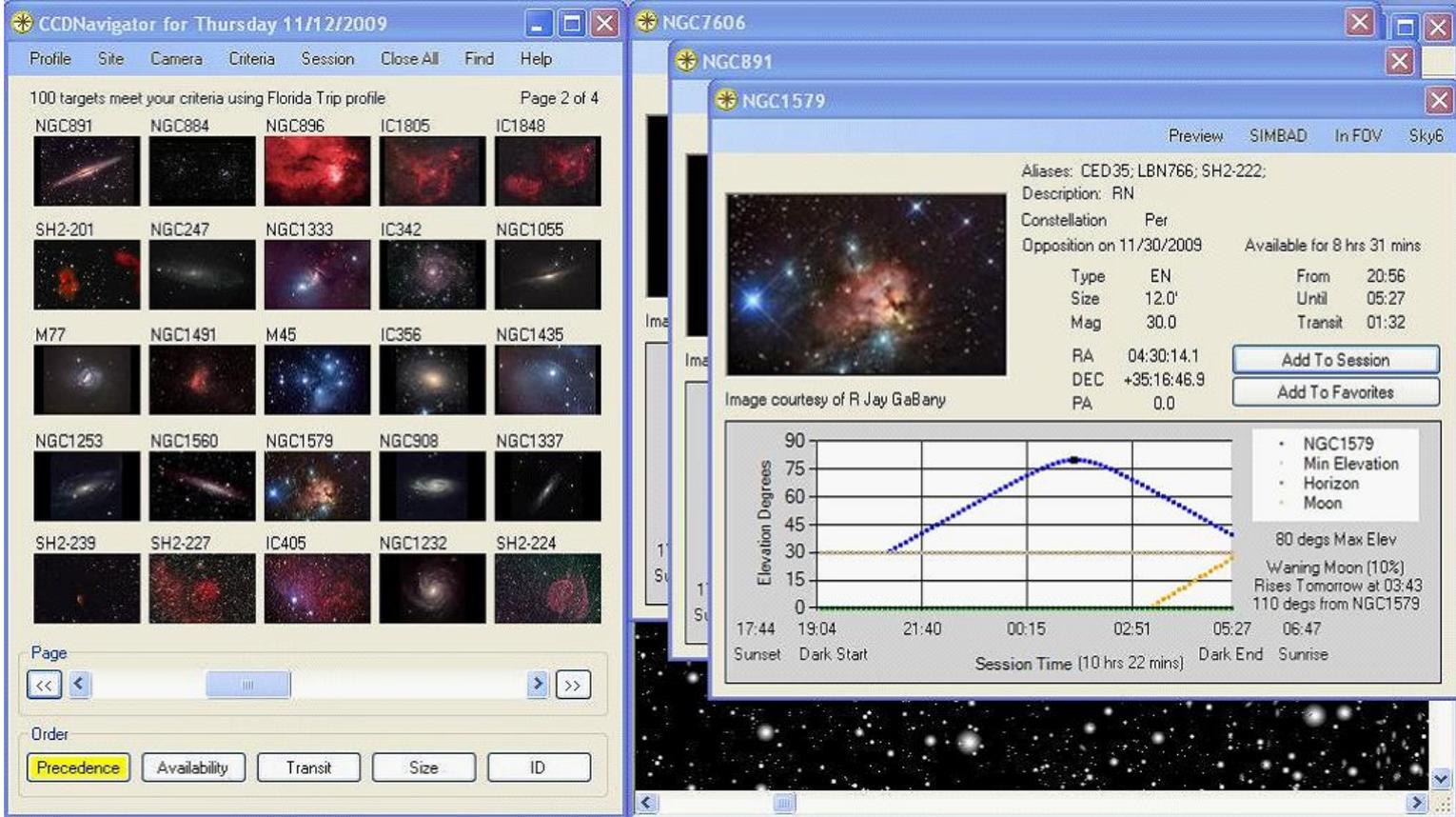
The main window of CCDNavigator lets you configure settings, view target candidates, get detailed information about them and select them for a plan. Controls are provided for finding targets, sorting them in various ways and browsing their thumbnails.

When CCDNavigator is first installed, you should set up your [Site](#) and [Camera](#) information. Simply click on these menu items and adjust the settings in the dialog screen that appears. Depending on the [Criteria](#) you have set, there may be several pages of targets. The slider lets you scroll between pages in the main window and the box at either end will move directly to the first and last page respectively. You can locate target candidates using the "Find" button which will search for it by catalog ID, alias ID or a common name (like "Horsehead nebula"). The targets can be sorted using the buttons "Precedence", "Availability", "Transit", "Size" or "ID".

- **Precedence** - This is the order in which the targets will be imaged. See [Optimal Scheduling](#) for a detailed discussion.
- **Availability** - This is the amount of time that the target is available for imaging. Targets with longer durations are listed first in the list.
- **Transit** - targets are sorted by their transit time. Earlier transits are listed first on the page.
- **Size** - Targets are sorted by their size. Larger targets are listed first on the page.
- **ID** - Targets are sorted alphabetically by their identification (eg. M31, NGC1499, etc).



To view detailed information about a target, simply click on its thumbnail to see a [Target Information Window](#) which displays technical data, a graph of its position throughout the hours of darkness and information about the Moon. You can view multiple information windows to compare targets in making your decision about including them in a session. "Close All" will close all open information windows.



Profiles store the global configuration of CCDNavigator. This consists of all Criteria settings (including [Catalogs](#), Classification settings and [Constellation](#) choices) plus the [Site](#) and [Camera](#) object names. When CCDNavigator is launched, it retrieves all these items and restores them to their various windows and menus.



When CCDNavigator is first installed, the Profile, Site and Camera assume Default setting values. The Site and Camera settings can be modified and saved in their respective window dialogs. Profiles can be loaded or saved using the drop-down menu on the main window. Because the Profile file name has limited space in the menus it is best to use short names. Session will let you view and adjust the targets in the session window and Find will locate a particular target in the target list.



The "Help" menu dropdown provides access to the Content of these helpfiles, "Auto Updates" can be turned on and off with the checkbox, a Dark Cycle Dates report can be generated including a file that can be imported to Outlook and iCal calendar programs. After specifying the number of months to calculate Dark Cycle Dates, two files are created and saved in the My Documents / CCDWare / CCDNavigator2 / Sessions folder as ".txt" and ".vcal". While viewing the file, it can be printed. The calendar appointments are of the form "Dark @ SITENAME" and with the start of darkness as their beginning time and the end of darkness as their ending time. There is an appointment on each day of the dark cycle for each month. "About CCDNavigator" gives the current version number.

