Visually Observing

with the RCOS 20″ Telescope

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Contents

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This document describes how to access the dome and to observe visually with the 20″ RCOS telescope.

First users should read through this whole document in sequential order!

Advice: practice during daytime with the dome closed. (No direct sunlight is allowed to fall on the telescope to prevent degradation of the carbon fiber construction.)

1 Quick reference start

The following sequence is the quickest and most convenient way to start observing.
1. Switch on the lights (Sect. 3)
2. Flip the Upper-dome switch to power on the dome shutters (Sect. 5)
3. Power on the mount and the telescope (Sect. 4)
4. Start the program *ACP* at the PC and wait 20 seconds (Sect. 6)
5. Open the dome with the program *AceSmartDome* (Sect. 5)
6. Point to a bright object (for focusing), either with the Hand Pad, or through *ACP* (Sect. 6)
7. Insert a suitable eyepiece (Sect. 8) and focus before proceeding (Sect. 9)

After observing (Sect. 10):
1. Close the dome and put it in the Home position with *AceSmartDome*: *Synchronized Close*, and *Home*
2. Close *ACP. Do NOT confirm Park and Close.* Switch off the PC monitors.
3. Remove and store the eyepieces. Put the dust cap in the eyepiece opening.
4. Park the telescope with the Hand Pad
5. Power off the telescope and the mount
6. Flip the Upper-dome switch to power off
7. Switch off the lights

2 Basic telescope data

Telescope type: RCOS (Ritchey-Chrétien Optical Systems), with two hyperbolic mirrors
Free opening of the primary mirror: 20″ = 50.8 cm
Focal length: 417 cm
Focal ratio $f/8.2$
Magnification: 110× with the wide-field 38 mm eyepiece
160× with the 26 mm eyepieces in the Binoviewer
175 – 520× with the 24-8 mm zoom eyepiece
Linear scale in the focal plane: 0.5 arcsec per 10 μm

3 Entrance doors and light switches in the dome area

1. The entrance door at the top of the stars from the 4th floor should always kept closed to prevent the heated air from below to enter the area at the 5th floor (= terrace) level.

2. For best results during observing the two doors to the terrace should be kept open to allow the outside air to circulate through the dome and keep the mirror in thermal balance with the air temperature. (For occasional observing these 2 doors could remain closed).

Fig. 1: Rope light switch

3. There are three lights *in the 5th floor area*:
– top light, with two switches. One is located just before entering the door, and the other in the dome (Fig. 2, middle).
– door light, with the switch next to the door to the terrace.
– rope light along the stairs, with a pushbutton (Fig. 1) next to the fire extinguisher, also operated with the remote control in the dome.

4. The lights *in the dome*:
– top light, operated with the top buttons of the *small remote controlbox* which hangs upside down with a small chain on the wall, close to the stairs (Fig. 2, bottom). *This controlbox should never be removed!*

– adjustable lights at several places at the wall, above the tables.

Fig. 2: Dome light switches

The following three lights are operated with the *large remote controlbox* which is stored on top of the metal pole with the other light switches (Fig. 2, top). All lights can be simultaneously switched on or off with the buttons at the bottom. It appears convenient to carry this remote control in the dome when observing, with the top light switched off.
– The circular dome (rope) light, switch 1. The light level can be adjusted with the dimmer, located just above the ground of the dome (near Zuid).
– The flood light (near Noord), switch 2. Its light level can also be adjusted (switch-dimmer on the floor).
– The rope light along the access stairs, switch 3.

4 Mount and telescope power

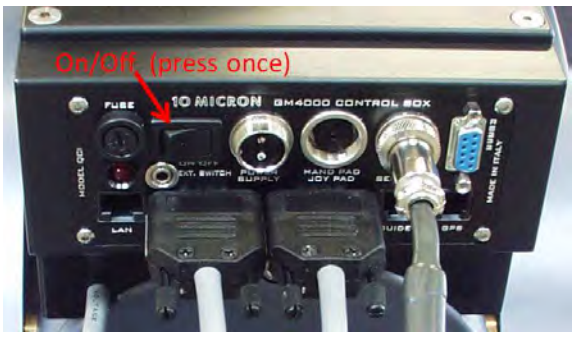


Fig. 3: Mount Panel with On/Off push button

To power-on the mount (for pointing) and the telescope (for opening the mirror cover and focusing) connect the powercords labeled ”Power Mount” and ”Power Telescope” which are located near the powerstrip attached to the WIFI box at the North side of the peer.
Turn the mount on by *pressing once* the black button at the panel of the mount (Fig. 3), which will turn on the red LED light. Booting messages from the built-in linux operating system will appear on the Hand Pad (takes about 30 sec). The Telescope Control Center (TCC) box, which is attached to the telescope, has also a red LED light to indicate that it is operational.

