🔧 **Fix Me!** This page is currently under revision.

Telescope Setup

Setup of the mount

Using the mount directly

Alignment

The accuracy of the tracking can be improved with a good alignment. This procedure can gather information on possible errors in the azimuth and pole-height settings (correction suggestions for the hardware), to reduce errors in the alignment of the pole axis.

Alignment with 2 stars

```
MENU - Alignment - 2-Stars - ENTER
```

- select one star from the presented list and press ENTER
- select the second star from that list (it should have a large distance to the first in RA/DEC) and press ENTER
- the telescope changes its position and points to the first star
- the star should be in the center of the eyepiece, adjust the pointing with the N - S - E - W buttons as needed (use the eyepiece with the cross hair to easily estimate the center)
- once the star is centered, confirm with ENTER
- repeat the previous two steps with the second star

If the alignment has been successful, the hand terminal will show

```
Alignment complete
```

Refining the alignment

It is advisable to refine the alignment with further stars. Select this option in the hand terminal

```
MENU - Alignment - Refine 2-Stars - ENTER
```

- as before, the hand terminal will display a list of stars
- select one star to which the telescope will move
- center the star in the eyepiece and confirm with ENTER
- the hand terminal will then show:

```
Alignment refined
```

- repeat this procedure until an alignment with 10 stars has been completed

- to improve the accuracy all stars should be spread across the whole sky

There are further methods to change/improve the alignment that are documented in the manual of the GM 4000 QCI, which can be found in room 2.009.

Saving, restoring, and deleting of an alignment

Once a good alignment has been reached, it is recommend to save it:

```
MENU - Alignment - Align Database - Save Model
```

The telescope will then swing to the so called "Home Search" position and saves the alignment. This alignment can then be restored after an alignment loss with:

```
MENU - Alignment - Align Database - Load Model
```

The telescope will then once again swing to the "Home Search" position and load the previously saved data.

It can be necessary to delete a (bad) alignment, e.g. if it only proves to be useless after it has been saved. An alignment can be deleted with:

```
MENU - Alignment - Align Database - Delete Model
```

Alternatively one can reset the mount:

```
MENU - Alignment - Reset at Home
```

In doing so, the alignment will be deleted and the mount restored to the factory settings. Only use this option with caution!

Alignment Information

Information on the current alignment can be found at:

```
MENU - Alignment - Align info
```

With this option, the mount among others gives information on how the orientation of the pole axis can be improved. The terminal will display something like:

```
To center pol ax
move .07 Rt 0.05 Up
```

Using the OMS

Creating a pointing model

The advantage of setting up the mount via the OMS is that a much more precise pointing model can be created, since not only a few stars are used, but up to 100 star fields distributed over the whole sky can be utilized. The exact position of these star fields is determined automatically with the help of the so-called Plate Solving.

We use the software *ModelCreator*.

The most important settings in the **Equipment** tab such as **Camera**, **Mount**, **Solver** and **Dome** should already be preset. These settings are stored as profiles. The predefined profiles can be selected from the **Profile** drop-down menu. By clicking on **Profiles** the profiles can be edited and also new ones can be created. By clicking on the Connect buttons at **Camera**, **Mount** and **Dome** the corresponding devices can be connected to the *ModelCreator*. In the case of the camera, it must be ensured that the camera is connected beforehand to *MaxIm DL* because *ModelCreator* fetches the data from there.

Next you should set the points where *ModelCreator* will create images of the sky. You should set a minimum height above the horizon (Min Alt), because points too close to the horizon do not make sense due to the long way the light travels through the atmosphere. It has been proven that at least a minimum altitude of 15° is necessary. Furthermore, it has turned out to be useful to activate the option Equal az spacing in order to achieve an optimized distribution of the points. If you also activate the option Show number the order in which the points are processed is also displayed. Afterwards you can click on **Generate** to generate the points. After that you can click on **Sort-EW** to sort the points from east to west. This significantly reduces the overall slewing time required by the mount. For our final pointing model we usually use up to 100 points. For this we usually set Points per row and Rows to 10 each. Additionally 3 base points can be selected. Click on the corresponding points with the mouse.