Optimal Scheduling

When imaging multiple targets, we should consider the order in which targets will be imaged and in what order to acquire the LRGBH frames for each.

Target Precedence

To get the best results, we should order targets according to when they become available and when they are no longer available. A target becomes "available" whenever darkness is reached and it satisfies all the [Criteria](#). In CCDNavigator, this is called the **From** time and it is shown in the Target Information window. This time is determined by the object's coordinates and the elevation criteria you have selected. Suppose for example, that the Minimum Elevation is 30 degrees. So, if an object rises at 5 pm, darkness falls at 7 pm, and the object reaches 30 degrees at 7:30 pm, then the "From" point is 7:30 pm. But if it were already above the mandatory 30 degrees at 7 pm, then the **From** time would be 7 pm. The "Until" time is when the object no longer satisfies all of your target criteria and is therefore no longer available. Continuing the example, if darkness ends at 4 am but the object passes below our chosen 30 degree elevation at 3:15 am, then the **Until** point will be 3:15 am. But if it didn't drop below 30 degrees until 4:30 am, then the **Until** point would be 4 am. Based on these times, the object's availability duration is calculated by CCDNavigator. If an object exceeds the required Minimum Availability criteria, it will be listed as a candidate target.

Once CCDNavigator has calculated the **From** and **Until** times plus the objects' transit times, it orders them for imaging using a precedence rule. The precedence is:

1. Objects with the earliest **From** times should be imaged first since we can start imaging them before the others.
2. If two or more objects have the same **From** times, then those with the earliest **Until** times should be imaged first since we can complete imaging them sooner and have some time available for the others.
3. If two objects have the same **From** and **Until** times, we should image the ones with the earliest transit time since this allows us to image them at their highest elevation before starting the next target.

The targets listed in the main window are (by default) ordered by this precedence rule. If, for example, there are 12 targets in the main menu, the earlier ones listed have the highest priority and will be imaged first in a session. Targets later in the list can be imaged later in the session or, for targets near the end of the list, even the following month. Targets that transit around the middle of the night can be identified by looking at the [Target Information window](#).

Whatever targets are selected, CCDNavigator will create a session plan in which targets are ordered by the precedence rules.

LRGBH Acquisition

Next, we must consider a plan for the acquisition of LRGBH (Luminance, Red, Green, Blue, H-alpha) frames for each target. CCDNavigator provides two methods for doing this, "Staircase" and "Shuffle" sequencing. "Staircase" scheduling attempts to obtain the best resolution by acquiring frames at an appropriate elevation as the target moves through the night sky. "Shuffle" scheduling attempts to ensure that some data for each filter will be acquired even if the session is cut short.

The method is chosen by a drop-down control in the ["Camera"](#) menu item and the method can be changed using the Exposure button in the [Session](#) window.

Staircase Sequencing

To achieve the highest resolution and least amount of color extinction in our data, we should image the L frames when the target is at its highest possible elevation because this is where seeing has the least effect on resolution. The B frames should then be acquired at the next highest possible elevation because of increased blue extinction that occurs at lower elevations. These can be followed by the G frames, the R frames and finally the H-alpha frames. This does not mean that the order should be LBGRH however because we must consider the elevation of the target as it moves during the session.

Suppose for example that we plan to image M42 from 10:00 pm until 2:00 am on a given night and that M42 transits at midnight. In this case, the transit will occur exactly in the middle of the session. If we are taking 10-minute frames during this 4 hour interval, we can take a total of 24 frames during the session (we're ignoring download and other lost time for this example but CCDNavigator includes these times in its calculations) so we might choose to take a total of 12 L, 4 R, 4 G and 4 B frames. To optimize resolution and minimize color extinction, we should image in order 2 R, 2 G, 2 B, 12 L, 2 B, 2 G and 2 R frames. If this sequence is considered, it can be seen that the L frames are centered on the transit time and the B, G and R frames are split on either side of the L frames so each set will be at the highest available elevation for the given filter. This is an optimal staircase sequence for this imaging situation and it acquires exactly the number of frames for each channel as planned.

Now suppose that we are imaging M42 on the same night but we choose to image it from 8 pm until midnight. Now, the transit occurs at the end of the imaging session. We can still take 12 L, 4 R, 4 G and 4 B frames during the allotted time but in this situation, the optimal staircase sequence would be 4 R, 4 G, 4 B, 12 L since this places the L frames at the highest available elevation, the B frames at the next highest point and so on. While this is the best we can do, it is not as good as the previous example because even though the frames are taken at the highest possible elevations, these are lower elevations than the previous example. Also notice that if we imaged from midnight until 4 am, the staircase sequence would be reversed, ie. 12 L, 4 B, 4 G, 4R.

As a last example, suppose we decide to image M42 on the same night but we want to image it from 9:10 pm until 1:10 am. So the transit occurs 1 hour and 10 minutes (7 frames) before we have to stop imaging. We still can take the same number of LRGB frames as before but now we should choose 3 R, 3G, 2 B, 12 L, 1 B. This sequence centers the L frames on the transit time (6 on either side of the transit) and splits the B frames on each side of the L frames so they are that the next highest possible elevation. Since there is only time for 1 B frame after the L frames are completed, we must take the other 2 B frames just before the L frames start. If we further delayed our start time until 9:20 pm, then the optimal sequence would be 3 R, 3 G, 1 B, 12 L and 2 B. In this case, a second B frame is placed after the L frames to optimize the elevation of all the frames.

While this is not rocket science, this calculation relies on knowing the transit time of the target, its times of availability, the time when we start imaging the target, how many frames we plan to take and the duration of each frame including overhead such as downloads, focusing, slewing and target acquisition. When multiple targets are to be imaged on the same night, this makes the calculations even more complex since we have to consider which target will be imaged first, when we should start and end imaging it, the different exposures for each filter, and we must make an optimal plan for each target. And the order in which we image the targets should be chosen to optimize the elevation for each. With the clock ticking, we have to quickly determine a plan or we will lose valuable time under a clear sky. It is nearly impossible for an unassisted human to figure out an optimal sequence in the field in a timely manner.

