# DSO Planner v3.1.0

## Advanced User Guide

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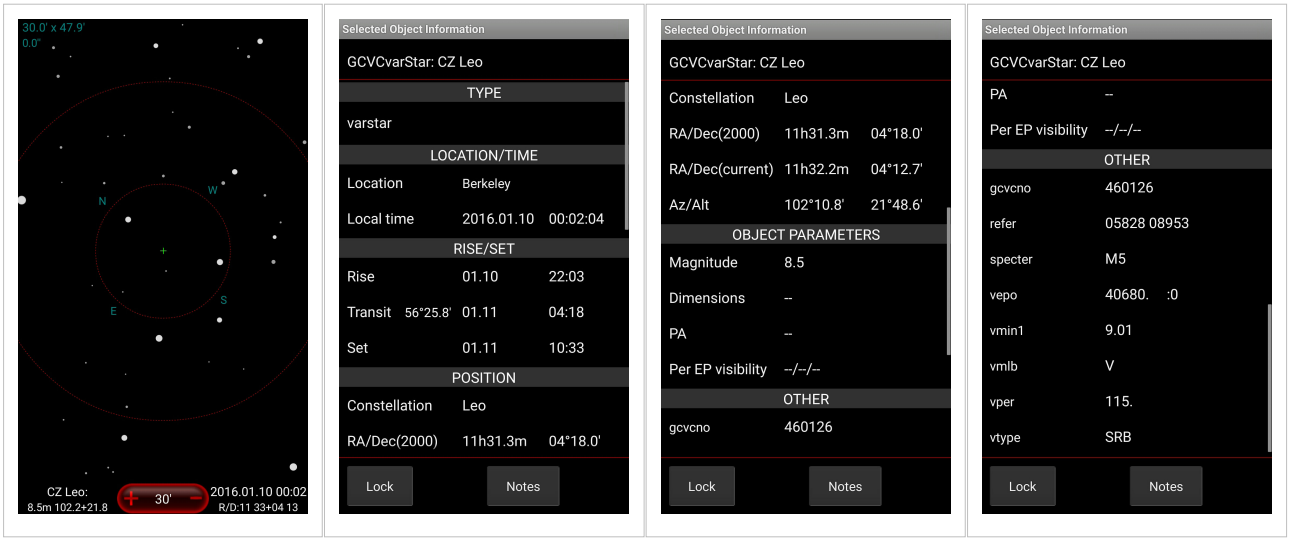
# Main Page

for Android smartphones and tablets!

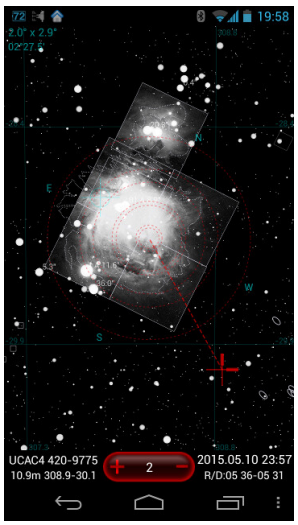
## What's new

The **free** fully functional General Catalog of Variable Stars (GCVS) [1] database file, adding all of its 47'987 variable stars to your databases pool and to the Star Chart on demand is readily available on the brand new discussion board of our users' forum "Objects Databases Exchange"! The powerful importing feature of DSO Planner is explained there as well (with the additional Knowledge Base reference), along with the proposed format of the users databases exchange posts example and explanation. Please contribute your lists on that board [2] (registered members only).




## About DSO Planner app

DSO Planner is the astronomy observations' planning tool with excellent star charting capabilities. It is made by experienced amateur astronomers with a passion for visual observations. It has huge deep sky objects databases and provides an opportunity to create any number of user own object databases. DSO Planner boasts the largest star catalog among all Android astronomy applications (USNO UCAC4, 113 mn stars), making any paper star chart obsolete. It excels at creating observation plans on the fly, has powerful note taking capabilities, powerful objects databases features, allows observing information sharing, works with settings circles' PushTo and computerized GoTo telescopes, and provides the best night (red) mode user interface for Android devices.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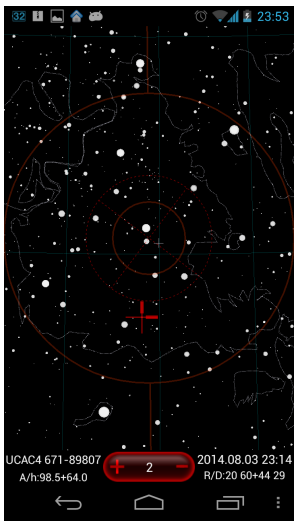
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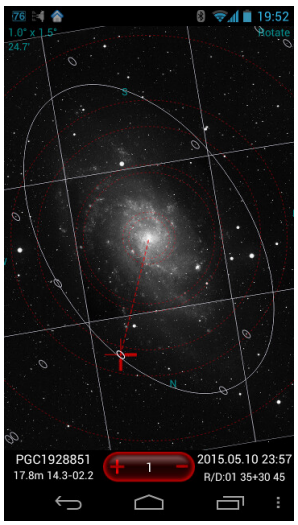
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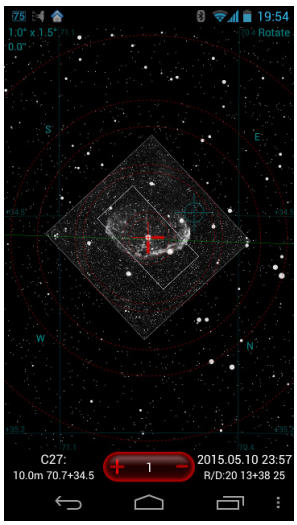
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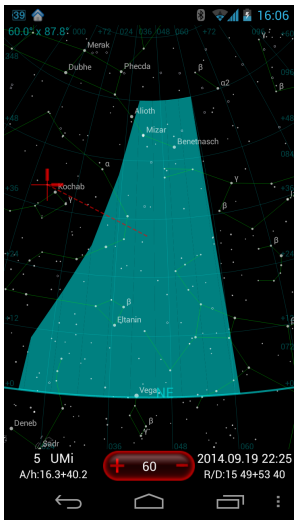
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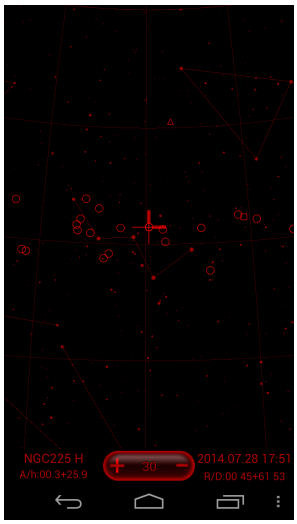
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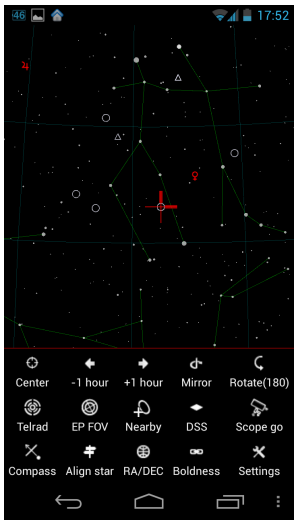
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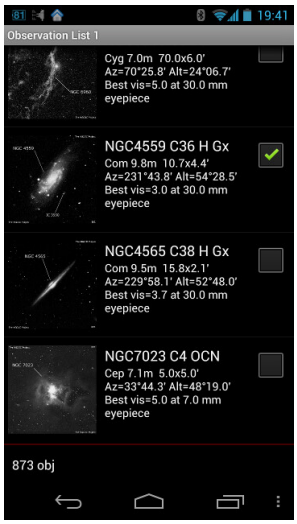
Center
-1 hour
+1 hour
Mirror
Rotate(180)
Telrad
EP FOV
Nearby
DSS
Scope go
Compass
Align star
RA/DEC
Boldness
Settings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eyepiece
NGC4559 C36 H Gx
Com 9.8m 10.7x4.4'
Az=231°43.8' Alt=54°28.5'
Best vis=3.0 at 30.0 mm
eyepiece
NGC4565 C38 H Gx
Com 9.5m 15.8x2.1'
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eyepiece
NGC7023 C4 OCN
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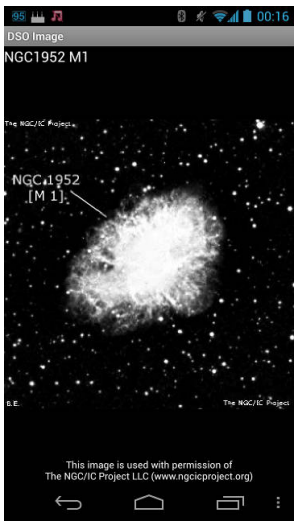
eyepiece
873 obj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DSO Image
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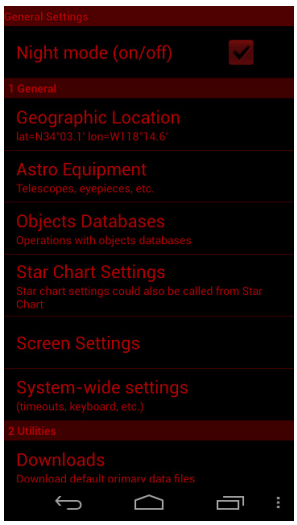
NGC1952
[M 1]
This image is used with permission of
The NGC/IC Project LLC (www.ngcicproject.org)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Night mode (on/off)
1 General
Geographic Location
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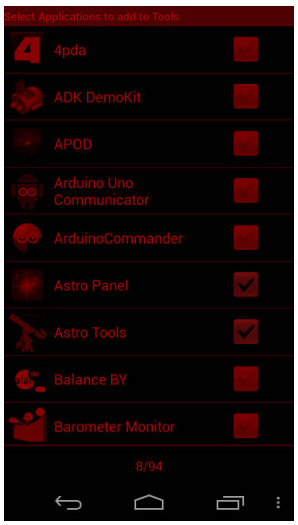
Astro Equipment
Telescopes, eyepieces, etc.
Objects Databases
Operations with objects databases
Star Chart Settings
Star chart settings could also be called from Star Chart
Screen Settings
System-wide settings
(timeouts, keyboard, etc.)
2 Utilities
Downloads
Download default primary data files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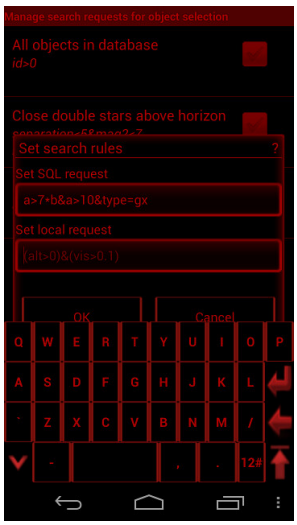
APOD
Arduino Uno Communicator
ArduinoCommander
Astro Panel
Astro Tools
Balance BY
Barometer Monitor
8/94


Manage search requests for object selection
All objects in database
id>0
Close double stars above horizon
Set search rules
Set SQL request
a>7*b&a>10&type=gx
Set local request
(alt>0)&(vis>0.1)
OK
Cancel

## Note

Before installation please make sure that you have at least 2 GB of free space on your internal SD card to download application databases!

## Brief features list

- Star catalogs: USNO UCAC4 (full star coverage up to 16m, 113 millions of stars - the largest star catalog ever available on Android platform, exclusively in the DSO Planner PRO), Tycho-2 (2.5 mn stars), Yale bright star catalog (9 000 stars).
- Deep sky objects catalogs: NGC/IC (12 000 objects including Messier, Caldwell and Herschel 400 objects), SAC (Saguaro Astronomy Club database, 10 000 objects), UGC (13 000 objects), Lynds Dark and Bright Nebula (3 000 objects), Barnard Dark Nebula (350 objects), SH2 (300 objects), PK (1 500 planetary nebula), Abell Clusters of Galaxies (2 700 objects), Hickson Compact Group (100 objects), PGC (1 600 000 galaxies).
- Double Star catalog: Brightest Double Stars (2 300 stars), Washington Double Star Catalog (120 000 stars), double stars from Yale catalog. Details panel with PA and separation for each component.
- Bright Comets: Orbital elements of around 700 observable comets; can be automatically updated over the Internet.
- Minor planets: Database of 10 000 brightest minor planets.
- Famous Steve Gottlieb Notes automatically attached to the NGC/IC objects details data.
- Custom user made catalogs: you can create or import fully searchable personal catalogs of any celestial objects you like to have charted.
- Object names cross-matching database: Search for objects by their less common names.
- DSS (Digital Sky Survey) imagery support: Download DSS images of any sky region into the offline cache and show the image on the star chart as an aligned overlay.
- Offline objects images: Integrated set of images for most of the objects from NGC/IC catalog, add your own images to custom user database records.
- Constellation boundaries.
- Nebula contours. Contours of famous nebulae.
- Milky Way Contours.
- Objects outer contours.
- The best in the industry Night Mode: Shades of deep red color scheme with custom red keyboard, menus, and floating Android navigation buttons - suitable for working in the "black" light pollution zones.
- Advanced and practical star hopping aids: Customizable oriented Telrad overlay, Eyepieces FOV overlay with RA/DEC guides and compass, directional guide, oriented object marker, target locking and centering, manual control of stars' boldness gradient individually per FOV level, fast mirroring and rotation of the chart.
- PushTo-like pointing technique support for dobsonian mounts with setting circles. Level your dobsonian mount and perform one star alignment. The app will automatically recalculate az/alt numbers to easily hunt the object
- GoTo serial protocols support for Meade and Celestron controllers using an arbitrary Bluetooth dongle.
- Eyepieces and CCD FOV overlay support (the finderscope FOV can be simulated as well).
- Night Planning tool: Use your particular geo-location, sky conditions, astronomical equipment, expected time range of observation, as well as the target objects features (type, dimensions, magnitude, minimal altitude, visibility, and any other custom data fields of your own catalogs) to filter objects available to observe on the night in the matter of minutes. Remove duplicate objects when searching in intersecting databases. Sort the observation list by the set time or primary parameters of the objects. Create up to 4 switchable observation lists to use simultaneously. Track and document your observations progress.
- Unique true visibility calculation algorithm, filtering the objects list out of any objects, which visibility quality is below the user defined threshold value, based on the selected observing equipment and the current sky conditions.

- Data Import tool: Import observation lists in the DSO Planner native, Sky Safari, and Sky Tools format. Use pre-compiled Night Sky Observer's Guide observation lists.
- Individual observations notes taking: Take and maintain textual and/or audio notes for observed objects within the app.
- Flexible observing location setup: user database, GPS fix, manual coordinates input, list of 24 000 cities worldwide to select from.
- Equipment database: Keep track of all your telescopes and eyepieces (including the CCDs). DSO Planner can use them for the true object visibility calculation and for the Star Chart marking. The 500 popular eyepieces database is provided for easy input of your eyepieces optical parameters.
- Standalone Twilight Calculator: Easy to read worksheet displaying periods of the maximal darkness on a given night, as well as for 30 days ahead.
- Two visual themes of the user interface (bright and dark).
- Dual screen mode with the Side Chart complementing objects lists (great for tablets, but works on phones as well).
- Powerful share/export/import capabilities for all of the DSO Planner databases, observation lists, and observation notes.
- Enormous possibilities for the look and feel customization of the app through the highly organized options menus.
- User settings and custom data backup capabilities.

## References

[1] http://www.sai.msu.su/gcvs/intro.htm
[2] http://forum.dsoplanner.com/index.php?topic=730.0

# Introduction

# Overview

## About

DSO Planner is the astronomy observations' planning tool with excellent star charting capabilities. It is made by experienced amateur astronomers with a passion for visual observations. It has huge deep sky objects databases and provides an opportunity to create any number of user own object databases. DSO Planner boasts the largest star catalog among all Android astronomy applications (USNO UCAC4, 113 mn stars - Pro edition), making any paper star chart obsolete. It excels at creating observation plans on the fly, has powerful note taking capabilities, powerful objects databases features, allows observing information sharing, works with settings circles' PushTo and computerized GoTo telescopes, and provides the best night (red) mode user interface for Android devices.

The application has several editions: Pro, Plus, Basic and Free. Plus Edition has reduced size UCAC4 catalog (15.4 mn stars compared to 113 mn stars in Pro Edition) and PGC catalog size (153 000 galaxies compared to 1 600 000 galaxies in Pro Edition), otherwise it has all of the functionality of Pro Edition. Basic Edition has even more reduced databases of stars and objects and some limitations in functionality (you cannot create your own databases or objects). Free edition has only the brightest stars and objects and functionality close to that of Basic Edition.

Before installation please make sure that you have at least 2 GB for Pro Edition, 540 MB for Plus Edition and 100 MB for Basic Edition of free space on your internal SD card to download application databases! (**Note**: *due to Google Play rules this data cannot be moved to your external SD card - you must have all this space on your internal SD card!*).

## Select features

(of the Pro edition, see above charts for other editions limitations)

- **Cross-match names database —** Search objects by less common names.
- **Unique visibility tool —** Only objects that are visible with selected equipment in the current sky conditions could be shown on the Star Chart (for objects from NGC/IC, SAC, PGC catalogs).
- **Comet support —** Orbital elements of around 700 observable comets could be automatically updated via internet.
- **Custom catalogs —** Unlimited capability to create fully searchable own catalogs.
- **Steve Gottlieb Notes —** Famous notes attached to NGC/IC objects.
- **DSS imagery support —** Download DSS images of any sky portion into offline cache and overlay it on the star chart.
- **Offline images —** Integrated set of images of most NGC/IC objects (7 840 items), opportunity to add own images when creating custom catalogs.
- **Nebula contours —** Contours of famous nebulae.
- **Object contours —** Ellipse in real dimension and orientation.
- **Night mode —** Fully red screen with red keyboard, menus, floating Android navigation buttons.
- **PushTo for dobsonian mounts with setting circles —** Level your dobsonian mount and perform one star alignment. The program will automatically recalculate az/alt numbers to hunt objects easily.
- **GoTo —** for Meade and Celestron controllers with bluetooth dongle.

- **Planning tool —** Filter any objects database by observer location, sky condition, astronomical equipment, time range of observation and object features (type, dimension, magnitude, minimal altitude, visibility and other fields of own custom catalogs). Remove duplicate objects when searching in intersecting databases. Create up to 4 observation lists. Easily track observed and remaining to be observed objects with note taking tool.
- **Import tool —** Import observation lists in Sky Safari and Sky Tools format. Use pre-compiled Night Sky Observer Guide observation lists.
- **Note taking —** Take text and/or audio notes.
- **Observing places —** GPS, manual coordinates, custom lists. Database with 24 000 cities worldwide.
- **Equipment —** Keep track of all your telescopes and eyepieces. Use them for object visibility calculation and star charting. Use 500 popular eyepieces database.
- **Twilight calculator —** Sun and Moon rise/transit/set time; Moon phase; civil, nautical and astronomical twilight on any date. Calculation of the full darkness for a current night and for a month ahead.
- **2 visual themes —** bright (black on white) and dark (white on black), plus - the night mode (dark red on black).
- **Powerful share/export/import capabilities —** common tool for databases, observation lists, and notes.