5 Dome operation

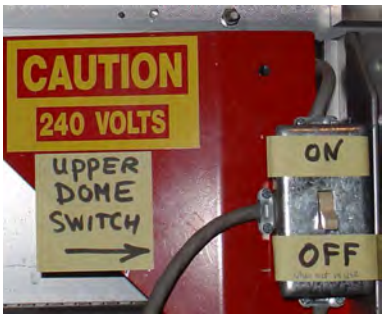


Fig. 4: Upper-dome switch

The dome has three moving parts: rotation of the dome, Main Shutter, and Dropout Shutter.
Notes:
1. The Dropout Shutter can move only if the Main Shutter is opened by at least 30 cm.
2. For safety reasons, the shutters of the dome should always be powered off with the upper-dome (flip) switch when not in use, see Fig. 4. (Don't forget after leaving! The upper shutter has been found spontaneously opened, which caused rain damage.)

The default orientation is the *Home* position, indicated with opposite arrows. This orientation has been chosen to minimize possible damage to the telescope and dome in case of strong wind or heavy rain.


Fig. 5: Manual Dome Control

Dome operations can be controlled in three independent ways:

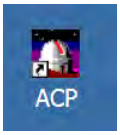
1. Manual dome control (Fig. 5), with the green/black push buttons on the dome controlbox (Zuid). The white buttons control the rotation. The two shutters can also be operated from the (similarly looking) dome controlbox next to the shutters. The red emergency push-button will stop any motion.

2. From the PC with the program AceSmartDome
The icon is on the Desktop (for username and pw see whiteboard).

Fig. 6: ACE SmartDome

– Click "Connect" to connect to the COM port.
– Options are to open/close the shutters independently, or, conveniently, together (Synchronized OPEN/CLOSE).
– Clicking on STOP will stop any motion.
– Don't forget to put the dome in the *Home* position after usage.
– Don't Reset, or use any other option.

3. Automated dome control which makes the dome corotate with the telescope.



In this mode the shutters have still to be opened by either of the two methods above. This is the most convenient way during testing and when observing, and is accomplished by starting the program *ACP* on the Desktop. (Not to be confused with *ACP Planner*.)

Before starting up ACP, make sure the mount and the telescope are powered on (Sect. 4). Double clicking on the icon will start up the program *which takes 20 seconds to complete, so be patient*.
ACP will start up several additional programs, the first of which is *AceSmartDome*, which automatically connects. The obvious message *"Cannot initialize Camera"* could be safely clicked away (normally hidden behind the SmartDome window). It will then start MaximDL with its subwindows.

After completion check the box *"Sidereal Tracking"*. The dome will now follow the telescope ("Slaved Dome"). The first time it will take a few moments before the dome starts moving.

At this point the telescope can be pointed and the dome can be opened (if wanted) through the *AceSmartDome* window, see above (Fig. 6). The dome does not have to be fully opened.

6 Object pointing

Object pointing can be (independently) either manually by the Hand Pad "HAND TERMINAL QCI", or by using *ACP*. In both cases the dome will follow the telescope provided the dome is slaved by *ACP* (with Sidereal Tracking on).

Fig. 7: Hand Pad

1. With the Hand Pad

– The NWSE direction keys move the telescope. Pressing two adjacent keys simultaneously causes diagonal motion.

– The *slew rate* can be adjusted with the + and − keys from the default maximum speed of 3°/sec down to 2.25″/sec.

– Object selection can be done in two ways:
(a) by going through *MENU*, *Object*, *ENTER*, and going through the list by the + and − keys, until the object is in the display, followed by *ENTER*. Pressing *ESC* moves back to the previous menu.

(b) by pressing a numeric key (annotated), for example 5 for *PLANET* and again 5 for Jupiter, pressing 7 for *Messier* followed by a number, 4 for *STAR* to select the binary Almach, or 9 for *IC* and 434 for the Horsehead Nebula, etc.

Pressing *ENTER* for a second time will move the telescope to the object. When the slew procedure completes correctly, the keypad will emit a beep sound. To interrupt, press *STOP*.

Note. When the pointing is not accurate enough, or to make sure that the (faint) object will be in the center of the field of view: first slew to a known object nearby and center it. Then holding *ENTER* for a few seconds will use this object as the reference point for slewing to the next target *(synchronizing)*.

2. Through ACP

– Click on the button *Slew or Sync (catalog)* and select the object in the new window. (A *Search* is helpful for selecting only visible objects.) Clicking on *GoTo* will start the slew.

– Note that the Moon is not in the preprogrammed *ACP* list. Use the Hand Pad instead.

– *Sync* (*synchronizing*), has the similar function as on the Hand Pad.