Fortunately, this is exactly the kind of problem that is easily solved by a computer. CCDNavigator first selects the order to image multiple objects so as to maximize their availability during the session based on the precedence rule described earlier. It then constructs an optimal staircase sequence for the user's allocation of frame counts for each target and it will prevent the total exposure duration from exceeding the availability of the target.

What is meant by "Optimal"? This is a good question and it is possible to have different definitions of what constitutes "optimal". It must be remembered that the user can define a set of targets and numbers of LRGBH frames that are a poor choice for a session. For example, suppose two objects that both transit at midnight are selected for imaging but the 1st object is imaged for nearly the entire session. This means that the 2nd target will have all its frames acquired at low elevations. CCDNavigator will create an "optimal" plan for this situation in the sense that it will select the best target to image first and will create a staircase sequence acquisition plan that best acquires the frames for each target's location and transit times. This is an optimal plan for doing what the user has ordered and CCDNavigator will generate the best possible plan given the user's choice of targets. But it would be better to image these two targets on different nights.

This means that the user still needs to make intelligent choices. So, if you plan to image two targets, it is best to notice the transit times of targets on the Target Transit and Availability graph and pick one target that transits during the first half of the session and a second one that transits during the second half of the session. If we divide the available session time between them, we can capture all the frames at high elevations. The graph can help you make these choices and by choosing targets that transit during the interval available for imaging them, CCDNavigator can create a good LRGBH allocation.

Shuffle Sequencing

An alternative to **Staircase** sequencing is **Shuffle** sequencing. This mode will repeatedly acquire the L, R, G, B and H frames in a cycle. The particular cycle depends on the number of frames to be taken for each filter but the frame counts default to "1" for each filter (except H which defaults to "0"). For example, a shuffle sequence could be LRGB repeated 11 times.. This sequence has several properties. For one, if clouds roll in early but some frames have been acquired, there is a chance of having enough data to create an image. If the clouds stay away a bit longer, more frames will be acquired which will improve image quality. As more and more time passes during the session, more and more data is acquired thereby improving the final image quality. This strategy is most useful when inclimate weather threatens to terminate a session early.

CCDNavigator allows a generalized shuffle in that it allows the user to set the number of LRGBH frames to be acquired during each cycle. In addition, the user can set the number of cycles to control the overall total number of frames acquired. For example, it would be possible to use a sequence of LLLRGB repeated 5 times. Or RRRGBBH repeated 4 times by setting the frame counts for each filter and the cycle count however you wish.

Saving and Viewing the Plan

You can examine the session plan's detailed LRGBH sequence using the "View " button in the [Session](#) window. Or, even better, import the session plan into CCDAutoPilot and look at the "Light Frames" panel to see the ordering of the LRGBH sequence and allocation. Plans can be saved using the Export button. Session plans are (by default) named for the session date and are stored in the "My Documents\CCDWare\CCDNavigator2\Sessions" folder but this can be changed by the user. Also, a text version of the session plan is created using the same name and is placed in the same folder. This can be viewed after CCDNavigator has been closed.

Elevation Priority

The filter properties window filter "Type" (seen by clicking on a filter name in "Camera") serves two purposes:

1. It determines the elevation priority and thus the order in which filters are scheduled in the Staircase sequence discussed above
2. It is used to set up initial values of the frame counts for a given "Series" when a target is added to the session.

The elevation priority and filter associations are as follows:

Elevation Priority	Filter Type
10	C (Clear)
9	L (Luminance)
8	B (Blue)
7	G (Green)

6	R (Red)
5	O (Oxygen III)
4	S (Sulpher II)
3	H (Hydrogen Alpha)
2	V (Visual)
1	X (Reserved)

A different way to state the priority for the filters is:

$$C > L > B > G > R > O > S > H > V > X$$

For Staircase acquisition, any filters with non-zero frame counts will be ordered based on this priority. The filter with the highest priority will be scheduled for each target's highest elevation with lower priority filters scheduled for lower elevations. Assuming the filters used have normal bandwidths and center wavelengths, such an arrangement will minimize the effects of seeing on luminance (or clear) data and minimize the impact of color extinction..

The "Series" property in the Camera window (and in the "Exposure" window in Session) can assume six values ZERO, L, RGB, LRGB, NB ("Narrow Band") or H which will initialize the frame counters for a particular set of filters. The filters to be initialized are chosen based on their elevation priority per the table above. Series choices of L, RGB and LRGB will use the L, R G and B filters. The NB and H series will use O3, S2 and H.

Release Notes

Version 2.0.56

1. Added support for TheSkyX Professional Edition build 3919. Note: As of 13 Jul 2010, SkyX has a problem with Win7 64-bit systems. Software Bisque is aware of this and is working to repair it.
2. Added "OSC" as a camera type in the Camera menu.

Version 2.0.53

1. Improved EZ-Guide for guidescope mode so user can reposition the initial FOVI if no guidestars are initially available.
2. Repaired "Criteria", "Constellation", "Tonight" calculations for the Southern Hemisphere.
3. Repaired a problem with calculation of the "From" and "Until" times for targets.
4. Added location information so there is no dependency on the computer for figuring if DST is in force or not. To be compatible with Sky6 / SkyX, the same locations are used however many of these no longer observe DST. Be sure to set the "DST Option" in the "Site" menu for your DST situation.
5. Repaired a problem associated with the "Dark Start" time at high latitudes.

Version 2.0.52

1. Increased the resolution of the Session graph to allow more accurate display when targets encounter obstacles.

Version 2.0.51

1. Revised logic so Constellations and Object Classes are always used for screening target lists. This simplifies the job needed to see objects only of a given type or in a given constellation since all other criteria can simply be turned off. There is a check to be sure some classes and constellations have been selected.
2. EZ-Guide now restores Sky6 settings for the display mode (Pole or Zenith up) and the screen field of view size.
3. The "Site" "Twilight Angle" is automatically adjusted if the Sun will never reach the user's setting.
4. Added a warning to Dark Cycle dates if the Twilight Angle is greater than 18 degrees. The warning includes the Twilight Angle setting.
5. Converted "Elevation Priority" (seen when renaming filters in the "Camera" window) to "Type". Elevation priority and frame counts are set according to the filter type chosen.
6. Revised EZ-Guide so that if the user moves the FOVI and then clicks "Restart", a new list of guidestars is created for that location. This allows the user to move to literally any location and set up autoguiding.