# Internal databases

| Database | Free | Basic | Plus | Pro |
|---|---|---|---|---|
| **Star Chart Layers** | | | | |
| USNO UCAC4 (star) | — | — | 15.4 mn to 14m | 113 mn to 16m |
| Tycho-2 (star) | — | 0.6 mn to 10.7m | 2.5 mn to 12m | 2.5 mn to 12m |
| Yale bright star catalog (star) | 9 000 | 9 000 | 9 000 | 9 000 |
| Yale bright star catalog (double star) | 50 | 500 | 3 100 | 3 100 |
| NGCIC/SAC (object) | 230 | 3 100 | 14 400 | 14 400 |
| PGC (Principal Galaxies Catalog) | — | — | 153 000 | 1 600 000 |
| **Object databases** | | | | |
| Messier | 110 | 110 | 110 | 110 |
| Caldwell | 109 | 109 | 109 | 109 |
| Herschel 400 | 219 | 400 | 400 | 400 |
| NGCIC | 230 | 3 100 | 12 000 | 12 000 |
| SAC (Saguaro Astronomy Club database) | — | — | 10 000 | 10 000 |
| UGC (Uppsala General Catalogue of Galaxies) | — | — | 13 000 | 13 000 |
| PGC (not including NGCIC and UGC galaxies) | — | — | — | 45 000 to 16m |
| Lynds dark nebula (Lynds' Catalogue of Dark Nebulae) | — | — | 1 800 | 1 800 |
| Lynds bright nebula (Lynds' Catalogue of Bright Nebulae) | — | — | 1 100 | 1 100 |
| Barnard (Barnard's Catalogue of Dark Objects) | — | — | 350 | 350 |
| SH2 (Catalogue of HII regions) | — | — | 300 | 300 |
| PK (Catalogue of Galactic Planetary Nebulae) | — | — | 1 500 | 1 500 |
| Abell (Catalogue of Abell Clusters of Galaxies) | — | — | 2 700 | 2 700 |
| Hickson Compact Group (Hickson Compact Group, cluster of galaxies) | — | — | 100 | 100 |
| Comets | — | ~700 | ~700 | ~700 |
| Minor Planets | — | 500 | 10 000 | 10 000 |

| | | | | |
|---|---|---|---|---|
| WDS (The Washington Visual Double Star Catalog) | — | — | 120 000 | 120 000 |
| Brightest Double Stars | — | — | 2 300 | 2 300 |

There are actually two types of star/object databases - usual object database optimized for efficient access and searching, and star chart layer database optimized for drawing Star Chart. Usual database could be used in Object Selection and Global Search, whereas star chart layers could be used in global search but not in Object Selection. Still there are enough tools to use the latter efficiently: you could limit the stars and objects displayed on the Star Chart by magnitude, object types and visibility in selected equipment.

| **Other databases** | **Free** | **Basic** | **Plus** | **Pro** |
|---|---|---|---|---|
| Preinstalled NGCIC images | 210 | 3 100 | 7 840 | 7 840 |
| Database of cross-match names (other star / object designations) | 1 700 | 72 000 | 233 000 | 233 000 |
| Database of SAO star cross-match names | No | 254 000 | 254 000 | 254 000 |
| Steve Gottlieb notes attached to NGCIC objects | 230 | 3 100 | 7 900 | 7 900 |
| Night Sky Observer Guide pre-compiled observation list (object) | — | — | 3 900 | 3 900 |
| 24 000 cities worldwide | Yes | Yes | Yes | Yes |
| 500 popular eyepieces database | — | Yes | Yes | Yes |

# Other differences of editions

| **Feature** | **Free** | **Basic** | **Plus** | **Pro** |
|---|---|---|---|---|
| Creation of custom (user) database | — | — | Yes | Yes |
| Adding a temporary user object to the observation list for a quick look up | — | — | Yes | Yes |
| DSS download in Star Chart | limited | Yes | Yes | Yes |
| Batch DSS download in Observation List | — | Yes | Yes | Yes |
| Bluetooth GoTo | — | Yes | Yes | Yes |
| Full darkness calculation | — | Yes | Yes | Yes |

# Quick Start Guide

## Object Selection

The application supports two approaches to object selection. The easier way is to turn on the Star Chart object layers (NGCIC/SAC, PGC) and either:

- set the limiting magnitude for each layer and field of view (FOV). All objects whose magnitude is below limiting will then be shown on Star Chart. Besides limiting magnitude you could also filter NgcIc/SAC layer by object types;
- or use the visibility filter for object layers to show only objects visible in your telescope.

The second approach is to look through several databases for objects to be observed using various filters in the Object Selection module, prepare observation list, and get its objects on the star chart automatically.

You could use each approach separately or combine them. For a separate use turn off the Object Layers option and fill the current observation list, or contrary — turn on object layers and clear current observation list (or switch to an empty one). For combination of both — turn on object layers and fill the current observation list. To distinguish objects from the observation list from layers' objects you could set the option to show labels for the list objects, as well as the option to dim layers' objects.

## Star Chart

The Star Chart shows stars and objects from the selected layers and *ALL* objects from the current observation list. For each FOV and layer you could adjust limiting magnitude to filter out too dim stars and objects from the screen (*keep in mind that the limiting magnitude in Range has no influence on how objects from current observation list are shown*).

Star Chart is highly customisable, there are many options in Star Chart Settings that help you adjust it to your needs.

By default, Star Chart depicts preinstalled Digitized Sky Survey (DSS) images and their contours. They are not objects in a usual sense, rather consider them belonging to DSS image layer. To download DSS image of any object or sky region select an object or a star, open Menu an select DSS. You can remove DSS image or download an image of adjacent area with long touch(es) over existing image or adjacent area.

## Object Selection

To search for objects go to Object Selection screen. Press **Select** button. Select object catalogs, set *Primary* as search type and configure Primary search (*e.g. set object types, minimum dimension, visibility or magnitude limit, minimum altitude*).

Also select your geographic location, observation time range and sky conditions. Return back and press "Update" button. Here you are, with the list of objects. You can sort them by name, constellation, type, magnitude or the viewing angle.

Tap the object to see it on the Star Chart. Mark objects you want to add to current Observation list (*note, that you may need to turn on "CheckBoxes" feature from the module menu first*), long tap on the list and select "Add marked to observation list" to add marked object(s) to the current Observation list (*after that they will become visible on the Star Chart*).

# Observations Lists

There are four slots for observations lists available. The current observations list content is displayed in the Observations Lists module. Objects on that list are displayed in the Star Chart module. You can quickly switch the current observations list slot from the module menu (to show it on the map or prior to populating it with objects using the Object Selection module).

There is an option to download DSS images for all objects in the current observation list using "DSS" main menu option of the module to display on the DSS overlay of Star Chart module. Use the main menu of the Observations Lists module for objects sorting, search, note matching, etc..

# Examples

## Bright objects to observe today

You need to set up search parameters only the first time. After that you may keep them or update only the necessary ones.

- **Star Chart/Menu/Settings/Star, object and image layers —** turn off NGCIC/SAC, and PGC layers
- **Object Selection/Select —** You come to Select Conditions screen
  - **Select object catalogs —** Messier, Caldwell, Herschel 400
  - **Select search type —** Primary
  - **Select Object types —** Select types of objects you wish to observe
  - **Primary search parameters/Filter type —** No filter
  - **Time of Observation —** Set up observation period, e.g. Begin Time - Astro Twilight Ends, End Time - Astro Twilight Begins
  - **Geographic Location —** Enable AutoLocation (if not already enabled).
- **Update —** Go back to the Object Selection module and tap **Update** button.
- **Add ALL to Observation List —** select that item in the Context menu (long tap on the list to open it), objects in the list are now shown on the star chart.

## Bright Comets to observe today

- **Settings/Object Databases/Comets/Update —** This updates orbital elements of Comets database and adds newly discovered comets (if not updated yet by auto updater)
- **Object Selection/Select —** You come to *Select Conditions* screen
  - **Select object catalogs —** Comets
  - **Select object types —** Comet
  - **Primary search parameters/Object minimal size —** 0
  - **Primary search parameters/Filter type —** Maximum magnitude filter
  - **Primary search parameters/Set maximum magnitude —** 12
- **Update —** Go back to the Object Selection module and tap **Update** button.
- **Add ALL to Observation List —** select that item in the Context menu (long tap on the list to open it), objects in the list are now shown on the star chart.

Alternatively, you could choose **No filter** as a **Filter type** to get all comets above horizon and then sort the resulting list by magnitude.

## All visible galaxies with dimension above 10 min

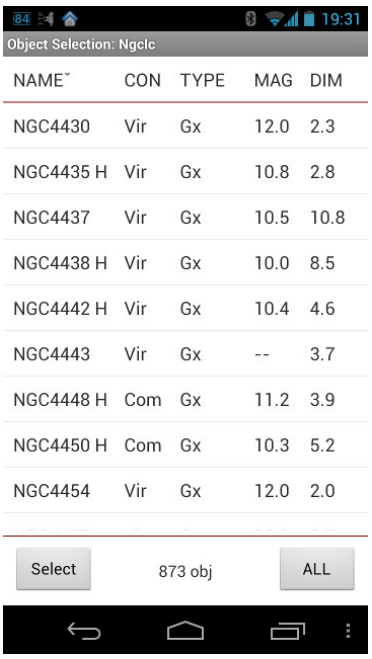
- **Object Selection/Select —** You come to *Select Conditions* screen
  - **Select object catalogs —** NgcIc, UGC
  - **Select search type —** SQL-like expression
  - **SQL-like expression —** Add new search request
    - **Set SQL Request —** Type: `type=gx&a>10`
    - **Set local request —** Type: `vis>0`
    - **Select this request**
- **Update —** Go back to the Object Selection module and tap **Update** button.
- **Add ALL to Observation List —** select that item in the Context menu (long tap on the list to open it), objects in the list are now shown on the star chart.

# Main Screen Modules

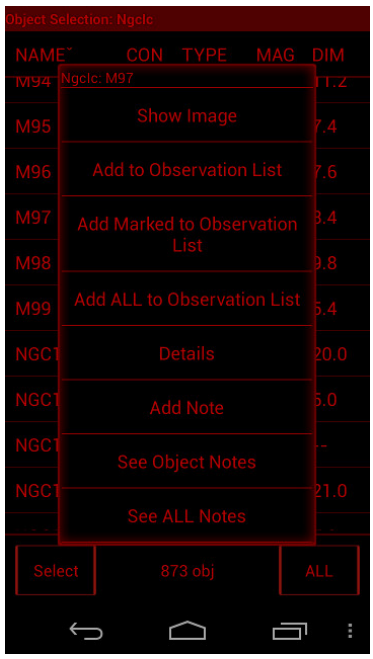
## Object Selection module

### Overview

Figure 1: Object Selection module screenshots




(using bright theme)




(in the night mode)

The Object Selection module provides a screen for easy management, selection, and filtering of different object databases (Figure 1).

- **Select/Update** button either takes you to the Select Conditions screen where you set object catalogs to search in and filter criteria (**Select** button), or performs a search in the selected catalogs based on filter criteria (**Update** button). After the search the list of objects from the current database complying with the filter criteria is displayed, and **Update** button turns into **Select** button. While the search is running the **Stop** button appears. Press it to stop the current search (e.g. if it takes too long). All objects found till the **Stop** button press will be displayed.
- **Select** button turns into **Update** button if some of the search criteria changes (e.g. location, observation time range, etc).
- **Constellation (ALL)** button on the right allows to filter search results by constellation.

Touching an object in the list takes to the star chart with a touched object in the center. Context menu provides a wide range of operations from forming observation list to note taking.

The list has the following columns: NAME, CON (constellation), TYPE, MAG (magnitude) and DIM (dimension). Touching column name sorts the list by that parameter. Second touch reverses the sort order.

# Main Menu

- **Search —** Global Search of an input string in all databases.
- **Export, Share —** convert list to text file and allow to share it with other applications.
- **Find, Next —** Search the list for a sub string of text in the object name.
- **CheckBoxes —** turn on/off display of checkboxes on the right side of the list, used to mark objects for batch operations (e.g. adding marked to the observation list).
- **Side Chart —** split the screen in 2 panels, adding the Star Chart view on the top (on the right in tablet mode). Touch object's record in the List to center the object on that Star Chart. Touch the record again or hold your touch on the Side Chart to show that object on the full screen Star Chart.

# Context Menu

- **Show image —** Show images for NGCIC objects, and custom catalog objects if they have ones.
- **Add to Observation List —** Add the object to the *current* observation list (one of the four). Current observation list could be changed in Observations Lists module.
- **Add Marked to Observation List —** Add marked objects to the *current* observation list.
- **Add All to Observation List —** Add all objects from the current Object Selection list to the *current* observation list.
- **Details —** Shows object's Details screen.
- **Add Note —** Shows Observation Notes module in the "Add new note" mode.
- **See Object Notes —** Shows list of notes made to selected object.
- **See ALL Notes —** Shows all notes in the Notes database.

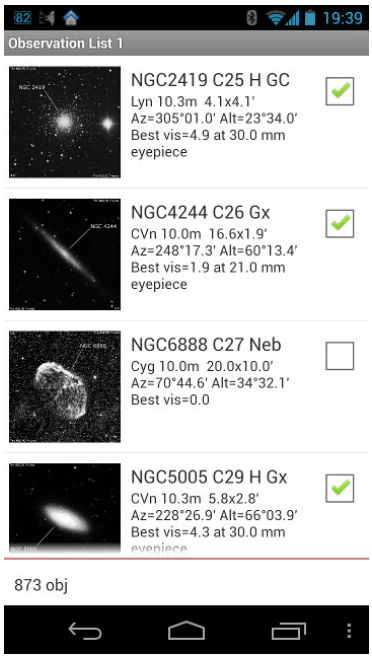
# Gestures

There are two simple flick gestures available, that could be called throughout the application for calling Menu and returning to the previous window.

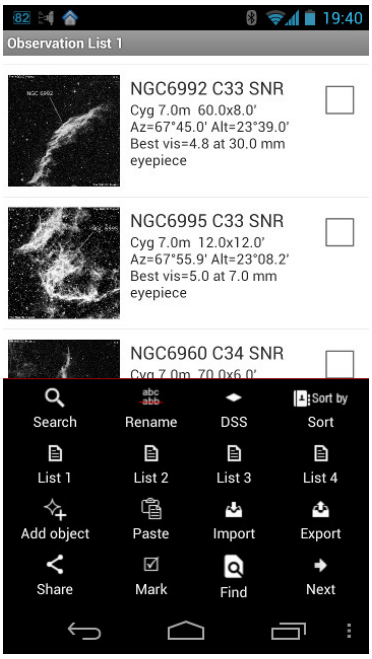
# Observations Lists module

## Overview

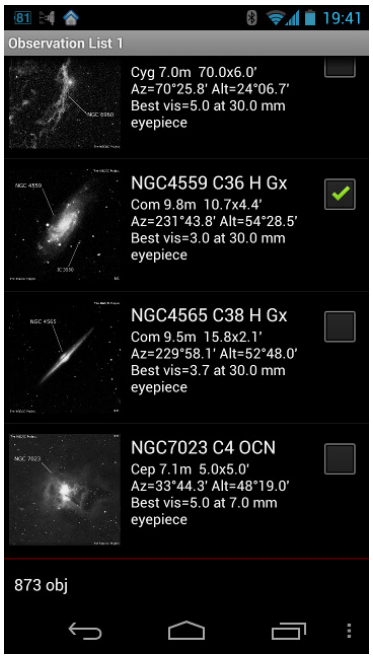
Figure 2: Observation List module screenshots




(using bright theme)




(main menu open)




(using dark theme)

Observation list shows a list of objects to be observed and corresponding object images if available (*Note, that images are available only for NGCIC objects and for custom catalogs' objects, provided that user has added them*) . To the right of an object — there is a checkbox indicating if user has observed it already. The check box could either be checked by a user directly or be checked automatically when taking a note for the object. Also it could be automatically checked by the Mark menu selector (see below).

Objects in the current observation list are those, which will be shown on the star chart (other objects will be hidden unless you turn on the layers feature). Also, depending on the Hide marked objects setting of star chart, you can hide marked objects from it (useful to avoid observing the same object twice over the night).

Touching an object in the list will open the Star Chart module with the that object centred and selected - ready to star hopping.

# Main Menu

- **Search —** Global Search of an input string in all databases.
- **Rename —** Rename current observation list.
- **DSS —** Download DSS (*Digitized Sky Survey*) images of observation list objects. Only images for objects absent on the offline DSS cache are downloaded. Requires Internet connection.
- **Sort by —** The list could be sorted by object name, constellation, magnitude, size and set time. The second selection of the same sort type reverses the sort order.
- **List 1-4 —** Select a current observation list.
- **Add object —** Add a temporary user object to the observation list for a quick look up. This object will not be associated with or added to any custom database.
- **Import —** Import external file with the list of objects.
  - Besides own format the app supports importing observation lists in Sky Safari and Sky Tools formats.
  - You could import pre-compiled Night Sky Observer Guide observation lists for each constellation into the current observation list.
  - When importing into non-named observation list from the file the file name is set as a list name.
- **Export —** Export list to text file.
  - When exporting named observation list its name is suggested as a file name.
- **Paste, Share —** Share the list with external applications.
- **Mark —** Mark objects in a batch for various operations.
  - **Mark objects with specific observation age (from 1 day to 12 month) —** The latest observation is derived from the object notes. This option is convenient to exclude recently observed objects from an observation list and the Star Chart to avoid observing them twice.
  - **Remove all marks —** Uncheck all items in the current observation list.
  - **Show/Hide Objects with marks —** Show/hide marked items in the current observation list.
- **Find, Next —** Search the list for a substring of text in the object name.
- **Side Chart —** split the screen in 2 panels, adding the Star Chart view on the top (on the right in tablet mode). Touch object's record in the List to center the object on that Star Chart. Touch the record again or hold your touch on the Side Chart to show that object on the full screen Star Chart.
- **Images —** Toggle on/off displaying the object's image thumbnail column in the List.

# Context menu

This is similar to Object Selection context menu.

- **Move —** You could change the object order within the observation list. Just press on list item to put the selected object before.
- **Show image —** Show images for NGCIC objects, and custom catalog objects if they have ones.
- **Details —** Shows object's Details screen.
- **Add Note —** Shows Observation Notes module in the "Add new note" mode.
- **See Object Notes —** Shows list of notes made to selected object.
- **See ALL Notes —** Shows all notes in the Notes database.
- **Remove from List —** Remove the object from the current observation list.
- **Remove Marked —** Remove all marked objects from the current observation list including hidden ones.
- **Remove ALL —** Remove all objects from the current observation list including hidden ones.
- **Edit —** Edit object parameters (this is applicable to temporary objects and custom catalog objects only).

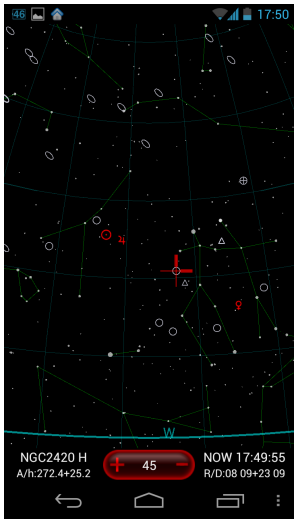
## Gestures

There are two simple flick gestures available, that could be called throughout the application for calling Menu and returning to the previous window.