It has proven useful to increase the exposure time for points close to the horizon, because there the air mass increases significantly. Otherwise not enough objects can be identified. For points in the Milky Way, on the other hand, it can happen that no solution can be achieved by plate solving, because there seem to be too many stars in this area. In this case, it might be helpful to reduce the exposure time. The exposure time can be adjusted via the **Control** tab. Here you should also set a Slew settle time of 3s and the focal length of the telescope (Focal Length).

Afterwards the calibration can be started by clicking **Run**. Before that, make sure that the options Clear exsisting alignment
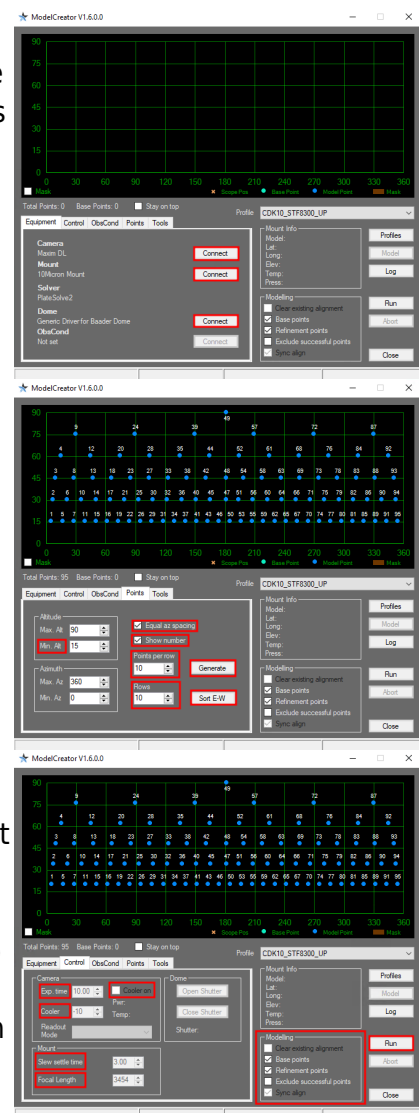
and `Sync align` are activated. Then *ModelCreator* moves the mount to the first point, takes an image, starts *PlateSolve*, searches for the exact coordinates of the star field, uses this solution to improve the pointing model and continues with the next point.
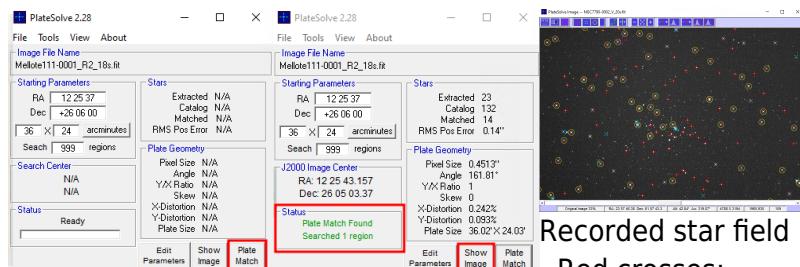
PlateSolve - Image loaded

PlateSolve - Solution found

Recorded star field
- Red crosses: detected stars,
Turquoise crosses: catalog stars,
Yellow circles: identified stars

PlateSolve identifies the stars in the respective star field and compares their position with star catalogs. Starting from the coordinates provided by the telescope, a spiral outward search is performed. In the example in the center below, the first step of the iteration was already successful and the star field was successfully identified. If the pointing model is not yet as good as in this example, which is usually the case when a completely new pointing model is created, it may take several iterations until the star field is identified. If after 99 iterations the star field has not been found, the iteration is aborted and *ModelCreator* moves on to the next pointing without any changes.

Analyzing a pointing model

Will follow soon…

A-PEC

The Periodic Error Correction (PEC) can help to improve the tracking accuracy of the mounting by accounting for periodic errors of the worm gear. This error usually has a period of approx. 3 min 20 sec (3.3 minutes), while the PEC can correct for shorter periods, too. The error of the worm gear is usually irrelevant as long as the observations are only carried out with an eyepiece – in case longer observations are taken with CCDs, the corrections of this error are getting important.