Version 2.0.48

1. Further modified system calls to achieve an even faster initial launch.
2. Revised settings to prevent tooltips from being disabled on some computers.

Version 2.0.42

1. Repaired a bug that forced the VCAL file (for importing Dark Cycle Dates to a calendar program) to give incorrect times (DST not included) in during the month when DST changed.
2. Modified system calls to achieve faster initial launch.

Version 2.0.35

1. Repaired a bug that kept circumpolar objects from having correct "From" and "Until" times.

Version 2.0.33

1. Repaired a bug introduced in version 2.0.32 that broke the Preview feature.

Version 2.0.32

1. Modified the Daylight Savings Time calculations so they are now linked to the PC's settings in "Date and Time" on the control panel.

Version 2.0.31

1. Repaired a bug that did not restore targets' RA, DEC and PA to their catalog values when either "Session" "Clear" or "Session" "Targets" "Clear" was used.
2. Added exception traps caused by Sky6 when an FOVI is corrupted.

Version 2.0.30

1. Added a feature in "Session" to allow the user to selectively override the exposure start time independently for each target.
2. In "Session" "Targets" a menu item, "Initialize Frame Counts", will recalculate the frame allocations for all targets.
3. Clicking on targets in "Session" no longer automatically positions Sky6 on the target which was very sluggish. Information windows now have a "Sky6" menu item for this.
4. Made a minor improvement in the LRGB frame count allocation to keep L and RGB counts more balanced in some situations.
5. Revised EZ-Guide to automatically adjust the query range of magnitudes when the Sky6 query overflows so users do not have to adjust their values.
6. Revised Helpfiles to catch up with these and other changes

Version 2.0.18

1. Corrected a bug that was overwriting the RA, DC and PA when a Target List was re-loaded in Session..

Version 2.0.17

1. Revised Dark Cycle date calculation (again...).

Version 2.0.16

1. Repaired a Dark Cycle date bug that gave incorrect dates.
2. Corrected a calibration error for cameras having non-zero initial angles and no rotators.

Version 2.0.15

1. Modified CCDNavigator to allow maximum functionality when TheSky6 is not available. See Helpfile for details.
2. Corrected a bug that could cause an exception when AutoUpdates are enabled at some WiFi hotspots.
3. Revised helpfiles for some spelling errors.

Version 2.0.14

1. Reformatted the SIMBAD query string for PK objects. SIMBAD uses a different format for the PK catalog.

Version 2.0.13

1. Repaired the Main window scroll bar logic which was inadvertently deleted.

Version 2.0.12

1. Sky6 FOVI references are now restored to their starting value after EZ-Guide setup.
2. Repaired a bug in Dark Cycle date calculations that was skipping some dates and duplicating others.
3. Repaired a bug that would crash the program if sessions were viewed or exported with no frame counts.

Version 2.0.11

1. Increased tooltip persistence on the main window.
2. Changed font type in the menu bar in an attempt to avoid loosing the "Help" menu item to font resizing in the OS.
3. Revised date comparison logic that selected the wrong profile on startup.

Version 2.0.10

1. Tooltips for main window thumbnails now give some data about the target.

Version 2.0.9

1. Added some margin to the printouts.
2. Revised logic that selected the wrong profile in certain situations.
3. Increased the size of the main window to keep "Help" on the screen.
4. Added notes on setting up FOVI for OAG and guidescopes to the EZ-Guide helpfile.

Version 2.0.7

1. Modified instructions (language) for camera calibration for better clarity.
2. Modified the printing command on the Session Plan viewer and the Dark Cycle date viewer.
3. Repaired a problem that was keeping the Site menu DST checkbox from being restored and used in Dark Cycle Date calculations.

Version 2.0.6

1. Repaired a bug with Dark Cycle Dates when more than 12 months were requested.
2. Increased page size for Main and Session windows to avoid margin problems with VISTA / Win7.

Version 2.0.5

1. Revised Dark Cycle calculation to achieve greater speed which made it slow to change dates in "Criteria".
2. Corrected date formatting in CCDAP export file for non-US English environments.
3. Session plans can be printed while viewing in "Session" "View".
4. The Annual Dark Cycle feature in the main window under "Help" is renamed "Dark Cycle Dates". When executed, it prompts for the number of months to calculate. The results can be printed while viewing them.
5. Target Information Windows are now listed in the operating system's task bar. This allows them to be brought forward if covered by another program window such as TheSky6.
6. Replaced "First" "Last" "Next" "Previous" buttons on the main page with a scroll bar which makes it easier to navigate large numbers of windows. A small button at each end of the scroll bar lets you jump to the first and last objects.
7. The "Find" button now puts the target at the upper right position on the main window if it is located.
8. The rotation angle of targets ("PA" in information windows) was not being initialized to "Initial PA" in the Camera menu.
9. Improved speed and accuracy of Opposition calculations (in Target Info Windows).
10. Revised EZ-Guide logic for "Unguided" method of positioning.

Version 2.0.4

1. Repaired logic associated with the "Opposition Date" on the information windows..

Version 2.0.3

1. Added an error message if the user does not properly calibrate the camera.
2. Eliminated duplicate guide stars coming from GSC, Hipparcos and Tycho catalogs
3. Trapped an exception that could occur if auto updates are enabled but there was no Internet access
4. Revised "Camera" logic to require recalibration of FOVI if guiding method was changed
5. Added a popup giving the camera FOV size after calibration

Version 2.0.2

1. Added an error message for corrupted Sky6 FOVI that cause exceptions

Version 2.0.1

1. Revised guidestar identification process to include both GSC and Hipparcos/Tycho catalogs.
2. Corrected the installation path for the database query files which led to an untrapped exception.
3. Revised helpfiles.

Version 2.0.0

1. The first release of CCDNavigator2

Issues

- While not a bug, DST calculations are based on the US dates of starting and ending Daylight Savings Time. If this program proves to be popular elsewhere in the world, I will consider adding other DST rules. Please contact me if you desire this capability.