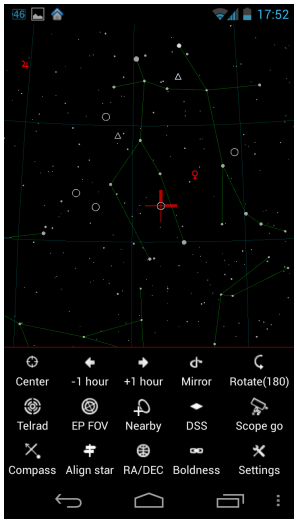
# Star Chart module

## Overview

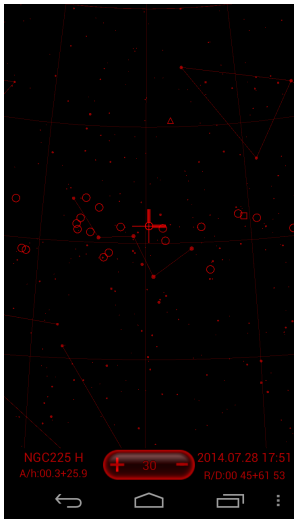
Figure 3: Star Chart module screenshots (click to zoom)



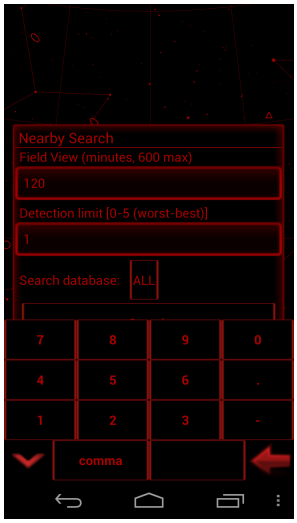

(typical screen)



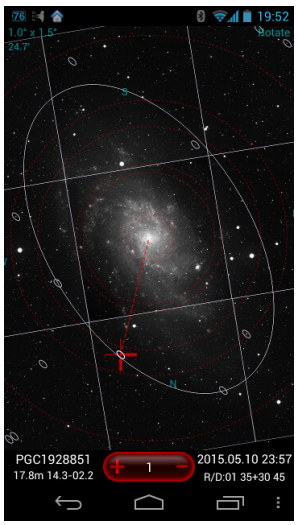

(main menu open)



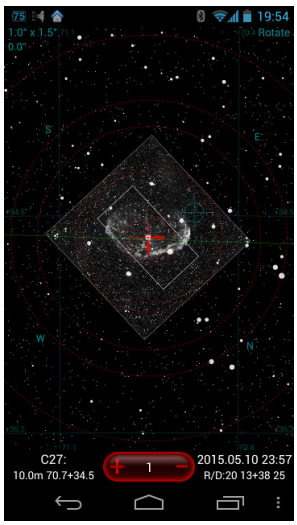

(in the night mode)



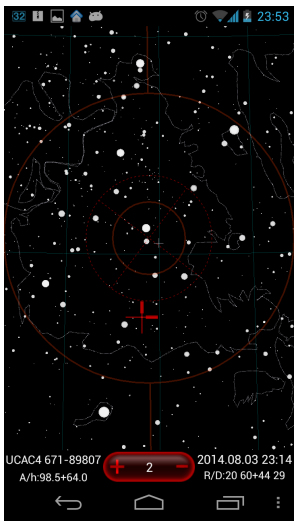

(night mode keyboard)



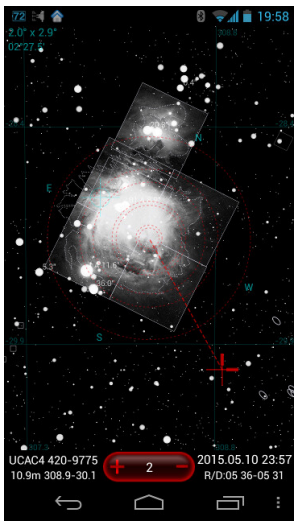

(9 patch DSS image with EP overlay)




(DSS and object size patch)




(DSO contour)




(custom DSS patches and contours)

Star Chart (Figure 3) shows stars and objects from selected layers and *ALL* objects from the current Observation list (OL). In the Settings menu you can select an option to limit OL objects to those without the check mark only (intended use - mark already observed objects in your OL to remove them from the chart).

Besides stars the Star Chart displays bright star and object labels (names, catalog numbers), bright planets, alt-azimuthal or equatorial grid, horizon line (mathematical and user defined shape), constellation figures lines and constellations boundaries, objects' contours and Milky Way contour, selected eyepieces field of view (red dotted circles), Telrad rings, square CCD FOV contour, selected object marker and hopping direction line, downloaded DSS images and their frames (useful to see where they are at a wide zoom of the chart).

## Chart's Layout

At the very top of the Chart you see the dynamic transparent notifications zone.

- In the top left corner you see the current chart FOV size (width and height), which might be complemented below by the angular distance of the selected objects from the previously selected one.
- In the middle of the top section you might see some system messages, like "Loading" note when the screen is pending long update (i.e. filtering the UCAC4 catalog), or "Battery Low XX%" (Night mode only).
- In the right top corner you might see "Mirror" note if the Chart displayed in left to right mirrored mode, or "Rotated" if the chart is in upside-down (180° rotation) mode.

At the bottom of the Chart you see the interactive Chart's Control Panel.

- In the bottom left corner you see the currently selected object's information.
  - First line is the short object's name (designation) and its object type, which might be followed by semicolon (:) marker if the object is from the current OL.
  - The second line displays object's magnitude and its current Azimuth and Altitude (apparent Azimuth and Altitude if the Aligned Settings Circles mode is in effect).
  - Tap on this side to open the Details screen with all of the information available for the selected object (offline data).
- In the middle of Control Panel you see the red zoom button with the current fixed FOV size value in angular degrees or minutes.
  - Tap in the middle to select the fixed FOV level from the drop down scrollable list (90°, 60°, 45°, 30°, 20°, 10°, 5°, 2°, 1°, 30', 15', 7.2', 3.6').
  - Tap + or - on the sides to increase or decrease the FOV level.
- On the right side of Control Panel you see the
  - Chart's time (day, hours, minutes). In case the Chart is in the Real Time self updating mode the Date will be replaced with "NOW" note.
  - The chart's center RA and DEC coordinates below the time line.
  - Tap on this side to open the Date/Time Picker panel where you can select a moment in time or start the Real Time clock drive, periodically updating the chart to current time.

General gestures are available from the Control Panel only.

## Object icons

- **ellipse —** galaxy
- **rectangle —** bright nebula, dark nebula, HII region, super nova remnant
- **triangle —** planetary nebula
- **circle —** cluster of galaxies
- **dashed circle —** open cluster, open cluster and nebula
- **circle with a cross —** globular cluster
- **filled circle with a horizontal crossing line —** double star
- **filled circle with a horizontal tail (3 short lines) —** comet
- **circle with a horizontal line —** minor planet

- **five angle star —** observation list star, asterism
- **small cross —** object from a user catalog with a user type, quasar

The chart also depicts icons of bright solar system objects: Sun, Moon, Venus, Mars, Jupiter, Saturn.

### Tips

To distinguish between objects displayed from the current OL and objects from the DSO layers you can either

- ask to show labels for the first, and not for the second;
- set diming object from layers option;
- watch for the colon (:) marker following the name of the selected object in the Control Panel.

By default, the double star info (component and separation) is shown as a double star label (can be disabled in the Chart's Settings, Double Star Info).

Layer objects can be limited either simply by their magnitude or by the visibility rate with the selected equipment given the current sky conditions (any objects impossible to see with your instrument will be automatically filtered out)

You can measure angular distance between any stars or objects. On each object selecting tap the distance from the previously selected object to the new one will be shown in the upper left corner of the Chart. You can turn that feature off within the **Other options** section of the Star Chart Settings.

## Main features

Depending on the current field of view (FOV) the program shows:

- Star Layers.
  - Yale Bright Star catalog for all FOV.
  - Tycho-2 layer for all FOV. There is a ceiling for limiting magnitude above 10° FOV (to avoid showing too many stars).
  - UCAC4 layer for FOV below or equal to 5°.
  - Limiting magnitude for each FOV and layer could be set in Menu/Layers.
- Object Layers.
  - PGC layer for FOV below or equal 30°.
  - NgcIc/SAC layer for all FOV.
  - Limiting magnitude for each FOV and layer and object types for NGCIC/SAC layer could be set in the Menu Range item.
- The program automatically changes the way it depicts objects (from an object icon to an ellipse or rectangle with real dimensions and orientation).
- The program starts showing downloaded DSS images below specified FOV (Max FOV to show DSS). The program comes with preinstalled DSS images of the brightest objects. You could download any other DSS images as you need.
- If available the program shows nebula contours instead of rectangle.

# Main Menu

- **Center —** Center selected object
- **-1 hour —** Move time one hour back
- **1 hour —** Move time one hour forward
- **Mirror —** Show mirror view of the sky
- **Rotate (180) —** Rotate sky view by 180 degrees
- **Telrad —** Show/Hide Telrad
- **Eyepieces —** Eyepieces database. Show/Hide eyepieces FOV
- **Nearby —** Search for nearby objects from selected catalogs within the specified field of view with the visibility above or equal to the specified detection limit
- **DSS**
  - Download a single DSS image (for small objects). The center of image coincides with current object marker position.
  - Download adjacent nine DSS images patch (simplifies downloading sky region for large objects).
  - Show/Hide DSS images; on the star chart.
  - Show/Hide DSS contours on the chart (DSS images remains in place).
- **Scope go —** GoTo for Meade and Celestron controllers with bluetooth dongle
- **Compass —** Turn on/off identifying stars and planets by holding the phone next to them. For Android devices with compass. You could choose among three compass modes
  - **Compass —** Tracks device center movement and adjusts star chart accordingly. Star chart is not adjusted for device rotation around the line perpendicular to device plane
  - **Compass Level —** Tracks device center movement and its rotation
  - **Level —** Tracks device rotation around the line perpendicular to device plane. Star chart is not adjusted for device center movement. To look for specific object make sure that direction line is turned on, select this object with object marker, turn either *Compass* or *Compass+Level* mode and follow direction line from the center of the screen which will guide you to the selected object eventually.
  - **Off —** Disable compass.
- **Align star —** PushTo for dobsonian mounts with setting circles
- **RA/Dec —** Set the screen center at the specified RA/Dec (Epoch 2000) and mark it position with a special marker
- **Boldness —** Set star sizes
- **Layers —** Set limiting magnitude for each FOV and star/object layer. Set object types for NGCIC/SAC layer
- **Search —** Global Search of an input string in all databases
- **Settings —** Additional Star Chart Settings

# Gestures

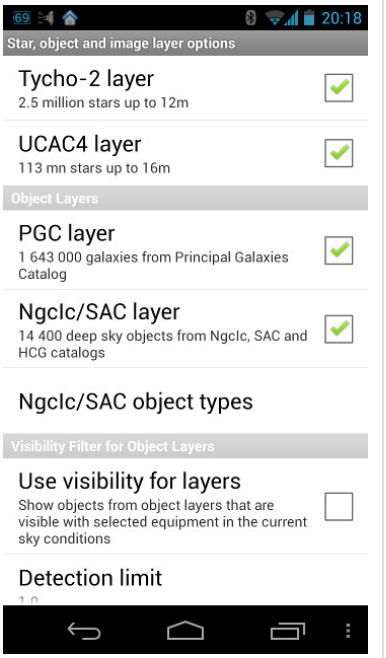
These gestures are specific for the Star Chart only, the general Gestures are working from the Control Panel only (at the bottom of the chart).

- **Finger movement —** Move the Star chart
- **Pinch-to-zoom gesture —** Increase/diminish field of view
- **Long touch —** Show/hide control/information zone
- **Long touch on DSS image —** Select DSS image
- **Long touch on selected DSS image —** Show DSS image menu
- **Long touch near selected DSS image —** Select an area adjacent to DSS image
- **Long touch on selected area near DSS image —** Show DSS image menu. This is convenient to download several adjacent DSS images covering large objects

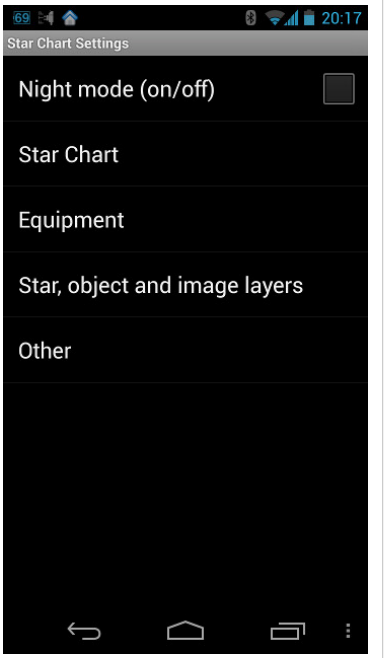
- **Touch on star/object —** Select a star/object. Put a marker on it
- **Flick up/down on the left screen side —** Increase or decrease screen brightness provided that the relevant setting is set. **Note** that in case the "Minimal brightness mode" is set in the "Screen Settings" - the brightness of the screen will be reset to a minimal one on exit from the Chart.

# Star Chart Settings

Figure 4: Star Chart Settings screenshots




(using bright theme)




(using dark theme)

See (Figure 4).

- **Night mode (on/off) —** Switch between day and night modes.
- **Star Chart**
  - **Object Marker**
    - **Enable Object Marker —** Show/Hide object marker (red cross).
    - **Settings —** Set orientation marks (bolder cross planks at N and E sides), direction line (the navigation aid line from the screen's center to the selected object), cross size, cross lines width.
  - **Star Chart elements**
    - **Grid —** Select grid type (Azimuthal, Equatorial, No grid).
    - **Constellations lines —** Show/Hide constellation figure lines.
    - **Constellations boundaries —** Show/Hide constellations sky regions border.
    - **Milky Way —** Show/Hide contour lines of Milky Way shape.
    - **Horizon line —** Show/Hide horizon line.
    - **Fill area below horizon —** If selected the area below horizon is filled with horizon color.
    - **Smooth hard line edges —** Anti-aliasing. May lower performance.
  - **Labels**
    - **Bright star labels —** Show/Hide bright star labels.
    - **Object labels (Obs List) —** Show/Hide labels for objects from observation list. This option could be used to distinguish observation list objects from star chart layer objects.

- **Double Star Info —** Show component and separation on the star chart for double stars from Yale Bright Star Catalog.
- **Object labels (Layers) —** Show/Hide labels for objects from star chart layers. This option could be used to distinguish observation list objects from star chart layer objects.
- **Grid labels —** Show/Hide grid labels.
- **Other labels —** Show/Hide other labels (zenith and nadir points, horizon compass labels).

- **Star Chart colors**
  - **Inverse sky —** In day mode black stars are shown on a white background.
  - **Daytime mode colors —** Set individual star chart elements colors manually (objects, cross-hair, eyepiece FOV, telrad rings, etc).
- **User Horizon**
  - **Enable User Horizon —** Show/Hide user horizon.
  - **Settings**
    - **File name with key points —** Select a text file containing user horizon data. If a file is already selected the program will suggest to update horizon from existing file. This is convenient when you update the text file on the fly and want to update your horizon in program as well.
    - **Line width —** Horizon width in pixels.
    - **Subdivision size in degrees —** Additional points are added between original points from the file to draw a smoother line on the sphere. Subdivision size is an azimuthal distance between these additional points. Larger number makes coarse line, small - may affect drawing performance.
    - **Fill area below horizon —** If selected the area below user horizon is filled with horizon color.

- **Equipment**
  - **Telescope**
    - **Telescopes Database —** Select a preferred instrument for observations.
    - **Show adjusted Az/Alt —** Enable to see adjusted az/alt for dobsonian mount with setting circles (PushTo).
    - **GoTo mount settings —** Setup BT controller connection.
  - **Eyepieces overlay**
    - **Eyepieces Database —** Select eyepieces for observations.
    - **Nested FOV rings —** Show/Hide eyepieces overlay.
    - **Cardinal direction labels —** North, South, East, West labels around eyepiece ring.
    - **Guide lines —** RA/Dec guide lines within eyepiece FOV.
  - **Telrad overlay**
    - **Telrad rings —** Show/Hide telrad overlay.
    - **Settings —** Fine settings (ring diameters, marks angle, ring width).
  - **Level and Compass**
    - **Disable down tracking —** Turn off tracking when pointing down.
    - **Alpha —** New point weight. The lower the alpha the smoother the compass, but the slower its speed. Higher alpha raises compass speed, but introduces noise and jitter.
- **Star, object and image layers**
  - **Star Layers**
    - **Tycho-2 layer —** Show/Hide stars from Tycho-2 catalog.
    - **UCAC4 layer —** Show/Hide stars from UCAC4 catalog.
  - **Object Layers**
    - **PGC layer —** Show/Hide galaxies from PGC catalog.
    - **NGCIC/SAC layer —** Show/Hide deep sky objects from NGCIC, SAC and HCG catalogs.

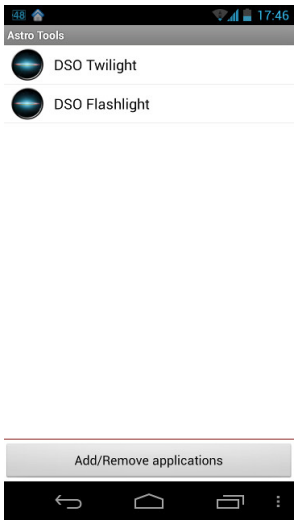
- **NGCIC/SAC object types —** Select object types to be shown for NGCIC/SAC catalog.
- **Visibility Filter for Object Layers**
  - **Use visibility for layers —** Objects in Object Layers are set to obey the Visibility Filter rules instead of the hard magnitude limit.
  - **Detection limit —** Only objects with visibility above or equal to detection limit are shown.
  - **Sky limiting magnitude —** The magnitude of faintest stars at zenith. Used for visibility calculations.
- **Options**
  - **DSO**
    - **Show near to real DSO shape —** Show elliptical shape at high zoom level.
    - **Zoom level for real size ON —** FOV ceiling for showing DSO real shape. For FOV above the ceiling DSO icon is shown, for FOV below the ceiling real shape is shown taking into account Scale factor for real DSO shape (see below).
    - **Scale factor for real DSO shape —** DSO is shown in real shape if its screen dimension is higher than that of DSO icon multiplied by scale factor. Set it to zero to show any (even the smallest) object in real size.
    - **Scale factor for DSO signs —** Set scale factor for reducing/enlarging DSO icons.
  - **DSS (Digitized Sky Survey)**
    - **Enable DSS imagery support —** Show/Hide downloaded DSS images on star chart.
    - **Display DSS contours —** Show/Hide DSS contours.
    - **Max FOV to show DSS —** Threshold FOV for showing/hiding downloaded DSS images.
    - **DSS images dimmer —** Dimmer downloaded DSS images in night mode.
- **Other**
  - **Real Time**
    - **Realtime mode —** Enable/disable realtime mode where the time and star chart are updated automatically using internal device clock.
    - **Auto update period —** Set the period for auto updating in real time mode.
    - **Real time screen update**
      - **Update screen for all FOVs —** In realtime mode screen is updated irrespective of magnification.
      - **Do not update screen for FOVs less or equal —** Screen is not updated for a FOV less or equal the threshold set here (this may be convenient when looking for objects at high magnification, so they don't jump out of the screen on update). Note that when the Chart FOV is under the threshold the Time panel (bottom right corner of the Chart) behaves as if the RT mode is OFF.
      - **Update screen and auto center selected object for FOV less or equal —** If enabled the selected object is auto centred in realtime mode for FOV less or equal the threshold set (this may be convenient to trace moving objects at high magnification).
    - **FOV threshold —** The threshold for the above dialog.
  - **Distinguishing observation list objects**
    - **Observation list object mark —** A colon ":" is put after the name of selected observation list object.
    - **Dim objects from layers —** Observation list objects are highlighted relative to objects from layers.
    - **Object labels (Obs List) —** Show/Hide labels for objects from observation lists. This option could be used to distinguish observation list objects from star chart layer objects.
    - **Object labels (Layers) —** Show/Hide labels for objects from star chart layers. This option could be used to distinguish observation list objects from star chart layer objects.
  - **Miscellaneous**
    - **Angular measurement —** Measure angle between two successive objects selected.