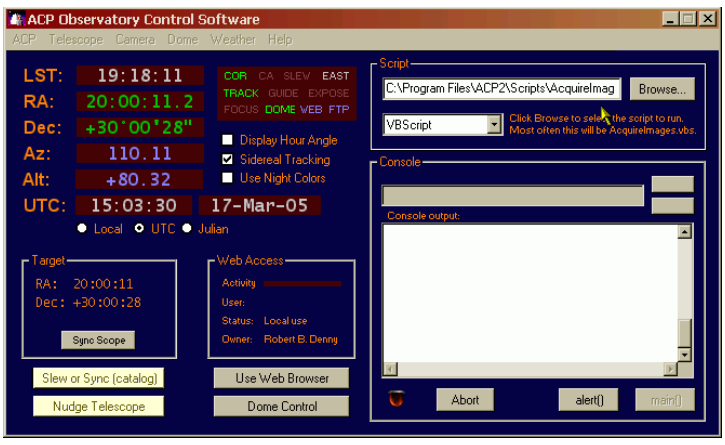


Fig. 8: ACP main window

– Selecting *Use Night Colors* in the main window will put both monitors in a comfortable low-level light environment.

– **Never** change any of the settings of *ACP* (on the penalty of a useless system).

Fig. 9: ACP subwindows

7 Optical port

By means of a rotatable mirror (called the ”Sidewinder”) the light-path can be directed into two directions, of which one is used for visual observing, in general in combination with a zenit mirror (see below).
The two white dots at the back end indicate the light path, and should be oriented as shown.
To rotate the mirror, slide the knob about 8 mm (only) outwards, bring it into position and slide it back.

Fig. 10: Orientation for visual observing

8 Eyepieces and filters

Eyepieces are stored in a box on the upperleft shelve of the cabinet. The useful eyepieces are:

– Wide field $f = 39$ mm (magnification $110\times$).
– Zoom eyepiece $f = 24 - 8$ mm (magnification $175 - 520\times$).
– The *Binoviewer* (on loan from J. Vreeling) with two identical 26 mm eyepieces (magnification $160\times$).

Fig. 11: Binoviewer, wide-field, and zoom eyepiece with Ultra-High-Contrast filter

The *Zenit Mirror* is convenient, but also needed, otherwise focus cannot be reached.

A *Ultra-High-Contrast Filter* (on loan from the VU) is useful for darkening the background, especially for Planetary Nebulae. This is best used with the zoom eyepiece.

9 Focusing and controlling telescope functions

The position of the secondary mirror determines the focus, which is controlled through the Telescope Command Center (TCC) box. Focusing can be done in two different ways:

1. Focusing using de hand controller of the TCC

Press the lower button to switch between three modes:
– – = fixed (no motion when turning the knob, default)
CS = Course
FN = Fine
The turning knob will change the focus in CS or FN mode. A higher number indicates a more outward focus.

The numbers indicate displacements of 1/40000 inch, so switching eyepieces may imply (very) many turns. Use a bright star to find an approximate focus (by decreasing the size of the donut shaped image), and a faint star (or Jupiter moons) to get the final focus. Remembering (or writing down) the setting for each eyepiece could save much time.

Fig. 12: Hand controller of the telescope functions

2. Focusing using the program RCOS

Start the program *RCOS* by Programs → RCOS → RCOS, which will bring up the RCOS TCC window (Fig. 13).

By entering the (known) focus setting and clicking *GOTO* much time can be saved after changing eyepieces, especially with and without zenith mirror and/or Binoviewer. (The HOME position around position 0 is not to be used).

A *thermally balanced mirror* gives better images. This is more rapidly reached by turning on the fans of the primary mirror, either through the function menu on the TCC hand controller, or under the Temperature Tab in the RCOS program.

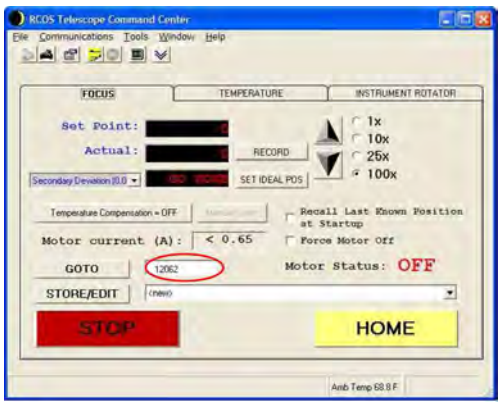


Fig. 13: RCOS window with telescope functions

10 Shutdown checklist after observing

1. Uncheck "Sidereal Tracking" in *ACP*. Use *AceSmartDome* to close the dome and put it in the Home position: *Synchronized Close*, and *Home*
2. Close *ACP*. *Do NOT confirm Park and Close*, and all other open programs. Switch off the PC monitors (not the PC).
3. Remove and store the eyepiece(s). Put the dust cap in the eyepiece opening.
4. Park the telescope: On the Hand Pad press *MENU* → *Alignment*, *ENTER*, → *Park*, *ENTER*, *Confirm Park? ENTER*. This will point the telescope to the North celestial pole in the highest position, which is the most safe position.
5. Power off the mount by pressing the black button (see Sect. 4) only once, and wait a few seconds until the red LED light goes off. Power off the telescope.
6. Flip the upper-dome switch to power off (Fig. 5).
7. Put back the used furniture, rotate the wooden table in the aligned position with the telescope, and close the sliding doors of the cabinet.
8. Switch off the lights.