This list will be corrected in a future version. If you notice any bugs, please notify me at the CCDWare User Forum

Session

In the "Session" window, CCDNavigator displays all the relevant information about the session for the selected date including thumbnails of all targets, their frame count allocation for each filter, an information window for each target and a graph of the session showing the real-time allocation among the targets. Within the graph, the transit times of each target is marked with a black dot and if the target moves behind an obstruction defined by your Site Horizon, it will be colored red during that interval of time. The Moon's presence is also graphed and the target information windows give additional details for the Moon in their graph.

If more than five targets are selected for a plan, the Page buttons (First, Next, Previous and Last) can be used to view the additional targets. The "Find" button allows the user to search for a particular target in the plan.

"Close All" simply closes all the information windows.

Clicking on a thumbnail will switch the frame count allocation to the set of values allocated to that object and will also bring that object's target information window to the foreground. The frame allocations can be changed at will however they cannot be adjusted beyond the target's availability times. Also, frame allocations are recalculated every time a target is added to the session so wait until you have added all your desired targets before bothering to adjust any frame allocation.

In the information window for each target, clicking on the "Sky6" "Show Object" menu item will place TheSky6 on the target at the right ascension, declination and position angle chosen using EZ-Guide. This lets you confirm your autoguiding setup and choice of guidestar if one has been selected.

The starting time for each target can be overridden by checking the "Override Start Time" checkbox. This can be used to delay starting a target if it is behind an obstacle at the beginning of its availability. Simply check the box and advance the time until the red portion of the target's line has disappeared but remember that this will result in some "dead" time in your session. Unchecking the box will recalculate the frame counts to fill the time available to the target. The the checkbox is checked, an up/down arrow pair will appear to the left of the checkbox, these move the start time forward or backward in time. The starting time cannot be set to values earlier than the target's "From" time or later than the target's "Until" time. In addition, the start time can never move beyond another target's overridden start time.

Session Plan For Thursday 11/12/2009

View Export Clear Targets Close All

2 targets - Page 1 of 1

Page

First Next Previous Last Find

NGC7635 NGC1579



NGC1579 Staircase for 4 hrs 30 mins from 00:56 until 05:27

	L	R	G	B	H
Exposure	11	4	4	4	0

Start at 00:56

Dark Start	Session Time	10 hrs 22 mins	Dark End
19:04	21:40	00:15	02:51

Targets

- NGC7635
- NGC1579
-
-
- Obstruction
- Transit
- Moon

OK

NGC7635

Preview SIMBAD In FOV Sky6

Aliases: CED35; LBN766; SH2-222;
Description: RN



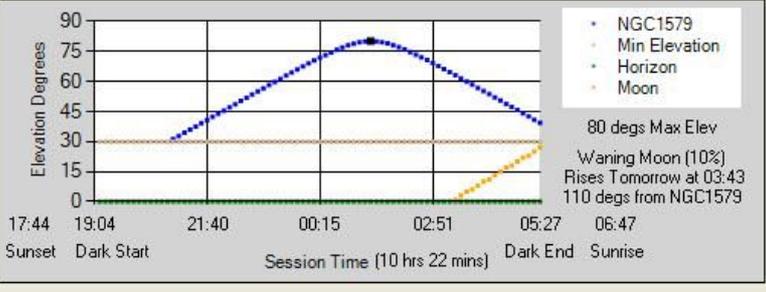
Constellation Per
Opposition on 11/30/2009 Available for 8 hrs 32 mins

Type	EN	From	20:54
Size	12.0'	Until	05:27
Mag	30.0	Transit	01:30

RA 04:28:28.0
DEC +35:09:24.3
PA 250.6

Remove From Session
Add To Favorites

Image courtesy of R Jay GaBany



Elevation Degrees

80 degs Max Elev
Waning Moon (10%)
Rises Tomorrow at 03:43
110 degs from NGC1579

17:44 19:04 21:40 00:15 02:51 05:27 06:47
Sunset Dark Start Session Time (10 hrs 22 mins) Dark End Sunrise



When targets are added to the session, the settings in the main Camera window are used. To change camera parameters for each individual target, simply click on "Exposure" and a new window will appear that allows you to change the Sequence type (Staircase or Shuffle), the Series type (RGB, LRGB, etc) as well as the Binning and Exposure for any filter. When "OK" is pressed in the Exposure Settings window, the frame counts will be reinitialized for all targets using the camera settings assigned to each. Each target can have a different Sequence, Series, Exposure and Binning settings.

The screenshot displays two windows from a software application. The left window, titled "Session Plan For Thursday 11/12/2009", has a menu bar with "View", "Export", "Clear", "Targets", and "Close All". It shows "2 targets - Page 1 of 1" and an "Exposure Settings" dialog box. The dialog box has a "Sequence" dropdown set to "Staircase" and a "Series" dropdown set to "LRGB". It contains a table with columns "Name", "Binning", and "Exposure (s)":