- **Center Object —** If enabled object is centred on double touch or on getting info in control and information zone.
- **Hide marked objects —** Hide marked objects from the current observation list on star chart.
- **Brightness Flick —** Use flick on the left side of the Star Chart to control brightness.
- **Battery level warning —** Set a minimum level to show a reminder that a charge is required.

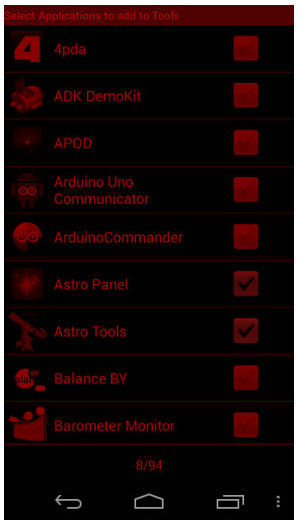
# Tools module

## Overview

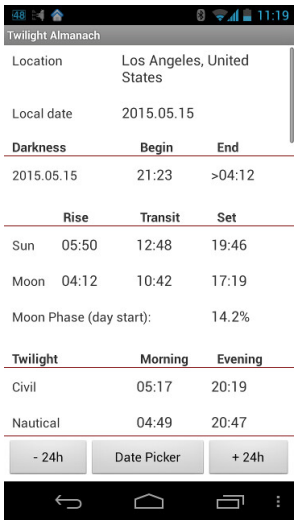
Figure 5: Astro Tools module screenshots




(default integrated apps, bright theme)




(external apps selection screen)




(integrated Twilight Calculator tool)


(darkness prediction calendar)

The Tools module is the home of the DSO Planners mini tools "DSO Twilight" and "DSO Flashlight". More tools could be added later there. In addition, it allows DSO Planner to serve as a simple mini launcher for select number of apps, which you might need close at hands while observing in the dark or preparing for observations.

## App Launcher

Use **Add/Remove applications** button at the bottom to initiate search of astronomy apps on your Android device. The App will attempt to mark all of the astronomy related apps installed on your device, however false positives possible. So, just scrollthrough the list and manually mark or unmark apps you want to include in the module's screen (Figure 5). At the top of the list you will always see the integrated applications:

## DSO Twilight Calculator

**DSO Twilight —** Calculates for the current date:

- Rise, Transit, and Set time for Sun and Moon.
- Moon phase.
- Civil, Nautical, and Astronomical twilight time.
- Periods (time intervals) of the darkest sky through the night and for 30 days ahead.

The calculation algorithm for periods of maximal darkness takes into account the Moon's rise/set/phase data. Rotate your device into landscape orientation for more comfortable view of the darkest periods data.

## DSO Flashight

**DSO Flashlight —** Simple adjustable flashlight, utilizing screen of the device as a dim light source. Both white and red light are available. Controlled by flick gestures:

- Swipe up and down - increases and decreases general brightness.
- Swipe left and right - changes the color from dark grey to white (or dark red to bright red in Night Mode).
- long tap turns the flashlight on and off (making screen black).

(turn it on and see basic instructions).

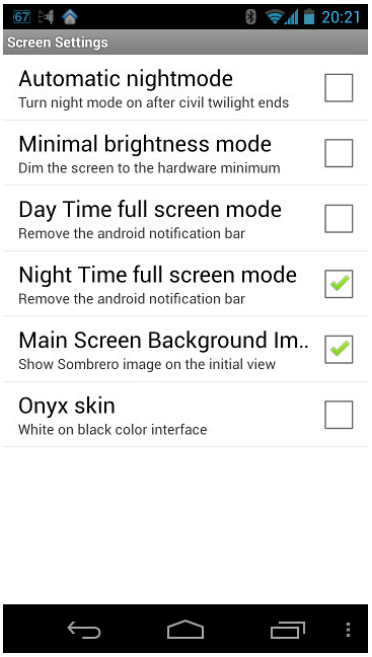
## Note

DSO Planner cannot force external applications, registered in the Tools module, into the night mode. Only apps' icons in the Tools module are in night colors. Be cautious when you tap any external app in the Tools mini launcher, if you don't use protective red film over your screen - your eyes darkness adaptation might be ruined.

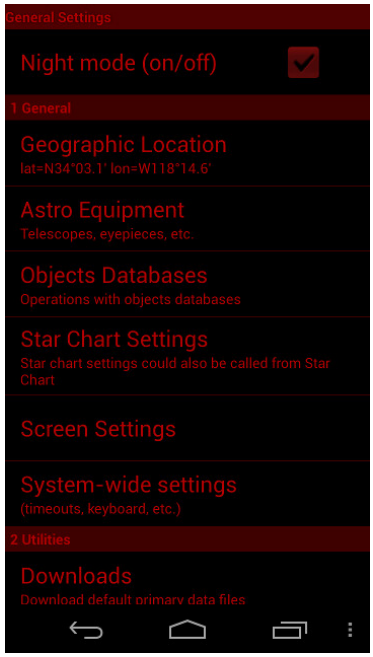
# Settings module

## Overview

Figure 6: Settings module screenshots




(using bright theme)




(using night mode)

These are the application main settings (apart from Star Chart settings). This module also provides a direct access to object databases.

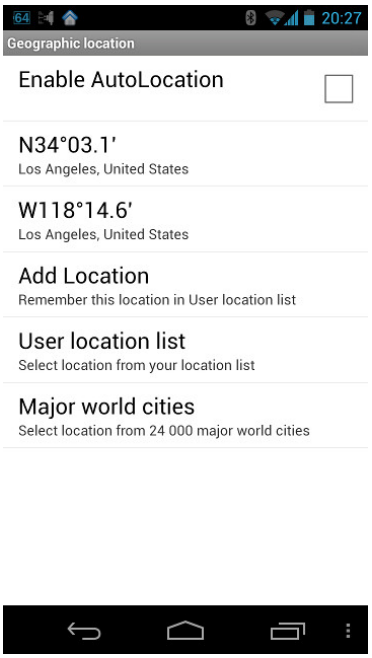
# Night Mode

Dedicated item to quickly turn on or off the Night mode at the very top of the module screen.

# 1. General

## Geographic location

Figure 7: Geographic location module screenshots




(using bright theme)


(major world cities)

Defines coordinates of the observation location (Figure 7).

- **Enable AutoLocation —** Enable/Disable auto location by GPS, network etc. If you want to use GPS as a location provider turn it on first. The program uses the best provider available at the moment (e.g. GPS if it is turned on, network if GPS is turned off). It queries current location provider once an hour. If no fix is available the last known location for the current provider is used.
- **Manual coordinate setting —** tap on two lines below **AutoLocation** to change location values, disabled if AutoLocation is ON.
  - **Latitude —** Use the following format when setting latitude: *N34 10 01* or *S34 10 01*. N/S stands for North/South latitude. The value is 34 degrees 10 minutes 1 second. Minutes and/or seconds could be omitted. The name of the closest major City is displayed below the value.
  - **Longitude —** Use the following format when setting longitude: *W118 10 01* or *E118 10 01*. W/E stands for Western/Eastern longitude. The value is 118 degrees 10 minutes 1 second. Minutes and/or seconds could be omitted. The name of the closest major City is displayed below the value.
- **Add location —** Add current location coordinates to your personal locations database (List).
- **List —** Open your personal locations database and select the location to use. You can Export/Import locations from/to the list.
- **Major World Cities —** Select location from the list of 24,000 major cities of the world.

The new observation location will be immediately recognized throughout the app by one of the nearest cities from the major world cities database, if the place is less than 20 kilometers (12.4 miles) away from the city or by closest user defined location if less than 5 km (3 mile) away.

## Astro Equipment

- **Telescopes Database —** Select the current instrument for observations.
- **Eyepieces Database —** Select eyepieces for observations and/or CCDs for imaging.
- **GoToMount Setup —** Paired device and telescope type selection (Meade/Celestron). You need to turn on bluetooth first.

## Objects Databases

Work with the list of integrated and user's sky objects databases. See the dedicated Objects Databases chapter.

## Star Chart Settings

See the Start Chart Settings dedicated page here.

## Screen Settings

- **Automatic nightmode —** When selected the program automatically turns on night mode after civil twilight ends.
- **Minimal brightness mode —** Wherever possible resets screen brightness to the minimum. Also overrides Star Chart gesture settings on exit.
- **Day Time full screen mode —** Android notification bar removed in day mode.
- **Night Time full screen mode —** Android notification bar removed in night mode.
- **Main Screen Background Image —** Show Sombrero image on initial view.
- **Onyx skin —** Set white on black color interface throughout the application.

## System-wide settings

- **Disable auto sleep in Star Chart mode —** Automatic Android power saving mode, turning the screen off, will be disabled for the Star Chart module.
- **Disable Night keyboard —** If selected android default keyboard is used in the night mode. This may negatively affect night vision.
- **Auto-dismiss Warnings —** Set a period after which application warning and information messages will be closed.
- **Auto update comet elements —** The app suggests to update comet database when new orbital elements are available on [www.minorplanetcenter.net]. In the dialog you could press **Cancel —** to postpone update till the next orbital elements become available or **Hide —** to turn the notification off. To turn the notification on just activate this item again.
- **Floating Back/Menu buttons —** Enable Android navigation buttons' substitute solution in assistance of the true night mode maintenance on some devices (notably tablets) with virtual navigation buttons shown at the bottom of the screen. You can either disable them completely in the Android System Settings or/and tape the bottom portion of the screen with some masking tape to ultimately hide them behind. These substitute control buttons (Back and Menu) will be displayed as a semitransparent overlay at the bottom portion of every screen of the app **in the Night Mode only**.

# 2. Utilities

## Downloads

This allows to download/redownload application databases (expansion pack and patch). Expansion pack and patch are usually downloaded automatically when application is installed. You need to download them only if there is a warning at the start of application that the expansion pack or patch is missing. Download is permitted via Wi-Fi connection only due to large file size. Start download by long-touching the *Expansion pack* title.

Before installation please make sure that you have at least 2 GB for Pro Edition, 540 MB for Plus Edition and 100 MB for Basic Edition of free space on your internal SD card to download application databases! (Note: due to Google Play rules this data cannot be moved to your external SD card - you must have all this space on your internal SD card!). If you redownload expansion pack or patch (they had been downloaded already) no additional free space is required - the application will automatically remove the old files.

## Reinstall

Issue the Reinstall Application Databases command, which might be required after major app updates.

## Backup/Restore

Backup and restore of application user databases (object databases, observation lists, instruments, notes, locations, advanced search requests) to *SD card /DSOPlanner/backup* folder. This may be needed if you would like to use the same databases on another device. Please note that when restoring the databases all existing user databases will be removed and replaced by the databases from the backup. To be on the safe side, we recommend to backup the most critical information into the text format as well (Import/Export).

## Quick Start Guide

Show the brief user guide, which was shown after the initial app's installation.

## What's new

Show the developers' note on the versions history.

## Rate

Open app's page on Google Play, so you can update or rate it conveniently.

## Localize

[lContact developers [1]] if you would like to help translate the app's interface to your own language (open email client).

## About

Show brief information about application, acknowledgements, and licensing rights.

## References

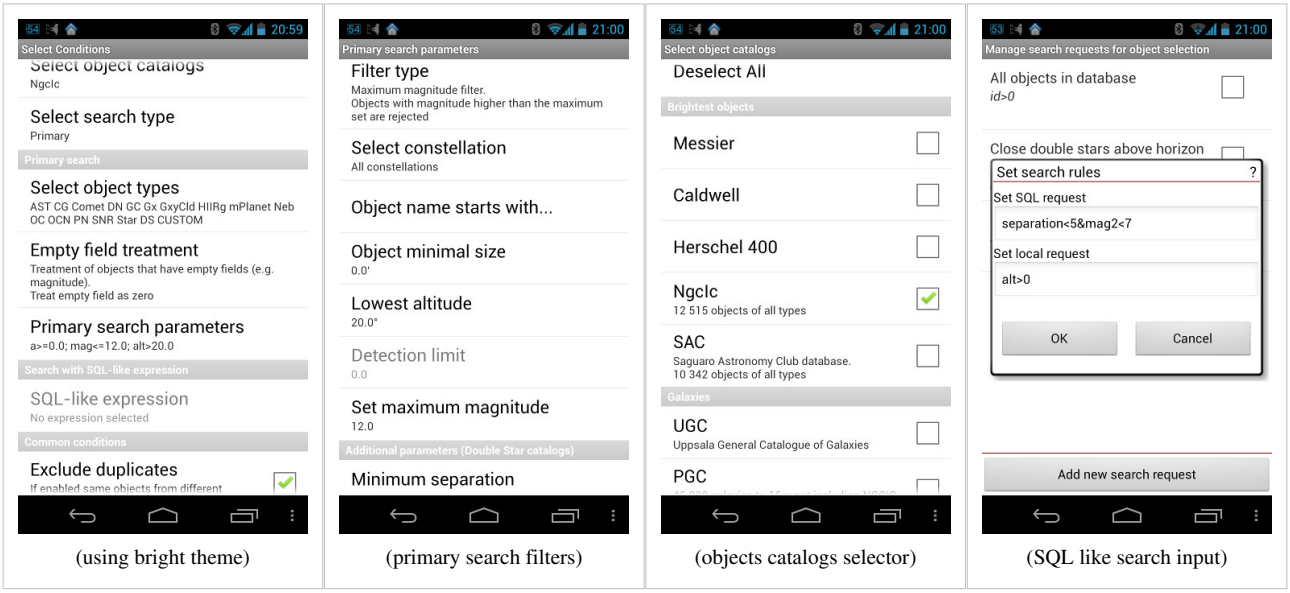
[1] http://dsoplanner.com/Mail:dsoplanner@gmail.com

# Sub-Modules

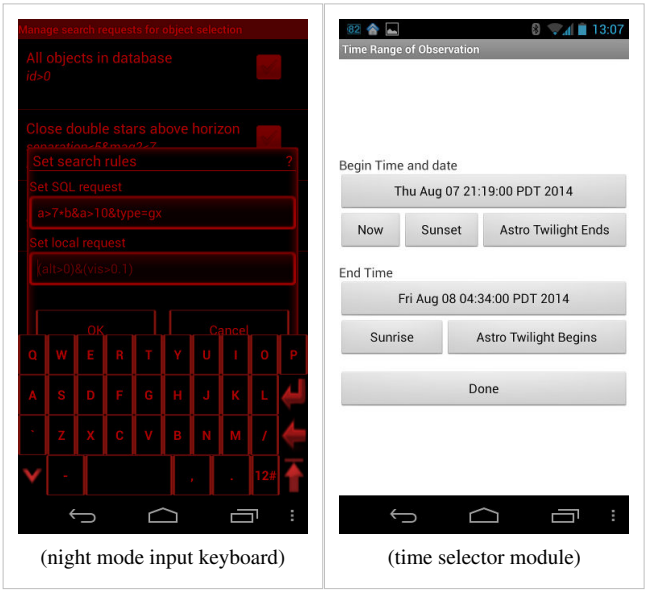
# Select Conditions

## Overview

Figure 8: Select Conditions screen module screenshots




(using bright theme) (primary search filters) (objects catalogs selector) (SQL like search input)




(night mode input keyboard) (time selector module)

Select Conditions module helps to set the objects filtering criteria for objects selection (Figure 8). DSO Planner provides two independent ways to select objects during observations planning phase: **Primary** and **SQL-like**. The Primary tool provides a special menu screen to select and setup a number of parameters for objects positive filtering, whereas the SQL-like method uses math logic based expressions to define most complex objects selection criteria.

The fact is that various internal catalogs of DSO Planner may contain same objects but with different names. To make sure that search results does not contain the same object several times - you need to turn the Exclude duplicates option On.

## Select object catalogs

The "Select object catalogs" option opens the list of internal object databases and custom user catalogs, available on the Android device at the moment, and allows to select those you are interested to search within with a simple check mark.

## Select search type

Select either Primary or SQL-like search filter type. Depending on selection the following items of the module will be enabled or disabled for modification (disabled items have grayed out text).

## Primary Search

- **Select object types —** Used to limit objects by DSO object type (multiple types could be selected).
- **Empty field treatment —** defines what to do if a particular data, used by the filter, is not available in one of the traversed databases (e.g. star magnitude for Dark Nebulas). There are three options provided:
  - Treat the empty field as zero value;
  - as a "very large number";
  - always count it as a positive (or a negative) match.
- **Primary search parameters** section
  - **Filter type —** There are 2 special filters provided to accustom for current atmospheric conditions or user's preference:
    - **Visibility Filter —** Each object's visual parameters (magnitude and dimensions) are analysed in conjunction with the observing conditions, telescope in use, and geographic location in order to assign it a visibility rating. Objects above or equal to the predefined Detection Limit will be included into the list of good matches.
    - **Maximum magnitude filter —** Simple magnitude limiter. Objects below or equal to the specified value will be included.
    - **No filter —** No filter will be applied.
  - **Select constellation —** Limit the search to the selected constellations only.
  - **Object name starts with... —** Name prefix based search. This option is convenient for catalogs combined from various sources like SAC. For example, by setting "cr" here you will limit the search to Collinder Open Clusters in that database. This trick could be used in the custom user databases as well, simplifying their preparation for use with DSO Planner engine.
  - **Object minimal size —** lower limit on the object's dimensions (no less than x).
  - **Lowest altitude —** cut off objects which will never get that high above the horizon throughout the defined observing period of time.
  - **Detection limit —** Set the Detection threshold for the visibility filter.
  - **Set maximum magnitude —** Set the threshold for maximum magnitude filter.
  - **Minimum separation —** For double stars only, limit the minimum distance between components.
  - **Maximum separation —** For double stars only, limit the maximum distance between components.
  - **Maximum mag2 —** For double stars only, limit the maximum magnitude of the second component (faintest to include).

# SQL-like expression module

This item opens the special module, containing the list of SQL-like expressions defined and saved by user. Select one of them to instantly use for the search. Initially, the list contains 3 simple expressions as examples. You can add your own by tapping the **Add new search request** button at the bottom of the screen.

Any SQL-like expression in DSO Planner is actually represented by two requests, referring to database and to the ephemeris calculating engine:

- **SQL request —** refers to static fields in the target databases.
- **Local request —** allows to filter by object's Altitude and Visibility.

## SQL request

The following fields could be used in the first expression (case independent).

- **ID —** the index of the object in the database (sequential number).
- **TYPE —** Object type. Could take the standard object type abbreviation value.
- **A —** Larger object dimension in minutes.
- **B —** Smaller object dimension in minutes.
- **RA —** Right ascension (E2000.0) in decimal hours (11.245621623).
- **DEC —** Declination (E2000.0) in decimal degrees (-10.2767289).
- **MAG —** Catalog's star magnitude.
- **PA —** Position angle (of the DSO shape or binary components).
- **CON —** Constellation name (standard 3 letters Latin abbreviation of it).