The PEC has to be calibrated before it can operate properly. For this purpose, the mount needs detailed information on the deviations from the ideal tracking behavior. One possibility to achieve this is by centering a bright star in an eyepiece and following its motions with the hand terminal (the N - S - E - W buttons) for a while. A more sophisticated option is based on the autoguide functionality of our

CCD cameras, as the precision is higher this way. Start the PEC calibration on the hand terminal with:

```
Drive -> A-PEC control -> A-PEC Training
```

In the next step choose the time period during which the PEC shall be "trained": 15, 30, or 60 minutes. The longer the training is, the better is the result of the PEC. After the training has been completed the corrections are calculated and the PEC is automatically activated.

Pole hight adjustment

- will follow…

CDK20

- will follow …

C14

Check and improve the collimation

Check

- the telescope should have ambient temperature
- drive to a bright star in zenith (Polaris can be used, too)
- use the 25mm ocular (or the webcam)
- defocus the star so it takes about one sixth of the FoV (field of view) and gets a doughnut shape
- if the shadow of the secondary mirror (the inner part of the doughnut/defoussed star) is off-centered, the collimation of the telescope is erroneous

Improvement

- move the star (using the N - E - S - W buttons) in the direction to which the shadow is off-centered until the edge of the FoV is reached
- turn the three screws on the backside of the secondary mirror (see Figure below) until the star is again in the center of the FoV. To achieve that:
    - tighten the screw(s) in the direction of the offset
    - loosen the other(s)
- repeat this procedure until the shadow is centered on the defocused star
- repeat with eyepieces of higher magnification (note: in 6mm eyepieces the star is kept focused and the correction is carried out in relation to a (very) thin diffraction ring)

Secondary mirror (right panel: the cover is rotated, so that the screws are visible)

ATTENTION: ONLY VERY MARGINAL CORRECTIONS NEED TO BE APPLIED TO THE SCREWS!
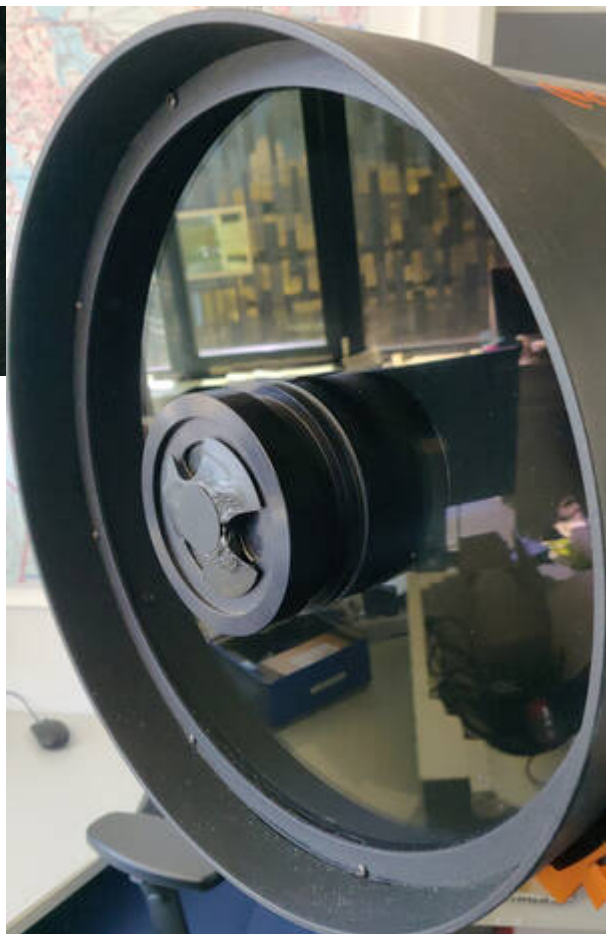
Maintenance

Schmidt plate

Do NOT touch it and always keep the cover on the telescope (except during observations) so the plate will not get too dusty! Especially in autumn and winter, it is a good idea to use the dew cap to prevent unnecessary condensation.

Cleaning:

Dirty Schmidt plate

Cleaned Schmidt plate

- More will follow…

Problems and their solution

We also have a [compilation of problem solutions](#) to known error sources.