Name	Binning	Exposure (s)
L	1	600
R	2	600
G	2	600
B	2	600
H	2	1800

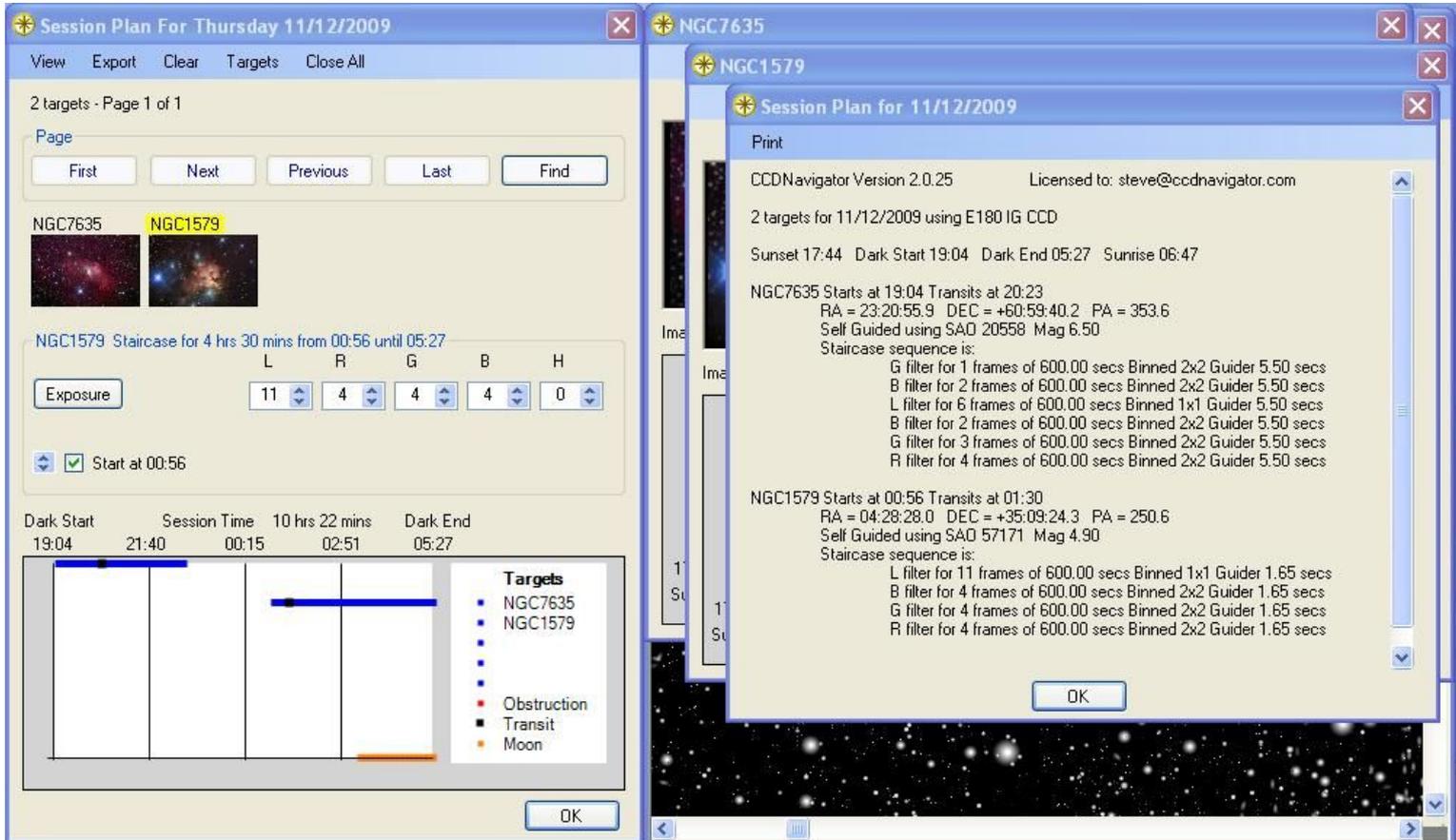
Below the table are "OK" and "Cancel" buttons. The right window, titled "NGC7635", has a menu bar with "Preview", "SIMBAD", "In FOV", and "Sky6". It features a preview image of the nebula, a description, and a table of properties:

Property	Value	Property	Value
Aliases	Bubble Nebula; CED210; LBN549; C11;	Available for	6 hrs 9 mins
Description	EN		
Constellation	Cas	Type	EN
Opposition on	9/11/2010	From	19:04
		Until	01:14
		Mag	30.0
		Transit	20:23
RA	23:20:55.9		
DEC	+60:59:40.2		
PA	353.6		

Below the table are "Remove From Session" and "Add To Favorites" buttons. A graph shows "Elevation Degrees" over "Session Time (10 hrs 22 mins)". The graph includes a blue curve for "NGC7635", a green horizontal line for "Min Elevation", a yellow horizontal line for "Horizon", and a yellow curve for "Moon". Text on the graph indicates "54 degs Max Elev", "Waning Moon (10%)", "Rises Tomorrow at 03:43", and "124 degs from NGC7635". The x-axis shows times: 17:44 (Sunset), 19:04 (Dark Start), 21:40, 00:15, 02:51, 05:27 (Dark End), and 06:47 (Sunrise). A "Session Time (10 hrs 22 mins)" bar is shown below the graph. At the bottom is a star field image.

There are five menu items in the session plan window "View", "Export", "Clear", "Targets" and "Close All":

"View" will display all information about the session including the session times and targets, the guiding method selected, the guidestar being utilized (if any) and the guider exposure for each target. The frame allocations for the series and sequence type selected for that target are also given. The print menu item in the Session Plan window will send the session plan to your default printer.



"**Export**" will save the session plan in a format appropriate to the "Acquisition" selection in the Camera window (CCDAP, ACP, CCDSoft or MaximDL). It defaults to My Documents / CCDWare / CCDNavigator2 / Sessions but a different location can be chosen.

"**Clear**" will re-initialize the session plan eliminating all targets and return the program to the main menu.

"**Targets**" has four submenu items:

- "**Load**" will let you load a list of targets saved previously. Target lists include the RA/DEC position, rotation angle and guidestar (for guided modes) for each target so a future session can be constructed using the same coordinates and angle. If targets are imaged over several months, this will let you precisely repeat the positioning of the target and save time setting up the session plan. By setting up one target at a time, saving it as a target list, and then clearing the session, you can build a catalog of targets that have been pre-positioned for your system. However, when loading target lists to a session plan, be sure they were set up for the camera configuration you are using. Otherwise, the guidestars may not be properly positioned for the autoguider. A session can have a mix of targets added by the normal process or by loading them as a target list and multiple target lists can be imported into a session. Individual targets, however, can only appear once in a session so attempts to load a target two or more times will be ignored.
- "**Save**" will save the current target list. Lists are saved in MyDocs/CCDWare/CCDNavigator2/Targets folder
- "**Clear**" will remove all targets from the session plan but leaves you in the session window.
- "**Initialize Frame Counts**" will restore the frame counts of all targets to their initial "fair time" values within the constraints of the target's available time and the setting of the start time override if checked. To restore the targets' allocations to the exact starting values, simply uncheck the override start time on each target and click this menu item.

"**Close All**" will close all open information windows.

Site

This window holds the various parameters associated with your location. The site parameters cannot be changed while planning a session, once targets have been added to the session, it is "locked" to disallow access. The site name is displayed in the title line of the window, in the example the site is named "Pocono Palace" but will initially be named "Default".

To create a new site, simply modify the parameters as you wish and then click "Save As". Enter the name which you prefer (short names are best) and click "Ok". This will create and save it as a new site. To modify the site, simply make your changes and click "Save" to update it. "Load" will let you choose any previously created site file.