These are the common DSO database fields. However, any additional numeric fields in the internal or user databases could be used as well (e.g. this is the valid expression for LDN database: OPACITY>3, and this is for WDS or Bright DS database: SEPARATION<5&MAG2<7) - just refer to the database fields definitions used.

### Examples

- **(a>15) & (con=and) —** All objects from Andromeda constellation with larger axis above 15 minutes.
- **a>10 & type=gc —** All globular clusters larger than 10 minutes.
- **a>7*b & a>10 & type=gx —** select Edge-On galaxies only.
- **id>0 —** List all objects from the database.

## Local request

So far there are only two fields supported:

- **ALT —** Minimal altitude (over the defined observing period of time)
- **VIS —** Visibility rating from 0 to 5

### Examples

- **alt>20 —** Objects that have an altitude above 20 degrees at least once during the observation period.
- **vis>1 —** Objects with visibility better than 1.
- **alt>20 & vis>1 —** Both above conditions should hold.

## Logical and math operations

The following logical and values comparison operations could be used in expressions:

- **x=y —** x is equal to y.
- **x>y —** x is greater than y.
- **x<y —** x is less than y.
- **x#y —** x is not equal to y.
- **x&y —** logical AND (e.g. (mag>12)&(type=GC) — object magnitude is higher than 12 and its type is GC).
- **x|y —** logical OR (e.g. (type=GC)|(type=OC) — object is either GC or OC).
- **+ - *** and **( ) —** could be used to calculate and group variables and values within complex expressions.

## Main Menu

The main menu of the module provides standard import/export operations for user's expressions list.

## Context Menu

Long tap each item on the list of SQL requests to

- **Edit —** Edit the selected expression.
- **Remove —** Remove the selected expression from the list.

# Common conditions

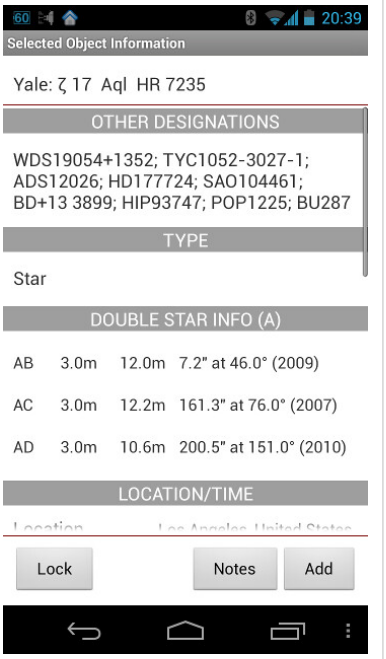
This part allows to set conditions common to both Primary and SQL-like search.

- **Exclude duplicates —** This is an option to remove physically duplicated objects when searching in intersecting databases with the same/different object name notations. As an example, if you select NGCIC and UGC catalogs and turn this option on, then among galaxies NGC2 and UGC59 (which are the same) only NGC2 will be found. Without this option the application finds both NGC2 and UGC59. This feature also excludes duplicated objects from the same catalog (e.g. NGC6/NGC20, NGC17/NGC34)
- **Time of observation —** Set observation range. In addition to setting the time range manually, one may easily define the ranges with a reference to astro twilight, sunrise and sunset.
- **Telescope/Instrument —** Select an instrument for observations.
- **Geographic Location —** Select observatory location.
- **Sky limiting magnitude —** The magnitude of faintest stars at zenith. Used for visibility calculations.

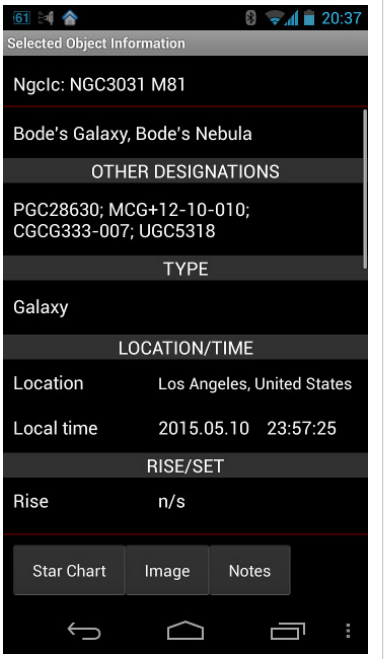
# Details screen

## Overview

Figure 9: Object Details module screenshots




(using bright theme)




(using dark theme)

The Details module presents all of the offline information available for selected object (Figure 9).

An object to show details for could be selected in the Object Selection module, Observations Lists module, Star Chart module and several other places throughout the DSO Planner user interface. Watch for "Details" context menu items.

The module will automatically search

- all databases for objects with the same name;
- internal databases for the same object even if it's named differently;
- Steve Gottlieb Notes for extended notes on selected object.

If any alternative databases has additional information for the object the "More" button will pop up at the bottom of the module screen. Tap it to show the information found. For each new match found only custom fields will be displayed.

## Useful Hint

That is a straightforward way to supplement object data from any existing database with the additional data you want to have available at hands. For example, if you want to supplement the integrated NGCIC database with your own object name (i.e. in your native language) and some colorful images - you could create a standard DSO user database with additional text and images folder path columns and populate it with data using Import functions and USB file transfer. Now, the Details screen for any NGCIC object will show its other name and the gallery of images. See the corresponding use case for more details.

For double stars the module provides Information panel with positional angle and separation for each component from Yale Bright Star Catalog, WDS (Washington Double Star Catalog), and the database of Brightest Double Stars. For about 1000 double stars positional angle and separation will be recalculated using known orbital parameters of these double systems.

# Screen Content

- **Other Designations —** Object names from database of objects' cross-match names (from other catalogs).
- **Double Star Info —** Position angle and separation for each component.
- **Type —** Object type.
- **Magnitude —** Object magnitude.
- **Dimension —** Object dimension in minutes.
- **PA —** Object position angle.
- **Per EP visibility —** An array of object's visibility ratings for each eyepiece selected.
- **Location —** Current latitude and longitude of observer location.
- **Local time —** Device time for which object position is calculated (as set in the Star Chart module). Android OS timezone will be taken into account for calculations.
- **Constellation —** Object's constellation.
- **Az/Alt —** Object azimuth and altitude for the local time.
- **Transit —** Time of object's transit and its altitude at that moment (maximum altitude).
- **Rise —** Object's rise time (could be **n/r** - never rise or **n/s** - never sets).
- **Set —** Object's set time.

# Controls

There are up to 4 conveniently even spaced buttons available at the bottom of the module screen. Depending on the current state some of them might be hidden or have different, context dependent functionality.

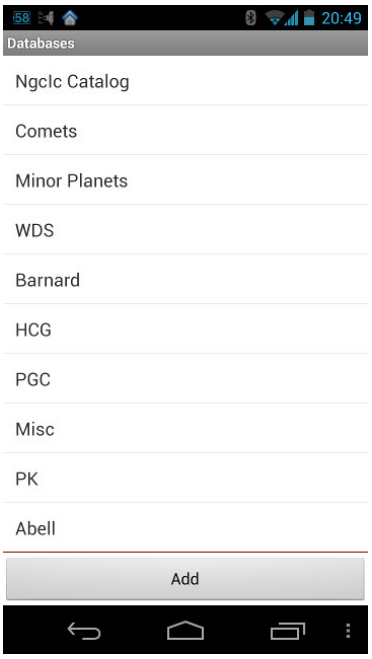
- **Star Chart/Lock —** Switch to the Star Chart module with the object centered. If Details Screen is called from Star Chart - that button will be replaced with the **Lock** button, which allows to set the mode which prevents accidental selection of other objects on the Chart by tapping it. To turn off that mode - return back to Details screen and tap the **Unlock** button.
- **Image —** Show images for both Ngc objects and user database objects containing images. Hidden if no images for the object found.
- **Notes —** Show all observation notes for selected object and allow to take a new observations note.
- **Add —** Add selected object to the current observation list. The button is hidden if the object is already in the current observation list.

The **GoTo** button will appear in the the top right corner when the Bluetooth connection with a telescope is established, and allows to control the telescope (point to the object).

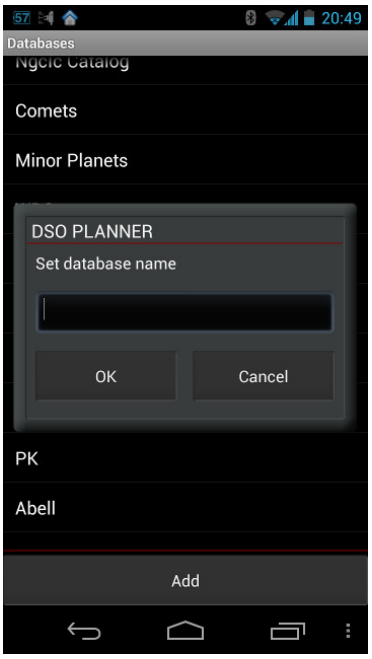
# Objects Databases

## Overview

Figure 10: Object Databases module screenshots




(using bright theme)




(in the night mode)

Objects Databases module provides tools to work with various DSO Planner databases of objects on the Android device (Figure 10). You can add you own databases and they will be treated by DSO Planner engine the same way as internal ones, including but not limited to the functions provided in Object Selection module, Global Search, Observation Notes, Observations Lists module, and Star Chart module. This unique feature greatly enhances application functionality as users could create any number of own databases for their needs and easily share and distribute them around.

The main screen of the module shows the list of databases available for DSO Planner on the Android device.

Tap the database row to open it, using the View Database module, where you can edit it, add new items, e.t.c.

## Editable Integrated Databases

Several Integrated databases of DSO Planner allows to add new objects of the similar kind to them or edit existing objects' records right through the database list screen. The format of the data in these databases explained below. To edit object in such a database - long tap on the object to open its context menu an select the "Edit" item. To add a new object or import a list of objects from the SD card - use the main menu of the database list screen.

### Comets

- **name1 —** Short name of the object
- **name2 —** Long Name of the object
- **comment —** free note text
- **month —** Orbit elements' Epoch month

- **year —** Orbit elements' Epoch year
- **absmag —** Absolute star magnitude
- **day —** Orbit elements' Epoch day
- **e —** Orbital Excentricity
- **i —** Inclination to the ecliptic, J2000.0 (degrees)
- **node —** Longitude of the ascending node, J2000.0 (degrees)
- **q —** Perihelion distance (AU)
- **slope —** Star magnitude slope parameter
- **w —** Argument of perihelion, J2000.0 (degrees)

### Minor Planets

- **name1 —** Short name of the object
- **name2 —** Long Name of the object
- **comment —** free note text
- **month —** Orbit elements' Epoch month
- **year —** Orbit elements' Epoch year
- **G —** Star magnitude slope parameter
- **H —** Absolute star magnitude
- **M —** Mean anomaly at the Epoch (degrees)
- **axis —** Semimajor axis of the orbit (AU)
- **day —** Orbit elements' Epoch day
- **e —** Orbital Excentricity
- **i —** Inclination to the ecliptic, J2000.0 (degrees)
- **node —** Longitude of the ascending node, J2000.0 (degrees)
- **w —** Argument of perihelion, J2000.0 (degrees)

See the Use Case for converting the asteroid data from the NASA JPL HORIZONS [1] orbit elements.

## Context menu

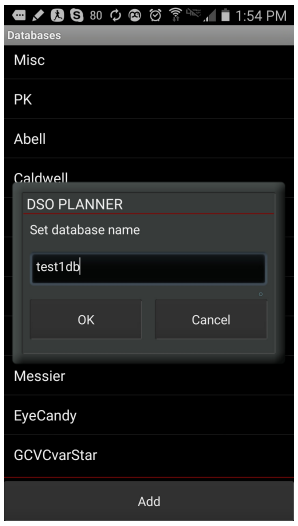
- **Fields —** Show all of the custom fields of the database.
- **Remove database —** Remove the database (delete it).

## Gestures

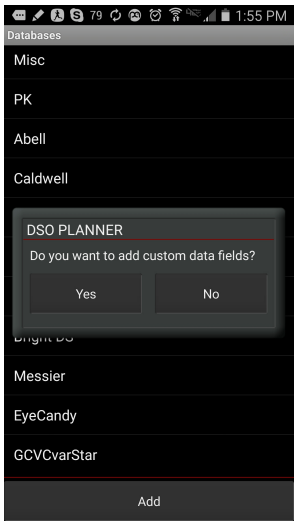
There are two simple flick gestures available, that could be called throughout the application for calling Menu and returning to the previous window.

# User Database

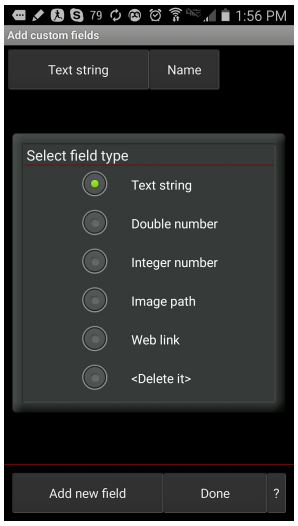
Adding new user database



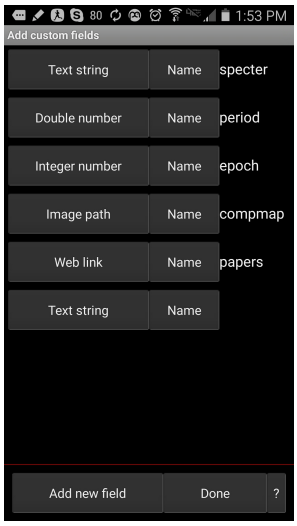

(Click Add and enter the new DB name)




(Decide on custom fields)




(Add custom fields names and types)




(Edit custom fields before clicking Done)

## Creating User Database

To create a new user database — tap the **Add** button at the bottom of the databases list. Set the name of the database in the dialog provided and decide if you want to add custom fields to it or not. When there are no custom fields required — the new database will be created with the set of default, standard data fields, similar to the NGCIC database. You can add any number of custom data fields of various types (Text String, integer, etc.) to your database. They are not only for the information representation, but also to define interaction model (eg, the Image Path type field will allow to open that image for preview). See the Data formats section for more details.

## Import data

After creating the new database you can import the data into that database from a special text file, containing rows of records per object with pairs of *name=value;* defining the object's information. Open the database from the databases list and select the "Import" option from the main menu of the View Database screen. Then navigate to the file you want to import and select it. The importing procedure may take a while for large files, so its progress and status will be displayed in the standard Android notifications area.

**Note**, that for a successful data importing you have to make sure the custom field names, which you have defined for the new database, are matching the field names in the database you plan to import exactly. Keep in mind though, that

it is possible for the import file records to omit any number of nonessential records (i.e. if they are not available or have no value assigned). So you may need to refer to the importing instructions to that file or review the entire file to recover all of the custom fields' names used. There is now way to edit data fields after the database is created. The records (lines) with the fields which was not defined in the new database will not be imported (skipped during the import loop).

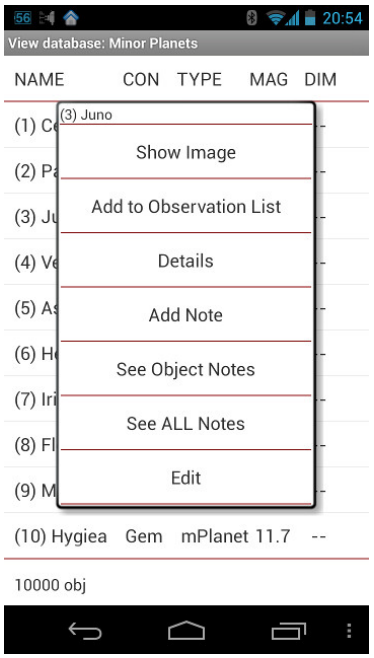
### References

[1] http://ssd.jpl.nasa.gov/horizons.cgi#top

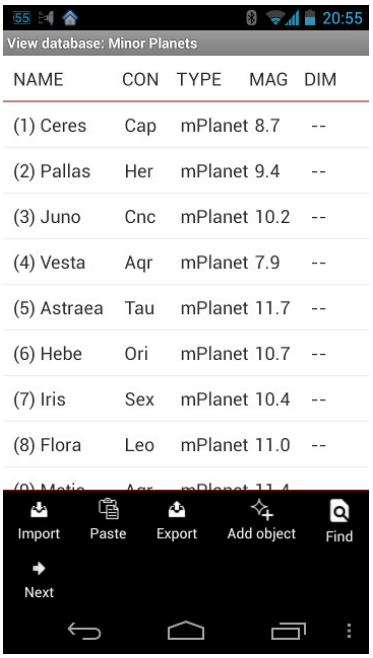
# View Database

## Overview

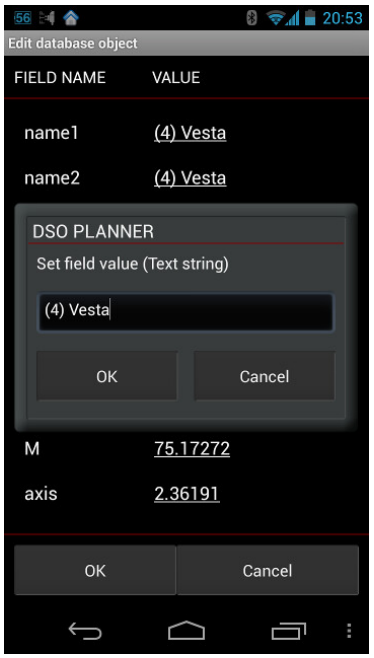
Figure 11: View database module screenshots




(showing object's context menu)




(showing main menu)




(Editing object's data field value)

View Database module allows to look through the content of selected database (Figure 11), add new objects to the database, and export it into text file in the DSO Planner text format.

# Menu

- **Add object —** Manually add an object to the database.
- **Import —** Import objects from the text file on the Android device (in DSO Planner text format) into the custom database.

**Note**, that for a really large file Android database import procedures might take a lot of time (about 2 hours for 100 000 objects), provided that your device does not go into sleep mode (the import will continue when you wake up your Android device, but it will be paused in the sleep mode). Fortunately, the import is performed in the background, so you can continue using the program while importing.

- **Export, Paste, Share —** See detailed explanation of these common menu items in the Other Modules section.
- **Find, Next —** Search object in the database by name. See the detailed explanation of these common menu items in the User Interface section.

# Context menu

- **Show image —** Show images for NGCIC objects, and custom catalog objects if they have ones.
- **Add to Observation List —** Add the object to the *current* observation list (one of the four). Current observation list could be changed in Observations Lists module.
- **Details —** Shows object's Details screen.
- **Add Note —** Shows Observation Notes module in the "Add new note" mode.
- **See Object Notes —** Shows list of notes made to selected object.
- **See ALL Notes —** Shows all notes in the Notes database.
- **Remove from List —** Remove the object from the database.
- **Remove ALL —** Remove all objects from the database.
- **Edit —** Edit selected object parameters

# Gestures

There are two simple flick gestures available, that could be called throughout the application for calling Menu and returning to the previous window.

