

Usage of the Schmidt telescope

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General remarks

Warning/Caution/etc: the full drive system of the Schmidt telescope has been replaced recently (as of 2021-06-23). Despite the fact that the CCDSH environment hides many of the internal details, one should consider the telescope as **a completely new system** and, therefore, **spend sufficient amount of time to learn** and/or to adapt to the new features and changes. In addition, this upgrade is still in progress (as of early August, 2021) therefore many subsystems are either disconnected as of this writing or their functionality and/or interfacing will change in the future. The planned (and already performed) upgrade sequence is designed to minimize the downtime (practically to zero) - thus, in between the various upgrade steps, some features are indeed temporary and these intermediate-stage functionalities might not be as convenient as these used to be and as these will be soon. Please bear these in mind while observing with the telescope.

Important notes related to the upgrade process and the current usage of the telescope in practice:

- The telescope is currently capable only for remote operations (in accordance to the aforementioned upgrade plan, with the exception of the dome slit door, see the next point). Therefore, even for local control, you need to bring a laptop, tablet or a smartphone with an SSH client in order to reach the control computer (which is still `m9.konkoly.hu`, where all of the software components are installed).
- The old local control panel is fully disconnected from the system, now it is not necessary to turn it on. (Moreover, it is not even recommended.) The dome slit door can locally be controlled from the old control panel, but the switch itself is powered from the new system.
- The upgrade did not affect the camera and its closely related subsystems (cooling, power control, etc.). Thus, one can use these as simply as before (and as it is stated in this document later on).
- The safety features are now fully implemented by software and the optical detector at the fork is temporarily disconnected. Please do not be at the fork of the telescope mount while the declination axis is moving.
- The dome home position is re-defined to be at/around 150 degrees of azimuth for practical and pre-caution reasons. Please aim to move the dome to this position after finishing observations.
- There is a "remote" vs. "local" key in the new control panel (see below). Due to the lack of real "local" control, it is recommended to leave it on "remote" state. However, for major engineering and/or maintenance, it is good to set to "local" in order to avoid accidental power-up or movement of the telescope system. In this sense, this key works exactly the same way as in the RCC telescope.
- The upgrade would not stop at the current stage, see at the end of this page for the further plans.

The cooler and the camera of the telescope is always on. If not, contact the support astronomer. There is no filter wheel at the moment. There is a PanSTARRS wide (w) filter installed in front of the camera, thus all of the image files created by CCDSH will have the filter suffix of "w".

Routine observations

Please follow the points below for routine observations.

1. If the telescope is turned off, go to the dome, and switch on the telescope using **only the new control panel**. The "new control panel" is currently an euphemism for a comparatively small panel with two big led lights, a local-remote key, two glowing push buttons and an emergency switch ^[1]. You do not need to switch on the old control panel (see photo, in the background), however, currently it shows the feedback light for the oil pressure. On the other hand, the oil pump is powered by the new system. If the old control panel is powered on, the three phases of the electric power can also be checked (lights with R, S and T, on the old control panel). These three light should

be on, and the oil pressure should be off once the system is ready for operations.

2. Remove the tube cover. ~~Since the convenient position for removing the tube cover is beyond the software limitations, always use the telescope control panel to move the telescope in this position. Similarly, after removing the tube cover, move the telescope manually (i.e. still using the telescope control panel) to some reasonable horizontal altitude in order to allow the software backends to handle the telescope motions properly.~~ Login to m9 (basically, using a smartphone or tablet or laptop), start `ccdsh` and issue the command `schctrl -s 0,-40`. It will move the telescope to the convenient position where the tube cover can easily be removed or put back by anyone. Once it is done, you may put the telescope back to nearly vertical by issuing `schctrl -s 0,48`.