The screenshot shows the 'Home' window of TheSkyX software. The window title is 'Home' and it has a menu bar with 'Load', 'Save', and 'Save As'. The main area contains several input fields and controls for site parameters:

- Latitude:** 41 Dega, 39 Mins, 38.0 Secs. Radio buttons for North (N) and South (S).
- Longitude:** 77 Dega, 49 Mins, 26.0 Secs. Radio buttons for East (E) and West (W).
- Time Zone:** -5
- Altitude (ft):** 2296
- DST Option:** U.S. and Canada (dropdown menu)
- Twilight Angle:** -18
- Planetarium:** TheSkyX (dropdown menu)
- Display Times in UT:** unchecked checkbox
- Horizon section:** Includes 'TheSkyX Local Horizon' with 'Import' and 'Export' buttons, and 'Scan With Telescope' with 'Start' and 'Stop' buttons.
- Manual section:** Includes 'Clear' button, 'Azimuth' (0) and 'Elevation' (0) spinners.

At the bottom, there is a graph titled 'Horizon' showing 'Elevation Degrees' on the y-axis (0 to 90) and 'Azimuth Degrees' on the x-axis (0 to 360). A red horizontal line represents the horizon at 30 degrees elevation. A green curve shows a target's path, starting at approximately 240 degrees azimuth and 45 degrees elevation, peaking at 270 degrees azimuth and 55 degrees elevation, and ending at 300 degrees azimuth and 45 degrees elevation. A legend indicates that the red line is 'Min Elevation' and the green line is 'Horizon'. 'OK' and 'Cancel' buttons are at the bottom right.

The parameters are:

- **Latitude** - This should be set to the latitude of your site and you must also select either North ("N") or South ("S") according to your position relative to the equator. The up/down buttons change the latitude parameters of degrees, minutes and seconds. The site must be below the Arctic circle and above the Antarctic circle so the latitude can range from 65 degrees North to 65 degrees South. Above or below these values, there are days when the sun neither rises nor sets leading to impossible calculations for the solar, lunar and session times.
- **Longitude** - This parameter should be set to your site's longitude and you must select either West ("W") or East ("E") according to your position relative to Greenwich. US longitudes are west of Greenwich. Setting the longitude also sets a range of time zones that can be selected.
- **Time Zone** - This parameter gives the offset in hours from UTC to your local time. It is negative for locations west of Greenwich and positive for locations east of Greenwich. For example, the offset for the US Eastern Time Zone is -5, Central is -6, Mountain is -7 and Pacific is -8. This offset should be for standard time time, eg. EST, not when DST is in effect. When longitude is set, the time zone is set to a value central to that position on earth and can be adjusted plus or minus 1 zone from this central value.
- **DST Option** - If your location uses Daylight Savings Time during the summer months, select your location from the drop down list of countries.
- **Altitude** - This parameter should be set to your site's altitude above sea level and is specified in feet.
- **Display Times in UT** - If you want ALL times displayed in Universal Time, then check this box. Leaving it unchecked will display Local Time for all displays. Times displayed in UT will have the lowercase letters "ut" following their value, for example "18:32ut".
- **Twilight Angle** - This parameter tells CCDNavigator how far below the horizon the Sun must be before imaging can commence and is used to calculate the times when darkness begins and ends. The default value is -18 degrees which is the normal definition of Astronomical Twilight. Standard definitions for the start and end of twilight are "Civil Twilight" which is 6 degrees below the horizon (-6), "Nautical Twilight" which is 12 degrees below (-12) and "Astronomical Twilight" which is 18 degrees below (-18). If the user wishes to modify their session start and end times, this value can be changed to values between -6 and -30 but be careful that the Sun does not interfere with your imaging. If your site is in high northern or low southern latitudes, the Sun may not reach the twilight angle which will cause the session to have ZERO duration and no targets will be presented.
- **Horizon** - Use these controls to manually create a horizon graph. When a target is behind an obstruction, this will be indicated in the "Target Transit and Availability Graph" and the target's graph line will be colored red in the "Session" display. From within the "Session" window, you will be able to override the start time or adjust the amount of time spent on a target to avoid any obstacles. The horizon can be entered manually, imported and exported with TheSky6 or by scanning with your telescope.
 - **Manual Entry:** One way is to simply step the azimuth value from 0 to 360 degrees and set the elevation of any obstruction at each

position. As the azimuth is incremented, the Elevation value will be written into the graph. To "jump" to a particular azimuth, simply highlight the azimuth parameter and type in a desired value (the elevation value can also be adjusted in this way). This method is useful if there are only a few simple obstructions to capture and you know the azimuth and elevations of the inflexion points of the obstructions. It can also be used to make minor corrections to data collected using the other methods. Azimuth is measured from the north in the range from 0 degrees to 360 degrees. East has an azimuth of 90 degrees, south is 180 degrees and west is 270 degrees. Elevation ranges from 0 degrees at the horizon to 90 degrees at the zenith (directly overhead).

- **Telescope Scanning:** Simply click the "Start" button and CCDNavigator will launch TheSky6 (if it is not already running) and connect to the telescope. Then, slew your telescope to trace the outlines of obstructions. Slew in small steps, use a moderate slewing speed and pause for a moment after each slew. When each slew is complete, CCDNavigator will update the graph and show the telescope's new azimuth and elevation position. When an obstruction has been captured, click on "Stop". If you make an error while slewing, simply backup and do it again - the old data will be overwritten. Slewing can be performed in any direction - east to west or west to east. After an obstruction has been captured, click "Stop", position the telescope at the next obstruction, click "Start" and capture that obstruction. Once all of the obstructions are captured, you can save the data with "Save" or "Save As".
- **Import** - Horizons created in TheSky6 can be imported to CCDNavigator using the "Import" button in the Horizon editor. Simply click on "Import" and navigate to a horizon file created by TheSky6 (this can be found in C:/Program Files/Software Bisque/TheSky6/). Such files use the file extension of ".hrz" and "Normal.hrz" is the default file. Just select the horizon file and CCDNavigator will import it. Then click "Save" to place this in stored camera object.
- **Export** - Horizons created or modified in CCDNavigator can be exported to TheSky6. Click on the "Export" button in the Horizon editor, browse to a convenient folder and give the file a name with an extension of ".hrz". Then, in TheSky6, select "View" "Reference Lines" and "Edit Local Horizon". Next click on "Open" and browse to and select the file which you saved from CCDNavigator. TheSky6 will then import the horizon values.
- **Clear** will erase all horizon data. At any time, you can leave the editor and return later to continue editing but don't forget to hit "Ok" to exit or your edits will not be saved. If you do not wish to overwrite your previously saved horizon data, exit the editor with the "Cancel" button.