# Equipment Database

## Overview

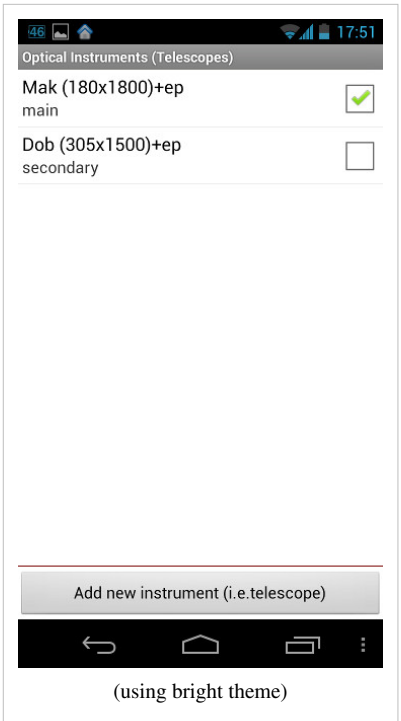
DSO Planner supports two user databases of optical instruments: telescope database and eyepiece database. Telescope and eyepiece data is used for visibility calculation and for depicting eyepieces field of view on the Star Chart.

Select necessary telescope before filtering objects based on their visibility in either Select Conditions module or Settings module.

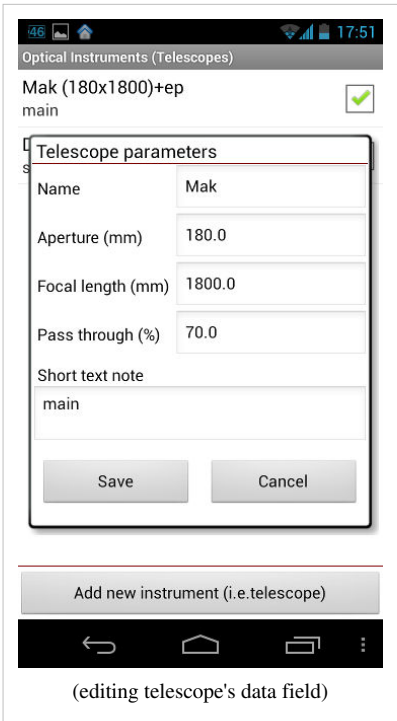
DSO Planner Star Chart module draws the field of view for each selected eyepiece of the selected telescope; the Details screen shows object's visibility for each of them as well.

## Telescopes List

Figure 12: Telescopes List module screenshots




(using bright theme)




(editing telescope's data field)

The telescopes list shows names and brief descriptions of your telescopes, on the right side there are checkboxes to indicate which telescope is currently active (Figure 12). Press on checkbox to make a new selection.

- **Add new instrument...** button helps you add a new telescope to your telescopes list.

## Context menu

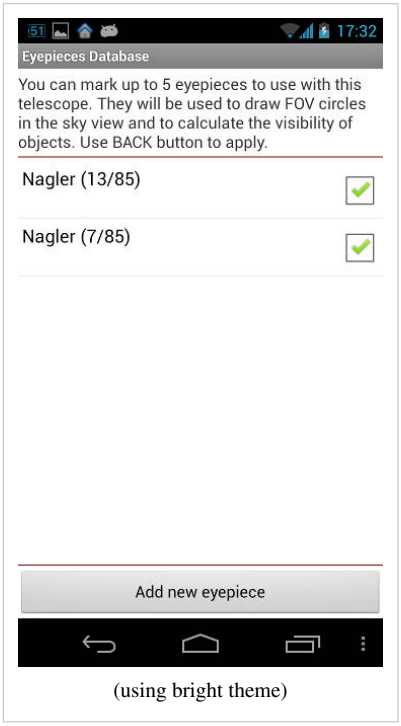
- **Edit —** Edit telescope parameters.
  - **Name —** Telescope name.
  - **Aperture (mm) —** Telescope aperture in mm.
  - **Focal length (mm) —** Telescope focal length.
  - **Pass through (%) —** The amount of light passing through the telescope. 70% is a usual benchmark for reflectors.
  - **Short text note —** Brief comment if required.
- **Assign Eyepieces —** Assigned eyepieces are used for Star Chart eyepiece ring drawing and visibility calculations. An eyepiece may be assigned to several telescopes.
- **Remove —** Remove telescope from the list.
- **Remove All —** Clear telescope list.

## Main Menu

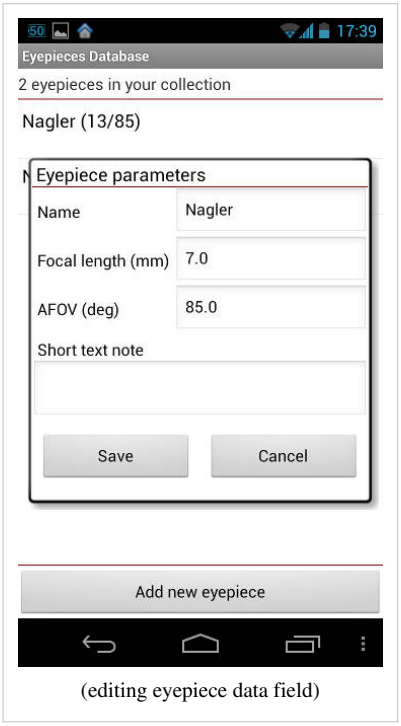
Provides access to export/import operations.

# Eyepiece List

Figure 13: Eyepiece List module screenshots




(using bright theme)




(editing eyepiece data field)

The Eyepieces List shows the names and brief descriptions of your eyepieces (Figure 13) and CCD camera sensors. The **Add new eyepiece** button adds an eyepiece to your eyepieces list, open the Main Menu to add a new CCD. When adding a new eyepiece you can either enter your own eyepiece parameters or select an eyepiece by its name from the integrated list of more than 500 popular eyepieces data available.

### Context menu

- **Edit —** Edit eyepiece parameters:
  - **Name —** Arbitrary short eyepiece name.
  - **Focal length (mm) —** Eyepiece focal length in millimeters.
  - **AFOV —** Eyepiece apparent field of view in degrees.
  - **Short text note —** Arbitrary note (longer description) if required.
- **Remove —** Remove selected eyepiece from the list.
- **Remove All —** Clear the eyepieces list.

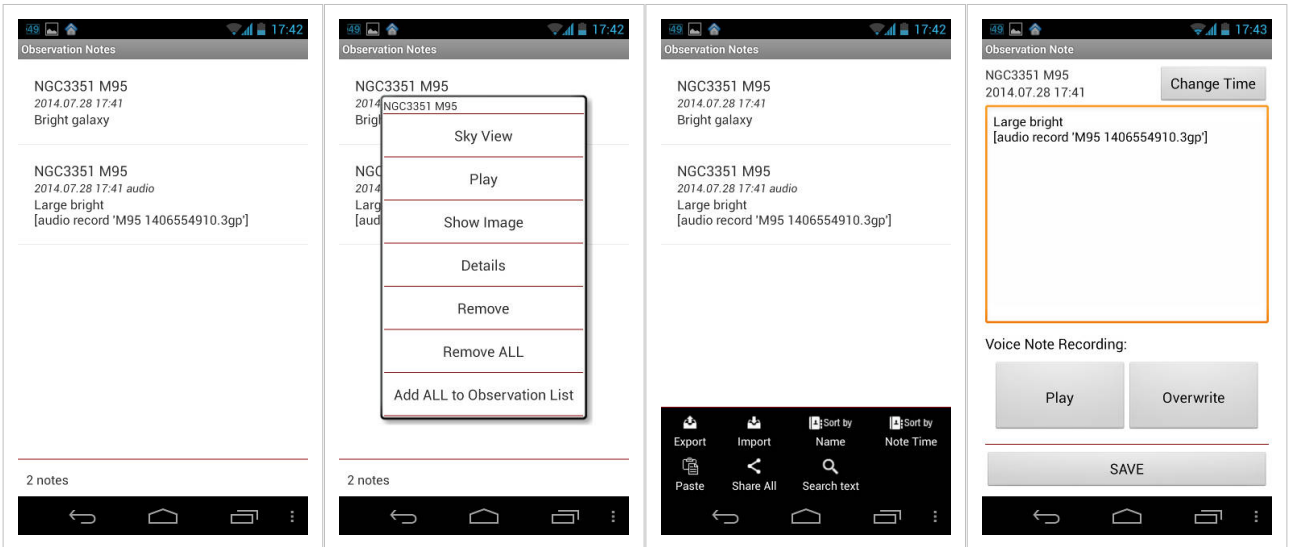
### Main Menu

- Provides access to export/import operations with the list.
- **Add CCD —** Open the CCD Add dialog window.
  - **Name —** Arbitrary short name for the CCD.
  - **Horiz.size (mm) —** Width of the CCD (N-S) in millimeters.
  - **Vert.size (mm) —** Height of the CCD (E-W) in millimeters.
  - **Short text note —** Arbitrary note (longer description) if required.

# Observation Notes

## Overview

Figure 14: Notes module screenshots




(using bright theme) (Context Menu open) (Main Menu open) (Edit Note screen open)

The Notes module shows user notes on observed objects (Figure 14). Notes database could be accessed from the context menu of the Observations Lists module, Object Selection module, View Database module, as well as from the Details screen module, using **Notes** button.

Either a list of all notes for the selected object, or the list of all notes in the Notes Database is shown on the Notes screen (that depends on what function was chosen to open the Notes module). Keep in mind, that notes for selected object will be stored in the common Notes Database by the long object's name, so if you have similarly named object

in several databases - all of them will have the same centralized observation notes list.

Each note record's line in the list shows the object's name, the time each note was taken, and the note content (plain text). The record may also have the *audio* marker, if an audio note was taken and attached to the text note.

Tap the note record's line to open the "Edit Note" screen.

# Main Menu

- **Export, Import, Paste, Share —** See corresponding chapter for details on these common menu items functionality.
- **Sort by Name —** Sort all notes by object name. The second selection reverses the sort order.
- **Sort by Note Time —** Sort all notes by their creation time. The second selection reverses the sort order.
- **Search Text —** Searches the whole note database for the specified string in note content.

# Context Menu

- **Star Chart —** Show the subject object on the Star Chart.
- **Play —** Play the audio note if the note has one.
- **Remove —** Remove the note from the list.
- **Remove ALL —** Remove all notes from the list.
- **Show image —** Show images for NGCIC objects, and custom catalog objects if they have ones.
- **Details —** Shows object's Details screen.
- **Add All to Observation List —** Add all objects from the note list to the *current* observation list.

# Edit Note

The Edit Note screen allows to enter or edit the note text, update its time stamp, listen to the audio note or record a new one (overwriting the existing audio note).

# Other Modules

## Import/Export/Paste/Share

DSO Planner app extensively supports data import and export operations using the dedicated DSO Planner text format. Any list with objects, notes, locations, telescopes, or eyepieces can be exported into the human readable text file, shared, using other applications, and imported back into DSO Planner either into the same module, or other module.

- **Export —** Export current list data to a text file on SD card, using the DSO Planner text format.
- **Import —** Import data from a text file in DSO Planner text format. When importing objects into the Observation List or Observation Notes list, you need to specify whether the source file is yours (exported by your own copy of the app) or someone else's (prepared manually or on other Android device with DSO Planner installed). That is crucial for most correct and optimal import of the data. When someone else's data is imported into the Observation List *temporary* objects will be created if the data does not contain reference to internal databases (if it does, permanent objects are made. This is the case when you import someone else observation list which contains only objects from internal catalogs). When your own file is imported *permanent* objects will created, provided that the database objects being imported still refers to the existing objects (weren't removed from the device).
- **Paste —** Paste objects from the Android clipboard. DSO Planner will try to interpret the text in the system's clipboard buffer as representation of object(s) data in DSO Planner text format, and if successful - insert them into the list or database.
- **Share —** Standard Android OS media object Share option. The third party application (such as Gmail, Evernote, etc.) will receive a text bundle in DSO Planner text format to deal with. Note, that Android share function has a size limitation, thus you cannot share more than about 300 objects at once.

## DSO Image

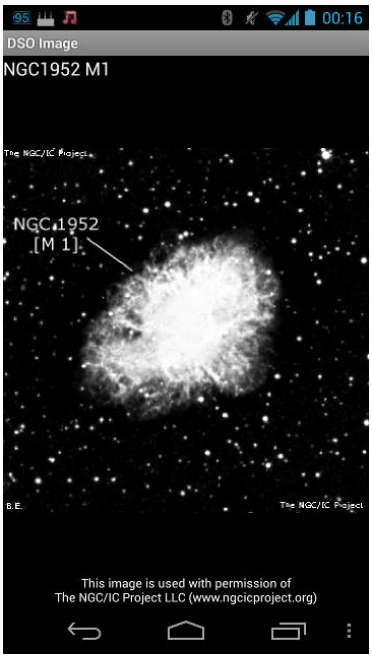



**Figure 15: DSO Image module screen**

This module shows object images (Figure 15). There is an internal image database that has images for almost every NGC object (7840 images) from the famous NGCICproject.org website. Also you can add any number of new images for your own user database objects, by creating a custom database with multiple custom fields of "Image Path" type in it (See the typical Use Case description for more details on exactly that procedure).

DSO Image screen is commonly available from the Context Menu of any list of objects, such as the Observations Lists module, Object Selection module, and the View Database module. The Details screen will show the dedicated "Image" button if selected object has any images attached.

## Controls

- In case there are several images for an object available - you can switch between them by flicking the screen up and down.
- Use pinch to zoom gesture to change the image scale.

# Global Search

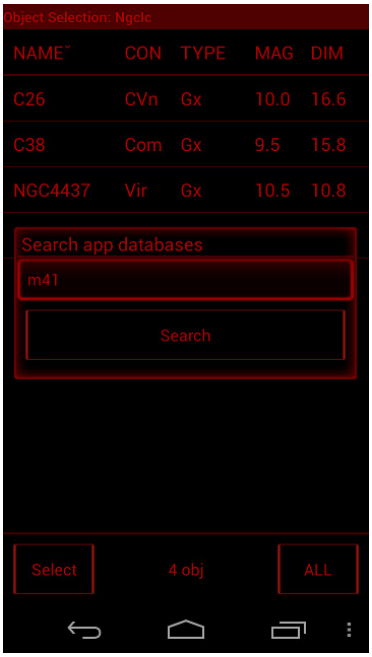



**Figure 16: Global Search module screen (night mode)**

The Global Search module looks up for a specified string in the name of objects from all of the object databases available in DSO Planner, including the Observation Notes database (object name and notes text), and the Star Chart module layers (in the object names, but excluding the USNO UCAC4, due to its enormous volume). This function (Figure 16) could be invoked from any place by pressing Android OS "Find" button, if it is available on the device, or using the Main Menu of Object Selection, Observations Lists and Star Chart.

## Examples

You can use the following string format to search for objects:

- **M1 —** Messier
- **m 1 —** any register, spaces
- **NGC1952 —** NGC
- **ngc 1952 —** any register, spaces
- **alpha and —** bayer designation, constellation short name
- **alpha andromeda —** bayer designation, constellation full name
- **alpheratz —** star name
- **21 and —** flamsteed designation
- **21 andromeda —** the same as above
- **MCG+07-02-016 —** M31 in different designation
- **CGCG535-017 —** M31 other designation
- **tyc 1179-1775-1 —** Tycho-2 layer stars
- **pgc1662164 —** PGC layer galaxies

# Main Concepts

# User Interface

## Find/Next

Simple context search of objects by a line of text within the object name in the current list only. **Find** menu item asks for the line of text, and looks for the first match, *Next* menu item looks up the next match. The object found is shown in bold text on the list. The search is inclusive (e.g. "12" will return "abc12" as a match). To reset the search just tap "Find" again.

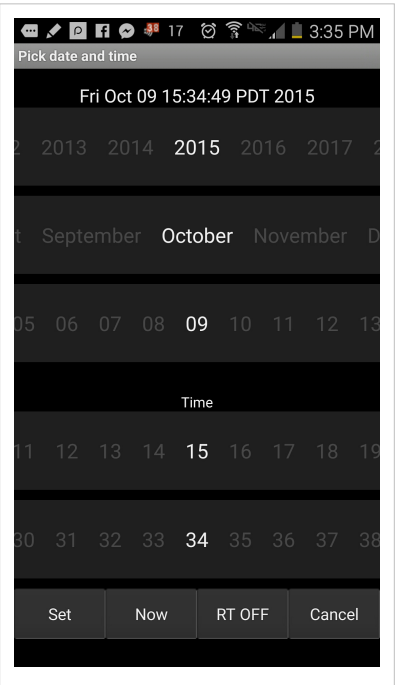
## Gestures

DSO Planner supports 2 simple gestures over the screen. Flick Up from any passive (non editable or movable. i.e. buttons, edit fields, lists) element of the screen to open the main menu of the module displayed; flick left — returns to the previous screen or closes the open dialog (similar to the "Back" button of Android OS). In most cases you can successfully use the thin red line (common decoration of DSO Planner screens) as a start point of the flick, or the window header.

In the Star Chart module the above flicks will work best from the "Red Button". In addition, flick up on the left edge of the screen will increase the screen's brightness; flick down will decrease it (provided the relevant setting is set).

## Date Time Picker

Date Time Picker Screen



This is the common tool of DSO Planner, which allows to set or select a moment in time conveniently in various contexts. It consists of 5 horisontaly scrolling bands. 3 for date and 2 for time selection. Selected time display at the top and control buttons at the bottom:

- **Set —** Set the selected time and close the picker.
- **Now —** Set the current system time of Android device.
- **RT ON/OFF —** control the Real Time Mode, which will automatically update the time used by DSO Planner for astronomy calculations and also updates the Star Chart (closes the Picker).
- **Cancel —** exit the picker without making any changes.

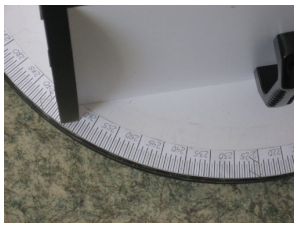
# Working with telescope

## PushTo aid

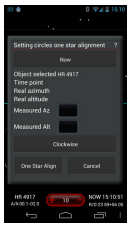
Figure 17: Dobsonian telescope with simple setting circles

(OTA setup)

(inclinometer)



(DIY azimuth circle)




(one star alignment panel)

### Overview

DSO Planner have the ability to work with the setting circles' readings for telescopes with Alt-Az mount. The dedicated calibration algorithm allows use them for "blind" objects finding without precise alignment of the setting circles to the true North and horizon points. Usually it is sufficient to just level the telescope's base with a simple bubble level and perform the single star alignment, using the special Alignment panel of the app. The telescope's base must be precisely level for correct calculations of setting circles Azimuth readings, however, if you cannot level the base reliably, you can Star Align as usual but work on a small region of the sky close to the alignment star by Azimuth (i.e. in a 20 degrees arch left and right for about 20 minutes) without losing much of a precision. Then just re-align to other star in the close vicinity of the objects you want to study.

DSO Planner's author has a Dobsonian telescope pictured above. The Azimuth circle is printed on paper and glued to the mount base, it has 0.5 degree steps. The classic Altitude circle is substituted with an inexpensive constructors grade digital inclinometer with a 0.1 degree accuracy. With practice and the help of DSO Planner, such a basic upgrade of the Dob could shorten the finding of almost any object in the Sky in under 2 minutes!

## One star alignment

- Select a bright enough alignment star on the Star Chart.
- Using the Chart, point your telescope to that star using a high power eyepiece for higher precision.
- Select the "Align Star" item from the Star Chart's Main Menu to open the "Setting circles one star alignment panel".
- Confirm that the star is precisely at the center of the FOV of your eyepiece once again,
- and immediately tap the "Now" button on the alignment panel to precisely register the current moment of time.
- Read your setting circles (or inclinometer), and
- enter the Azimuth and Altitude values in decimal degrees into dedicated data fields on the panel ("Measured Az" and "Measured Alt").
- Select azimuth setting circle direction ("Clockwise" or "CounterClockwise").
- Tap the "One Star Align" button to save the alignment data.