3. Turn off all the lights and leave the dome.

4. Login again to the control computer, `m9.konkoly.hu`, with your own account.

Run `eng-schmidt test` to see if everything is OK.

```
rszakats@m9:~$ eng-schmidt test
[ Ok ] Checking gateway at 172.31.90.1... done.
[ Ok ] Checking gateway at 172.31.90.2... done.
[ Ok ] Checking Archon ARP state at 10.10.111.3... resolved.
[ Ok ] Checking camera reset relay driver module at 172.31.90.19... done.
[ Ok ] Checking MDSNACD bus master at 172.31.90.225... done.
[ Ok ] Checking TAU motor driver (//172.31.90.225/0x63/0x01)... done.
[ Ok ] Checking TAU coarse control (//172.31.90.225/0xDD/0x01)... done.
[ Ok ] Checking TAU encoder (//172.31.90.225/0xEC/0x01)... done.
[ Ok ] Checking DEC motor driver (//172.31.90.225/0x63/0x02)... done.
[ Ok ] Checking DEC encoder (//172.31.90.225/0xEC/0x02)... done.
[ Ok ] Checking dome relay controller (//172.31.90.225/0xDD/0x05)... done.
[ Ok ] Checking dome encoder (//172.31.90.225/0xEC/0x05)... done.
[ Ok ] Checking focus motor driver (//172.31.90.225/0x63/0x17)... done.
[ Ok ] Checking focus encoder (//172.31.90.225/0xEC/0x17)... done.
[ Ok ] Checking accelerometer (//172.31.90.225/0xAC/0x01)... done.
[ Ok ] Checking mains controller (//172.31.90.225/0xDD/0x21)... done.
[ Ok ] Checking mains input state (//172.31.90.225/0xDD/0x22)... done.
[ Ok ] Checking PSCHTCM server (ALIX)... done.
[ Ok ] Checking PSCHTCM status... telescope is ready.
[ Ok ] Checking dome surveillance camera... done.
rszakats@m9:~$
```

The new system is controlled via the MDSNACD ^[2] network, implemented over CAN bus ^[3]. The wiring of the CAN bus runs from the dome controller electric cabinet up to the focus motor within telescope tube - and this bus connects the ~dozen individual logic nodes performing the motion control of the telescope.

5. Start `ds9`.

Start a `screen` session. (See Usage of the screen program)

If the `postproc_schmidt_bin.sh` script is not running, start it.

Important note: Always save your images to the `/data` directory, because with the new camera one fits file is around 220MB!

Start the program `ccdsh` in the screen.

Type `CCD> status` to see if everything is OK.

```

CCD> status
CCD:      ready # 0 idle
Mount:    ready # 0 idle udec=29.9755 st=342.0044 utau=86.8298 mx=0,0,0,0,0
Dome:     ready # 0 tracking 0x0
Filter:   ready # 0 nothing_to_do
Focuser:  ready # ready
Logger:   ready # 0 idle
Logger:   ready # 0 idle
Logger:   ready # 0 idle
Resolver: ready # 0 idle
Resolver: ready # 0 idle
Resolver: ready # 0 idle
Command:  ready # 0 idle
Command:  ready # 0 idle
Command:  ready # 0 idle
Command:  ready # 0 idle
Keyword:  ready # 0 idle
Keyword:  ready # 0 idle
CCD> CCD>

```

6. Check the camera temperature: `CCD> get temperature` It should be around -50. Never try to change the camera temperature from `ccdsh`!

7. Open the dome, and set it to automatic:

```
CCD> set dome slit open
```

```
CCD> set dome auto on
```

~~The mount should be tracking the sky, but you can type `CCD> set mount track on` if it was off.~~ A major difference w.r.t the previous system is about the sidereal tracking:

- By default, the telescope do not track.
- Once the telescope is commanded to a J2000 R.A./dec position (with the command `slew` or from `sequence`), it also starts to track regardless of the previous state of the tracker.
- Once the telescope is commanded to a specified hour angle - declination position, it also stops tracking.
- The command `set mount track on|off` still works: it stops tracking if the telescope was commanded to a J2000 coordinate and can also be used to start tracking if it was not tracking before.

The first three points imply exactly the same behavior what is known from the RC80 telescope. However, while the command `set mount track on|off` is not supported by the RC80 system (due to the limitations of the ASA mount), it is supported by the Schmidt system.

The command `CCD> get dome slit` can be used to track the status. Wait until the slit door is fully opened. If the dome is in home position, and there are some lights in the dome area (see the notes at the end), you can clearly see the slit door via the webcam (see also the notes).

8. Start observing. The telescope can be slewed to any position using the `CCD> slew` command of `ccdsh`. Individual images can be taken using the `CCD> acquire` command (for testing purposes, for example). Complex series of images can be created via the command `CCD> sequence`. There are many commands in `ccdsh` that makes the observations convenient (object name resolves using databases such as Simbad or MPC, definitions of favourite and frequently observed objects, visibility calculations and visibility graphs, and so on). Here we refer the full documentation of CCDSH (in English). Please use the command `status` regularly, both after and before complex operations and/or long image sequences to check if every subsystem operates properly. Wait until the operations

complete: if the status of some of the subsystems (e.g. mount, etc.) is **busy** (displayed in yellow), you might have to wait a little bit until the operations are completed and the telescope system becomes ready to use.