The "Import from TheSky6" button will load all these parameters, including the Horizon graph, from the current Location used in TheSky6. However, in TheSky6, different local horizon files can be present and there is no means for determining which one is being used. So CCDNavigator simply imports "Normal.hrz" which is the default TheSky6 horizon file. If your local horizon is not loaded by this button, use the "Import" feature described above to find the correct TheSky6 horizon file and load it to CCDNavigator.

Users Without TheSky6

If TheSky6 is not installed on your computer, a great many functions performed by CCDNavigator cannot be accomplished. Primarily these include the positioning of the camera's Field-Of-View to achieve a particular composition and the selection of guidestars and calculation of the appropriate guiding exposure. In addition, the "Slew" feature will also not work.

Due to these reasons, only the "Unguided" method of autoguiding can be used if TheSky6 is not installed. When the Camera's "Select and Calibrate FOVI" is executed, CCDNavigator will automatically switch to the "Unguided" method. It will also collect the Field-Of-View X and Y sizes from the user in a dialog window. Once this has been done, the user will be able to "Preview" images of targets in the catalogs and they will be able to add targets to a session plan. Session plans created in this manner can be viewed and exported for acquisition. When adding targets to the session, EZ-Guide will not be utilized and the RA/Dec coordinates of the target as found in the catalog will be passed directly to the session without modification.

Session plans created and exported using this arrangement will not have guidestar exposures included. However, in CCDAutoPilot4, you can still use autoguiding by setting the options in CCDAP4 so that guidestar exposures are automatically set by CCDAP4. However, because the target's position is the default catalog location, a guidestar may not be available for guiding with either Off-Axis guiders or Self-Guided cameras. Guidescopes will most likely be able to locate a guidestar for which CCDAP4 can set up a proper guiding exposure.



CCDNavigator is a powerful tool that helps you select interesting targets and create an optimal multi-target session plan that can be executed by automatic image acquisition software, such as CCDAutoPilot, for any given night.

- CCDNavigator uses "*The Advanced Imager Catalog*" which consists of objects imaged by some of the world's best imagers and includes a thumbnail of each object. Thus, you can see in advance if an object will make an interesting photo. A second catalog, "*The Deep Sky Explorer Catalog*" which combines numerous astronomical catalogs and includes a thumbnail of each object, can also be used for target selection. This allows you to easily hunt down and image little known objects.
- Criteria controls are provided so you can manage the session date plus the availability, elevation, size, and brightness of objects selected from the catalog. In addition, targets can be restricted to certain classifications such as galaxies, nebula, etc and they can be restricted to selected constellations. This allows you to focus on objects that "fit" your system and to plan automated all-night imaging runs of multiple targets while focusing on sky regions and object categories that you find interesting.
- Objects in the catalog meeting your criteria on the session date are displayed for possible target selection. All potential targets are ordered by the priority of their availability for imaging and can be browsed visually by clicking on their thumbnail.
- All useful details about targets are displayed in information windows that include Sun rise and set, start and end of darkness, the maximum length of the session in hours & minutes, plus information about the Lunar dark cycle and possible interference by the Moon. Multiple target information windows can be displayed allowing you to compare targets and make decisions about imaging choices. A graph displays the starting time, ending time and transit time for the target as well as indicating when it is behind an obstruction at your local horizon and the target's elevation is graphed for the duration of darkness. Users can preview an image of the target that is the precise Field-Of-View for their telescope / camera and have the option of slewing their telescope to the target immediately. Scientific information about the target can be retrieved from the SIMBAD database. The "In FOV" feature lets you find out what other objects will be captured in your camera's field-of-view when you image a target by providing a list of all objects within your camera's field-of-view (including camera rotation angle).
- The "EZ-Guide" feature lets you position targets for autoguiding with a guidescope, internal guidechip or off-axis guider. This fully automatic process selects a guide star, positions the autoguider and prompts for user approval. The user can preview images of the target while adjusting the camera/telescope position and rotation angle. This "Interactive Preview" can be used while composing an image letting you set up the image precisely as you wish and see what your photo will look like before ever taking it. Once the composition is complete, EZ-Guide will calculate guidestar exposures based on two guidestar reference exposures and the system's guiding method (guidescope, OAG, etc).
- Once objects are selected for imaging, a session plan for the combined set of targets will be created automatically that can be imported into automated acquisition software such as CCDAutoPilot. Information about the session plan can be viewed including its start and end times, duration, and the targets that will be imaged including an initial LRGBH allocation for each target. The LRGBH allocation is easily modified and separate binning controls as well as exposure duration for each filter is also provided. Two methods of acquiring the frames are provided - "Staircase" sequencing which schedules the frames based on the elevation of the object to maximize resolution while minimizing blue extinction and "Shuffle" sequencing which cycles between the filters to ensure getting some frames through each filter. Up to ten filters can be used simultaneously. The session plan uses the optimal order of the targets to maximize your time for imaging them and it conveys the target's co-ordinates and rotation angle for the camera and an guiding exposure so an autoguider will be properly positioned and operate. Full session sequences can be exported to CCDAutoPilot and Astronomer's Control Panel while single target sequences can be exported to MaxIm DL and CCDSoft.
- Target lists can be exported and re-used later in a session plan. This preserves the autoguiding position and guide star information set up by EZ-Guide so a session plan for the targets can be quickly created with the same setup used previously..
- The user can maintain a personal catalog of targets ("*Favorites*") which is checked by CCDNavigator. If a target on the *Favorites* list is available for imaging, the user is alerted when CCDNavigator initially runs or whenever the session date is changed. The "*Favorites*" list can be used exactly as any catalog but can be supplemented with objects that might not be present in the other catalogs.
- Dark cycle information for the next 12 months can be calculated and displayed or exported to Outlook or iCal

calendar programs.

- Your site and camera information can be saved and later retrieved so you can easily switch between different locations and equipment configurations. Site and camera combinations can be saved as profiles so imagers with multiple sites can switch between them easily.