The "Clockwise" / "CounterClockwise" button below the coordinates input fields of Alignment panel allows to select a different direction for the Azimuth setting circle, as some models might be graduated clockwise and most counterclockwise.

## How to use

Now, you need to tell DSO Planner to show the Altitude and Azimuth of objects on the Star Chart in the coordinates space of your telescope mount.

- Open the Main Menu of the Star Chart.
- Select Settings.
- Find the "Equipment" section and tap the "Telescope" item.
- Turn on the Show adjusted Az/Alt option there.

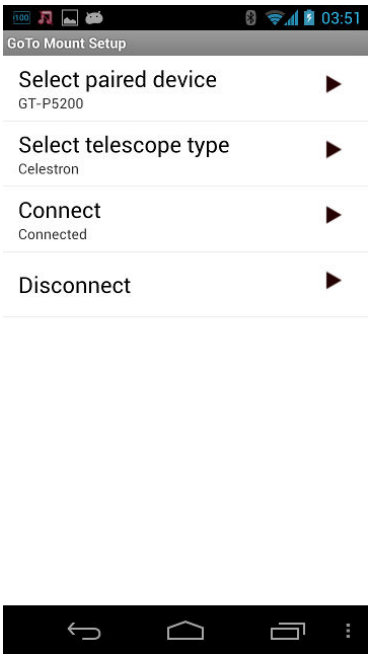
From now on, DSO Planner will calculate all the necessary adjustments for your setting circles on the fly, and show the adjusted coordinates for any object selected on the Star Chart (they are displayed in the left bottom corner of the chart with **"%"** sign followed by values).

To point the telescope to an object from the chart:

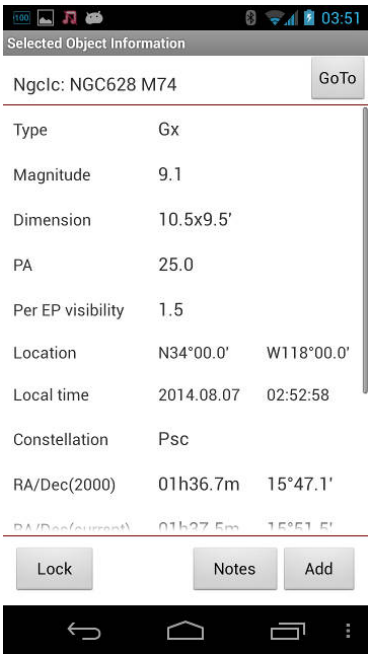
- Select the desired object on the Star Chart.
- Make sure the Chart is set to the current time:
  - Tap the "Time/RA-DEC" info bar in the right bottom corner of the Star Chart to open the "Pick date and time" panel,
  - either set it manually, or turn On the Real Time drive mode for the Chart - tap the "RT ON" button (if it's ON already the button's label will be "RT OFF" instead, and the "Time/RA-DEC" info bar will show "NOW" word).
- Dial your telescope circles to the values provided in the "Object Name/Az-Alt" info bar in the left bottom corner of the Chart.

# Bluetooth GoTo

Figure 18: GoTo Mount Setup panel screenshots




(using bright theme)

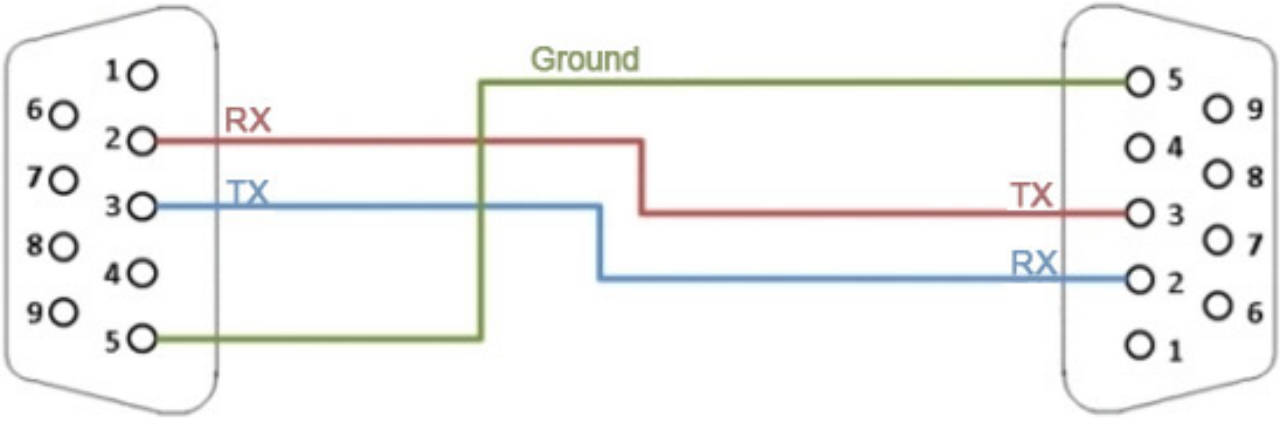



(GoTo button on the Details screen)

The **GoTo Mount Setup** module allows to setup the bi-directional communication with a GoTo telescope mount over the Bluetooth wireless connection of the Android device. At the moment, DSO Planner supports GoTo control commands of select Celestron (16- and 32-bit), SkyWatcher (16- and 32-bit) and Meade telescope models, such as Meade ETX-125 and Celestron CPC. In order to control them from your Android device you need to convert the wired serial port signal of the telescope mount into the wireless Bluetooth signal. In most cases you need to purchase an RS-232 to Bluetooth converting dongle (sometimes called Wireless Serial Port Extender) and properly connect and power it using your mount's ports or external wiring.

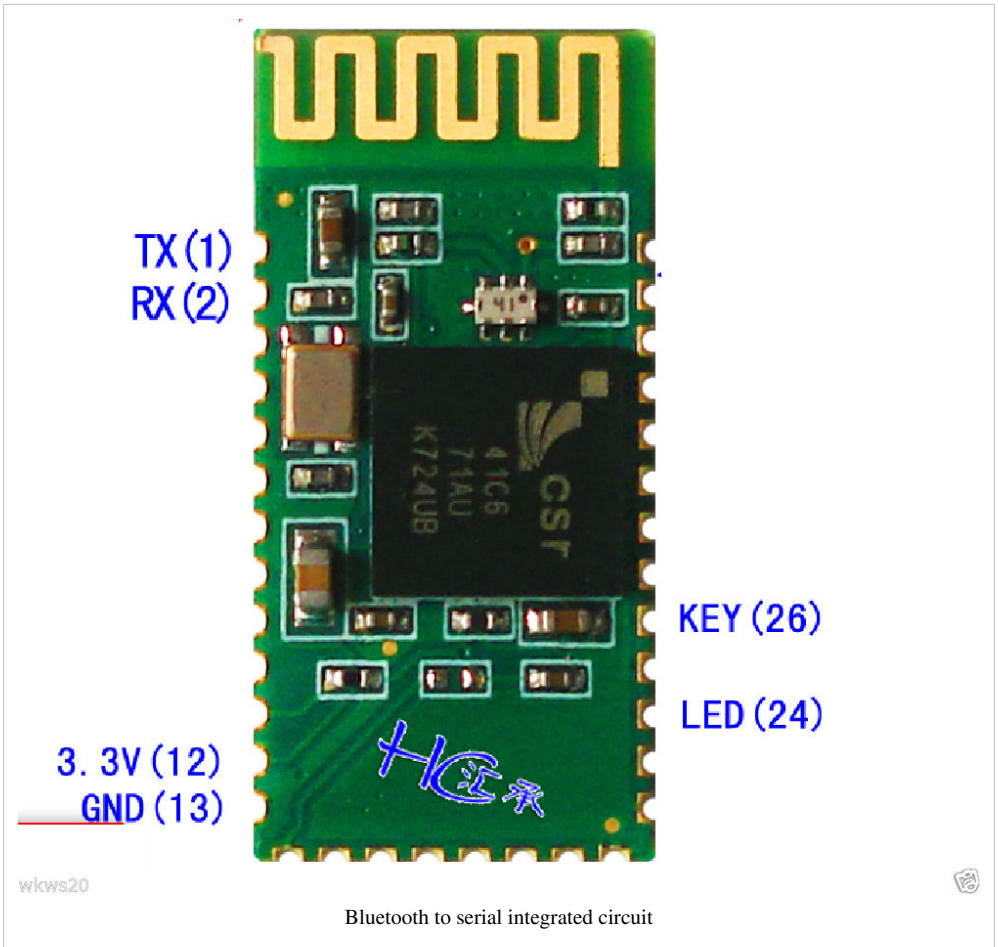
Typical bluetooth serial dongle

**Note**, that with some adapters you might need to add a Null-Modem adapter between the dongle and the mount's serial cable connector, or simply swap the Rx and Tx lines in your DIY cable. It is safe to experiment with that.




Null modem wiring

For example, here is the Alex's Meade ETX-125 mod [1], providing that connectivity. Any RS-232 dongle you could find should work just fine with DSO Planner. However, some telescope models might require the communication protocol tweaking in the code. Please don't hesitate to report any issues with your GoTo setup on our forum [2]! Some of the telescope manufacturers may provide the Bluetooth dongle dedicated for their mounts, but there are plenty much cheaper dongles available on the market, including the eBay. Also, if you have electronics skills you might integrate a Bluetooth circuit right into your GoTo mount housing.




Bluetooth to serial integrated circuit

## Connection setup

To register your telescope for Bluetooth control:

- Open Android Settings and find "Bluetooth" in the "Wireless and Networks section" at the top
- Turn it on.
- Turn on your GoTo Telescope mount power, initialize it using the Telescope users manual.
- Turn on the Bluetooth radio of the Telescope (or insert the BT dongle).
- Tap the "Bluetooth" item in the Android Settings and pair the phone/tablet with the Telescope BR controller.

## GoTo Mount Setup screen

To setup the Bluetooth control of your telescope in DSO Planner:

- Open DSO Planner.
- Open the Settings module and open the "Astro Equipment" item there.
- Find the "GoTo Mount Settings..." option either in the Settings module's "Astro Equipment" chapter, or in the Star Chart module's Settings "Equipment" chapter.
- Tap it to open the BT control panel.

In the panel (refer to the the Fig.18 above):

- **Select paired device —** Select your telescope from the list of previously paired telescopes.
- **Select telescope type —** Select your telescope type (Celestron or Meade).
- **Connect —** Initiate connection between phone/tablet and the telescope.
- **Disconnect —** Break the Bluetooth connection with the telescope.

## How to use

- **Point to an object —**
  - Select the target object in any DSO Planner module (e.g. on the Star Chart).
  - Open the Details screen module for it.
  - Tap the "GoTo" button in the top right corner of the module's screen.
- **Make the Star Chart to center where the telescope is pointing to**.
  - Tap the "Scope go" item in the Main menu of the Star Chart module.

# Advanced Telrad

The DSO Planner's Telrad circles overlay feature can be of a great help with the "blind" pointing of your Alt-Azimuth mounted telescope (Dob) to hidden Deep Sky Objects with the naked eye, if used properly. The most popular Telrad device (see the picture below) has an often overlooked feature - gaps in the circles at 12, 3, 6, and 9 hours. They can be efficiently used to position the circles between bright stars (including direction lines to them from the Telrad's center out of the outmost circle) to make precise pointing a breeze.

Figure 21: Working with Telrad

(Popular telrad model)


(Starchart excerpt)

(Advanced Telrad use)

Example (refer to images with circles above): To point at the object on the chart precisely - all you need is a single naked eye star nearby, which you want to put close to the outer circle at the slightly less than 7 hours angular position. That became possible because DSO Planner is constantly tracking the orientation of the Telrad on the real sky and also provides precise manual controls for the circles' sizes, gaps orientation, circles outlines thickness, color and transparency (see the Start Chart Settings Menu), Equipment section. Just maintain a leveled scope base and calibrate your particular Telrad, using wide enough pairs of stars, just one time.

## References

[1] http://www.dobmod.com/2015/01/meade-etx-125-electric-wiring-mod.html
[2] http://forum.dsoplanner.com

# Temporary and Permanent Objects

Objects in DSO Planner databases context could be *permanent*:

- internal database objects (such as NgcIc, SAC, etc);
- user database objects;

and *temporary*

- objects existing in one of the observation lists only. Such objects could be created
  - in observation list, using the "Add Object" command;
  - when importing objects into observation list, if imported objects does not contain references to already installed databases (e.g. if the database was removed or a foreign external data file is used).
- It is necessary to emphasize that when objects are added into an observation list from the Object Selection module or View Database module they will be always *permanent*. The same stands for objects imported into the observation list along with references to existing databases.

*Temporary* objects creation and maintenance are much easier than that of *Permanent* objects. They are perfect for adding something *quickly* to the Chart to see between the stars and calculate local ephemeries, but you don't really care whether they will still exist in the app later or not. *Temporary* objects are also required for observation lists sharing between users, as they are independent from the particular DSO Planner version or set of installed databases. Also the functionality of *Temporary* objects in the DSO Planner have some limitations.

*Permanent* objects could be used in the Object Selection module to filter through, as well as for the Global Search.

*Temporary* object exists until it is removed from its Observation list, cannot be used in the Global Search, however they are still involved in the Find/Next search.

When importing external list into observation list (from other users) it is *temporary* objects (with limited functionality) that are created, *with the only exception of internal database objects* (i.e. when internal database objects from other user list are imported they are created permanent). This is understandable as every user may have its own database structure and its own object location within it. Therefore, other user objects could not be referred to your own databases.

This issue could be partly solved by creating a new user database and importing objects into it. However, before importing you need to create a database with exactly the same additional fields as used in object lists, otherwise information in additional fields will be lost. This may not be a solution when an external observational list that you import contain objects from various user databases.

# Data formats

## DSO Planner text format

Each object is represented by a text string which starts with " & " symbol and then contains pairs of the form "field=value" separated by " ; " symbol. The pairs could be put into a text string in any order. It is possible to use only some fields and omit other, in this case omitted fields will be automatically set to 0 or zero string. To deal with several objects at once place several lines into the text file, every line corresponding to its own object.

If you need to use " & " or " ; " within the value (e.g. within text fields), just put " \\ " in front of the symbol: " \\& " or " \\; ".

### Standard data fields

- **ra —** Right ascension in epoch 2000. Its value lies in 0 to 24 range.
- **dec —** Declination in epoch 2000. Its value lies in -90 to 90 range.
- **a —** Object dimensions in minutes, longer axis.
- **b —** Object dimensions in minutes, shorter axis.
- **pa —** Position angle in degrees.
- **name1 —** Short object name.
- **name2 —** Long object name.
- **comment —** Text comment on an object.
- **mag —** Magnitude of an object.
- **type —** Object type.
- **typestr —** The name of the custom user type. This field is required only if you use your own (custom) object type (e.g. using custom object type you could assign a "meteor" type to your objects).

### Additional (custom) object fields

If standard object fields are not sufficient for object description one could use any number of additional fields. Additional fields could have the following types:

- **Text —** Text field.
- **Double —** Fractional number field.
- **Integer —** Integer number field.
- **Image path —** Field with a path to an image on SD card.
- **Web link —** Field with a web link.

### Auxiliary fields

When exporting or importing data, DSO Planner uses several auxiliary fields for database reference, note description, location description, etc. Users should not use these names for their object description:

- afov
- aperture
- catalog
- date
- id
- latitude
- longitude

- note
- notebaseid
- path
- selected
- time

### Possible abbreviations

- ngc — Simplifies import of NGCIC objects. Just use object description in the form &ngc = <object number>, for example: **&ngc=3031;**
- ic — Simplifies import of NGCIC objects. Just use object description in the form &ic = <object number>; for example: **&ic=2;**

### Examples

Double star from WDS (Washington double star) catalog:

```
&name1=00000+7530;name2=00000+7530;ra=0.001844;dec=75.483276;mag=10.27000;pa=235;type=ds;year=1982;
          components=;mag2=11.50000;spectrum=;separation=0.600001;
```

This double star description uses the following custom fields (see Creating User Database).

- **year —** Integer number.
- **components —** Text string.
- **mag2 —** Double number.
- **spectrum —** Text string.
- **separation —** Double number.

Dark nebula from Lynds catalog:

```
&name1=LDN1;name2=LDN1;ra=16.480963;dec=-16.107859;opacity=3;a=13.942740;b=13.942740;type=neb;
```

Bright nebula from Lynds catalog:

```
&name1=LBN1;name2=LBN1;ra=17.752939;dec=-28.851336;brightness=5;a=4;b=4;type=neb;
```

## Temporary and Permanent Objects

Affects data Import operations and manual adding of custom objects (See important to understand details here).

## Object Types reference

The following object types are used throughout the program:

- **GC —** Globular cluster
- **Gx —** Galaxy
- **GxyCld —** Galaxy cloud
- **HIIRg —** HII region
- **Neb —** Nebula
- **OC —** Open cluster
- **OCN —** Open cluster nebula
- **PN —** Planetary nebula
- **SNR —** Supernova remnant

- **mPlanet —** Minor planet
- **Planet —** Planet
- **Star —** Star
- **DS —** Double star
- **Comet —** Comet
- **CG —** Cluster of galaxies
- **DN —** Dark Nebula
- **AST —** Asterism
- **QS —** Quasar
- **NF —** Not found
- **CUSTOM —** User defined type. Any string could be set as a user (custom) object type (*typestr*)

# User Horizon file format

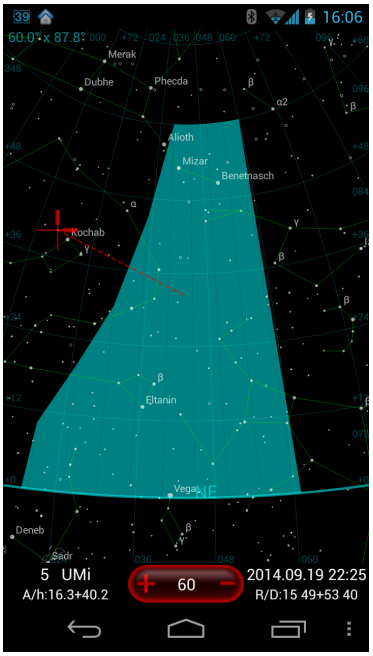



**Figure 19: User horizon on the Star Chart**

You can show your local horizon on the Star Chart, if you can prepare a text file with coordinates of the key points, describing your local horizon line, in the simple format, where each row in the file represents the coordinates pair of Azimuth and Altitude in degrees for each point. The last point will be automatically linked with the first one in the file. For example (Figure 19 above) shows a fake user horizon, defined by the following data file:

```
19 0
20 10
30 30
40 60
60 60
61 0
```

The easiest way to prepare such a file would be on a good night observe stars which are visible near the edges of significant local horizon's obstructions (window or balcony frame, buildings walls, hills or trees contours, etc) and

use their coordinates and coordinates of other, less visible, stars from the map to approximate the key points for the horizon's line. Another approach - make a panoramic image in known projection, find the key points, measure their x,y coordinates on the image, and finally convert them to the Azimuth and Altitude values for the file.

# Visibility value explained

Object visibility is measured on 0-5 scale,where 0 is invisible and 5 bright. Visibility depends on object brightness and dimensions, sky condition (its limiting magnitude - the magnitude of the faintest star one could see at zenith), telescope aperture, its passthrough and magnification (that is an eyepiece used with the telescope). Blackwell model is used for visibility calculations.