If you have a script, type `CCD> source myscript` in `ccdsh`. The `ccdsh` will interpret the script and start to execute it line by line.

9. If you have to stop your script while running (preferably during 'delaying'), always check if the telescope has stopped with the `CCD> status` command. If mount and/or dome is **busy**, type `CCD> set mount stop` and `CCD> set dome stop`.

How to finish observations

1. Make sure that the telescope subsystems completed their work. Never start shutting down the system before any of the controls is in a busy state.

2. Close the dome slit door (locally from the telescope control panel in the dome area or remotely, using the appropriate `ccdsh` command), e.g. `CCD> set dome slit close`.

3. You may want to move the dome to its home position. The normal home position of the dome is at `azimuth=150` (the slit door looks west-southwest). It is not essential, but recommended. You can use the appropriate `ccdsh` commands as well:

```
CCD> set mount track off
```

```
CCD> set dome auto off
```

```
CCD> set dome azimuth=150
```

 , then wait until the dome moves to its home position (see also the status command).

4. Exit from the `ccdsh` program.

5. Go to the dome. Put on the tube cover (for this, you need again your smartphone, tablet, or laptop, see above, how to remove the tube cover, etc).

6. Move the telescope to a vertical position (using again the `ccdsh` command of `schctrl -s 0,48`, etc, see above). Switch off the telescope.

Notes

- The orders of the procedures in lists above are not so strict, so the observer may alter the order depending on the actual needs. If the steps are not performed in the order, one may get related notifications. For instance, `ccdsh` prints a warning if started while the telescope is powered down.
- The observer can also use the `ccdsh` commands `CCD> set dome light 0 on` and `CCD> set dome light 0 off` to switch on and off the flat lights in the dome. The `light 0` is the fainter one (that is used routinely for taking dome flats) and the `light 1` is the brighter one. By switching on the latter one, the dome slit can be seen clearly if the dome is rotated to `CCD> set dome azimuth=150`.
- The state of the telescope, dome position, the image of the all-sky camera (including the marks of the telescope pointing) and the dome area web camera can be tracked real-time from this location: <http://ccdsh.konkoly.hu/static/tmp/psch-state.html>. This web address is temporary, and might be changed in the future. If the brighter dome flat light is on (see above) and the dome is at the home position (`azimuth=150`), the slit door can clearly be seen via the web camera.
- **Troubleshooting:** just in any kind of unexpected behavior, run and save the output of `schctrl status` (from within the CCDSH session), stop everything and do another `schctrl status` (and save the output). Following this, try to a restart of the CCDSH session. If needed, do a power cycle from the shell using `eng-schmidt power off` and `eng-schmidt power on` after a few seconds.

Upgrade plans

According to the current schedule, the upgrade plans are as follows:

- ~~First, the old control panel will fully be disconnected by separating the dome slit door radio control module.~~
(done, as of 2021-08-01)
- The next step is planned to be the replacement of the old control panel interior with the electronics of the new control panel (i.e. only the on-off buttons, the remote key and the status lights). All of the other buttons and leds would not operate on the control panel.
- Following this, the interior of the (now again just simply) control panel will be upgraded with the electronics responsible for all of another buttons and status lights in order to allow manual control of the telescope from site (without your smartphone, tablet or laptop).
- Finally, all of the electrical wiring from the old system will be expunged from the telescope, mainly from the hour axis. Wiring will be replaced by the new system - which operates with much less cables.

The timeline of the above steps is not known. As of this writing (Aug 1, 2021) expect something like the calendar year of 2021 to be fully finished. However, all of these steps imply minimal or zero practical downtime for the system. Our goal is to keep the retro style of the system while all of the internal and control parts are fully upgraded to modern standards.

References

- [1] https://ccdsh.konkoly.hu/wiki/File:20210629_162044.jpg
- [2] <https://ccdsh.konkoly.hu/wiki/Flyseye:MDSNACD>
- [3] https://en.wikipedia.org/wiki/CAN_bus