Visibility is not calculated for comets and objects with absent magnitude or dimension. For such objects visibility is considered a missing parameter. Set Empty field treatment as you need to include / exclude such objects when filtering them in the Object Selection module.

As an exception if dimension is missing in planetary nebula, minor planet, or double star its visibility is calculated as that of a star (point-like lighting source).

*Detection limit* is a minimum visibility threshold: when using visibility filter to look for objects only objects with visibility above or equal to the detection limit are found.

# Use Cases

## General use of DSO Planner

```
I am new to astronomy and would appreciate some suggestions as to what
settings to configure DSO planner pro to for a beginner. For example,
some deep sky objects are beyond my skill level to find but when I zoom
 in my screen is cluttered with things that I cannot even begin to see.
```

DSO Planner had been specifically designed to address this particular question exactly. However, our user base is quite diverse. Many observers are used to the simple traditional astronomy planetarium software user experience, widely represented on the digital astronomy software market for various hardware platforms. So, we had to introduce some additional features and ship the app with the defaults which supposed to make the transition to our advanced observations planner easier for everyone. But DSO Planner is way ahead of any Planetarium app!

I would like to share my own approach to using DSO Planner on my Android smartphone for planning the night, finding my objects of interest, and observing them - all with the help of the app.

---


I'm rarely planning my night long ahead, as I know for sure that I can do that right on the dark site of my choice in 5-10 minutes after setting up my telescope in the dawn, while dark adapting in my car or in a chair. However, if you plan to include comets in your observing night it would be a good idea to start the DSO Planner beforehand, while you still have an Internet connection. Most certainly you will immediately see a prompt from DSO Planner offering to update orbital elements for them. It'll take just seconds. At the same check point, I would also make sure the DSO Planner is in the Night Mode already, so at the dark site I have no sudden "blinding accident" opening it in the dark. Sure thing, if you have found an interesting list of objects to observe and it's not in DSO Planner format yet, you should spend some time, prior to the observing night, for entering that list into DSO Planner, but that's a huge subject in itself, which I'm leaving for the future FAQ.


If that's your first use of DSO Planner, you should register your observation instruments first, using the Settings menu (just tap the button at the bottom of the first screen), picking the "Astro Equipment" item there. One of your instruments must be checked on that list as the default one, along with the set of your favorite eyepieces, which is necessary to display FOV (Field Of View) guides for them and to calculate visibility grades (so, choose wisely, especially, if you plan to do star-hopping using 2-3 eyepieces, so they have widely varying FOVs).


So, I'm in the field, dark adapting, and on the first screen of DSO Planner. The first thing I do - go to the Airplane mode to conserve the power. The second - turning on the GPS radio to start obtaining my observing location fix a.s.a.p. (Actually, if you still have phone service available on the site - the coarse location, obtained from cell towers, is good enough to use for the app's calculations, but I'm usually too far from any usable service).

Then, I close the Android settings and open the "Settings" module of DSO Planner (the button at the bottom of the Main screen). I would select the "Geographic Location" item and make sure the "AutoLocation" checkbox is selected. If it is already - usually by then I should have my GPS fix ready (just watch for the time of the last known location fix displayed right there, or, sometimes, it might show "current update" message there), so I'm just swiping down the notification bar again and disabling the GPS to conserve the power. The last location acquired

will stay put for now.

Sure thing, you don't have to do all of the above if you are on the same location again, i.e. observing from your backyard. Just make sure the location you have entered and named for your home observatory is selected when you go through the step 5 below, and skip this step (3) all together.

Now, I would go back to the main screen and prepare the brand new Observations List, using the second button "Observations Lists". It usually displays the last list of objects I've been working with. Typically, that's the list from the prior New Moon outing for me, so it's too old to be reused. So, I'm just long-taping an object on that old list and selecting the "Remove All" option from the pop-up context menu to wipe it completely. But, sometimes, I may want to keep a particular list for later use... So, instead, I would see if I could wipe one of the other 3 lists available for selection from the main menu of this module. Personally, I'm using the first list (List 1) for a new night planning, and other 3 for more specific lists of objects (usually for "non fuzzies", for objects from custom databases, as well as for building compound lists or manipulating custom databases). For example you can use them to quickly switch between lists created for different instruments (like one for your Dob, another for your refractor, and another one for binoculars), or for different object types, or for the same object type, but having different parameters, e.t.c. the sky is the limit. To avoid confusion, I'm using the Rename function from the main menu of this screen to set some easy to remember descriptions to my lists.

As the current Observations List is ready to be populated with new set of objects, I'm going back to the Main screen, and commence the actual planning for the night by tapping the topmost button "Object Selection". Another recent list of objects will be displayed. That's what I had selected for my prior observing night or while tinkering with some databases I have on the phone. On any new night I would usually just go straight down to the "Select" button at the bottom of that screen (it could read "Update" instead, if something has changed in the conditions, e.g. I have updated the location or instrument in the settings - in that case I just tap it once to turn into "Select" and tap again), which opens the "Select Conditions" screen, and go through the items provided in order to define my preferences for the entire night or for the observing session like the following:

- I'm considering myself a seasoned DSO hunter, so I usually have all of the object catalogs except those in "Double Stars" and "Comets" sections already selected. The easiest choice for a beginner would by to select Messier and NGC/IC - they provide years of enjoyment and also better represented in DSO Planner, thanks to the NGCIC.org project, which DSO images we have directly integrated into our app, and to the Steve Gotlieb DSO descriptive notes tightly integrated as well.
- The "Select Search type" is "Primary" by default. The other option is for more advanced tasks of traversing the SQL database using its dedicated request syntax.
- The "Select object types" usually have all of the items checked. But that's purely personal option (I'm often removing asterisms and open clusters).
- The "Empty field treatment" is at maximally relaxed settings (first item selected by default), as, for example, there is no magnitude provided for dark nebulae, but I want to observe them anyway.
- Now the most sophisticated part, the "Primary search parameters" item, which hides another list of parameters:
  - The "Filter Type" option I use is the "Visibility" filter. This is the mode where your selection of the telescope, eyepieces, and sky limiting magnitude is utilized in order to figure if the DSO object is visible (and to what degree) or not.
  - The next item is "Select constellation" this is where you can immediately reduce the size of your list by searching only within a set of constellations (I never used it, but I know people doing that religiously).
  - The "Object name starts with" option is dedicated for working with custom databases, where you can use a special name prefix to group objects in a custom ways. Or you can target a specific object catalog using it (like IC*). Never used it yet.

- "Object minimal size" - self explanatory. Never changed it, but could be useful to skip very small sized galaxies, i.e. on a turbulent night.
- "Lowest altitude". It's recommended to keep it at 20 degrees (default), as the atmospheric extinction is almost unnoticeable down to that altitude, so the Visibility filter will work right. But I love to relax looking for Southern sky globular clusters glowing with delicious "fatty" star disks, when they are floating just above the sea horizon, so I'm keeping it at 0 deg.
- The "Detection limit" is considered the most mysterious item on the list. But, if you think about it as about the quality of the picture viewed, - it will be intuitive. Just decide how good the visibility of the objects you want on the scale from 0 to 5. If your goal is to showcase some goodies for friends, select 5. If you are a beginner select 3 to 4. If you are a seasoned observer, hunting the faintest glimpses of the distant light in the black LPZ - enter 0.1 (0 is for objects below your instrument's penetration capabilities).

Done with this one (in fact, I'm rarely touching this item, after setting the altitude to 0 once and having the limit defaulted to 1.1, at all).

- The "Exclude duplicates" is usually On (default), unless you are investigating the identity of the objects from different catalogs. It helps with the clutter when you have a popular object registered in more than one active catalog.
- The "Time of observation" for me is obviously from "Now" or "Astro Twilight Ends" - to "Astro Twilight Begins" - that's just 4 screen taps to setup.
- I can change my current instrument right from that screen as well, if I need to. Or/And update the location (but my method, described at the step 3 above, is better, as in case the GPS satellites constellation is weak, the fix will be there by the time I'm done configuring the night on this screen. So, I'm just confirming that the fix is good and current (or the name of the observing location is matching), the telescope is the one I have at hand, reading corresponding screen items descriptions.
- And, finally, the last one - "Sky limiting magnitude". That's the magnitude value of the faintest star you could distinguish by naked eye near Zenith. I wish we have an additional button to show the current zenith on the Star Chart and allow to pick that star (just made a note for such a feature), but usually, I'm just figuring that by observing conditions and assigning 5 for a fairly good sky in a better than yellow light pollution zone (LPZ), 6 for an excellent looking sky in the blue or better LPZ, and 7 for an exceptionally clear sky observed in the true black LPZ. But, sure thing, if you'd prefer the true scientific approach, learn to figure that value from the actual sky observation beforehand.

Done with this screen. Just click the Android's Back button and see your Objects Selection list populating with good candidates to hunt for! But the planning part is not over just yet.


Looking at the new Objects Selection list, I'm making sure the number of objects found here is not 15'000, as that's the limit for this list, so "15000 obj" means that I lost some of the objects I could observe otherwise due to the device memory limitations. Most of them will be Galaxies, the other types contribution to the count is minimal. So on a huge telescope, I may consider observing non galaxies separately (like first), and then make a separate observation list for galaxies only, i.e. filtering them per constellation, per magnitude ranges, etc. But for my 12" I'm usually getting something around 9500 objects found here in a "worst case" scenario. In order to refine that list you can tap the "Select" button again and correct anything you think will reduce the list conveniently. Just make sure that when you are back to the list - you tap the "Update" button to apply your new settings to the list. Watch for the "Stop" button to the right from the "Update" one, as the little spinner, indicating that the database crunching is in progress, is less visible in the top right corner of the list in Night mode. When it disappears you can continue with adding objects found to the actual observations list you will be using at the eyepiece.

If the resulting list is less than 5000 objects - I'm simply long-tapping on one of the objects and selecting the "Add All to Observation List" item from the pop-up context menu. So everything on the Objects Selection List is copied to

the current Observations List, which I have prepared on the step 4 above. Keep in mind though, that if the current Observations List is not empty, new objects will be appended to the existing entries (that's, by the way, how you can create complex compound observation lists from multiple unrelated data sources). The magic of the 5000 number is due to the another memory limitation, now for the Observation List size. I believe, it's a reasonable limit, as even on a 10 hours long night you will have to observe more than 8 objects per minute in order to run it all through. Also, that's a good size to keep the Star Chart's clutter at bay.

In case my resulting Objects Selection list is larger than 5000, I'd usually prefer to modify my search criteria to reduce it as described above. Another option would be to use the Constellation button (ALL) at the bottom-right of the screen to effectively reduce the list by about 40 times, showing the portion of the list for a single constellation. Then I can use the Add all..." the same way, switching the constellation and adding them one by one until I have about 5000. Then switching to the second Observation List and adding the rest.

That's it for the Object Selection screen. It will remain intact through you observing session, so you can always get back to it and add objects as you go. But I don't usually do that, making sure I have the final set of Observation Lists complete.


Return to the main screen and tap the Observations Lists button to open your final list of objects, that's your plan for the night or the session.

The first thing I do - sorting my list by the "Set Time" using the "Sort" option in the main menu of the list. So the list starts from objects, which are going below the horizon soon. It's logical to observe them before they are gone.

Tap the first row to open the Star Chart with that first object centered and selected.

Note, that by default, the Chart will have the special objects layers system configured to display the NGCIC database regardless of your Observations List data. As the result you will usually have more NGCIC objects on the Chart than you really need (have on your current Observation List), as the only limitation of that independent objects layer is the object's magnitude (that's what a regular planetarium app will do - show some objects on the Chart). The one time fix for that is to open the Star Chart's Settings from the Main menu, and select the "Star, object and image layers" option. You want to clear checks in the "Object Layers" section. After that you should notice significant reduction of the clutter on the Chart, as only objects visible in your instrument and selected on the Observation List are displayed. These settings need to be set just once to stay in place forever. But if you don't want a hassle of going through the planning interface (it's enough to disable the filter there to achieve the same effect), and just want to see the Chart of DSO's down to certain magnitude - you can use these layers and sliders to draw all of them easily.

The first thing to check on the map is the Time Mode, displayed in the bottom right corner. While you are at the eyepiece, the first word in that corner text you want to see must be "NOW", what means the Chart is synchronized with your Android OS time (and thus with the real time). If that's not the case, just tap that corner and select the "RT ON" button at the bottom to toggle the Real Time mode and synchronize the Chart view with the sky view.


So, again, I have my fist object on the Observations List selected and centered on the Chart already and want to point my telescope there.

I'm a Telrad guru, and usually can hit the spot with it right away, thanks to the advanced Telrad feature of DSO Planner, but the Star Hopping is a great fun too, so let's pretend I don't have neither Telrad, nor a finderscope. My only option is the wide field eyepiece... Another side note here. In fact, the finderscope could be considered an eyepiece too, so if you have one - the same technique will do perfectly fine, you just need to add a "fake" eyepiece to your eyepieces database, which would effectively produce a right FOV circle on the chart, corresponding to the FOV of your finderscope. The easiest way to do that is the trial and error. The only caveat is that the crosshair of your finderscope will be most likely useless, as it's out of sync with the crosshair of the eyepiece circle on the Chart (the later is Polar aligned).

Prior to finding and pointing to the bright base star for star-hopping start point, I would open the selected object's Details screen (tap the left bottom corner, containing object's name) and tap the "Lock" button there. That will prevent an accidental selection of other objects on the Star Chart screen while I'm manipulating it one-handed from and awkward posture behind the eyepiece - very useful. Also, I would turn on the eyepieces circles display in the Chart's main menu if they are off.

Now, using the low zoom on the Chart, I would try to match some bright stars around my object with what I see in the sky, and then point my telescope to one, closest to my object, making sure it's in the center of the EP FOV. After that I would zoom in the Chart to that star, making sure I can still see the EP FOV ring within the screen bounds. That's my star-hopping navigation Chart. Note the dashed thin red line, which will point in the direction of selected object from the center of the chart, it's the great aid in hopping between the stars to the target. Don't be confused with the Chart being rotated or mirrored (if using star diagonal) relative to the Chart. You can either rotate your phone to match the EP view, or use the special "Rotate 180", and "Mirror" Menu items of the Chart to amend the issue.

If you hadn't done that yet, there is one more step to do prior to starting pushing and pulling the mount. Open the Chart's main menu and select "Boldness" item. You will see two disks on the horizontal guide line at the bottom of the Chart. Moving them along the line allows to adjust sizes of stars' circles on the Chart (it's easier to try and master than try to explain what you need to do with these disks). That makes matching the magnitude differences you see in the eyepiece with the Chart's information much easier. These settings are individual to your Android screen, your eyes, and your instrument, so they always need some initial tuning and may need tuning again, after changing the instrument (telescope, eyepieces set). Each "Boldness" setting is saved per zoom level, so you do have some flexibility here to minimize the need of adjusting that every time, by tuning some reasonable average boldness). As an avid AVSO (variable stars) observer I prefer to simply ramp up the difference between brightest and faintest stars significantly (That's how AAVSO Charts are made on purpose), so I can see the difference clearly, regardless of how realistic the image looks. Besides, it's a map, not a planetarium projection.


I'm ready for star-hopping now. Looking with one eye to the Chart and with other eye through the Eyepiece, using one hand to push the OTA, and other hand to slide my map along the red line until both hit the target. In case the object is small, I can change the EP and the Chart's zoom to continue hopping at higher magnification as necessary. If I want to make a note of my observations for that object, I would tap the left bottom corner of the Chart again to open the Object Datails screen, select the Notes button, then Add new note button in the notes list, and either type something, or hit the Start Recording button and narrate some nonsense to decipher later. Either way, the note must be explicitly saved using the Save button at the bottom.

When done, don't forget to release the Lock on the object, so you can select another one either from the Observation List or right from the Star Chart screen.

---

**Tip:** Quite often, I may notice a mysterious glimpse in vicinity of my target object, it could be another DSO, which hadn't been listed for some reason. I would almost certainly use the "Nearby" menu item of the Chart to research the region further and figure what could it be. Basically, it will search every database in order to reveal any objects close to the center of the Chart's screen and display its findings.

---

Hope that helps.

# Add additional information

## Add additional information to the integrated database

User wants to supplement the integrated NGCIC database with his own object name (i.e. in your native language) and some colorful images of the object.

**Follow the steps:**

1. Create a new user database called "myngc" with a text field called "myname" and an image path field called "photo".
2. Add a new object to this database. Set its "name1" and "name2" fields to "ngc224". Set "myname" field to "Andromeda" and "photo" field to the full path to the image of the NGC224 (M31) on the SD card. There is no need to set other (default) fields values.
3. Find the NGC224 (M31) in Messier or NGCIC catalog and use "Details" context menu item tapping over its record.
4. The Details screen will open. Tap "More" button at the end of the list of default information. At the screen bottom among others you would see section headed "myngc: ngc224" with fields "myname" showing "Andromeda" and "photo" showing your image path. Click on the path line to see your image.

# Add new asteroid

## Add new asteroid to the database from NASA JPL HORIZONS

After generating the ephemeris file for an object at the http://ssd.jpl.nasa.gov/horizons.cgi#top you will see the following data at the top:

```
*******************************************************************************
JPL/HORIZONS                      (2015 TB145)               2015-Oct-28 17:06:18
Rec #:744206 (+COV)   Soln.date: 2015-Oct-28_15:37:38      # obs: 521 (18 days)

FK5/J2000.0 helio. ecliptic osc. elements (au, days, deg., period=Julian yrs):

  EPOCH=  2457314.5 ! 2015-Oct-19.00 (TDB)         Residual RMS= .24911
   EC= .8604298432540967   QR= .2947048588271607   TP= 2457368.1336012329
   OM= 37.73289761771034   W=  121.5380282169528   IN= 39.68563358401836
   A= 2.111517717671481    MA= 342.7714416664973   ADIST= 3.928330576515801
   PER= 3.06832            N= .321226945           ANGMOM= .012737428
   DAN= .99698             DDN= .37811             L= 166.3048156
   B= 32.9736307           MOID= .00187776         TP= 2015-Dec-11.6336012329

Asteroid physical parameters (km, seconds, rotational period in hours):
   GM= n.a.                RAD= n.a.               ROTPER= n.a.
   H= 19.8                 G= .150                 B-V= n.a.
                           ALBEDO= n.a.            STYP= n.a.
```

In order to add that object's orbit to the Minor Planets database of DSO Planner on your Android device:

1. Open the Settings module from the main screen

2. Select "Objects Databases" item
3. Tap the "Minor Planets" line in the list to list objects from that database.
4. Open the main menu of the database screen (Android Menu button, flick up from the bottom of the screen, or floating menu button if you have it enabled in the Night Mode)
5. Select the "Add Object" command.
6. On the "Create new object" screen you need to enter following parameters to fully define the new minor planet's orbit:
   - **name1 —** any
   - **name2 —** any
   - **comment —** any
   - **month —** value of month from the EPOCH= field
   - **year —** value of year from the EPOCH= field
   - **G —** value from G= field (Asteroid physical parameters)
   - **H —** value from H= (Asteroid physical parameters)
   - **M —** value from MA=
   - **axis —** value from A=
   - **day —** value of day from the EPOCH= field
   - **e —** value from EC=
   - **i —** value from IN=
   - **node —** value from OM=
   - **w —** value from W= field.

See the Objects Databases chapter for more details.

# Article Sources and Contributors

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